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DRILLING PLAN for INTERMEDIATE WELL CdV-37-1i and CdV-37-1i COREHOLE

Los Alamos
NATIONAL LABORATORY
EST. 1943

Prepared by TPMC for the Environmental Programs Directorate

Drilling Plan for Intermediate Well CdV-37-1i and CdV-37-1i Corehole

September 2009

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ACRONYM LIST

APS	Accelerator Porosity Sonde
ASTM	American Society for Testing and Materials
bgs	Below ground surface
BMP	Best management practices
CD	Compact disc
CMR	Combinable Magnetic Resonance
DOE	Department of Energy
EES	Earth & Environment Science Division
EP-WSP	Environmental Programs Water Stewardship Program
ER-SOP	Environment and Remediation Standard Operating Procedure
ES&H	Environment, Safety and Health
FMI	Formation Microimager
ft	Feet
FTL	Field Team Leader
FOD	Facility Operations Director
gal	Gallons
gpm	Gallons per minute
HP	Horsepower
ID	Inside diameter
IDW	Investigation Derived Waste
in	inch
IWD	Integrated Work Document
LANL	Los Alamos National Laboratory
LANS	Los Alamos National Security
MDA	Material Disposal Area
M&O	Management and Operations
NMED	New Mexico Environment Department
NTU	Nephelometric turbidity units
OD	Outside diameter
OM	Operations Manager
PIC	Person in charge
PM	Project manager
ppm	Parts per million
PR-ID	Project Review and Requirements Identification
PSTR	Primary Subcontract Technical Representative

PVC	Polyvinyl chloride
RCT	Radiological control technician
RP-1/ RP-3	Radiological protection group(s)
SMO	Sample management office
SOM	Shift Operations Manager
SOW	Statement of Work
SSTR	Secondary Subcontract Technical Representative
STR	Subcontract Technical Representative
SWPPP	Storm Water Pollution Prevention Plan
TD	Total Depth
TOC	Total organic carbon
TPMC	TerranearPMC
WCSF	Waste Characterization Strategy Form

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1.0 INTRODUCTION

1.1 Background

TerranearPMC has been contracted to install a perched intermediate monitoring well and drill a co-located shallow corehole by Los Alamos National Security (LANS) Environmental Programs (EP) Directorate Water Stewardship Project (WSP). Both the perched intermediate well and the corehole, designated as CdV-37-1i, will be located near the confluence of Water Canyon and Cañon de Valle within Los Alamos National Laboratory (LANL) Technical Area (TA) 15 in Los Alamos County, New Mexico (Figure 1). The CdV-37-1i borehole and corehole will share a new drill pad.

All work will be performed under the statement of work (SOW) and in accordance with the Compliance Order on Consent (2005) between the New Mexico Environment Department (NMED) and the United States Department of Energy (DOE)/LANL, and the Drilling Work Plan for Perched-Intermediate Aquifer Well CdV-37-1i (LA-UR-09-4726).

The CdV-37-1i intermediate-depth borehole will be installed to a depth of approximately 800 ft below ground surface (bgs). The screen interval will likely be located in the Puye Formation above the Cerros del Rio basalt or in the upper portion of the Cerros del Rio basalt. It is possible that Tschicoma dacitic lava may be encountered rather than Cerros del Rio basalt; stratigraphic interpretations in this area are problematic. The current hydrostratigraphic model anticipates Cerros del Rio lavas at this site.

Well CdV-37-1i is being installed to help define the eastern extent of contaminated perched-intermediate groundwater. CdV-37-1i is expected to encounter perched saturation at some depth above the top of lavas expected to be related to the Cerros del Rio volcanic field, which were sampled farther east (e.g., in R-27). CdV-37-1i is tentatively designed with a single 20-ft-long screen within the perched groundwater saturation zone (Figure 2). A final well design will be based on hydrogeological conditions encountered during drilling and will incorporate requirements that stem from discussions with NMED. If perched groundwater is encountered during drilling, the depth of the single screen interval for CdV-37-1i will be selected based on field observations of hydrology, stratigraphy, and borehole video/geophysics. A sampling system capable of effectively purging groundwater from the screened interval will be installed. A well will be installed at this location only if perched groundwater is encountered. If no perched intermediate groundwater is encountered, the borehole will be abandoned.

The CdV-37-1i corehole will be advanced to a depth of 300 ft bgs. Multiple core samples will be taken during drilling for contaminant analyses. Data from the core hole will help to determine if infiltration near the Water Canyon/Cañon de Valle confluence is partly or completely related to contamination that may be identified in CdV-37-1i. After drilling, the corehole will be plugged and abandoned.

This Drilling Plan provides guidance for drilling, sampling, borehole geophysics, well installation, well development, sampling system installation, and site restoration activities. Project staff, health and safety, waste management, security, schedules, and required permits are also discussed in this document.

1.2 Objectives

The intermediate-depth CdV-37-1i monitoring well is intended to provide hydrogeologic and groundwater quality data to achieve specific data quality objectives consistent with the Groundwater Protection Program for the Laboratory and the Compliance Order on Consent (March 2005) and the NMED approved work plan. Specifically, this new well is intended to determine if perched-intermediate groundwater zone(s) occur in the area of the confluence of Cañon de Valle and Water Canyon and, if so, to monitor the perched water. Monitoring at this location will help characterize potential groundwater contamination and pathways from potential upgradient sources. The corehole objective is to determine if infiltration near the Water Canyon/Cañon de Valle confluence is partly or completely related to contamination that may be identified in CdV-37-1i, R-25, R-47, or other up-gradient wells.

Secondary objectives are to collect drill-cutting samples, borehole geophysical data, and sample potential perched groundwater zones, if present.

The end-users of the data collected from this project will be LANL, DOE, NMED, and the general public.

2.0 ORGANIZATIONAL STRUCTURE

This project is being performed for LANS. The LANL Environmental Programs-Water Stewardship Program (EP-WSP) Drilling Subcontract Technical Representative (STR) will assist with obtaining the necessary LANL-required permits and assist with scheduling and logistical issues. An organizational chart is presented in Table 1.

2.1 TerranearPMC Project Management Team

The TerranearPMC Management Team consists of the Program Manager, Project Manager (PM), Drilling Superintendent, Environment, Safety and Health (ES&H) Representative, and Quality Assurance (QA) Manager. The Management Team will review all task order work plans, ensure compliance with QA, ES&H plans, and perform project audits of ongoing work.

The Management Team will also provide technical assistance to the Field Team. In addition, they will provide health and safety oversight and quality control guidance for well-construction and procedure compliance.

The ES&H Representative will provide health and safety related technical assistance and senior review of all project specific safety plans. He will also conduct daily project site safety inspections. The TPMC and LANS Management Team key personnel and their respective roles are detailed in Table 2.

2.2 Field Team

TerranearPMC's field team personnel and their respective roles are shown in Table 2. Additional qualified staff may be added as necessary to ensure all project requirements are met. These staff will be identified and their roles assigned before work begins.

During the drilling operations, there will be two onsite TerranearPMC personnel. One geologist will be onsite full time as the Field Team Leader (FTL) and lead site geologist. The other TerranearPMC team member will assist the geologist as needed. The field geologists will maintain field notes detailing daily site activities, compile and submit daily field reports, document

down-hole tools, collect samples, conduct lithologic logging, document wastes generated, and conduct daily safety meetings and equipment inspections. The FTL will be the main point of contact at the site.

Field operations will run 12-hours a day, seven days per week and shifts will be 12-hours per day throughout the duration of the project. Shift timing is yet to be determined; TA-15 operations and shot scheduling may necessitate working night or partial night shifts in order to reduce downtime (standby time). TerranearPMC staff will rotate shifts on a regular basis. TerranearPMC field team members will be interchangeable and their exact scheduling is expected to be flexible.

2.3 Drilling Subcontractor

Boart Longyear will be the drilling subcontractor supporting the drilling, well installation, and development of Intermediate Well CdV-37-1i and the CdV-37-1i corehole. The drilling subcontractor will be responsible for site safety, consistent and adequate sample recovery, ensuring that equipment is appropriate for the goals of the respective drilling projects and in proper working order, and that daily drilling logs are maintained.

The Boart Longyear drilling staff will rotate on a 14-day schedule. Continuous operations will require two crews. One crew will start the job and will work 14 consecutive days before the relief crew arrives. The relief crew will work 7 consecutive days, giving the start-up crew a 7-day break.

3.0 FIELD ACTIVITIES

Field activities will include well drilling, sample collection, down-hole geophysical characterization, well installation, well development, aquifer testing, permanent sampling system installation, surface completion, and site restoration. The Drilling Work Plan for Perched-Intermediate Aquifer Well CdV-37-1i (LA-UR-09-4726) will be used to guide field operations and ensure all objectives are met. A tentative schedule for project field activities is presented in Table 3.

3.1 CDV-37-1i Intermediate Well Drilling

Drilling equipment and supplies for the completion of the project will be staged around the work site in an organized and secure manner. Surplus and/or inactive equipment and supplies may be stored at the LANL drilling project laydown yard located at the northwest corner of Pajarito Road and New Mexico State Road 4. Access to the laydown yard is through a locked gate. The FTL will control the gate key.

3.1.1 Mobilization

Mobilization will consist of transporting and setting up equipment at the location. Mobilization will include the following:

- Mobilize drill rig, trailers, support vehicles, drilling tools and materials, and well construction materials to the drill site.
- Stage alternative drilling tools and construction materials at the laydown yard.
- Entrance radiological screening of all equipment and tooling by RP-1.
- Set up drill rig, trailers, support vehicles and tools at the location.
- Review scope of work and project-specific health and safety issues with crew.

- Complete all required training for all personnel.
- Obtain Facility Operations Director (FOD) Work Authorization, including rig inspection and Integrated Work Document (IWD) review.

The CdV-37-1i site will be accessed through the TA-36 gated entrance off of State Highway 4.

3.1.2 CDV-37-1I Intermediate Well Drilling Methods

The borehole for CdV-37-1i will be drilled using a Foremost DR-24 HD drill rig. Specifications for this machine may be found at Foremost's website (http://www.foremost.ca/dr_24hd.php).

The primary drilling methods will be conventional dual-rotary casing-advance and open hole drilling. Several different sizes of casing will be available. The casing diameters will be sufficient to allow smaller casing to telescope through larger casing with the smallest diameter casing allowing a minimum 2-in annular filter pack thickness. All casings will be standard wall, A53 grade B welded casing and the anticipated sizes for CdV-37-1i are 18-in., 16-in. and 12-in.

Figure 2 illustrates the predicted stratigraphy and schematic well design for CdV-37-1i. The discussion of drilling methods that follows refers to the stratigraphic contacts shown in Figure 2.

A retractable 18-in. surface casing will be advanced with fluid-assisted air-rotary methods through the alluvium (if present) and ash flows of the upper unit of the Bandelier Tuff to approximately 100-ft bgs. A retractable 16-in. casing will then be advanced with fluid-assisted air-rotary methods through the Cerro Toledo interval, and into the Otowi Member of the Bandelier Tuff to approximately 350 ft bgs. A retractable 12-in. casing string will then be advanced with fluid-assisted air-rotary methods through the remaining Otowi Member of the Bandelier Tuff, the Guaje Pumice Bed, and upper Puye Formation sediments to the top of the Cerros del Rio lavas. Open hole drilling methods will be avoided due to the unconsolidated nature of the formations above the Cerros del Rio lava. However, all of the casing strings may be retracted to investigate potential perched groundwater intervals, if requested. It is anticipated that the Cerro Toledo Interval will be of specific interest for perched groundwater occurrence; the Guaje Pumice Bed may also provide an interval of perched water. The 16-in. casing string may be partially or entirely retracted from the Cerro Toledo Interval or the Guaje Pumice Bed upon identification of the bottom of the unit in order to investigate perched groundwater. Open-hole fluid-assisted air-rotary methods will then be utilized to drill approximately 70 ft into the top of Cerros del Rio lavas.

All casing strings installed in the CdV-37-1i borehole will use welded drive shoes on the bottom of the string to protect the leading edge of the casing and to assist in cutting the borehole. The drive shoes will be cut off the 16-in. and 12-in. casing strings using a pneumatic casing cutter on drill rods before casing extraction. The 16-in. casing string and the attached drive shoe will be cut prior to installing the 12-in. casing string. Short sections of each string of casing and the attached drive shoes will remain in the borehole and will be isolated in bentonite during well construction. Currently, no cutter is available for the 18-in. casing. If the drive shoe on the 18-in. casing presents problems during casing extraction, the DR24-HD rig will be used to extract the casing with the aid of rotation.

The DR24-HD drill rig will move off the CdV-37-1i borehole after reaching planned TD. Well construction (or abandonment activities), development, and permanent pump installation will be carried out by a work-over (pump hoist) rig.

3.1.3 Proposed Alternative Drilling Methods

Drilling conditions may require converting to alternative methods. Consultation with the LANL STR will precede any deviations from the above referenced drilling methods. Conventional dual-rotary and casing advance will be the primary drilling methods employed at the CdV-37-1i borehole.

3.1.4 Drilling Additives

Potable water from a municipal source will be used to cool the drilling tools, help evacuate cuttings from the borehole, and suppress dust from the discharge of dry returns. Filtered compressed air will be the primary circulation 'fluid' for returning cuttings to the surface. Drilling foam will be used as needed only above a depth of approximately 640 ft bgs. Drilling fluid (i.e. foam), other than air and water, will be terminated at 640 ft bgs within the upper Puye Formation sediments. Descriptions of potential drilling foaming agents are as follows.

- AQF-2®: Added at a rate of 0.5 to 2.0% by volume. AQF-2 is an anionic surfactant that is added to fresh water for air/foam, air/gel-foam, or mist drilling applications. AQF-2 is the newest foaming agent in the Baroid line and is the preferred foaming agent for environmental drilling applications.
- Quik Foam®: Added at a rate of 0.5 to 1.0% by volume. Quik Foam provides the surfactant necessary for foam formation.

3.1.5 Decontamination

Decontamination of the drill rigs and tools will be performed by hot water/steam pressure washing before arriving onsite prior to the start of drilling activities and before leaving the site. Decontamination water will be containerized in 55-gallon drums, properly labeled and stored onsite. Decontamination of sample tools will be performed with a wire brush followed by spraying with Fantastik® and wiping clean with paper towels. Bailers will be washed with LiquiNox® detergent and potable water and rinsed with deionized water prior to sample collection.

3.1.6 Demobilization

Demobilization activities will include:

- Final decontamination and screening for radioactivity by RP-1 of the drill rigs, tools, and support equipment.
- Loading and removal of the drilling tools, including alternative tools, from the site.
- Removal of the drill rigs and support vehicles from the site.
- Staging and securing of investigation derived wastes (IDW) for future disposition.
- Removal of municipal waste (e.g. materials packaging).
- Final site cleanup.

The LANL STR will inspect the site prior to final demobilization of the drill crew. Final demobilization of the drill crew will not be permitted until the condition of the site is acceptable to the STR.

3.2 CdV-37-1i Intermediate Well Groundwater Detection

The primary indicator for groundwater will be the driller's observations. If the driller notes any indication of groundwater, drilling will stop, the drilling tools will be removed from the borehole and the presence of water will be verified using a water level meter. Alternatively, if the drill tools employed allow, the presence of water may be verified through the tooling without removal from the borehole. If water exists in the borehole, the tools will either be pulled from the borehole or remain out of the hole to allow the field team to check for accumulation of water in the borehole, collect a sample(s) for analyses, and establish a stabilized depth to water. If the depth to perched water does not stabilize, a series of bentonite plugs will be used in an attempt to seal off the perching horizon and reach a stable water level.

The anticipated intervals for perched intermediate groundwater are within the Cerro Toledo Interval, Guaje Pumice Bed, within Puye Formation sediments, and in the Cerros del Rio lavas. The STR will be contacted for direction at all groundwater occurrence decision points.

3.3 CDV-37-1I Intermediate Well Sample Collection Procedures

3.3.1 Groundwater Screening and Groundwater Characterization Sample Collection

Sample collection and handling procedures will be conducted in accordance with TPMC procedures that are equivalent to EP-ERSS-SOP-5057, "Handling, Packaging, and Transporting Field Samples" (formerly Standard Operating Procedure [SOP]-1.04 and ENV-DO-207) and EP-ERSS-SOP-5058, "Sample Control and Field Documentation" (formerly SOP-1.04). See Table 4 for analytical suites, container size, and preservation.

Groundwater screening samples will be collected if significant perched groundwater is encountered, and from the well screen interval at the end of well development. All screening samples will be analyzed for dissolved cations/metals and anions by the LANL Earth and Environmental Sciences Division (Group EES-14) chemistry laboratory. Samples for high explosives and low-level tritium analyses will also be collected in any perched groundwater intervals encountered. High explosives and tritium analytical samples will be analyzed by offsite laboratories. Screening samples collected will be held before analysis. Direction for sample submittal will be given by the STR.

Groundwater characterization samples will be collected from the completed well between 10 and 60 days after well development in accordance with the Consent Order. The samples will be analyzed for the full suite of constituents including: radioactive elements, metals/cations, general inorganic chemicals, volatile and semi-volatile organic compounds, and stable isotopes of hydrogen, nitrogen, and oxygen. This sampling event will be performed by others and is not a part of this drilling plan.

3.3.2 Cuttings Samples

Cuttings will be collected from the discharge line at 5-ft intervals. The cuttings will be examined to determine lithologic characteristics and will be used to prepare lithologic logs. Portions of the cuttings will be wet sieved (using #10 and #35 mesh) and placed in chip trays along with unsieved cuttings. The sieved fractions in chip trays will be submitted to the LANL archive. Lost circulation zones with no cuttings returns will be indicated by empty chip trays and cuttings-loss markers (core boxes) labeled 'no returns'. The remaining bulk cuttings will be sealed in Ziploc® bags, labeled, and archived in core boxes. The core boxes and chip trays will be delivered to the

LANL archive at the conclusion of drilling activities. A summary of cuttings sampling is presented in Table 5.

3.4 CDV-37-1i Intermediate Well Down-Hole Geophysics

The CdV-37-1i borehole may be logged with LANL-owned geophysical tools as requested during drilling. It is anticipated that LANL geophysical runs will be coordinated with specific drilling targets (e.g. upon reaching TD). Additionally, the LANL-owned down-hole video camera may be used to evaluate and remedy adverse drilling conditions.

Subcontract geophysical logging may be performed in the CdV-37-1i borehole by Schlumberger Wireline Services. If requested, Schlumberger will log the entire borehole after TD is reached. The following cased-hole Schlumberger geophysical suite may be run in the CdV-37-1i borehole:

- Natural and Spectral Gamma Logs
- Elemental Capture Sonde
- Accelerator Porosity Sonde (APS)
- Triple Litho Density

In the event that the borehole is open, the following open-hole Schlumberger geophysical suite may be performed:

- Natural and Spectral Gamma Logs
- Accelerator Porosity Sonde (APS)
- Formation Microimager (FMI); can only be operated below the water table
- Array Induction
- Combinable Magnetic Resonance (CMR)

The logs will be used to characterize the hydraulic properties of saturated rocks within the intermediate perched zone and to help select the well screen depth. The geophysical logging operation will consist of one mobilization after reaching the total depth for CdV-37-1i. Personnel from RP-3 will perform radiological screening and documentation of Schlumberger's down-hole radioactive source tool(s) upon arrival and prior to departure. If logging is conducted in an open hole, no radioactive sources will be used; however, RP-3 will be notified of Schlumberger's arrival. A TPMC field crewmember will be present during logging operations to oversee logging runs and calibration checks.

Schlumberger will process the geophysical logs and provide a preliminary interpretation within 24 hours of completion. Five copies of the raw field geophysical logs and a compact disc (CD) containing the field logs (in .las format) will be provided to LANL immediately after completion of logging. Final logs, electronic files, and montages will be provided in the well completion report.

The drilling subcontractor shall assist in hanging a sheave from the rig mast or tophead for wireline access to the borehole during all geophysical logging operations.

3.5 CDV-37-1i Intermediate Well Installation and Completion

If perched water is present, a well will be installed and completed with a single screen; the length will be determined based on the hydrostratigraphy. The screen and filter pack will likely be submerged in the upper part of the perched water zone. Data from screening samples and the lithologic, geophysical, and video logs will be used to determine the exact placement of the screened interval of the well. The well will be designed in accordance with TPMC's procedure equivalent to EP-ERSS-SOP-5032. LANL will provide an approved well design to TPMC prior to the start of well installation. Final well design will be based on data review and discussions between TPMC, EP-WSP, DOE and NMED.

The total well screen length and well construction details will be based upon site-specific conditions and will be approved by the LANL STR in writing before the start of well construction. NMED will approve the design prior to well construction.

If no perched water is encountered, the borehole will be plugged and abandoned.

3.5.1 Well Construction

The well will be constructed of 5.0-in. inside diameter (ID)/ 5.56-in outside diameter (OD), type A304, stainless steel casing fabricated to ASTM A312 standards provided by LANS. The screened interval of the well will consist of nominal 11-ft length(s) of 5.88-in OD, 0.020-in slot, rod-based wire wrapped well screen. Each well screen segment has an effective screen length of 10 ft. Stainless-steel casing will be installed below the bottom-most well screen to provide a 10-ft or 20-ft sump with a threaded end cap. External couplings, also of type A304 stainless steel fabricated to ASTM A312 standards, will be used to connect individual casing and screen joints. All well screen and casing will be thoroughly washed/ decontaminated before use and wrapped in plastic if staged after washing. Centralizers will be placed approximately 2 ft above and below the well screen. A secure cap will be welded or threaded onto the top of the well casing to prevent backfill materials from entering the well during construction.

During well construction, a tremie pipe will be used to gravity feed annular fill materials installed below the top of water. The bottom of the borehole will be tagged at the beginning of well installation and a 50/50 mix of bentonite chips and sand will be placed from the bottom of the borehole to within 5 ft of the bottom of the screened interval. The well shall be supported from the top at all times during construction.

The primary filter pack of the screened interval will consist of 10/20 silica sand and will be placed approximately 5 ft above and below the screened interval. The primary filter pack material and interval will be based on site-specific data. After placement, the screened interval will be swabbed to promote settling and compaction of the primary filter pack. A 2 to 5-ft thick collar of finer-grained (20/40) silica sand will be placed above the primary filter pack.

A bentonite seal consisting of 100 percent bentonite chips or pellets will be placed above the fine sand collar. Potable water will be used to transport the materials down-hole.

Backfill material will consist of bentonite chips to fill the borehole annulus to within 100 ft of the ground surface. Cement with 1 to 2% Baroid IDP-381 additive will be used to fill the remainder of the borehole annulus. The depth to annular fill material will be physically measured with a tag line periodically to determine that the materials are settling properly.

3.5.2 Well Development

Development of CdV-37-1i will begin no sooner than 24-h after the well has been cemented to ground surface. The primary objective of well development is to develop the filter pack and remove suspended sediment from the well until water turbidity is less than 5 nephelometric turbidity units (NTUs) for three consecutive samples collected at 30-minute intervals. Additional water quality parameters to be measured during development include pH, temperature, specific conductance, dissolved oxygen, and total organic carbon (TOC). If the turbidity standard is not attainable, an alternate standard of stabilization of pH, temperature, conductivity, and a TOC level of less than 2.0 parts per million (ppm) must be achieved before termination of development procedures. Water will be collected daily in 40-ml septum vials and 250-ml poly bottles and transferred to LANL Earth and Environmental Sciences Division (EES-14) laboratory for analysis. Samples will be submitted unfiltered and without preservatives.

Development of the well will begin by swabbing and bailing the screened interval and sump to remove any backfill and/or formation materials that have been introduced into the well during drilling and well construction and to clean the filter pack. The screened interval will be swabbed using a surge block to enhance filter pack development. The surge block will consist of a 4.75-in. OD, 1-in. thick nylon (or similar) disc attached to a weighted static rod operated on a wireline. The swabbing tool will be lowered into the well and drawn repeatedly across the screened interval for approximately 1 hour. After swabbing, a conventional 4-in. bailer will be used to bail water and suspended sediment from the well. Bailing will continue until water clarity visibly improves. Water quality parameters will not be measured during the swabbing and bailing process.

If the well appears to have sufficient groundwater availability during bailing, a 4-in. diameter submersible pump with an appropriately sized pump motor will be used for the final stage of the well development. The pump intake will be set at multiple depths within the screened interval and in the sump to remove as much suspended sediment as possible until the desired results (parameters) are achieved. Alternatively, if groundwater availability appears limited, a pneumatic Bennett pump will be used for the final stage of the well development. The pneumatic pump used during development will be similar to the unit installed for the dedicated sampling system.

Hydraulic testing of the well will be conducted if a sufficient volume for doing so is available.

3.5.3 Sampling System Installation

A dedicated sampling system consisting of either an electrical submersible pump or a pneumatic Bennett pump will be installed in the well. Pump selection will depend upon groundwater availability which will be determined during development. Likewise, the pump size (horsepower and/or discharge rate) will be specified after well screen interval specific capacity observations are made during well development.

All materials that contact the groundwater will be constructed of either stainless steel, Teflon, or PVC. All components of the pump column will be new. If an electrical submersible pump is installed, the pump column will be constructed of 1 in. threaded/coupled stainless steel pipe with check valves installed in the pipe string every 200 ft. A weep hole will be installed at the bottom of the uppermost pipe joint to protect the pump column from freezing. To measure water levels in the well, two 1-in. I.D. schedule 80 polyvinyl chloride (PVC) tubes will be installed to sufficient depth to set a dedicated transducer and to collect manual water levels. The PVC transducer tubes will be equipped with 6-in sections of 0.010 in. slot screen with threaded end caps at the bottom of the tubes. A LANS provided, weather-resistant pump control box will be installed next

to the wellhead. If a Bennett pump is installed, the pump column will be a tube bundle containing Teflon discharge, supply, and exhaust lines along with a stainless support cable. The dedicated transducer will be installed banded directly to the tube bundle if a Bennett pump is installed.

3.5.4 Surface Completion

The wellhead surface completion will include a 10-in. steel outer protective casing to protect the stainless steel monitoring well. The wellhead completion will be a 'stick-up' with an overall height, including riser cap, of 3-ft, 6-in. A weep-hole will be installed to prevent water build-up inside the protective casing. The top of the protective casing will be fitted with a LANL supplied tamper-proof well cover plate and will be set in a 10-ft by 10-ft by 6-in.-thick reinforced concrete pad. A brass survey monument, imprinted with well identification information, will be placed in the northwest corner of the pad. A total of four bollards, painted yellow for visibility, will be set at the outside corners of the pad to protect the well from traffic. All four bollards will be designed for easy removal to allow access to the well.

Southwest Mountain Surveys, a New Mexico licensed professional land surveyor, will survey the well location and elevation. Survey points will include: ground surface elevation near the concrete pad, the top of the brass pin in the concrete pad, the top of the well casing, and the top of the protective casing. The accuracy of the survey data will be in accordance with NMED Regulations and LANL procedure. Survey data will be supplied to the LANL STR and will also be provided in the completion report.

3.6 CdV-37-1i Corehole

The CdV-37-1i corehole will be drilled on the drill pad adjacent to the CdV-37-1i intermediate well. The coring will be conducted to determine if infiltration near the Water Canyon/Cañon de Valle confluence is partly or completely related to contamination that may be identified in the CdV-37-1i monitoring well. Multiple core samples will be taken during drilling for contaminant analyses. After drilling, the corehole will be plugged and abandoned.

The timing of the corehole drilling is yet to be determined. It is anticipated that site access and drill rig availability will dictate that the CdV-37-1i monitoring well borehole will be drilled first and the corehole will be drilled second.

3.6.1 Corehole Drilling and Abandonment

A roto-sonic drill rig will be utilized for drilling/coring of the CdV-37-1i corehole. The corehole will be advanced through the Tshirege Member of the Bandelier Tuff, Cerro Toledo interval, and upper portion of the Otowi Member of the Bandelier Tuff to a depth of 300 ft bgs. Roto-sonic drilling methods rely upon a core barrel and returned core as a means of circulation. Core tooling and casing will be advanced continuously to maintain hole stability and will be used to seal off any perched water encountered. Dry drilling methods are preferred but potable water may be used if needed to assist in advancing casing. The addition of potable water will be avoided within targeted analytical sampling intervals. Several different sizes of flush-threaded casing will be available. The casing diameters will be sufficient to allow smaller casing to telescope through larger casing and will allow the sealing-off of any perched water encountered. The anticipated sizes are 9-in., 7-in, and 6-in. Core will be collected in Lexan sleeves using a split barrel sampler at the target intervals for analytical samples as indicated in Table 6.

Mobilization, demobilization, and decontamination activities and procedures will be as described in Section 3.1 for Intermediate Well CDV-37-1i drilling.

3.6.2 Corehole Sample Collection Procedures

Moisture-protected core samples will be obtained from thirteen targeted intervals. The intervals are as follows: 10, 20, 30, 40, 50, 60, 80, 100, 140, 180, 220, 260 and 300 ft bgs. Three core samples will be collected from each interval and pore water from the core will be analyzed at the LANL EES-14 laboratory for the following: major ions (Ca, Mg, K, Na, SO4, Cl, NO3, NO2, Br, PO4, F, oxalate, perchlorate, chlorate, total carbonate alkalinity [calculated]) and metals/trace elements (Au, Ag, As, B, Be, Cd, Co, Cr [total], Cs, Fe, Hg, Li, Mn, Mo, Ni, Pb, Rb, Sb, Se, Si, Sn, Sr, Th, Tl, Ti, U, V, and Zn). The third core sample will be analyzed for high explosives compounds at an offsite laboratory. Table 6 details sample collection activities.

The analytical samples will be collected from a 5 ft long, 4-in. I.D., steel split barrel core sampler run on a string of roto-sonic drill rods. Lexan sleeves will be loaded in the split barrel to retrieve the three required core samples per interval. Each sleeved core sample will be immediately capped and secured with Teflon tape. If possible, the Lexan sleeves will be precut in order to target the intended sample interval precisely (e.g. three 6-in. sleeves precut and loaded in the split barrel sampler with exact placement). Core samples between the targeted analytical sample intervals may be drilled with a 10-ft core barrel without the use of Lexan liner sleeves. The entire corehole will be continuously cored and all returned core will be archived in core boxes.

3.7 Potential Borehole Abandonment

The borehole will be plugged and abandoned if no perched intermediate groundwater is encountered at the CDV-37-1i location. The corehole will be plugged and abandoned after reaching TD. Borehole abandonment(s) will be consistent with the requirements and guidelines of the "New Mexico Environment Department Monitoring Construction and Abandonment Guidelines" and in Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent.

3.8 Investigation Derived Waste

All IDW generated during implementation of this work plan will be managed in accordance with applicable Environmental Programs–Waste and Environmental Services (EP-WES) and Environmental Protection Water Quality and Resource Conservation Recovery Group (ENV-RCRA) SOPs. These SOPs incorporate the requirements of all applicable U.S. Environmental Protection Agency (EPA) and NMED regulations, DOE orders, and Laboratory requirements. Documents applicable to the characterization and management of IDW are the following:

- EP-ERSS-SOP-5022, Characterization and Management of Environmental Restoration Project Waste (http://int.lanl.gov/environment/all/docs/qa/ep_qa/EP-ERSS-SOP-5022.pdf);
- the NMED-approved Notice of Intent (NOI) Decision Tree for Drilling, Development, Rehabilitation, and Sampling Purge Water; and
- the NMED-approved NOI decision Tree for IDW Solids from Construction of Wells and Boreholes.

A Waste Characterization Strategy Form (WCSF) will be prepared by LANS in accordance with EP-ERSS-SOP-5022 and will provide more detailed information on waste descriptions, quantities, handling, and disposition. All wastes generated during the CdV-37-1i project will be managed according to the WCSF.

Table 1
CDV-37-1i Project Organizational Chart

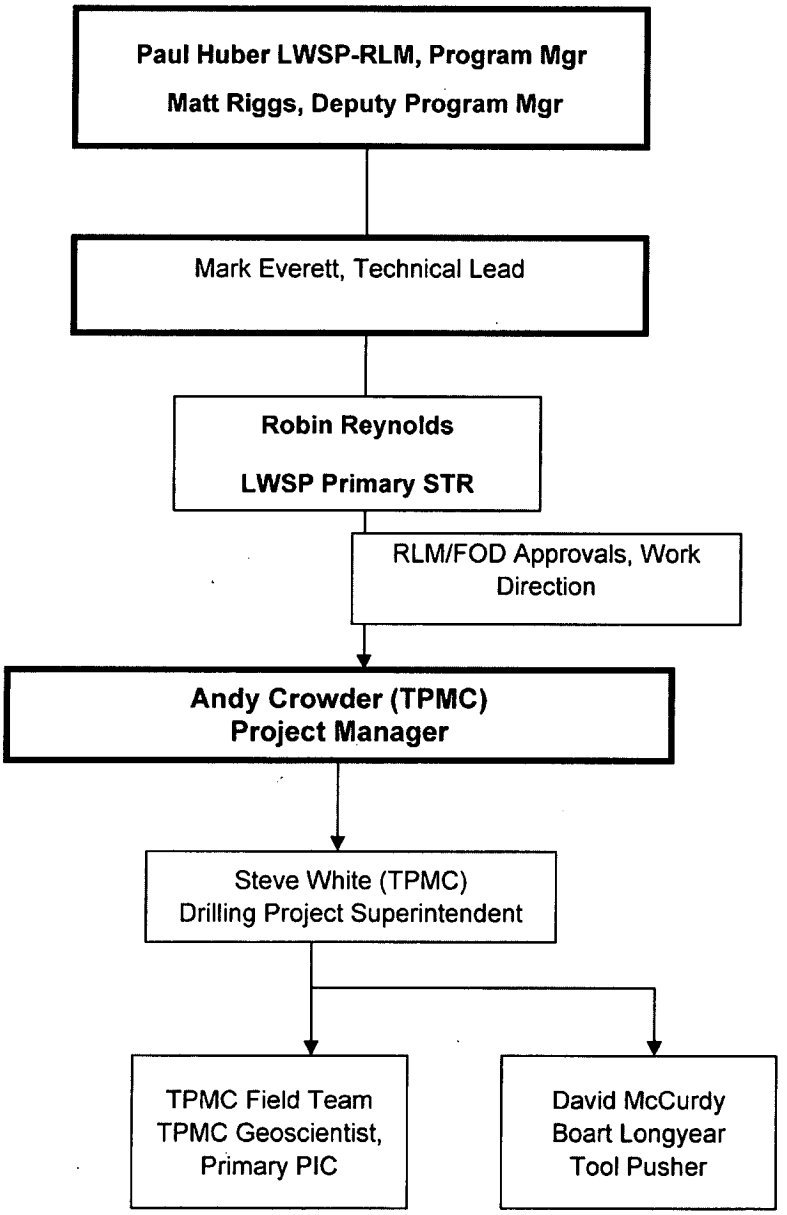


Table 2
TerranearPMC Key Team Personnel Roles and Responsibilities

Name	Role	Responsibilities
Peter Gram	Program Manager	Program Management
Andy Crowder	Project Manager, Alternate Person in Charge (PIC)	Project management, budget, resource commitments, and LANS interaction
Steve White	Drilling Superintendent, Principal Field Team Leader (FTL), Alternate PIC	Project and field management, LANS interaction, geology, and subcontractor coordination
Robert Brounstein	ES&H Representative	IWD and Health and Safety compliance
Al Whiteaker	Quality Assurance Manager	Quality assurance management oversight
Gary Stoopes	Environmental Professional	Regulatory compliance
Ryan McGuill	Field Geologist, FTL/ Alternate PIC	Field management, geology, and subcontractor coordination
Rick Lawerence	Field Geologist, FTL/ Alternate PIC	Field management, geology, and subcontractor coordination
Andy Miller	Field Geologist, FTL/ Alternate PIC	Field management, geology, and subcontractor coordination
Mickey Jojola	Field Geologist, FTL/ Alternate PIC	Field management, geology, and subcontractor coordination
Pattie Baucom	Field Geologist, FTL/ Alternate PIC	Field management, geology, and subcontractor coordination
Selene Moseley	Field Waste Management Technician	Management of waste and implementation of WCSF
Robert Stadeli	Boart Longyear Drilling Supervisor	Project and technical management oversight of drilling operations
David McCurdy	Boart Longyear Tool Pusher	Project and technical management oversight of drilling operations

Table 2 (Continued)

Name	Role	Responsibilities
Matt Riggs	LANL Water Stewardship Program (LWSP) Deputy Responsible Line Manager (RLM)	Responsible to the RLM Program Director for the overall planning, coordination, approval, execution and closeout for this project. Authorizes and approves project work
Mike Alexander	LWSP Facility Ops Director (FOD)	Facility Operations and Security Management/Coordination; When delegated authorizes and approves project work
Mark Everett	LWSP Drilling Project Technical Lead	Project leadership for overall drilling projects planning, coordination, oversight, execution and closeout for this project
Terry Forrester	Procurement Specialist, (PS)	Responsible for solicitation, negotiation, award, and administration of subcontracts and has overall commercial responsibility for respective subcontracts; designated authority to direct subcontractor
Robin Reynolds, MTOA Task 5 Primary STR Marvin Gard, Secondary STR	LWSP, Primary Point-of-Contact (POC), Subcontract Technical Representative (PSTR)	Responsible for monitoring and documenting the subcontractor's day-to-day performance, providing day-to-day oversight, assuring work is performed in a safe manner. STR is the single Point-of-Contact for interaction between LANS and Subcontractor.

Table 3
Tentative Drilling Schedule

Activity	Start Date	Date of Completion
Drill Site Preparation	9/01/09	9/10/09
Driller Mobilization	9/22/09	9/23/09
CDV-37-1I Drilling	9/24/09	10/18/09
CDV-37-1I Geophysics	10/19/09	10/20/09
Well Design	10/21/09	10/21/09
CDV-37-1I Well Construction	10/21/09	11/9/09
CDV-37-1I Development	11/10/09	11/14/09
CDV-37-1I Pump Installations	TBD	TBD
CDV-37-1I Corehole Drilling and Abandonment	TBD	TBD
IDW Analyses	TBD	TBD

Notes: TBD = to be determined

Table 4
Analytical Suites, Sample Containers, Preservation, Sample Volume, and Preferred Laboratories for Groundwater Collection from Well CDV-37-1i

Analytical Suite	Sample Container	Filtered (0.45 micron filter)	Sample Volume (L)	Preferred Laboratory
Groundwater Screening Samples				
Metals/cations (dissolved)	Poly	No	1.0	EES-14*
Anions (dissolved) [including perchlorate]	Poly	No	1.0	EES-14
Tritium	Poly	No	1.0	TBD^
VOCs	Amber glass	No	40 ml	TBD^
High Explosives	Amber glass	No	1.0	TBD^
Total Organic Carbon (TOC)	Amber glass	No	40 ml	EES-14

Notes:
*EES-14: LANL Earth and Environmental Sciences-Hydrology, Geochemistry and Geology Group.
^TBD: to be determined

Table 5
Sample Collection Activities for Drill Cuttings from Intermediate Borehole CDV-37-1i

Sample Description	Test	Sample Size	Container	Sample Frequency
Cuttings	Bulk cuttings systematically collected for archival purposes and for supplemental sample needs	500-700 ml	Plastic Ziploc™ bags	One sample every 5-ft.
Cuttings	Sieved cuttings for lithologic description and binocular microscope examination	Enough to partly fill trays	Plastic chip trays	One sample every cutting run (nominally every 5-ft.) Normally, an unseived sample, >10 mesh sample, and a >35 mesh sample every cuttings run.

Table 6
Sample Collection Activities for Core from Corehole CDV-37-1i

Sample Description	Analyte (Laboratory)	Sample Size	Container	Sample Frequency
Core	Major ions (EES-14*)	3-in. ID core, 6-in. length	Sealed Lexan sleeved core sections	Samples collected from the following selected depths: 10, 20, 30, 40, 50, 60, 80, 100, 140, 180, 220, 260 and 300 ft bgs.
Core	Metals/trace elements (EES-14)	3-in. ID core, 6-in. length	Sealed Lexan sleeved core sections	Samples collected from the following selected depths: 10, 20, 30, 40, 50, 60, 80, 100, 140, 180, 220, 260 and 300 ft bgs.
Core	High explosives compounds (GEL; offsite)	3-in. ID core, 6-in. length	Sealed Lexan sleeved core sections	Samples collected from the following selected depths: 10, 20, 30, 40, 50, 60, 80, 100, 140, 180, 220, 260 and 300 ft bgs.

*EES-14: LANL Earth and Environmental Sciences-Hydrology, Geochemistry and Geology Group.

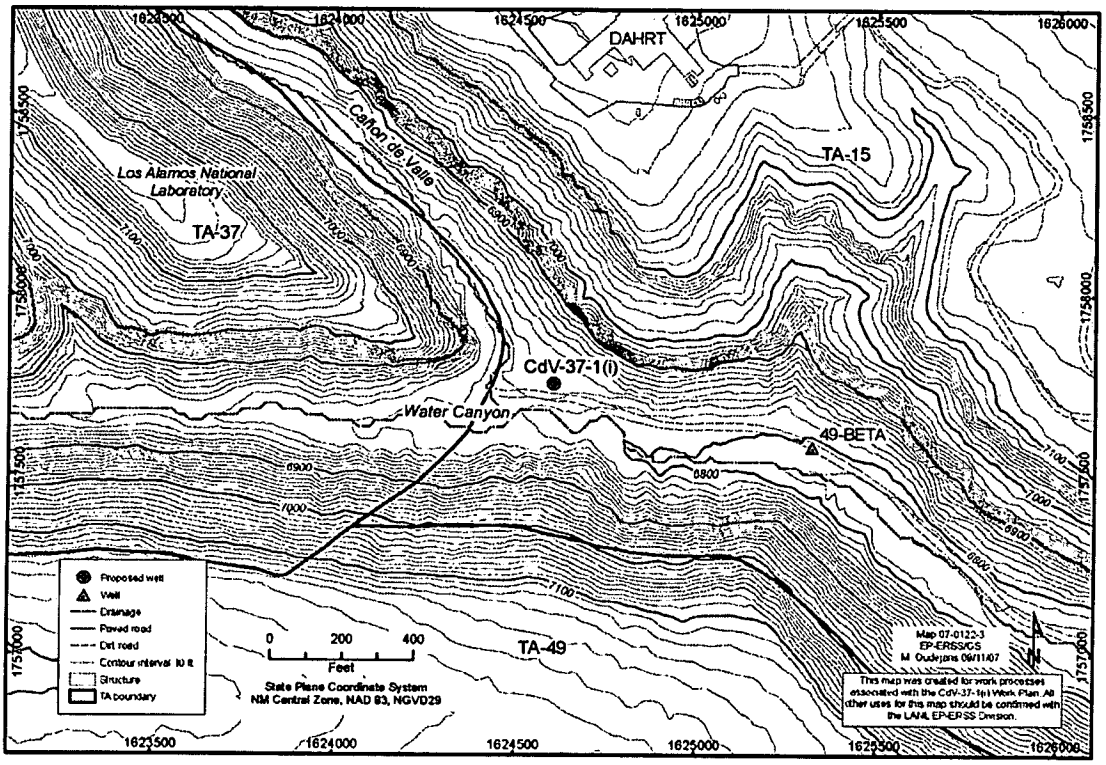
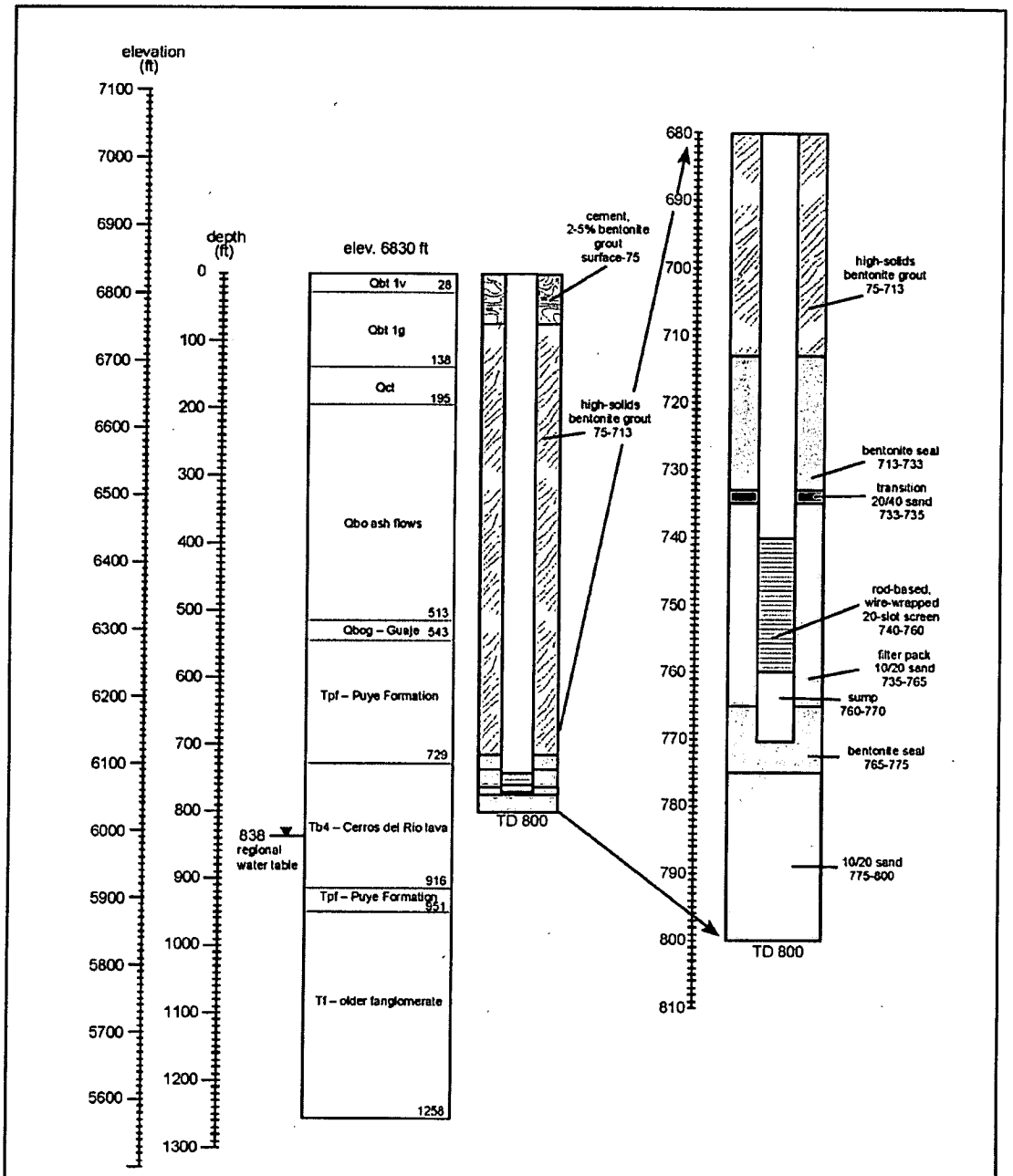


Figure 1 Proposed location of Intermediate Monitoring Well CDV-37-1i and Corehole



Note: Qbt 1v = unit 1v of the Tshirege Member of the Bandelier Tuff, Qbt 1g = unit 1g of the Tshirege Member of the Bandelier Tuff; Qct = Cerro Toledo Interval; Qbo = Otowi Member of the Bandelier Tuff; Qbog = Guaje Pumice of the Otowi Member of the Bandelier Tuff; Tpf = Puye Formation, Tb4 = Cerros del Rio lavas; Tf = older fanglomerate or possible Santa Fe Group sediments; TD = total depth.

TerranearPMC	PROPOSED STRATIGRAPHY AND WELL DESIGN CdV-37-1i Canyon de Valle Los Alamos National Laboratory Los Alamos, New Mexico	Fig. 2 NOT TO SCALE
Drafted By: TPMC Project Number: 80004	Date: August 25 2009 Filename: Cdv37-1i_ProposedWellDesign	

Figure 2 Predicted stratigraphy and schematic well design for Intermediate Monitoring Well CDV-37-1i.

Environmental Programs (EP)
Document Signature Form

Document Catalog Number: EP2009-0512
(Please prefix the name of all electronic versions of this document with this number.)

Document Title /Subject: Drilling Plan for Intermediate Well CdV-37-1i and CdV-37-1i Corehole
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Associated Document Catalog Number(s): None
Author: Everett, Mark 667 5931 meverett@lanl.gov
Organization: EP: LANL Water Stewardship Program (LWSP) – PKG #1729
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