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Date: **SEP 28 2017**
Symbol: EPC-DO: 17-353
LA-UR: 17-27940
Locates Action No.: U1501760

Ms. Michelle Hunter, 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

Subject: Extension Request for Multiple Activities Work Plan for the Treatment and Land Application of Groundwater from Mortandad and Sandia Canyons, DP-1793 Work Plan #5

Dear Ms. Hunter:

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). DOE/LANS submitted Work Plan #5 on March 16, 2017 (EPC-DO: 17-050) for the continued land application of treated groundwater at Technical Area (TA)-05 (Enclosure 1). NMED approved Work Plan #5 with conditions on June 15, 2017 (Enclosure 2). Section 12 of Work Plan #5 identified a project schedule ending on December 31, 2017.

The purpose of this letter is to amend Work Plan #5 to extend the project schedule end date identified in Section 12 of Work Plan #5 to match the term end date of DP-1793. Based on experience gained by DOE/LANS from operating the extraction, treatment, and land application system for the groundwater in Mortandad and Sandia Canyon the quantity, quality, and discharge location of treated groundwater to be land applied will be consistent with the approved Work Plan #5 during this extension period. Each of these items is addressed separately below. In addition, a comparison of the reporting requirements for discharge reports, submitted at the completion of an approved work plan discharge per DP-1793 Condition 8, and annual reports, submitted annually per DP-1793 Condition 9, is provided.

Water Quality

Work Plan # 5 identifies four activities generating groundwater to be treated and land applied: (1) legacy water from 2016, (2) water generated from 2016/2017 well installations, (3) maintenance activities at injection wells, and (4) monitoring well purge water. These activities, except activity number 2, will remain consistent with the current approved work plan. Activity number 2 relates to water generated related to extraction/injection well installation(s). If during the amended period of performance for Work Plan #5, additional extraction/injection/monitoring well installations are planned separate amendment(s) will be submitted to NMED for approval. Those amendment(s) will demonstrate the additional source(s) are consistent in quality to the current sources included in Work Plan #5.

In addition to the compliance and operational samples included in Work Plan #5, NMED's June 15, 2017 conditional approval requires DOE/LANS to conduct confirmation sampling of the treated water in the lagoons prior to land application. This ensures that the quality of water being land applied will be consistent with the approved Work Plan #5.

Water Quantity

An increase in the maximum daily discharge identified in DP-1793 and Work Plan #5, Section 10 is not requested. DOE/LANS requests the total volume specified in Work Plan #5 (53,282,900 gal) be applied annually during the project schedule.

Based on this information the daily discharge quantity or the total annual volume will not increase.

Location of Land Application

The approved land application locations identified in Section 1 of Work Plan #5 are not being modified.

Comparison of Reporting Requirements

Table 1 provides a summary of the reporting requirements outlined in DP-1793 Conditions 8 and 9.

Table 1
DP-1793 Conditions 8 and 9 Reporting Requirements

Item Description	Condition 8 (Discharge Report)	Condition 9 (Annual Report)
Total volume of discharge	X (for each work plan)	X (annual for all work plans)
Average application rate	X	
Analytical results	X	X (including copies of laboratory analytical reports)
Soil sampling results, if required by NMED	X	
Map of land application areas	X	X
Quantity, source and date of each discharge		X

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The discharge reports and annual reports have many duplicate items. As part of this proposed amendment to Work Plan #5 DOE/LANS will ensure the annual reports contain all of the information that is required under the Discharge Reports (average application rates and soil sampling results). The only potential exception could be soil sample results, dependent upon when soil sampling was completed. If those results are available with sufficient time to meet annual report deadlines they will be included. If not these will be identified and submitted separately, when available.

Please contact William J. Foley by telephone at (505) 665-8423 or by email at bfoley@lanl.gov if you have questions regarding this request.

Sincerely,



John C. Bretzke
Division Leader

Sincerely,



Cheryl L. Rodriguez
Program Manager, FPD-II

JCB/CLR/MTS/WJF:am

Enclosures:

- 1) LANL March 16, 2017 Submittal Letter and Enclosure 1, DP-1793, Work Plan #5
- 2) NMED Letter Dated June 15, 2017, Approving Work Plan #5

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GROUND WATER

SEP 28 2017

BUREAU

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Dear Ms. Hunter:

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ENCLOSURE 1

**LANL March 16, 2017 Submittal Letter and Enclosure 1,
DP-1793, Work Plan #5**

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Date: **MAR 16 2017**
Symbol: EPC-DO: 17-050
LA-UR: 17-20362
Locates Action No.: U1501760

Ms. Michelle Hunter, 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

**Subject: Multiple Activities Work Plan for the Treatment and Land Application of
Groundwater from Mortandad and Sandia Canyons, DP-1793 Work Plan #5**

Dear Ms. Hunter:

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 Condition No. 3 of the above-referenced discharge permit, DOE/LANS are required to submit detailed, project-specific work plans for approval by NMED before any activities are undertaken.

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 enclosed work plan is for the proposed discharge of treated groundwater from four Chromium Project activities: (1) legacy water remaining from 2016 activities, (2) water generated from 2016/2017 well installations, (3) maintenance activities at injection wells including backflush/surge water, and (4) routine monitoring well purging during sampling and five-day pumping at monitoring wells/piezometers.

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The activities listed above will be conducted as specified in the NMED-approved *Interim Measures Work Plan for the Evaluation of Chromium Mass Removal, Work Plan for Chromium Plume Center Characterization* and the *Interim Facility-Wide Groundwater Monitoring Plan for the 2017 Monitoring Year, October 2016-September 2017*. Produced groundwater will be treated and discharged in accordance with the enclosed work plan and supporting information.

Please contact William J. Foley by telephone at (505) 665-8423 or by email at bfoley@lanl.gov if you have questions regarding this work plan.

Sincerely,



John C. Bretzke
Division Leader

Sincerely,



Cheryl L. Rodriguez
Program Manager, FPD-II

JCB/CLR/MTS/WJF:tav

Enclosures:

- 1) Multiple Activities Work Plan for the Treatment and Land Application of Groundwater from Mortandad and Sandia Canyons, DP-1793, Work Plan #5
- 2) Interim Measures Work Plan for Chromium Plume Control and Work Plan for Chromium Plume Center Characterization
- 3) Topographic Map of the Project Site
- 4) Table 3.4-1 (Chromium Investigation Monitoring Group) from the Monitoring Year 2017 Interim Facility-Wide Groundwater Monitoring Plan
- 5) As-Built Specifications for CrEX-3, CrIN-1, CrIN-2, CrIN-3, CrIN-4, CrIN-5, R-15, R-61, and CrPZ-4
- 6) Water Quality Data from CrEX-1, CrEX-3, CrIN-1, CrIN-2, CrIN-3, CrIN-4, CrIN-5, R-15, R-28, R-42, R-43-S1, R-50-S1, R-61, R-62, CrPZ-1, CrPZ-2a, CrPZ-2b, CrPZ-3, CrPZ-4, and CrPZ-5
- 7) Schematic of the IX Treatment System and Technical Specifications of the IX Vessels and Resin

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GROUND WATER

MAR 16 2017

BUREAU

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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 enclosed work plan is for the proposed discharge of treated groundwater from four Chromium Project activities: (1) legacy water remaining from 2016 activities, (2) water generated from 2016/2017 well installations, (3) maintenance activities at injection wells including backflush/surge water, and (4) routine monitoring well purging during sampling and five-day pumping at monitoring wells/piezometers.



ENCLOSURE 1

**Multiple Activities Work Plan for
the Treatment and Land Application of
Groundwater from Mortandad and Sandia Canyons,
DP-1793, Work Plan #5**

EPC-DO: 17-050

LA-UR-17-20362

U1501760

Date: MAR 16 2017

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 chromium (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 chromium(III). 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 75 ft of the aquifer. Several wells along the downgradient edge of the plume in the regional aquifer show increases in chromium concentrations, suggesting potential expansion of the plume. Because of these recent increases, the Laboratory is implementing plume control 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 Chromium Plume Control” (IMWP) was submitted on May 26, 2015 (Enclosure 2). The New Mexico Environment Department (NMED) approved the IMWP on October 15, 2015 (Enclosure 2). The IMWP establishes the technical foundation for the activities to control chromium plume migration in groundwater beneath Mortandad and Sandia Canyons and provides the technical information to support a proposed configuration and operational mode for extraction and injection wells.

An additional work plan, the “Work Plan for Chromium Plume Center Characterization,” was submitted to NMED on July 28, 2015 (Enclosure 2). It describes activities and studies to further refine the Laboratory’s assessment of potential remedial strategies for chromium in the regional aquifer and vadose zone. NMED approved the work plan on October 15, 2015. The scope is largely centered on the installation of a new extraction well located within the plume centroid and testing (pumping) to evaluate the feasibility of efficient mass removal from the centroid.

During calendar year (CY) 2016, land application under NMED-approved Discharge Permit (DP)-1793 Work Plan #3 was completed related to the above activities.

This DP-1793 Work Plan (Work Plan #5) is for the proposed CY2017 discharge of treated groundwater from four activities planned as part of the overall Chromium Project. These activities will support implementation of both the IMWP and Interim Facility-Wide Groundwater Monitoring Plan (IFGMP). These activities consist of the following:

- (1) Legacy water remaining from CY2016 activities:
 - a. Groundwater generated from extraction well CrEX-1 to assess the potential for hydraulic control of the plume in the regional aquifer;
 - b. Groundwater generated from extraction well CrEX-3 to evaluate the feasibility of efficient mass removal within the centroid of the groundwater plume;

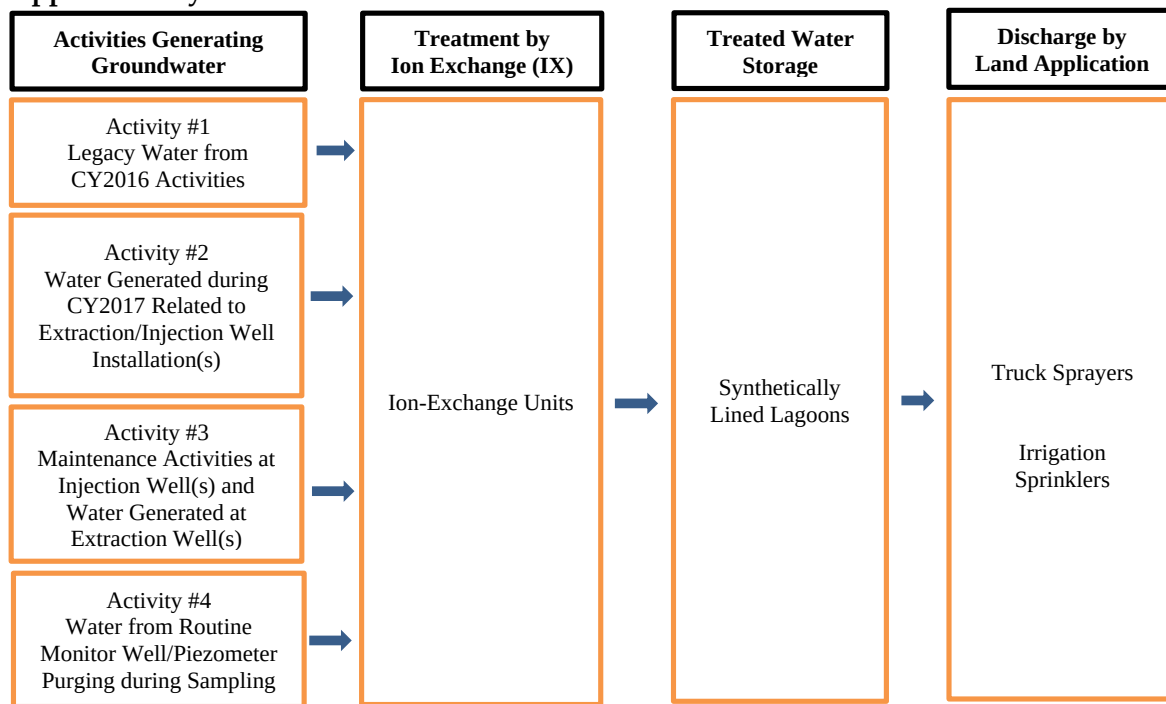
- c. Well development and aquifer testing water generated from the installation and subsequent activities at injection wells CrIN-1 through CrIN-5 and extraction well CrEX-3; and
 - d. Groundwater generated from routine purging during sampling of monitoring wells under the NMED-approved 2016 Monitoring Year and 2017 Monitoring Year IFGMPs;
- (2) Water generated from well installations in 2017:
- a. Development, aquifer testing, and extended pumping at new extraction well(s);
 - b. Development, aquifer testing, and injection capacity evaluation at new injection well(s); and
 - c. Monthly sampling at injection wells before injection at these locations;
- (3) Groundwater generated during operation and maintenance activities at extraction wells and injection wells in 2017. This consists of extraction water during periods when injection wells are not operating and backflush/surge water from the injection wells; and
- (4) Groundwater generated from routine purging during sampling of contaminant-affected monitoring wells under the NMED-approved 2017 Monitoring Year IFGMP and up to 5-d of pumping at additional piezometers/monitor wells associated with the Chromium Project.

Water generated during operation of extraction wells will not be land-applied under this Work Plan, except as identified in activities (1) through (3) above. All other treated water generated during operation of extraction wells will be injected in accordance with DP-1835. Groundwater originating from the four activities in this Work Plan will be treated before land application under this Work Plan. Although generated from four different activities, because the water quality of the groundwater is similar, it will be treated and combined into the existing synthetically lined lagoons before land application.

Groundwater produced during these four activities will be treated to less than 90% of the NMWQCC groundwater standard for chromium of 50 µg/L, stored in synthetically lined lagoons, and discharged by land application in accordance with this Work Plan and DP-1793 (July 27, 2015). Figure 1 shows the treatment, storage, and land-application flow diagram.

Volumes of water proposed for land application from the four activities planned in CY2017 are only estimates. Administrative controls will restrict the actual volume applied to less than the permitted volume of 350,000 gallons per day (gpd) total for all work plans submitted during this period under DP-1793.

Figure 1. Block Flow Diagram of Multiple Activities Treatment, Storage, and Land-Application Systems



Proposed Activities.

Additional information related to the sources of water to be treated and land-applied as a result of the above activities is provided below. Table 1 provides a summary of the estimated volume of treated water to be land applied under this Work Plan.

Table 1. Volume of Treated Groundwater to be Land Applied Under Work Plan #5.

Activity	Estimated Volume (gal.)
Activity No. 1: Legacy Water Remaining from 2016 Activities	486,700
Activity No. 2: Water Generated during CY2017 Related to Extraction/Injection Well Installation(s)	5,764,800
Activity No. 3: Maintenance Activities at Injection Well(s) and Water Generated at Extraction Well(s)	46,944,000
Activity No. 4: Water from Routine Monitor Well/Piezometer Purging during Sampling	88,400
Total	53,283,900

Activity No. 1: Legacy Water Remaining from 2016 Activities. Most of the water generated during CY2016 related to these activities was land-applied in CY2016 under DP-1793 Work Plan #3. However, some residual water remains. This water will be treated and land applied under this Work Plan during CY2017. The volume of water related to Activity No. 1 represents less than 1% of the total water proposed for land application under this Work Plan.

- **Pumping at one extraction well conducted during CY2016** to test the feasibility of hydraulic control of chromium migration and to assess the potential for long-term removal of chromium from the regional aquifer and to optimize an injection strategy based on the characteristics of both the aquifer and the pumping-induced capture zone.
- **Injection wells and extraction well installations were completed during CY2016.** Five injection wells, CrIN-1 through CrIN-5, and one extraction well, CrEX-3, were installed, developed and tested during CY2016.
- **Pumping at one extraction well was conducted during CY2016** to evaluate optimum pumping rate(s) for chromium mass removal within the centroid of the groundwater plume and to optimize an injection strategy based on the characteristics of both the aquifer and the pumping-induced capture zone.
- **Monitor well/piezometer purge water in storage.** Groundwater generated which is currently on-site from purging during sampling and maintenance of monitoring wells under the NMED-approved 2016 Monitoring Year and 2017 Monitoring Year IFGMP.

Activity No. 2: Water Generated during CY2017 Related to Extraction/Injection Well Installation(s). Extraction and injection wells will be installed in CY2017. In addition to these activities, additional water will be generated as a result of monthly sampling at injection wells prior to the start of injecting treated groundwater under DP-1835. Approximately 11% the water volume proposed for land application under this Work Plan is from new well installation and monthly sampling at injection wells.

Activity No. 3: Maintenance Activities at Injection Well(s) and Water Generated at Extraction Well(s). During operation of the extraction/injection wells and the groundwater treatment system, periodic maintenance activities will be required. In addition, this activity also includes land application of extraction water when injection wells are down for any reason and additional extraction water which could be land applied if any delays are encountered in bringing the injection wells on-line. The volume of water produced during Activity No. 3 represents 88% of the total water proposed for land application under this Work Plan.

Activity No. 4: Water from Routine Monitoring Well/Piezometer Purging during Sampling. The Laboratory conducts periodic sampling from groundwater wells to monitor the nature, extent, fate and transport of contaminants in accordance with the IFGMP. Additional periodic sampling/monitoring occurs for the Chromium Project at groundwater wells and piezometers. Before a sample is collected from a groundwater monitoring well and piezometer, it is necessary to purge the well to ensure the sample collected is representative of water in the aquifer. Typically, three casing volumes are purged from a monitoring well before a sample is collected. In addition, existing piezometers will be purged continuously for up to 5 d to collect

additional data. 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 Decision Tree for Land Application of Groundwater (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. For the wells listed in Table 2, treatment before land application may be required as identified above. The volume of water produced during Activity No. 4 represents less than 0.2% of the total water proposed for land application under this Work Plan.

Table 2. Monitor Wells and Piezometers Included in Activity 4.

Well	Source of Groundwater
R-13	Well purge water
R-15	Well purge water
R-28	Well purge water
R-42	Well purge water
R-43 S1	Well purge water
R-45 S1	Well purge water
R-45 S2	Well purge water
R-50 S1	Well purge water
R-50 S2	Well purge water
R-61	Well purge water
R-62	Well purge water
SCI-2	Well purge water
CrPZ-1	Piezometer purge water (sampling and 5-d pumping)
CrPZ-2a	Piezometer purge water (sampling and 5-d pumping)
CrPZ-2b	Piezometer purge water (sampling and 5-d pumping)
CrPZ-3	Piezometer purge water (sampling and 5-d pumping)
CrPZ-4	Piezometer purge water (sampling and 5-d pumping)
CrPZ-5	Piezometer purge water (sampling and 5-d pumping)

- 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.
 1. Seven of these wells—R-28, R-42, R-43, R-45, R-50, R-62, and SCI-2 and five piezometers (CrPZ-1, CrPZ-2a, CrPZ-2b, CrPZ-3, and CrPZ-5)—exhibit concentrations near or above the NMWQCC Regulation 3103 groundwater standard of 50 µg/L for chromium (total), and therefore, may require treatment before disposition via land application.

2. Two of these wells—R-15 and R-61 and one piezometer—CrPZ-4 (also known as CrCH-4) —exhibit concentrations near or above the NMED Risk Assessment Guidance for Site Investigations and Remediation, Table A-1, Tap Water Soil Screening Level (Table A-1 Tap Water SSL) for perchlorate (ClO_4) of 13.8 $\mu\text{g/L}$, and therefore, may require treatment before disposition via land application.

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

1. **Location.** Although DP-1793 references 55 sections within the New Mexico State Plane Coordinate System at the 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 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 2016 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 quarterly within a group of monitoring wells contained in the Chromium Investigation monitoring group under the annual IFGMP. Annual submittal of the IFGMP is required under the Consent Order. The wells comprising the Chromium Investigation monitoring group are situated within Sandia and Mortandad Canyons. Sampling during CY2017 is being carried out in accordance with the NMED-approved 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 treated effluent from the Radioactive Liquid Waste Treatment Facility to the Mortandad Canyon watershed. The IFGMP excerpts for the Chromium Investigation Monitoring Group for 2017 (October 2016–September 2017) 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.** Groundwater may be present in the land-application area within alluvial, perched-intermediate, and regional aquifers.

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, when present, 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. Saturated intervals can be present above, within, and at the base of the basalts underlying the site, making determination of an overall aquifer flow direction difficult.

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 chromium, nitrate+nitrite as nitrogen ($\text{NO}_3 + \text{NO}_2\text{-N}$), total dissolved solids (TDS), chloride (Cl), and perchlorate (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.

In addition, NMED's approval (as modified) of Work Plan #3 placed requirements for monitoring groundwater level if continuous flows occur in the Mortandad Canyon watercourse for greater than 48 h in the proximity of the treatment areas. As part of Work Plan # 5, should a storm event cause continuous flow through the Mortandad Canyon watercourse for greater than 48 h in the proximity of the land application areas, the monthly groundwater-level measurements and associated sampling shall be scheduled as soon as is safely and operationally possible, and no more than 15 d from the cessation of flow.

4. **Well Specifications.** Enclosure 5 provides the as-built specifications for existing wells CrEX-3, CrIN-1, CrIN-2, CrIN-3, CrIN-4, CrIN-5, R-15, R-61, and CrPZ-4. As-built specifications for all other existing wells and piezometers referenced in this Work Plan, with the exception of extraction well CrEX-1, were previously supplied in DP-1793 Work Plan #3 in March 2016.

The as-built specification for CrEX-1 was previously supplied in the DP-1793 Permit Application.

5. **Expected Contaminants.** The source of groundwater generated from all activities listed in this Work Plan is the intermediate and regional aquifer. Table 3 presents maximum concentrations of contaminants from all wells proposed for land application under this Work Plan. Because the proposed extraction/injection well(s) have not yet been drilled, water quality from monitoring well R-42 and R-28, respectively, represent worst-case proxy for these well(s).

Table 3 provides the maximum concentrations of chromium, nitrate+nitrite-N, and perchlorate detected between January and November 2016 from all existing wells and piezometers listed in Activities 1 through 4. Enclosure 6 contains summary water-quality data for these wells from this period.

Chromium is the only contaminant which exceeded the NMWQCC Regulation 3103 groundwater standard at most of the wells and piezometers listed in Table 3. Nitrate+nitrite concentrations are above background levels in some wells and may become elevated even further before anionic equilibrium is reached in the IX vessel because of sorption-site flooding. In addition, NMED's May 2016 approval (as modified) of DP-1793 Work Plan #3 required perchlorate sampling of treated effluent. Perchlorate exceeded the Table A-1 Tap Water SSL in one well listed in Table 3. An analysis of other compounds in the NMWQCC Regulation 3103 groundwater standards and Table A-1, SSLs for toxics was completed. Total dissolved solids exceeded at CrEX-1 in a single, anomalous sample. All other samples from this location have been at or below 525 mg/L with an average of 238 mg/L.

Treated water monitoring conducted under this Work Plan and operational monitoring conducted by the Laboratory using Hach methods for real-time field results will closely track chromium and nitrate-N concentrations in the treated water (see item 8 below).

Table 3. Maximum Concentrations of Chromium, Nitrate+Nitrite, and Perchlorate in Wells and Piezometers, January through November 2016¹.

Wells and Piezometers	Cr (µg/L)	NO₃+NO₂-N (mg/L)	ClO₄ (µg/L)
CrEX-1	201.7	na ²	0.9
CrEX-2 ³	836	6.3	1.2
CrEX-3	192.4	5.4 ⁴	1.0
CrIN-1	92.4	2.24	0.7
CrIN-2	112	4.83	0.9
CrIN-3	55.1	1.6	0.6
CrIN-4	99.9	2.67	0.7
CrIN-5	95.4	2.46	0.9
CrIN-6 ⁵	430	4.02	1.0
R-13	8.3	0.77	0.4
R-15	15.9	2.3	10.8
R-28	430	4.02	1.0
R-42	836	6.3	1.2
R-43-S1	167	6.15	1.0
R-45-S1	42.3	3.24	0.7
R-45-S2	34.2 ⁶	0.44 ⁶	0.3 ⁶
R-50-S1	174.7	2.72	0.7
R-50-S2	5.3	0.54	0.3
R-61	26.7	2.27	10.1
R-62	261 ⁶	1.39 ⁶	0.8 ⁶
SCI-2	385	4.12	1.0
CrPZ-1	431.2	3.78 ⁷	2.17 ⁶
CrPZ-2a	128.7	4.04 ⁷	1.0 ⁶
CrPZ-2b	118.4	1.20 ⁷	1.0 ⁶
CrPZ-3	351.6	4.72 ⁷	1.3 ⁶
CrPZ-4	14.9	4.26 ⁷	63.7 ⁶
CrPZ-5	258.2	2.02 ⁷	1.3 ⁶
NMWQCC GW Std⁸	50	10	13.8⁹

¹ Data obtained from IntellusNM for period from January 1, 2016 through November 30, 2016.

²na or not available indicates no results are available for this constituent.

³Data unavailable from this well, which has not been installed. R-42 data presented as a proxy well for CrEX-2 conditions.

⁴Data reported is nitrate as nitrogen. Nitrate+nitrite as nitrogen data unavailable for this location.

⁵ Data unavailable from this well, which has not been installed. R-28 data presented as a proxy well for CrIN-6 conditions.

⁶ No data available for 2016 period. Value provided based on data for period between January 1, 2011 and December 31, 2015.

⁷ Data reported is nitrate analytical results converted to nitrate as nitrogen values. Nitrate+nitrite as nitrogen data unavailable for this location.

⁸NMWQCC Regulation 3103 standards for groundwater, except as noted.

⁹NMED Risk Assessment Guidance for Site Investigations and Remediation, Table A-1, Tap Water Soil Screening Levels.

6. **Raw Water Storage.** The type, quantity, and capacity of tanks storing untreated groundwater from all activities are listed in Table 4.

Table 4. Type, Quantity, and Capacity of Storage Tanks Receiving Untreated Groundwater¹.

Well	Type of Storage	Quantity	Tank Capacity (gal.)
All activities listed in Table 1	21,000-gal. metal storage tank	18	~378,000

¹Water stored in poly tanks at individual well sites will be transferred to the tanks listed in Table 4 before treatment.

7. **Treatment System.** Groundwater, produced from activities referenced in this Work Plan that does not meet Decision Tree criteria for land application without treatment, will be treated by IX to reduce chromium concentrations to below 45 µg/L, 90% of the NMWQCC Regulation 3103 groundwater standard. In addition, groundwater produced from activities referenced in this Work Plan will be treated by IX to reduce perchlorate concentrations to below 12.4 µg/L, 90% of the Table A-1 Tap Water SSL. The project has both a centralized IX unit staged at well R-28 (CTUB) and two additional units (CTUA and CTUC) that can be used at the extraction well sites. Enclosure 7 provides a conceptual schematic of the CTUB IX treatment system and technical specifications of the IX vessels and resin. The large treatment system contains three treatment trains, and the portable unit contains two trains. Each train is composed of both a first stage and a second stage IX unit. Sample collection ports are located at all stages of treatment. The treatment system design is based on an influent chromium concentration of up to 1000 µg/L. Spare vessels will be staged on-site for replacement, as needed.

Groundwater pumped from new extraction/injection well(s) during installation, development, and testing activities will either be: (1) treated at the well site(s) and then transferred via single-wall high-density polyethylene pipeline to the synthetically lined lagoons for storage before land application or (2) transferred to the storage tanks and combined with other untreated groundwater at R-28 via truck, treated, and stored in the synthetically lined lagoons for storage before land application. Before injection operations commence at injection well(s), monthly sampling will be completed. Once injection operations commence, periodic maintenance may also be conducted at the injection well(s). Groundwater produced as a result of these activities will be transported via truck to the treatment system located at well R-28. Groundwater produced from the wells and piezometers listed in Table 3 will be transported by truck to the treatment system located at well R-28. This water will be transferred to the storage tanks and combined with other untreated groundwater prior to treatment before disposition via land application. Treated water from the four activities covered by this Work Plan will be comingled in the synthetically lined lagoons before land application.

The performance and removal efficiency of the proposed IX treatment system for chromium treatment was demonstrated previously during pumping tests and operations conducted under the following:

- NMED-issued temporary permissions in 2012, 2013, and 2014
- NMED-approved DP-1793 Work Plan #2 in 2015
- NMED-approved DP-1793 Work Plan #3 (as modified) in 2016

The IX treatment system will remove chromium to concentrations below 45 µg/L, less than 90% of the NMWQCC groundwater standard of 50 µg/L. Figure 2 below shows chromium concentrations in effluent (treated water) from each of the IX treatment units under DP-1793 Work Plan #3 in 2016. Effluent concentrations did not exceed 29.8 µg/L during 2016. All results are no greater than 60% of the 50 µg/L groundwater standard.

Figure 3 below shows nitrate+nitrite-N concentrations in effluent (treated water) from each of the IX treatment units under DP-1793 Work Plan #3 in 2016 through November. Effluent concentrations did not exceed 6.35 µg/L during 2016, which is no greater than 65% of the 10 mg/L groundwater standard.

Figure 4 below shows perchlorate concentrations in effluent (treated water) from each of the IX treatment units under DP-1793 Work Plan #3 in 2016. Effluent concentrations did not exceed 0.96 µg/L during 2016 through November, which is less than 10% of the 13.8 µg/L Table A-1 SSL.

The maximum results for perchlorate in purge water from CrPZ-4 exceed the 13.8 µg/L standard and the maximum results for R-15 and R-61 are greater than 10 µg/L but less than the 13.8 µg/L Table A-1 SSL. Figure 5 depicts the influent and effluent perchlorate concentrations when paired samples were obtained from IX treatment systems in 2016. Figure 6 depicts the removal efficiencies obtained for the same data. These results demonstrate the IX treatment system is achieving greater than 83% removal of perchlorate. Based on maximum result for CrPZ-4 purge water, 83% removal will meet the DP-1793 permit requirement for discharges to be less than 90% of 13.8 µg/L. In addition, this CrPZ-4 purge water is proposed to be treated and land applied under this work plan. The mean of all sample results from CrPZ-4 is 20.2 µg/L with a median value of 2.7 µg/L.

The IX vessels and resins will be sampled and characterized before they are shipped 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.

Figure 2. CrEX-1, CrEX-3, and R-28 Treatment Systems' Effluent Chromium Concentrations, 2016.

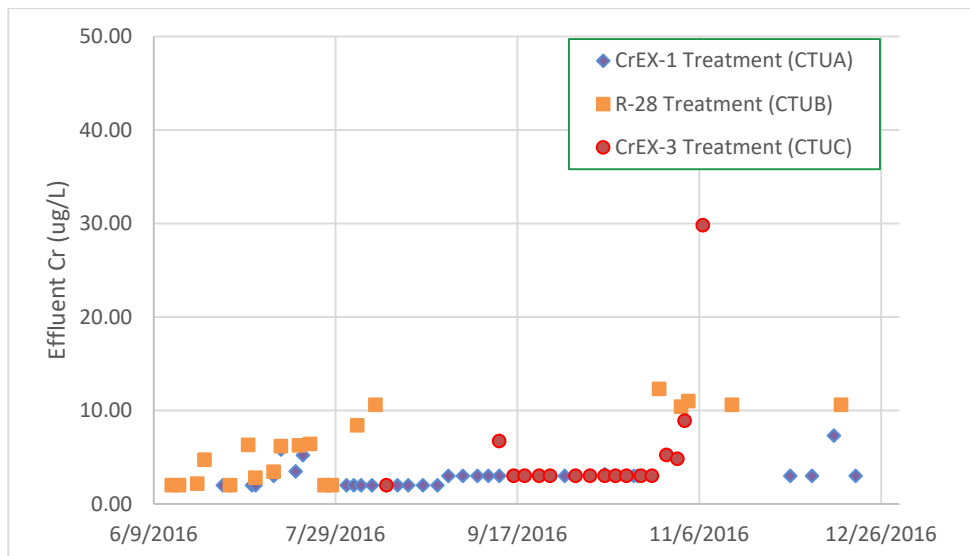


Figure 3. CrEX-1, CrEX-3, and R-28 Treatment Systems' Effluent Nitrate+Nitrite Concentrations, 2016.

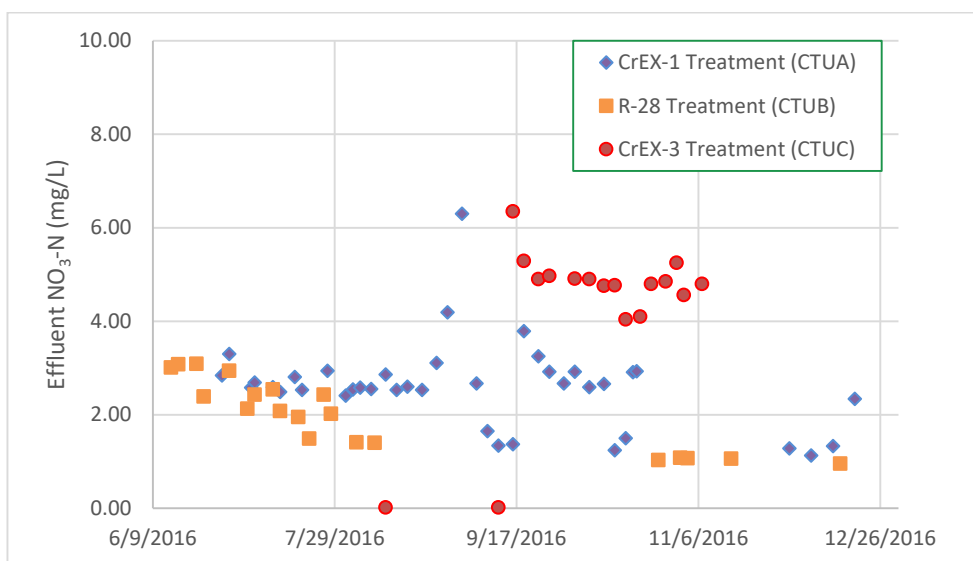


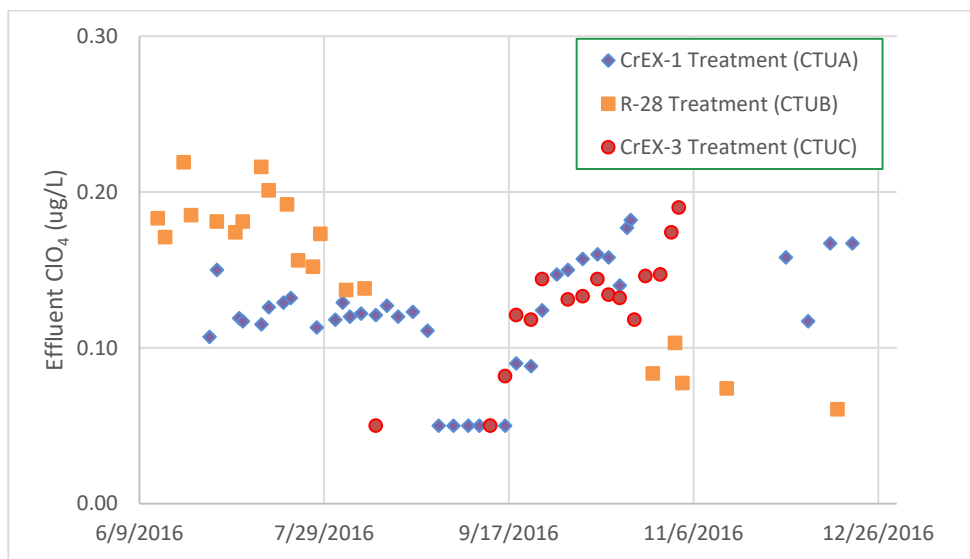
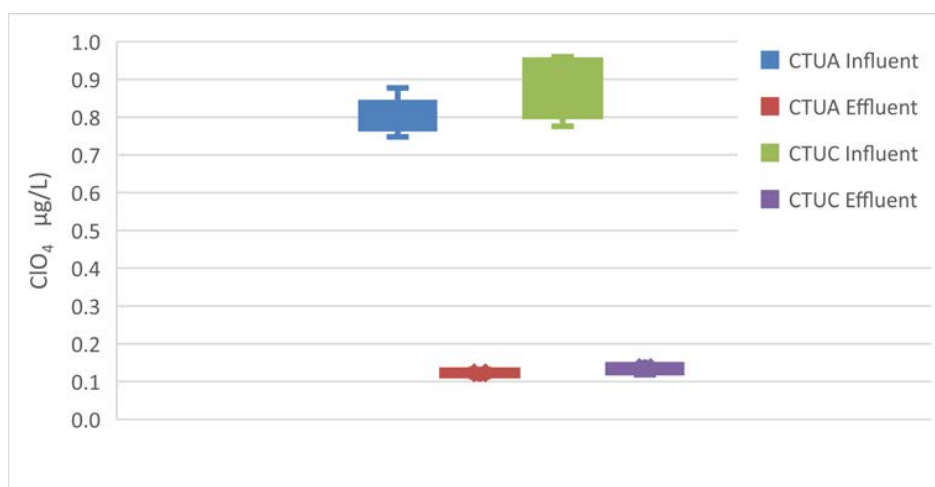
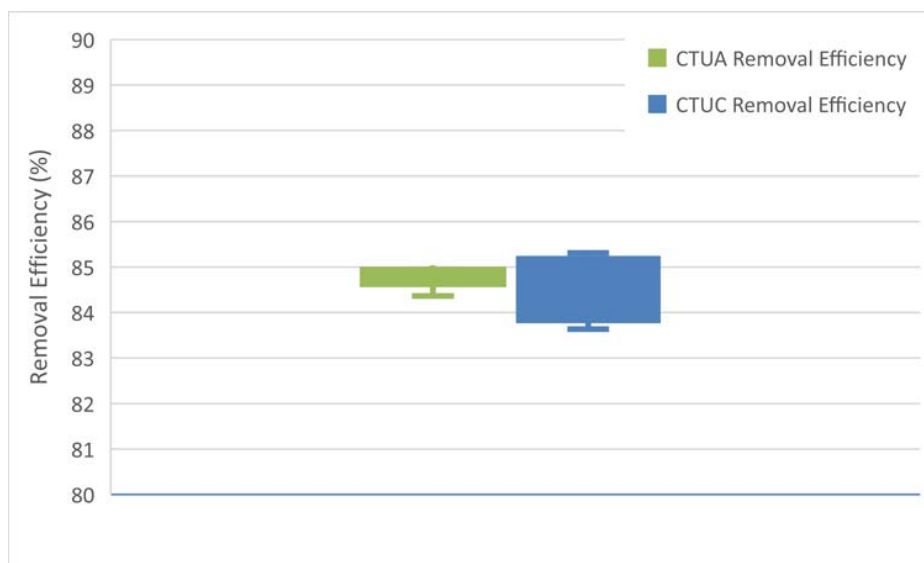
Figure 4. CrEX-1, CrEX-3, and R-28 Treatment Systems' Effluent Perchlorate Concentrations, 2016.**Figure 5. IX Treatment System 2016 Paired Perchlorate Influent/Effluent Results.**

Figure 6. IX Treatment System 2016 Perchlorate Removal Efficiency.

8. **Sampling Plan.** To demonstrate compliance with the NMWQCC Regulation 3103 groundwater standards for chromium and nitrate+nitrite-N, grab samples will be collected routinely and throughout the entirety of land application operations from the sample port downstream of the last IX treatment vessel at each treatment site when treated groundwater will be land-applied in accordance with this Work Plan. In accordance with NMED's modified approval of Work Plan #3, perchlorate grab samples will also be collected routinely and throughout the entirety of the pumping from the sample port downstream of the last IX treatment vessel at each treatment site when treated groundwater will be land-applied in accordance with this Work Plan. These treated water grab samples will be collected at a minimum frequency of once per week when land application operations are occurring for chromium, nitrate+nitrite-N, and perchlorate analysis by an off-site, independent NELAP-accredited analytical laboratory.

In addition, operational samples will be collected routinely and measured for chromium and nitrate-N using HACH® System, or equivalent, for real-time field results to monitor the IX treatment system performance. These treated water grab samples will be collected at a minimum frequency of two times per week when land application operations occur.

Table 5 summarizes the proposed sampling plan.

Table 5. Proposed sampling plan for treated water from all Work Plan activities.

Parameter	Sample Type	Analytical Method	TAT ¹	Frequency	MDL ²	Laboratory
NO ₃ +NO ₂ -N	Grab, filtered	EPA 353.2	10 d	1 time/wk	0.033 mg/L	Off-site NELAP- accredited laboratory
Total Cr	Grab, filtered	SW-846:6020	10 d	1 time/wk	2 µg/L	
ClO ₄	Grab, filtered	SW-846:6850	10 d	1 time/wk	0.05 µg/L	

¹TAT indicates the analytical turnaround time.

²MDL indicates the method or instrument detection limit.

The following contingencies will be applied under this sampling plan.

- ✓ If chromium, perchlorate, and nitrate concentrations collected under the above sampling plan for on-site samples are less than 45 µg/L, 9 mg/L, and 12.4 µg/L, respectively, then treated groundwater will move directly from the treated water storage lagoon(s) to land application.
- ✓ If chromium or nitrate concentrations collected under the above sampling plan exceed 45 µg/L or 9 mg/L, respectively, then land application will cease immediately, and the following will be completed:
 1. Representative sample(s) from the lagoon(s) receiving treated water will be collected for chromium and nitrate-N analysis for on-site analysis. If the contents of the sampled lagoon(s) meet the above referenced criteria for land application they will be land applied.
 2. If the contents of the sampled lagoon(s) do not meet the above-referenced criteria for land application, then they will be re-treated and reanalyzed to verify concentrations meet land-application criteria.
 3. If chromium and nitrate-N 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. In addition, the IX vessel replacement process may also be conducted proactively prior to observing elevated results or to meet other operational requirements. Following this modification the effluent will be reanalyzed on-site to verify concentrations meet land-application criteria.
- ✓ If perchlorate concentrations collected under the above sampling plan for off-site samples exceed 12.4 µg/L land application will cease immediately, and the following will be completed:
 1. Representative sample(s) from the lagoon(s) receiving treated water will be collected for perchlorate analysis by the off-site laboratory. A duplicate sample may also be obtained for analysis by the Geochemistry and Geomaterials Research Laboratory (GGRL) operated by LANL's EES-14 group for fast turn results. If the duplicate sample is obtained these results may be used for the determination in steps 2 and 3 below.

2. If the contents of the sampled lagoon(s) meet the above-referenced criteria for land application, then they will be land applied.
 3. If the contents of the sampled lagoon(s) do not meet the above-referenced criteria for land application, then they will be re-treated and reanalyzed to verify concentrations meet land-application criteria. This analysis and determination will be based on the same process as Step 1 above.
 4. If perchlorate 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 and the effluent. In addition, the IX vessel replacement process may also be conducted proactively prior to observing elevated results or to meet other operational requirements. Following this modification the effluent will be reanalyzed on-site to verify concentrations meet land-application criteria consistent with the process in Step 1 above.
9. **Treated Water Storage.** Treated groundwater from all sources will be stored in the existing synthetically lined lagoons before land application. Lagoons which may be used before land application are the same ones used under DP-1793 Work Plan #3 during 2016 and previously approved by NMED Ground Water Quality Bureau (GWQB) for this use.
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 1–4 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 and NMED’s approval (as modified) of Work Plan #2:
- ✓ Avoidance of watercourses, water bodies, and wetlands by observing a 20-ft no-spray buffer
 - ✓ Avoidance of AOCs by observing a 20-ft no-spray buffer, 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 by observing a 20-ft no-spray buffer
 - ✓ Avoidance of cultural sites
 - ✓ Application on areas with average slopes <2% when groundcover is <50% and average slopes <5% when groundcover is >50%

Treated groundwater will be land-applied by (1) water trucks (3000–10,000-gal. capacity) equipped with both standard rear-mounted dust control sprayers and multiple high-pressure water sprayers, and (2) by irrigation-type sprinklers. Zones 1–3 are unpaved roads and road shoulders; zone 4 is an irrigation site. Each type of land-application zone is discussed below.

Water trucks will be filled with treated water from the synthetically lined lagoons located near the well R-28 site (see Enclosure 3). A totalizing meter will record the volume of treated water loaded into each truck.

The unpaved roads in zones 1–3 will receive water for dust suppression. The frequency and volume of treated water land-applied for dust control will be based on field conditions. The Operations Manager, or designee, 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 Operations Manager. Enclosure 3 shows the location of unpaved roads.

The road shoulders in zones 1 and 3 have been identified as suitable terrain for the land application of treated water by high-pressure water sprayers. These areas meet the criteria of having >50% vegetation and have slopes that average <5% over the land-application area. Additionally, these areas are relatively flat and heavily vegetated in the strip closest to the road that will be used for spraying. 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 zone 3.

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. High-visibility markings such as stakes with flagging are placed 25 ft from the road center line to identify the appropriate spray distance. The frequency and volume of land application to the road shoulders in zones 1 and 3 will be directed by the Operations Manager, or designee, based on the history of discharges to each zone and a field assessment of soil moisture. The Operations Manager objective is to achieve an equitable distribution of treated water across zones 1 and 3. Enclosure 3 shows the location of road shoulder land-application zones 1 and 3.

Zone 4 is the area approved for receiving treated water by irrigation-type sprinklers. Treated groundwater from the 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 Operations Manager, or designee, 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 and NMED's approval (as modified) of previous Work Plans under DP-1793 establishes the following conditions for the land application of treated groundwater:

- ✓ Do not land apply water within 20 ft of watercourses or water bodies.
- ✓ 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 internal Laboratory standard operating procedure and regulatory documents:
 - ENV-RCRA-QP-010.3, Land Application of Groundwater (internal Laboratory procedure)
 - NMED-issued Discharge Permit DP-1793, LANL Groundwater Projects (July 27, 2015)
 - Multiple Activities Work Plan for the Treatment and Land Application of Groundwater From Mortandad and Sandia Canyons, DP-1793 Work Plan #5
 - NMED-GWQB Approval of DP-1793 Work Plan #5 (pending)
- b. All field personnel will participate in pre-job briefings and morning tailgate talks to provide field personnel with the following critical information: daily weather reports, daily land-application activities, system maintenance and repairs scheduled, and daily inspection schedule.
- c. Existing signs identifying the beginning and end of each land-application zone will be maintained (e.g., ZONE 1), areas where land application is permitted (green signs designating "SPRAY") and not permitted (red signs designating "NO SPRAY"). Note: high visibility markings are placed at the appropriate distance from the road to identify the usable land-application area.

- d. Field personnel will maintain written records of the volume and date of treated water land-applied to each zone.
- e. The maximum daily discharge under this and all other active work plans approved under DP-1793 will not exceed 350,000 gpd through administrative controls. Volumes will be monitored closely to ensure this volume limit is not exceeded, documented, and verified by the Operations Manager.

➤ **Inspections.** The following inspections will be conducted when land application operations are on-going 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 synthetically lined lagoons for minimum 2-ft freeboard

11. Water Conservation and Reuse Options. In lieu of using potable water for dust suppression, treated water discharged will be land-applied to approximately 3 mi of dirt road in Mortandad Canyon (zones 1–3). 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.

12. Project Schedule. Land application will commence following NMED approval of this Work Plan and will continue until December 31, 2017, or when field conditions prohibit land application (see item 10 above).

13. Reporting. In accordance with requirements B.8 and B.9 of Discharge Permit DP-1793 (July 27, 2015), the Laboratory 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

**NMED Letter Dated June 15, 2017,
Approving Work Plan #5**

EPC-DO: 17-353

LA-UR-17-27940

U1501760

Date: SEP 28 2017



SUSANA MARTINEZ
Governor

JOHN A. SANCHEZ
Lieutenant Governor

ENCLOSURE 2
**NEW MEXICO
ENVIRONMENT DEPARTMENT**

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BUTCH TONGATE
Cabinet Secretary

J.C. BORREGO
Deputy Secretary

Sent Via Electronic Mail

June 15, 2017

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RE: Approval with Modification of Work Plan #5 for Treatment and Land Application of Groundwater at TA-05, Los Alamos National Laboratory, Discharge Permit 1793

Dear Mr. Bretzke and Ms. Rodriguez:

This letter replaces a previous letter on the topic inadvertently dated May 31, 2016.

On March 16, 2017, the New Mexico Environment Department (NMED) Ground Water Quality Bureau (GWQB) received the *Multiple Activities Work Plan for the Treatment and Land Application of Groundwater for Mortandad and Sandia Canyons, DP-1793 Work Plan #5* (Work Plan) from DOE/LANS (Permittees) for the continued land application of treated groundwater at TA-05. The Work Plan is required by Condition 3 of Discharge Permit 1793 (DP-1793 or DP) for activities regulated under the DP and addresses the extraction, treatment, and land application of chromium contaminated groundwater from Mortandad and Sandia Canyons during calendar year 2017. Prior year discharges of a similar nature were authorized under Work Plans #2 and #3, which were approved by NMED on October 8, 2015, and May 24, 2016, respectively.

The Work Plan identifies the following chromium contaminated waters requiring treatment and discharge.

- Legacy waters from calendar year 2016 activities associated with extraction wells CrEX-1 and CrEX-3, injection wells CrIN-1 through CrIN-5, and monitoring wells associated with the Chromium Investigation Monitoring Group referenced in the *Interim Facility-Wide Groundwater Monitoring Plan* (IFGMP).

- Water generated from various activities associated with the installation of injection and extraction wells within the chromium plume in 2017.
- Groundwater brought to the surface during operation and maintenance activities at extraction and injection wells within the chromium plume in 2017.
- Groundwater extracted during routine sampling and pumping of monitoring wells and piezometers associated with the Chromium Investigation Monitoring Group.

The activities that produce these waters are conducted in coordination with, and as specified in, the *Interim Measures Work Plan for Chromium Plume Control*, dated May 26, 2015, and the *Work Plan for Chromium Plume Center Characterization*, dated July 28, 2015. NMED's Hazardous Waste Bureau approved these plans in a letter dated October 15, 2015.

A copy of the proposed Work Plan was posted on LANL's Electronic Public Reading Room on March 21, 2017. In accordance with DP Condition 3, the proposed Work Plan was subject to public comment for a period of 30 days. Comments received by NMED from Communities for Clean Water on April 20, 2017 have been considered in the preparation of this response.

Groundwater discharges associated with the Work Plan shall be performed in accordance with the Work Plan and are subject to all conditions of the DP. The Work Plan is approved as submitted, with the following modifications.

1. The Permittees shall measure total chromium in soils from a representative location in each land application zone. These measurements shall occur six months prior to the end of the term of the Discharge Permit (July 27, 2020) and at the termination of discharge and final closure under the requirements of DP-1793. The analyses of these soil samples shall be performed by an off-site, independent, NELAP-accredited analytical laboratory. The Permittees shall submit an associated work plan for NMED approval at least 60 days prior to the date of the required soil sampling. The Permittees shall report the results of those measurements, and all other historical chromium measurements in soils in all land application zones, in the final Discharge Report required by DP Condition 8.
2. The Permittees shall confirm that waters in lagoons do not exceed the numeric standards of 20.6.2.3103 NMAC for chromium and nitrate prior to land application. To perform this confirmation the Permittees shall collect a representative sample of the water in a lagoon and analyze the sample utilizing the Hach method for real time field results. The results of the confirmation analyses shall be reported to NMED in the final Discharge Report required by DP Condition 8.
3. NMED understands that the piping from the untreated water storage tanks at R-28 to the treatment system is not double-walled. The Permittees shall conduct daily inspections of all single-walled piping transferring untreated waters. A log of each inspection shall be kept on-site.

Within 60 days of cessation of the discharge authorized under this Work Plan, the Permittees shall submit a Discharge Report in accordance with DP Condition 8.

June 15, 2017

Page 3 of 3

Approval of this Work Plan does not relieve the Permittees of the responsibility to comply with any other applicable federal, state, and/or local laws and regulations. This approval does not relieve the Permittees of liability should operations associated with this Work Plan result in actual pollution of ground or surface waters.

If you have any questions, please contact Steve Pullen at (505) 827-2962. Thank you for your cooperation.

Sincerely,



Michelle Hunter, Chief
Ground Water Quality Bureau

MH:sp

cc (e-version):

Shelly Lemon, NMED/SWQB
John Kielling, NMED/HWB
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