



**Sandia National Laboratories, New Mexico (SNL/NM)
Environmental Restoration Operations**

**Monitoring Well Plug and Abandonment Plan
and
Well Construction Plan**

**Decommissioning of
Groundwater Monitoring Well TA2-SW1-320**

**Installation of Groundwater Monitoring Wells
TA2-W-28, CYN-MW14, and CYN-MW15**

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**United States Department of Energy
Sandia Field Office**

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Acronyms and Abbreviations

AOC	Area of Concern
AOP	Administrative Operating Procedure
ARCH	air-rotary casing-hammer
bgs	below ground surface
BSG	Burn Site Groundwater
CSSP	Contract-Specific Safety Plan
DC	drilling contractor
DOE	U. S. Department of Energy
ER	Environmental Restoration
FOP	Field Operating Procedure
GIS	Geographic Information System
ft	feet
HASP	health and safety plan
HSWA	Hazardous and Solid Waste Amendments
HWB	(NMED) Hazardous Waste Bureau
KAFB	Kirtland Air Force Base
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
NNSA	National Nuclear Security Administration
NTU	Nephelometric Turbidity Units
OSHA	Occupational Safety and Health Administration
P&A	plug and abandonment
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
Sandia	Sandia Corporation
SFO	Sandia Field Office
SNL/NM	Sandia National Laboratories/New Mexico
SOW	Statement of Work
SWMU	Solid Waste Management Unit
TAG	Tijeras Arroyo Groundwater
WMP	Waste Management Plan

1 Project and Site Information

This Monitoring Well Plug and Abandonment Plan and Well Construction Plan (Work Plan) describes the procedures that will be followed by the U.S. Department of Energy/National Nuclear Security Administration/Sandia Field Office (DOE/NNSA/SFO) and Sandia Corporation (Sandia), hereafter referred to as DOE/Sandia, for the decommissioning and installation of monitoring wells associated with the Sandia National Laboratories/New Mexico (SNL/NM) Tijeras Arroyo Groundwater (TAG) Area of Concern (AOC) and the Burn Site Groundwater (BSG) AOC. This Work Plan outlines the activities and procedures to decommission one existing groundwater monitoring well TA2-SW1-320; and installation of new groundwater monitoring wells TA2-W-28, CYN-MW14, and CYN-MW15.

Task Description:	SNL/NM decommissioning with plugging and abandonment (P&A) of one groundwater monitoring well, installation of three replacement groundwater monitoring wells, and the preparation of a Well Installation Report
Scheduled Start Date:	October 2013 – start of field work is contingent upon New Mexico Environment Department (NMED) approval of this Work Plan
Estimated Completion Date:	March 2014 – submittal of the Plug and Abandonment and Well Installation Report to NMED

2 Regulatory Criteria

The NMED Hazardous Waste Bureau (HWB) implements and enforces the Resource Conservation and Recovery Act (RCRA) requirements. Section VIII.C of the Compliance Order on Consent (the Consent Order) discusses well abandonment (NMED April 2004):

“Wells shall be abandoned when they are no longer required in the monitoring network, no longer provide representative groundwater samples because of falling water levels or insufficient productivity, or become damaged beyond repair. The goal of well abandonment is to seal the well in such a manner that it cannot act as a conduit for the migration of contaminants from either the ground surface to the saturated zone or between saturated zones. Respondents shall prepare an abandonment plan for any and all wells that are to be plugged and abandoned, and shall submit the plan to the Department for approval. Respondents shall not abandon any groundwater monitoring well without prior written approval of the Department.”

Further regulatory requirements for well P&A procedures can be found in the New Mexico Office of the State Engineer (NMOSE) “Rules and Regulations

Governing Well Driller Licensing; Construction, Repair and Plugging of Wells"
(NMOSE August 2005):

"To plug a well, the entire well shall be filled from the bottom upwards to land surface using a tremie pipe. The well shall be plugged with neat cement slurry, bentonite based plugging material, or other sealing material approved by the state engineer for use in the plugging of non-artesian wells"

The NMOSE regulations also state that:

"Wells encountering contaminated water or soil may require coordination between the office of the state engineer and the New Mexico environment department (or other authorized agency or department) prior to the plugging of the well."

And,

"A licensed well driller shall keep a record of each well plugged as the work progresses. The well driller shall file a complete plugging record with the state engineer and the permit holder no later than twenty (20) days after completion of the plugging. The plugging record shall be on a form prescribed by the state engineer . . ."

To meet these regulatory requirements, the following tasks will be completed:

- Submit this Work Plan to the NMED/HWB and NMOSE requesting to decommission TAG well TA2-SW1-320 [the polyvinyl chloride (PVC) casing for this well is damaged] and install replacement well TA2-W-28. Due to regional drought conditions, two BSG wells (CYN-MW3 and CYN-MW6) have gone dry and will be replaced by proposed wells CYN-MW14 and CYN-MW15, respectively. CYN-MW3 and CYN-MW6 will not be decommissioned at this time, as the water levels in these wells may recover when the regional drought abates.
- Use a NMOSE-licensed well driller and approved materials to install the replacement wells and to seal the decommissioned well so that the well cannot act as a conduit for the migration of potential contaminants from the ground surface to the saturated zone.
- Upon completion of the P&A activities, submit a P&A/Installation Report to the NMED and NMOSE.

3 Pre-Field Activities

The pre-field activities that will be completed prior to drilling operations include the preparation, review, and approval of:

- The drilling contract Statement of Work (SOW);
- SNL/NM excavation permit;
- SNL/NM site-specific Health and Safety Plan (HASP);
- Drilling contractor's (DC) Contract-Specific Safety Plan (CSSP);
- NMOSE permit to decommission and install monitoring wells;
- SNL/NM National Environmental Policy Act Checklist;
- SNL/NM Waste Management Plan (WMP);
- SNL/NM Field Work Checklist (punch list); and

- SNL/NM Readiness Review.

4. Health and Safety

The field personnel will perform field activities safely in accordance with the HASP and CSSP. Level D personal protective equipment is anticipated for all drilling and well installation operations. Training records associated with the drilling personnel will be maintained on site and will be available at the commencement of drilling activities. The field personnel will operate under both the HASP and CSSP and will have SNL/NM-required training, including 40-hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response training and a current 8-hour annual-refresher course.

An SNL/NM Subject Matter Expert will perform a safety inspection of the drill rig and associated equipment before drilling commences. If any of the items are found to be in poor repair, significantly different than bid by the DC, or inadequate, the SNL/NM representative may delay commencement of drilling until the DC provides the equipment/services required. Daily equipment inspections for the drill rig and support equipment shall be documented by the DC and the records maintained on site. Noticeable drips of hydraulic oil, fuel, or other fluids will be contained by plastic sheeting placed under the rig at each drilling location. The leaks will either be repaired immediately at the site, the rig will be removed from the site for required repairs, or the DC will provide a substitute rig.

Prior to the start of drilling operations, SNL/NM Facilities Engineering will complete an Excavation Permit for the vicinity of the three proposed wells. SNL/NM personnel will mark on the ground surface the buried utilities that may be present at each of the drilling locations. The DC will physically verify that buried utilities are not present by "potholing" with a hand shovel to a depth of 3 feet (ft) below ground surface (bgs) at each drilling location. If needed, the DC can adjust each drilling location by a maximum of 10 ft laterally to ensure safe drilling operations relative to buried utilities and/or other features (i.e., adjacent monitoring wells or fence) that limit adequate working space. However, buried utilities or overhead power lines are not anticipated to be a concern at these drilling locations.

5. Equipment Decontamination

The drill rig and associated equipment will be decontaminated with a pressure washer or steam cleaner prior to use at each drilling location. The decontamination work will be conducted at either the SNL/NM decontamination pad in TA-III or at Building 9925 - Environmental Resources Field Operations. Decontamination waste (water and soil) will be contained in polyethylene drums and placed on spill control pallets. The waste will be managed in accordance with the site-specific WMP. The drill rig and associated equipment will be decontaminated after the last well is installed and prior to leaving SNL/NM property.

6. Existing Well Information

Groundwater monitoring well TA2-SW1-320 is proposed for decommissioning in this Work Plan. This well is located in the TAG study area in DOE-controlled property on Kirtland Air Force Base (KAFB) property (Figure 1 and Figure 2). Groundwater monitoring wells CYN-MW3 and CYN-MW6 are not proposed for decommissioning in this Work Plan; however deeper wells will be placed next to these two existing wells. These wells are located in the BSG study area in the eastern portion of the KAFB Withdrawn Area (Figure 1 and Figure 3). The well completion diagrams for these three existing wells are provided in Attachment 1 and the pertinent well completion information is summarized below.

TA2-SW1-320 is a groundwater monitoring well installed using air-rotary casing-hammer (ARCH) methods in November 1992 with the following well completion details:

- Total depth of the well – 325 ft bgs, including a 5-ft bottom cap/sump.
- Screened interval – 299.6 to 319.6 ft bgs.
- Construction materials – Schedule 80 PVC riser pipe and screen (~3.8 inch internal diameter), carbon-steel protective surface casing, and a concrete well pad.
- Current water level – 317.52 ft bgs (January 2013).
- Water-bearing strata – unconsolidated silt, sand, and gravel (alluvium) of the Santa Fe Group.
- Reason for decommissioning – As described in the memo entitled “*Evaluation of the Integrity of Groundwater Monitoring Well TA2-SW1-320 in the Tijeras Arroyo Groundwater (TAG) Study Area*” (Attachment 2) the PVC well casing has failed at several depth intervals. Video-camera logging was used to determine the failure depths.

CYN-MW3 is a groundwater monitoring well installed using ARCH methods in June 1999. This well is completed in the bedrock aquifer with the following well completion details:

- Total depth of the well – 135 ft bgs, including a 5-ft sump.
- Screened interval – 120 to 130 ft bgs.
- Construction materials – Schedule 80 PVC riser pipe and screen (~5 inch internal diameter), carbon-steel protective surface casing, and a concrete well pad.
- Current water level – approximately 130 ft bgs (too dry to sample as of October 2011).
- Water-bearing strata – Groundwater occurs as fracture flow in Precambrian phyllite/metavolcanics.
- Reason for drilling a replacement well – this well will not be decommissioned. It is currently dry due to regional drought conditions and will be retained in anticipation of water level recovery. Attachment 3 shows the hydrograph for this well.

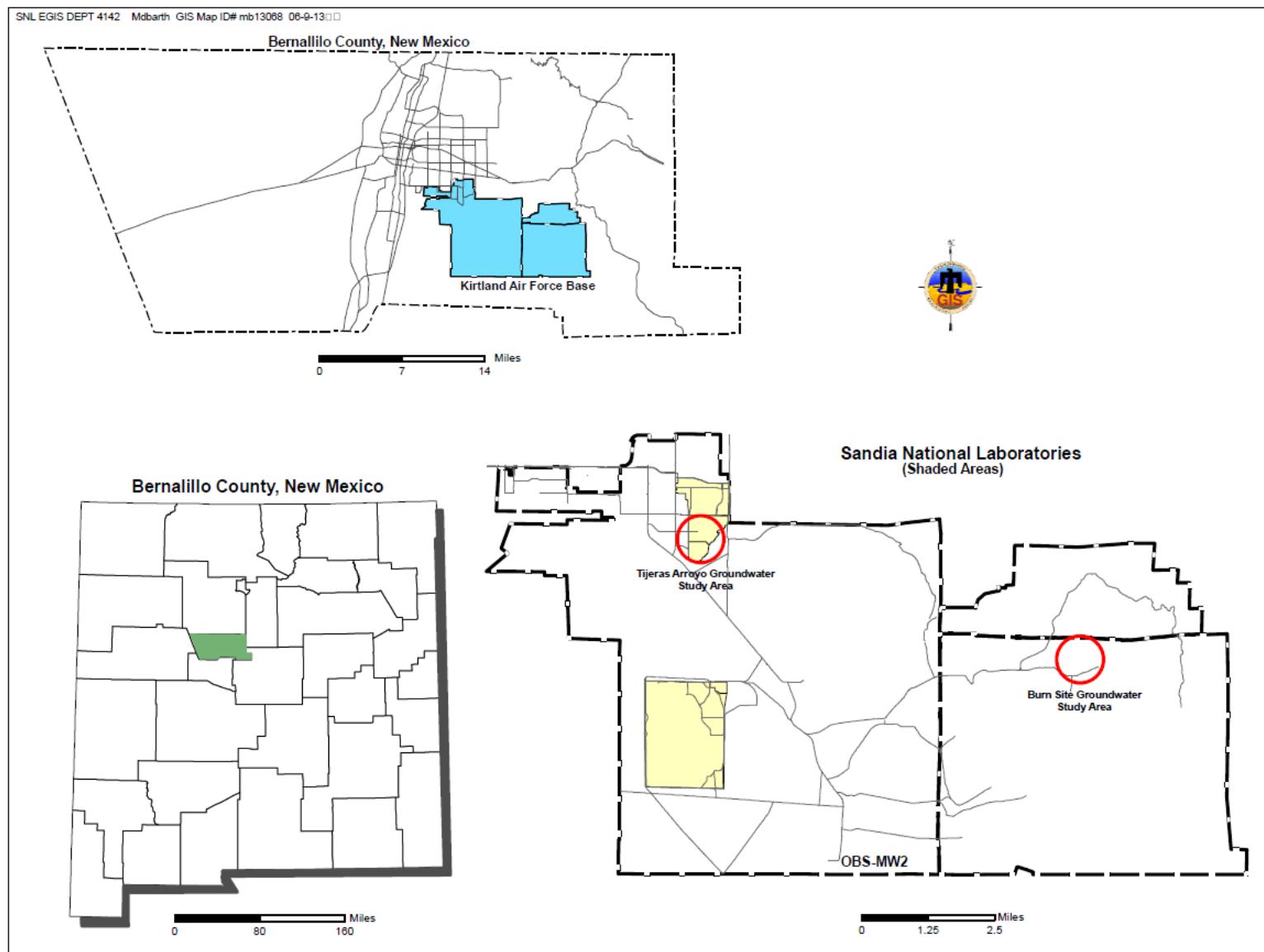


Figure 1 Location of the Tijeras Arroyo Groundwater and Burn Site Groundwater Study Areas

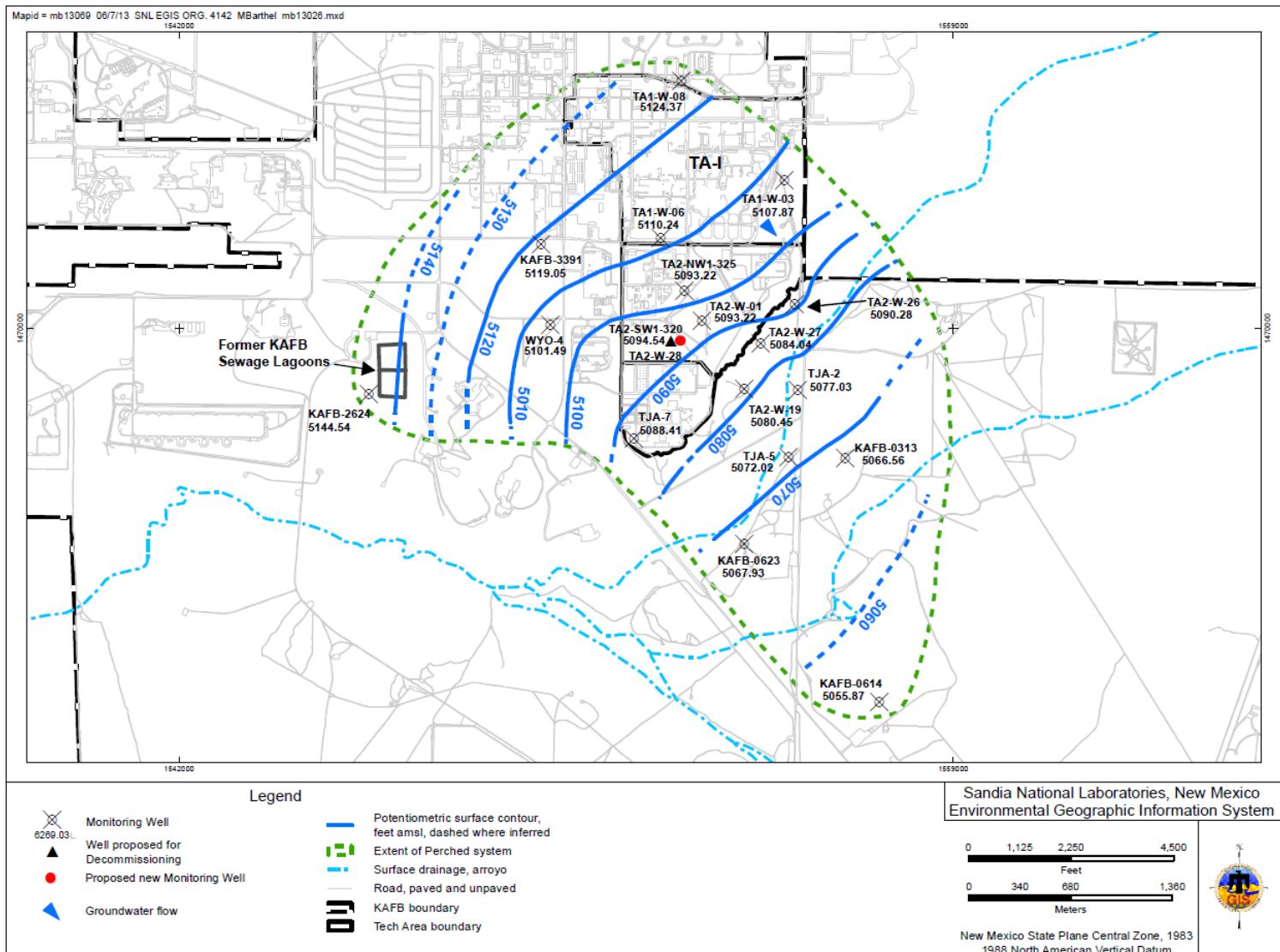


Figure 2 Tijeras Arroyo Groundwater Well Location and Potentiometric Surface Map (October 2012 data), Showing Location of Proposed New Well and Location of Well Proposed for Plug and Abandonment

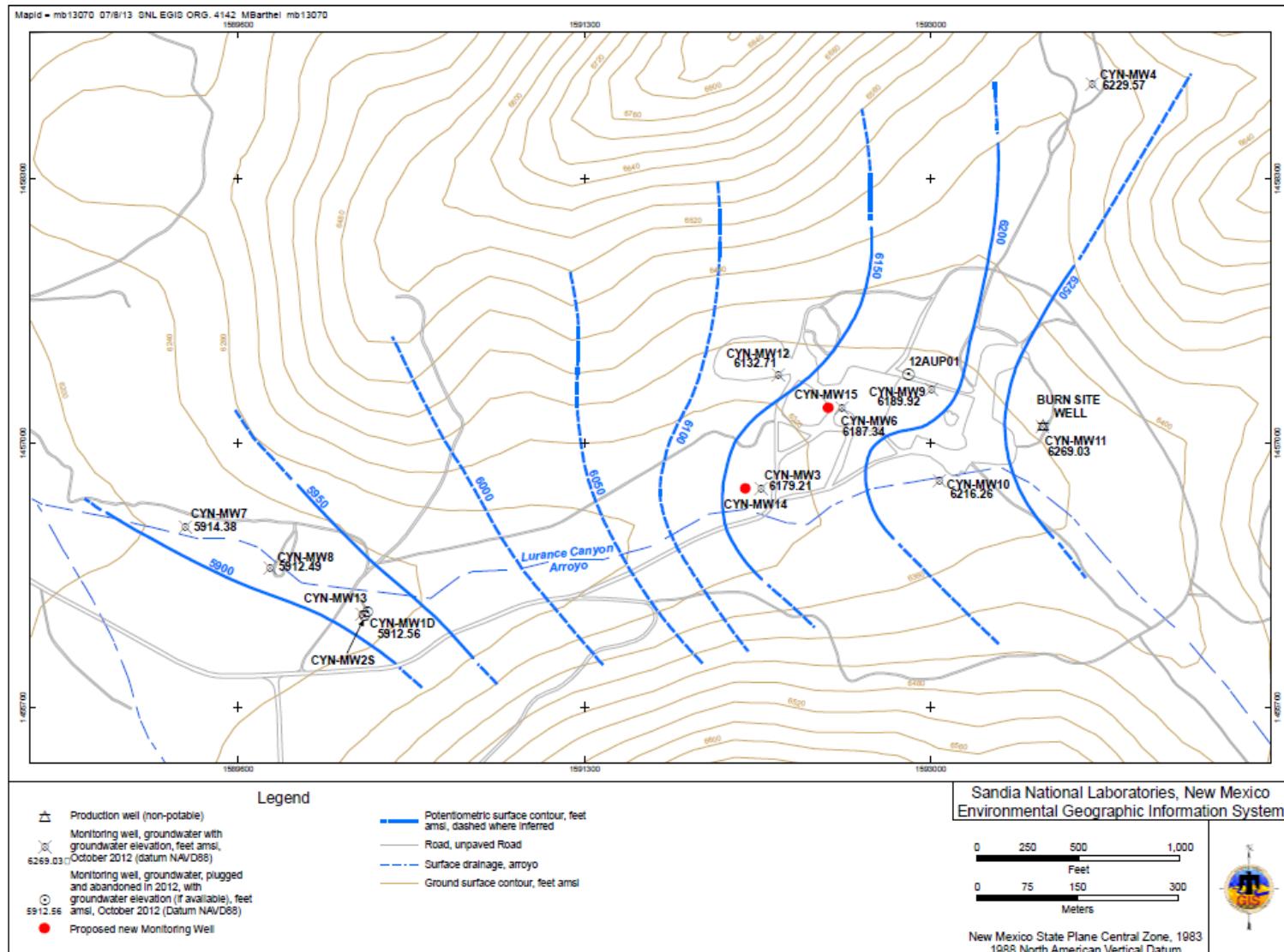


Figure 3 Burn Site Groundwater Well Location and Potentiometric Surface Map (October 2012 data),
Showing Location of Proposed New Wells

CYN-MW6 is a groundwater monitoring well installed using ARCH methods in December 2005. This well is completed in the bedrock aquifer with the following well completion details:

- Total depth of the well – 162 ft bgs, including a 5-ft sump.
- Screened interval – 141.5 to 161.5 ft bgs.
- Construction materials – Schedule 80 PVC riser pipe and screen (~5 inch internal diameter), carbon-steel protective surface casing, and a concrete well pad.
- Current water level – approximately 161.5 ft bgs (too dry to sample as of April 2013).
- Water-bearing strata – Groundwater occurs as fracture flow in Precambrian phyllite/metavolcanics.
- Reason for drilling a replacement well – this well will not be decommissioned. It is currently dry due to regional drought conditions and will be retained in anticipation of water level recovery. Attachment 3 shows the hydrograph for this well.

7 Plugging and Abandonment

Based on the requirements established by the NMED and NMOSE, groundwater monitoring well TA2-SW1-320 will be decommissioned. The applicable SNL/NM Field Operating Procedures (FOPs) and Administrative Operating Procedures (AOPs) will be used. The requirements of this Work Plan will take precedence over any FOPs and AOPs.

The goal for decommissioning monitoring well TA2-SW1-320 is to eliminate the potential of this well to act as conduit for the migration of potential soil contamination to groundwater. The well materials and annular seal are not believed to pose a threat to groundwater, and therefore will be backfilled in place with proper sealing materials.

The objective is to seal monitoring well TA2-SW1-320 in such a manner that there is reasonable certainty that the abandonment has adequately eliminated the potential for cross-communication between the land surface, vadose zone, and the aquifer; and the potential for downward migration of potential contaminants through the borehole annulus to the aquifer. All grouting techniques and grout mixtures used during decommissioning will minimize grout intrusion into the native formation.

General activities for the implementation of the P&A field activity include:

- 1) Remove all monitoring well surface completion features,
- 2) Backfill the casing with well-plugging materials, and
- 3) Construct a new surface pad/monument at the former well location.

SNL/NM personnel and the drilling contractor will remove all surface completion features, such as guard posts, concrete well pads, and surface protective casings. Care will be taken to prevent materials from falling down the well casing and possibly causing a downhole obstruction. The well will be abandoned with casing left in place. The

uppermost PVC will be unscrewed or cut off flush with the ground surface to allow a new concrete pad to be installed flush with the ground surface after plugging and abandonment is complete.

The well screen and blank well casing will be sealed by lowering a tremie pipe to the base of the well casing (below the base of the screen) and injecting the plugging material (bentonite grout) using a pump system. The tremie pipe will be progressively raised as grout is pumped into the casing. The tremie pipe will be removed after grout reaches 10 ft of the ground surface. If the level of the plugging material in the well casing settles over several hours, additional bentonite grout will be added to again reach within 5 ft of ground level.

Once monitoring well TA2-SW1-320 has been properly plugged, the decommissioning process will be completed by placing concrete in the upper 10 ft of the well/borehole and installing a concrete slab on the surface of the abandoned well location. The concrete pad will be approximately 1ft thick with a 2 ft by 2 ft area. A brass marker containing the well name and date of decommissioning will be set in the concrete pad.

8 Drilling and Monitoring Well Installation

Monitoring well TA2-W-28 will be installed to replace TA2-SW1-320. Monitoring well CYN-MW14 will replace CYN-MW3, and CYN-MW15 will replace CYN-MW6. The boreholes will be drilled using a combination of ARCH (in alluvium) and Air-Rotary downhole hammer (in bedrock) drilling methods depending on subsurface conditions. The three new wells will be located within 30 ft of the existing wells (Figure 2 and Figure 3). The precise location of the wells will be determined in the field to avoid existing above-ground and underground utilities and structures. The objective is to install 5-inch nominal diameter PVC-casing monitoring well to provide representative groundwater samples of the same water-bearing horizon at each location.

8.1 Borehole Drilling

The ARCH drilling method will use environmentally-friendly lubricants and is suitable for penetrating highly variable unconsolidated lithologies such as cobbles, boulders, gravel, sand, clay, and caliche. ARCH will be used for the total depth of TA2-W-28. However, once competent bedrock (Precambrian igneous and metamorphic rocks) is encountered at CYN-MW14 and CYN-MW15, air rotary drilling without casing advance will be used to drill to the total depth.

The borehole lithology will be logged by the SNL/NM field geologist during drilling. The total depth of the boreholes for the well will be determined by the SNL/NM field geologist and will be dependent on water yield encountered during drilling. The total depth is anticipated to be about 25 to 35 ft below the water table as determined in the adjacent well (Table 1). The depth of the first groundwater will be noted and recorded on the borehole log. For CYN-MW14 and CYN-MW15, the uncased portion of the borehole will be video logged using a wire-line camera for the purpose of evaluating bedrock fracture patterns.

Minimal water (but no other foams/liquids) in the form of “mist” may be introduced into the borehole to aid in the removal of cuttings. Waste generation will be kept to a minimum. Borehole cuttings will be contained within an area adjacent to the well. Water produced from the well during drilling or development will be contained in 55-gallon drums and placed on spill control pallets. Management and final disposition of cuttings and water will be performed as stipulated in the project WMP.

Replacement well TA2-W-28 will be installed in the perched aquifer system that underlies a large portion of the TAG study area (Figure 2). The perched system is a limited thickness and there is currently only 4 ft of water in the screen interval at TA2-SW1-320; it is unclear how much saturated strata will be encountered below the bottom of the screen at this location. The 20-ft screen interval for TA2-W-28 (Table 1) is based on the current water level in the existing well and it will capture the air/groundwater interface with 5 ft of screen above the potentiometric surface. Monitoring well TA2-W-28 is anticipated to be drilled to a total depth of approximately 336 ft bgs to allow for a 5-ft sump to be placed below the screen and with several more ft for slough.

Due to semi-confined conditions and the nature of fracture flow in a structurally complex bedrock aquifer, depths to groundwater at existing wells in the BSG study area are quite variable from 120 to 322 ft bgs. The screen interval for CYN-MW3 is 120 to 130 ft bgs and the current depth to groundwater is >130 ft bgs; and the screen interval for CYN-MW6 is 141 to 161 ft bgs and the current depth to groundwater is >161 ft bgs. To monitor the same water-bearing horizon as the existing wells, the replacement wells will be screened with at least 1 ft of overlap of the existing screen intervals (Table 1). Due to the extreme declines (3 to 4 ft/year) in groundwater elevations in the eastern portion of the BSG study area (Attachment 3), 30-ft well screens are proposed for the replacement wells (Table 1). Monitoring well CYN-MW14 is anticipated to be drilled to a total depth of approximately 164 ft bgs and monitoring well CYN-MW15 will be drilled to a total depth of 195 ft bgs. These total depths will allow for a 5-ft sump to be placed below the screen and with several more ft for slough. Due to the complexities of fracture flow, the same set of fractures found in the existing wells might not be intercepted during borehole drilling of the replacement wells. Consequently, groundwater elevations in the replacement wells may be considerably deeper. If the boreholes are drilled to the total depths as described in this Work Plan and insufficient water is encountered, DOE/Sandia personnel will contact NMED to discuss drilling deeper to encounter more productive groundwater intervals.

Table 1: Specifications of Proposed New Wells

Well	Proposed Total Depth (ft bgs) of Borehole	Proposed Screened Interval (ft bgs)	Anticipated Completion Zone
TA2-W-28	336	311 to 331 ^a	Perched groundwater system in alluvium of the Tertiary Santa Fe Group
CYN-MW14	164	129 to 159 ^b	Precambrian Phyllite/Metavolcanics
CYN-MW15	195	160 to 190 ^b	Precambrian Phyllite/Metavolcanics

Notes:

^a Current water level in the existing well is approximately 316 ft bgs; proposed 20-ft screen interval will capture the air/groundwater interface with 5 ft of screen above the potentiometric surface.

^b Due to extreme declines in groundwater elevations in existing wells of 3 to 4 ft per year, 30 ft well screens are proposed for these replacement wells.

8.2 Well Construction

The groundwater monitoring wells will be installed through the temporary steel drive casing (nominal 10-inch diameter), and completed using 5-inch nominal diameter, flush threaded, PVC Schedule-80 water well casing. No solvents, cleaners, or lubricants will be used for construction of the monitoring well. The well casing will be delivered pre-cleaned and bagged, or steam-cleaned at a decontamination pad prior to installation. To preserve the integrity of the well materials, the well screen and riser pipe will be suspended in the boreholes until the filter packs, bentonite chip seal, and annular bentonite-grout seal are installed.

A 20-ft length of PVC screen (at TA2-W-28) or a 30—ft length of PVC screen (at CYN-MW14 and CYN-MW15) with a 0.020-inch slot size will be used and a 5-ft sump will be placed at the base of the screen and sealed with a threaded end cap. PVC centralizers will be placed at the base and top of the well screen and then at intervals not to exceed 100 ft up to the land surface.

A primary filter pack of clean #10-20 (or equivalent) silica sand will be placed in the annulus from the bottom of the sump to at least 5 ft above the top of the screen. Preliminary well development using a surge block will be performed at this time to help settle the filter pack. A 5-ft thick layer of clean #60 (or equivalent) sand will be placed above the primary filter pack. Both filter packs will be tagged using a tag line to verify their depth.

A 30-ft thick layer of 3/8-inch (or equivalent) grade bentonite chips will be placed above the filter pack prior to emplacement of the bentonite-grout annular seal. The bentonite pellets/chips will be hydrated and allowed to set for a time adequate for hydration (at least 1 hour). The remaining annular space to the ground surface will then be filled with

bentonite grout. To prevent overloading, the bentonite grout will be installed in multiple lifts. Per NMED requirements (NMED June 2007), the first bentonite grout lift will be approximately 100 ft thick and will be allowed to set a minimum of 24 hours before installation of the next lift. Based on the anticipated depth to groundwater, only one more subsequent bentonite grout lift of less than 200 ft will be required. The bentonite grout will be topped off to within 10 ft bgs.

The well casing will extend approximately 30 inches above ground surface and be sealed with a water-tight cap. The well will be completed with protective steel casing with a hinged locking cap. The protective casing will be primed and painted yellow. A 3-ft by 3-ft, sloped concrete pad will be constructed around each casing. The pad will contain a 3-inch brass cap stamped with the well identification. Three, 4-inch diameter concrete-filled, steel guard posts (also primed and painted yellow) will be placed around the pad, equidistant from the well. The posts will extend 2.5 ft above, and at least 2 ft below ground surface.

8.3 Well Development

Well development will be initiated after at least 48 hours following final grout placement. The well will be developed for approximately 8 hours, and will consist of pumping, surge-block, swabbing, and bailing techniques. During development, the groundwater field parameters (pH, specific conductivity, temperature, and turbidity) will be continuously monitored, and development will continue until parameters have stabilized. All development water will be contained in drums and will not be allowed to discharge to the ground surface. All waste will be disposed of according to applicable State and Federal regulations and in accordance with the site-specific WMP. The method of development, the volume of water added or removed, the parameters measured, the results of the measurements, and the time these activities take place will be documented on field forms. If required, only potable water shall be added to the well during development.

During well development, a minimum of five well bore volumes (casing and saturated filter pack) will be removed. After the minimum volume has been removed, development will continue until representative groundwater is obtained. Representative water is assumed to be obtained when pH, temperature, and specific conductivity readings stabilize (less than 10% variability over three consecutive well bore volumes) and the water is visually clear of suspended solids with a target turbidity of less than five Nephelometric Turbidity Units (NTU).

9 Records Management and Reporting

Based on the requirements established by the NMED/HWB, NMOSE and SNL/NM procedures, the field activities associated with decommissioning and installation of the monitoring wells will be documented accordingly.

9.1 Decommissioning Records

All decommissioning field activities will be documented in a field log book per guidance in SNL/NM FOPs. Upon completion of decommissioning of the wells, the P&A Report

will document all site activities and provide final as-built Groundwater Well Abandonment Diagrams (Attachment 4). The Well Plugging and Abandonment Form (Attachment 5) will be used to assure that all records are completed, approved, and submitted for proper records management. The following list of documents and records that are generated as part of the decommissioning process will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Monitoring Well Plugging and Abandonment Request
- Site-Specific Well Plugging and Abandonment Work Plan
- Site-Specific Well Plugging and Abandonment Report
- Plugging and Abandonment Documentation and Approval Checklist
- WMP
- Field Log Book
- Detailed as-built Groundwater Well Abandonment Diagram (Attachment 4)
- Well Plugging and Abandonment Form (Attachment 5)

All decommissioning activities performed at SNL/NM will be accurately and concisely documented in a final P&A Report to be submitted to the NMED/HWB and the NMOSE within 90 days after the completion of all related field work, including new monitor well installation and development. The P&A Report will be combined with the Well Installation Field Report and contain a brief narrative describing actual work performed at the sites and any variances to the site-specific Work Plan. Information to be contained in the P&A Report include: (1) daily field activity notes, (2) all materials used, (3) final as-built plugging and abandonment diagrams, and (4) documentation of notification of SNL/NM Geographic Information System (GIS) group and the appropriate regulatory agencies. The Well Plugging and Abandonment Forms (Attachment 4) will be completed and included as part of the P&A Report.

Additional P&A reporting elements are required by the NMOSE (NMOSE August 2005). SNL/NM personnel and the licensed well driller (contractor) will submit a plugging record with the NMOSE no later than twenty (20) days after completion of the plugging. The record will include the following elements:

- Name and address of the well owner
- Well driller's name and license number
- Name of each drill rig supervisor that supervised the well plugging
- State engineer file number for the well (if available)
- Location of the well (reported in New Mexico state plane coordinates to ± 0.01 ft)
- Dates when plugging began/concluded
- Plugging material(s) used
- Depth of the well
- Size and type of casing
- Location of perforations
- Location of the bentonite (sanitary) seal
- Completed well log with depth and thickness of all strata plugged, including whether each stratum was water bearing

9.2 Well Installation Records

The well installation field activities will be documented in a field log book per guidance in SNL/NM FOPs. A P&A and Well Installation Report will be prepared and submitted to the NMED within 90 days upon completion of all well installation and development activities, or after completion of related well decommissioning work. The report will document all site activities and provide the final as-built well completion diagram developed from the Well Registry Data Sheets (Attachment 6). The report will contain a narrative describing work performed at the site and any variances to the site-specific Work Plan. Information to be contained in the report includes: (1) daily field activity notes, (2) all materials used, (3) final as-built well completion diagrams, and (4) documentation of notification of SNL/NM GIS group and the appropriate regulatory agencies (NMED and NMOSE).

The documentation will also include the 37 information elements required in Section VIII.D of the Consent Order (NMED April 2004). The following list of documents and records that are generated will be provided to the SNL/NM Well File Coordinator who, in turn, will submit them to the SNL/NM Customer-Funded Records Center:

- Well permit agreement
- Well file contents checklist
- Well Registry Data Sheet
- SOW
- Drilling permit
- Lithologic (boring) log
- Well construction diagram and completion parameters
- Well development data and groundwater parameters
- Copies of field logbook (geologist, driller)
- Surveyed elevations and locations in New Mexico state plane coordinates (with an accuracy of ± 0.01 ft) supplied by an NM-licensed surveyor.
- Location map
- Water level measurements
- Waste management documentation
- Photographs

10 Schedule

Initiation of field work is dependent upon NMED's approval of this Work Plan. However, pre-field activities will commence prior to NMED approval to expedite the installation schedule, but will not be completed until NMED approval is received. The monitoring wells will be installed as soon as possible after NMED's approval of the Work Plan. Per the requirements of the Order, DOE/Sandia will notify the NMED in writing, by e-mail, or by fax a minimum of 15 days prior to commencing field work. The P&A and Well Installation Report will be submitted within three months after completion of the wells.

11 References

New Mexico Environment Department (NMED) April 2004, "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act 74-4-10: Sandia National Laboratories Consent Order," New Mexico Environment Department, Santa Fe, New Mexico.

New Mexico Environment Department (NMED) June 2007, "Notice of Disapproval: Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan, Decommissioning of Groundwater Monitoring Well MWL-BW1, Installation of Replacement Groundwater Monitoring Well MWL-BW2, April 9, 2007, Sandia National Laboratories NM5890110518, HWB-SNL-07-014," Letter to Patty Wagner (SSO/NNSA) and Francis Nimick (Sandia) from James Bearzi, New Mexico Environment Department, Santa Fe, New Mexico.

New Mexico Office of the State Engineer (NMOSE) August 2005, "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells," New Mexico Office of the State Engineer, Santa Fe, New Mexico.

Attachment 1

Monitoring Well Completion Diagrams for
TA2-SW1-320, CYN-MW3, and CYN-MW6

Well Name: TA2-SW1-320
Project Name: TECHNICAL AREA II
NMOSE Well File Code: RG-90065, Point of Diversion: 70
Owner Name: SNL/NM
Date Drilling Started: 11/21/1992
Date Well Dev. Completed: 11/30/1992

Drilling Contractor:
Drilling Method: AIR ROTARY/DRIVE CASING
Borehole Depth (FBGS): 324.8
Casing Depth (FBGS): 324.6
Geo Location: SW CORNER TA-II
Completion Zone: SAND
Completion Formation: SANTA FE GROUP

Survey Data

Survey Date: 11/9/1993
Surveyed By: GREINER
State Plane Coordinates: NAD 83
(X) Easting: 1552796.36
(Y) Northing: 1469732.72

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5412.70
Top of Inner Well Casing: 5411.85
Concrete Pad: 5410.03
Ground Surface: 5410.1

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 310.93

Date Initial Depth Measured:

Last Measured Water Elevation (FAMSL): 5094.33

Date Last Measured: 1/2/2013

Miscellaneous Information

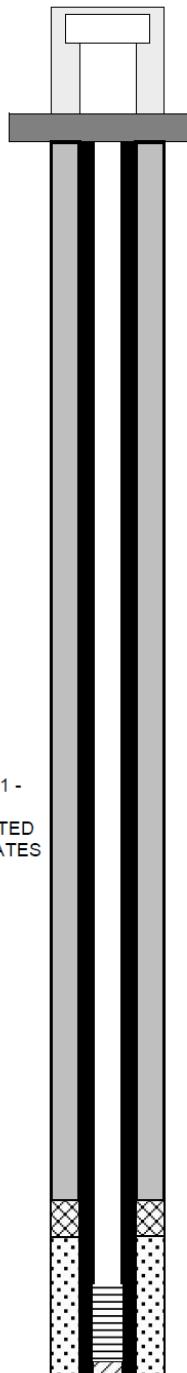
Screen Slot Size (in.): 0.01

Date Updated: 14-MAR-00

Date Printed from EDMS: 6/3/2013 3:28:26 PM

Comments:

WATER LEVEL MEASURED ON 07-OCT-93 1/1/11 -
 ORIGINAL STATE PLANE FEET NAD27/NGVD29
 SURVEY COORDINATES HAVE BEEN RE-PROJECTED
 IN STATE PLANE FEET NAD83/NAVD88 COORDINATES



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.8

Interval	Material	Start	Stop	Length	ID / OD (in.)
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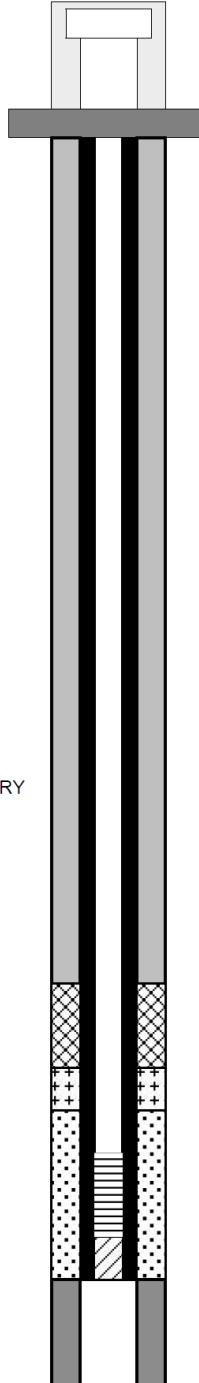
<input type="checkbox"/> BOREHOLE		0	324.8	324.8	/ 11
<input checked="" type="checkbox"/> CASING	SCH 80 PVC	0	324.6	324.6	3.826 / 4.5
<input checked="" type="checkbox"/> GROUT/BACKFILL	VOLCLAY	0	277.5	277.5	
<input checked="" type="checkbox"/> SEAL	VOLCLAY PELLETS	277.5	287	9.5	
<input checked="" type="checkbox"/> PRIMARY PACK	10/20 MESH SILICA	287	324.8	37.8	
<input checked="" type="checkbox"/> SCREEN	SCH 40 PVC	299.6	319.6	20	
<input checked="" type="checkbox"/> SUMP		319.6	324.6	5	
<input checked="" type="checkbox"/> PLUG BACK		324.6	324.8	0.2	

Well Name: CYN-MW3
Project Name: CANYONS GROUNDWATER
NMOSE Well File Code: RG-90065, Point of Diversion: 23
Owner Name: SNL/NM
Date Drilling Started: 6/14/1999
Date Well Dev. Completed: 6/18/1999

Drilling Contractor: WATER DEVELOPMENT INC.
Drilling Method: ARCH/AIR ROTARY
Borehole Depth (FBGS): 148
Casing Depth (FBGS): 135
Geo Location: LURANCE CANYON BURN SITE
Completion Zone: SCHIST/PHYLLITE
Completion Formation: COYOTE METASEDIMENTARY

Survey Data

Survey Date: 8/18/2010
Surveyed By: STEPHEN TOLER
State Plane Coordinates: NAD 83
(X) Easting: 1592168.20
(Y) Northing: 1456774.34



Completion Data Measured Depths (FBGS)

Casing Stickup: 0.9

Interval	Material	Start	Stop	Length	ID / OD (in.)
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<input type="checkbox"/> BOREHOLE		0	135	135	
<input checked="" type="checkbox"/> CASING	SCHEDULE 80 PVC	0	135	135	5 / 5.5
<input checked="" type="checkbox"/> GROUT/BACKFILL	BENTONITE SLURRY	0	100	100	
<input checked="" type="checkbox"/> SEAL	BENTONITE PELLETS	100	110	10	
<input checked="" type="checkbox"/> SECONDARY PACK	20-40 COLORADO SA	110	115	5	
<input checked="" type="checkbox"/> PRIMARY PACK	4-8 COLORADO SAND	115	135	20	
<input type="checkbox"/> SCREEN	SCHEDULE 80 PVC	120	130	10	
<input type="checkbox"/> SUMP		130	135	5	
<input checked="" type="checkbox"/> PLUG BACK	4-8 COLORADO SAND	135	148	13	

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 6313.85
Top of Inner Well Casing: 6313.26
Concrete Pad: 6312.52
Ground Surface: 6311.9

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 121.00

Date Initial Depth Measured:

Last Measured Water Elevation (FAMSL): 6178.36

Date Last Measured: 1/2/2013

Miscellaneous Information

Screen Slot Size (in.): 0.05

Date Updated: 06-APR-2011

Date Printed from EDMS: 6/3/2013 3:29:35 PM

Comments:

WELL COMPLETED IN COYOTE METASEDIMENTARY

Well Name: CYN-MW6
Project Name: BURN SITE GROUNDWATE
NMOSE Well File Code: RG-90065, Point of Diversion: 26
Owner Name: SNL/NM
Date Drilling Started: 12/7/2005
Date Well Dev. Completed: 12/9/2005

Drilling Contractor: WTER DEVELOPMENT CORP.
Drilling Method: AIR ROTARY AND ARCH
Borehole Depth (FBGS): 165
Casing Depth (FBGS): 161.69
Geo Location: LURANCE CANYON
Completion Zone: BEDROCK AQUIFER
Completion Formation: PHYLLITE

Survey Data

Survey Date: 8/18/2010
Surveyed By: STEPHEN TOLER
State Plane Coordinates: NAD 83
(X) Easting: 1592563.70
(Y) Northing: 1457170.60

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 6343.74
Top of Inner Well Casing: 6343.37
Concrete Pad: 6340.76
Ground Surface: 6340.5

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 136.75

Date Initial Depth Measured:

Last Measured Water Elevation (FAMSL): 6186.65

Date Last Measured: 1/2/2013

Miscellaneous Information

Screen Slot Size (in.): 0.02

Date Updated: 06-APR-2011

Date Printed from EDMS: 6/3/2013 3:32:31 PM

Comments:

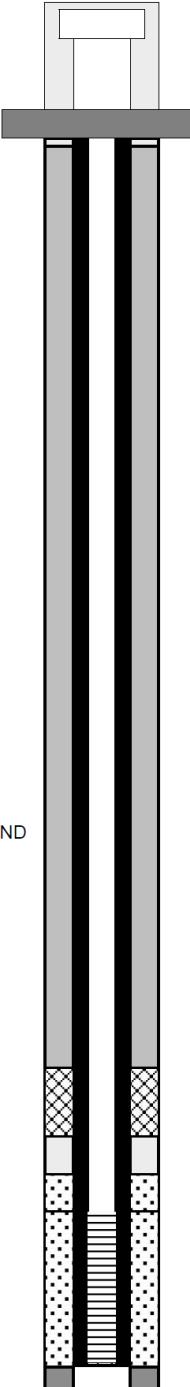
NO SUMP INSTALLED IN WELL. NO WATER DETECTED DURING DRILLING. DUST DISCHARGE CHANGE AT 138.5 FBGS. AT 155 FTLET WELL STAND 1 HR., WATER ROSE TO 146 FT. NO WATER OBSERVED DURING DRILLING FROM 155-165 FT.

Completion Data Measured Depths (FBGS)

Casing Stickup: 2.7

Interval	Material	Start	Stop	Length	ID / OD (in.)
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<input type="checkbox"/> BOREHOLE		0	165	165	
<input checked="" type="checkbox"/> CASING	SCHEDULE 80 PVC	0	161.7	161.7	/ 5.5
<input type="checkbox"/> GROUT/BACKFILL	BENTONITE GROUT	1	122.6	122.6	
<input checked="" type="checkbox"/> BENTONITE CHIP SEAL	HYDRATED BENTONI	122.6	131.5	8.9	
<input checked="" type="checkbox"/> PRIMARY FILTER PACK	10/20 SILICA SAND	136.6	141.5	4.9	
<input checked="" type="checkbox"/> PRIMARY FILTER PACK	10/20 SILICA SAND	141.5	162	20.5	
<input type="checkbox"/> SCREEN	SCHEDULE 80 PVC	141.5	161.3	19.8	/ 5.5
<input checked="" type="checkbox"/> SUMP	SCHEDULE 80 PVC	161.3	161.7	0.4	
<input type="checkbox"/> SLOUGH PLUG BACK		162	165	3.3	



Attachment 2

Technical Memorandum

Evaluation of the Integrity of Groundwater Monitoring Well TA2-SW1-320 in the Tijeras Arroyo Groundwater (TAG) Study Area



Sandia National Laboratories

Operated for the U.S. Department of Energy by
Sandia Corporation

Albuquerque, New Mexico 87185-0729

date: 30 January 2013

to: David Miller, 6234 (MS 0718)
Pam Püssant, 4142 (MS 0729)

from: Tim Jackson, 4133 (MS 0729)
Michael Skelly, 6234 (MS 0718)

subject: Evaluation of the Integrity of Groundwater Monitoring Well TA2-SW1-320 in the Tijeras Arroyo
Groundwater (TAG) Study Area

History of TA2-SW1-320

Groundwater monitoring well TA2-SW1-320 (see attached TAG Study Area Map) was installed in November 1992 with the bottom of the well at 325 feet below ground surface (ft bgs) (see attached Well Completion Diagram). The purpose of this well is to characterize groundwater conditions in the perched groundwater system around Technical Area II, specifically at Solid Waste Management Unit 165 (Building 901 Septic System). [The septic system leach field was connected to a personnel shower/laundry facility and HE synthesis laboratory (Building 901) and small research/ machine shop (Building 902). The septic system was in use from 1948 to 1992 and received possibly millions of gallons of water. Possible TCE and high explosive compounds were present in the wastewater. No significant contamination has been detected in soil samples. Nitrate in groundwater is the primary concern.]

For at least ten years this well has been sampled with a dedicated QED Micro-Purge sampling system. A conventional sampling system was not used due to a suspected bend in the casing. Using the QED system, very high turbidity measurements were observed during the December 2012 sampling event. The QED system was removed from the monitoring well and sediment and possibly grout material was found on the pump system (See attached Photographs). As sand/silt and grout material had been observed on the sample pump and tubing, it was assumed that the well was in disrepair. A camera survey was requested to evaluate the integrity of the well and determine if the well could be rehabilitated.

Well Video Logging

Bruce Reavis and Tim Jackson performed a video camera survey on January 23, 2013 to try to determine the integrity of the well casing and see how much sediment had entered the screen interval. Mike Skelly and John Copland observed the video surveying.

Field notes from the video camera survey are summarized below:

- Depth to water measured at 317.85 ft btoc (3.5 feet of water column within the screen interval).
- ~ 61 ft btoc – PVC well casing is damaged at the casing joint. The fractured casing exposes open borehole (gravel and O-ring are visible). The gap is about 1-inch wide and extends about halfway around the well circumference.
- ~ 102 ft btoc – PVC well casing is damaged at the casing joint. The fractured casing exposes open borehole (gravel and grout material are visible). The gap is about 1.5-inches wide and extends about halfway around the well circumference.
- ~102 to 302 ft btoc – casing appears in good condition.
- ~302 – 318 ft btoc – well screen has bio-fouling, good condition, 10 slot.
- ~318 – 321 ft btoc – clear water with some material (bio-fouling) on surface; water is generally clear, no soil/sediment observed in well screen interval.
- ~321 -322 ft btoc – silt/sediment/gravel fills about 4 feet of the well sump.

The video tape will be transferred to DVD format, and three DVD copies were made. The original video cassette and one DVD copy will be submitted to the Customer Funded Records Center with the other copies going to Mike Skelly and the well video library at ERFO.

Findings and Recommendations

The video camera survey clearly shows that the well is beyond repair and we need to begin P&A discussions with NMED. The well appears to have been damaged during installation in 1992. We are concerned that a newly installed replacement well in the perched aquifer may not reach any deeper perched water below the current well screen. The existing well was installed to the total depth of the borehole; SNL did not drill deeper and information of additional saturated strata is not available. In this part of the TAG Study Area, the perched aquifer has a very limited thickness and we're concerned that a newly installed replacement well to be located nearby may be dry or nearly so. We will have to contact NMED to determine how to proceed with well P&A and/or replacement. The nearest downgradient perched well, TA2-W-19, is located about 1,800 feet to the southeast.

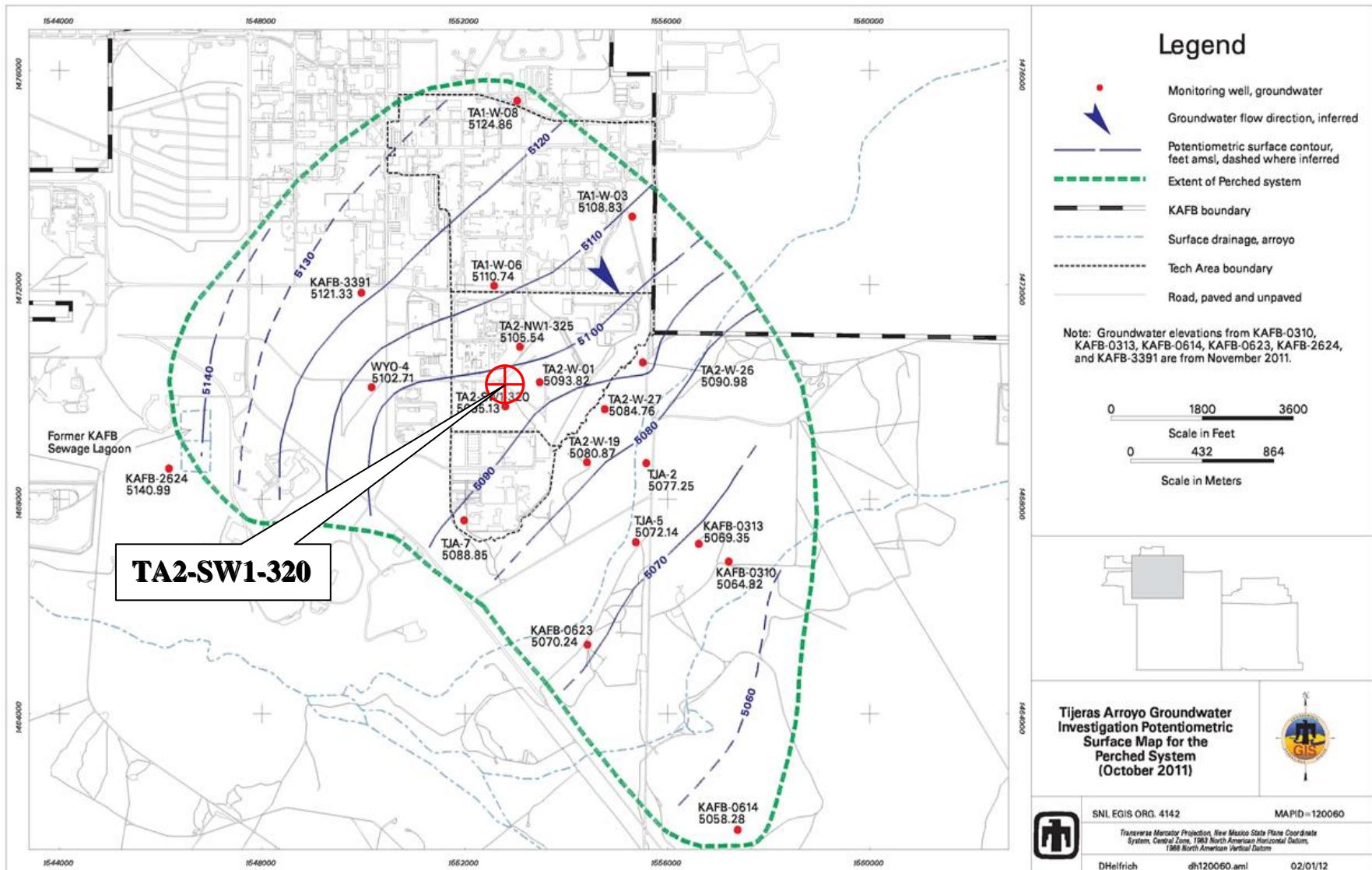
Well TA2-SW1-320 is critical to the investigation of nitrate in the perched aquifer system (see attached graph of Historical NPN concentrations). Until we can determine a plan for this well with NMED concurrence, we recommend continued sampling and water level measurements. This well is sampled quarterly and the next sampling event will occur in early March 2013. Remaining FY13 events are tentatively scheduled for June and September. In order to continue sampling we will have the field crew replace all tubing on the QED system and reinsert the pump before the March 2013 event.

Attachments:

TAG Study Area Map showing the location of TA2-SW1-320
Well Completion Diagram for TA2-SW1-320
Photographs of QED Micro-Purge pump after removal from TA2-SW1-320
Historical Nitrate Plus Nitrate Concentrations at TA2-SW1-320

Cc:

John Cochran, 6234 (MS 0718)
Caroline Byrd, 4142 (MS 0729)
John Copland, 6234 (MS 0718)
Robert Ziock, 4142 (MS 1126)
SNL/NM Customer Funded Record Center (MS 0651)



Well Name: TA2-SW1-320
 Project Name: TECHNICAL AREA II
 NMOSE Well File Code: RG-90065, Point of Diversion: 70
 Owner Name: SNL/NM
 Date Drilling Started: 11/21/1992
 Date Well Dev. Completed: 11/30/1992

Drilling Contractor: AIR ROTARY/DRIVE CASING
 Drilling Method: AIR ROTARY/DRIVE CASING
 Borehole Depth (FBGS): 324.8
 Casing Depth (FBGS): 324.6
 Geo Location: SW CORNER TA-II
 Completion Zone: SAND
 Completion Formation: SANTA FE GROUP

Survey Data

Survey Date: 11/9/1993
 Surveyed By: GREINER
 State Plane Coordinates: NAD 83
 (X) Easting: 1552796.36
 (Y) Northing: 1489732.72

Surveyed Evaluations (FAMSL) NAVD 88

Protective Casing: 5412.70
 Top of Inner Well Casing: 5411.85
 Concrete Pad: 5410.03
 Ground Surface: 5410.1

Calculated Depths and Elevations

Initial Depth to Water (FBGS): 310.93

Date Initial Depth Measured:

Last Measured Water Elevation (FAMSL): 5095.13

Date Last Measured: 10/11/2011

Miscellaneous Information

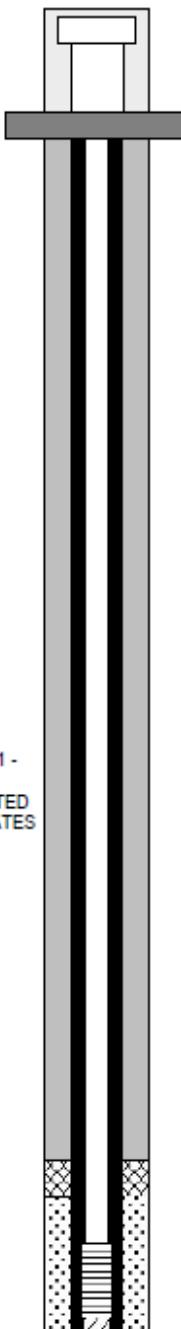
Screen Slot Size (in.): 0.01

Date Updated: 14-MAR-00

Date Printed from EDMS: 11/21/2011 9:59:02 AM

Comments:

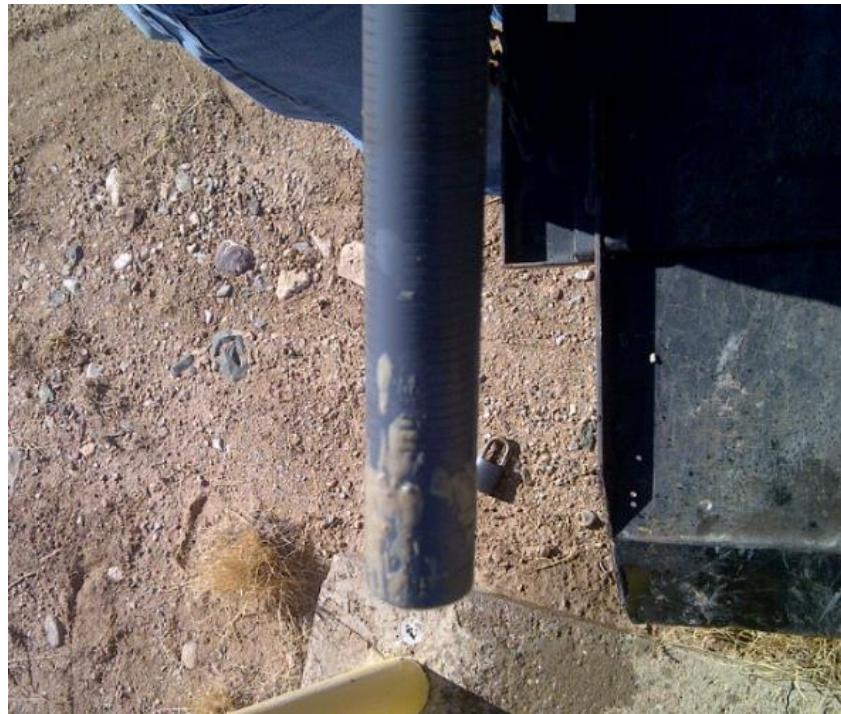
WATER LEVEL MEASURED ON 07-OCT-93 1/1/11 -
 ORIGINAL STATE PLANE FEET NAD27/NGVD29
 SURVEY COORDINATES HAVE BEEN RE-PROJECTED
 IN STATE PLANE FEET NAD83/NAVD88 COORDINATES



Completion Data Measured Depths (FBGS)

Casing Stickup: 1.8

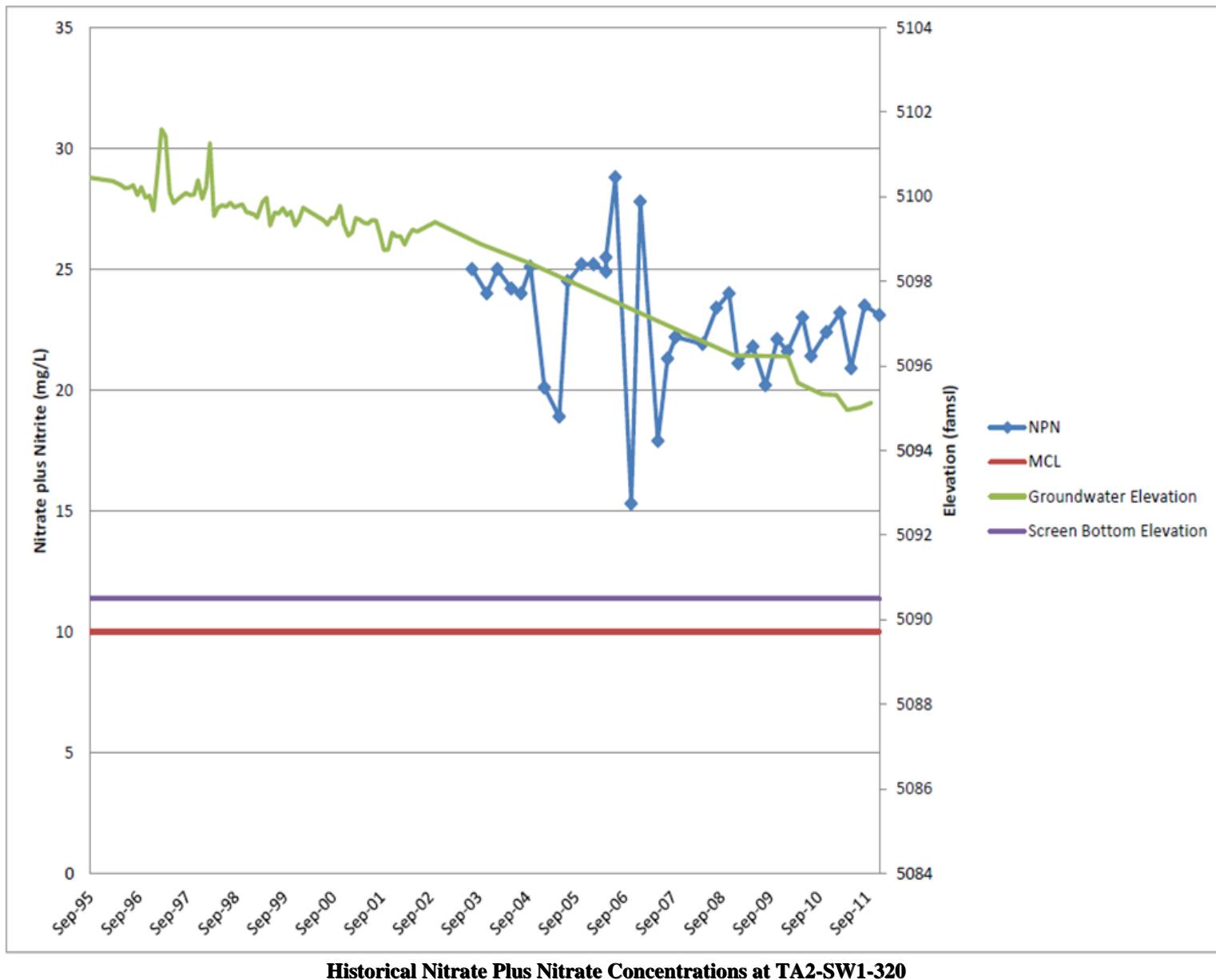
Interval	Material	Start	Stop	Length	ID / OD (In.)
BOREHOLE		0	324.8	324.8	/ 11
CASING	SCH 80 PVC	0	324.6	324.6	3.825 / 4.5
GROUT/BACKFILL	VOLCLAY	0	277.5	277.5	
SEAL	VOLCLAY PELLETS	277.5	287	9.5	
PRIMARY PACK	10/20 MESH SILICA	287	324.8	37.8	
SCREEN	SCH 40 PVC	299.6	319.6	20	
BUMP		319.6	324.6	5	
PLUG BACK		324.6	324.8	0.2	



Photograph of the bottom of the QED Micro-Purge pump after removal from TA2-SW1-320

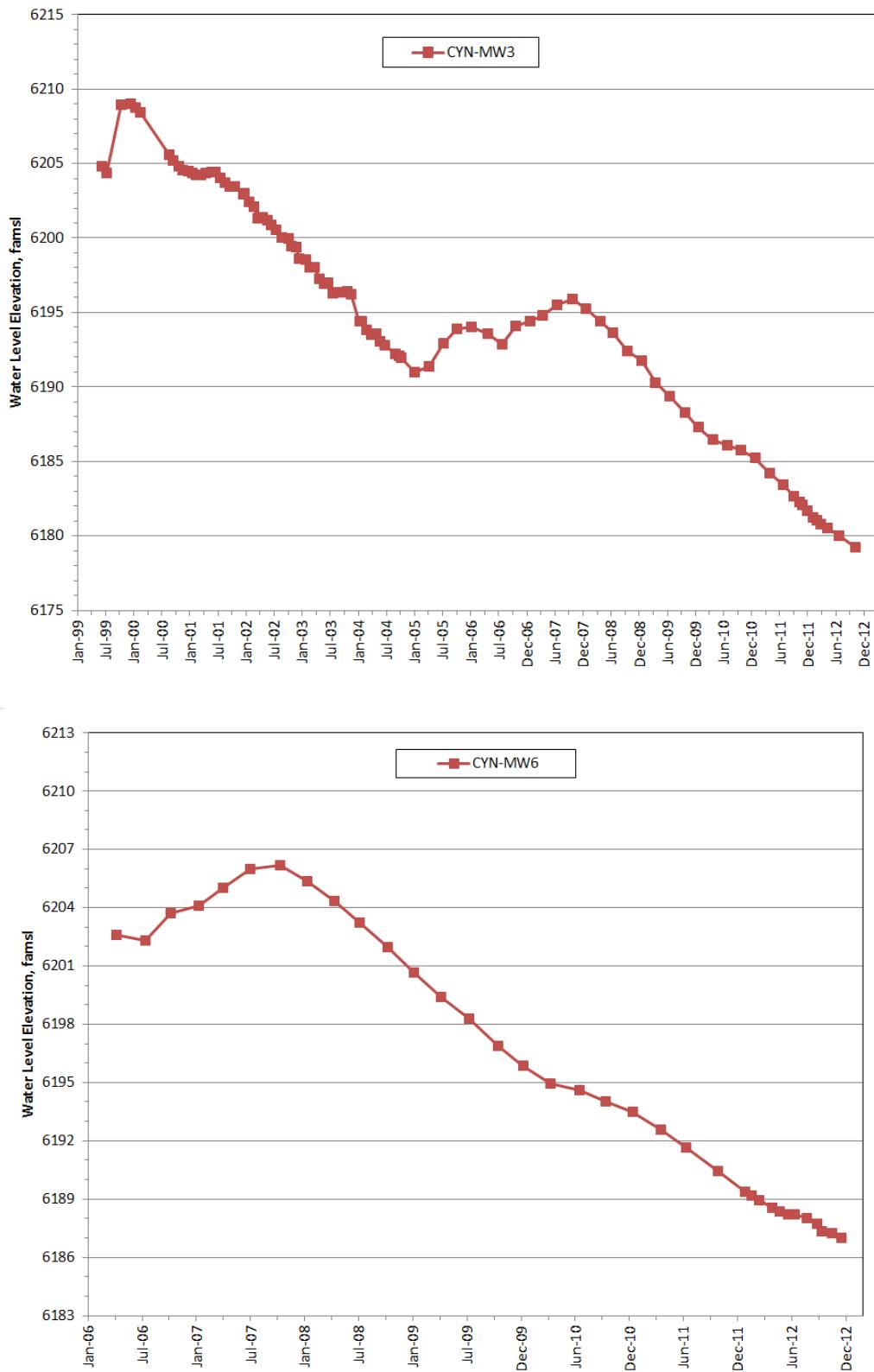


Photograph of the top of the QED Micro-Purge pump after removal from TA2-SW1-320



Attachment 3

Hydrographs for CYN-MW3 and CYN-MW6



Attachment 4
Groundwater Well Abandonment Diagram

**SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM**

Not to Scale

<p>WELL NAME _____</p> <p>LOCATION DESCRIPTIVE _____</p> <p>STATE PLANE COORDINATE X: _____</p> <p>Y: _____</p> <p>SURFACE CASING TYPE _____</p> <p>SURFACE CASING LENGTH _____</p> <p>I.D. OF WELL CASING _____</p> <p>WELL CASING DEPTH _____</p> <p>SCREEN INTERVAL _____</p> <p>PLUGGING GROUT TYPE _____</p> <p>GROUT VOLUME USED _____</p> <p>DEPTH LIFT 1 _____</p> <p>DEPTH LIFT 2 _____</p> <p>DEPTH LIFT 3 _____</p> <p>DATE OF DECOMMISSIONING _____</p>	<p>WELL NAME _____</p> <p>LOCATION DESCRIPTIVE _____</p> <p>STATE PLANE COORDINATE X: _____</p> <p>Y: _____</p> <p>CASING REMOVAL METHOD _____</p> <p>FINAL HOLE DIAMETER _____</p> <p>FINAL HOLE TOTAL DEPTH _____</p> <p>PLUGGING GROUT TYPE _____</p> <p>GROUT VOLUME USED _____</p> <p>DEPTH LIFT 1 _____</p> <p>DEPTH LIFT 2 _____</p> <p>DEPTH LIFT 3 _____</p> <p>DATE OF DECOMMISSIONING _____</p>
---	--

Attachment 5

Well Plugging and Abandonment Form

Completion of Well Decommissioning (Plugging and Abandonment) Form

Well Identification Number	
Location (TA-II, etc.) and SWMU Number	
Total Depth on Well Log, feet btoc	
Well Diameter (ID, inches)	
Well Material (PVC, SS, etc. and Schedule No.)	
Sandia Field Staff for Decommissioning	
Drilling Contractor, NMOSE License Number	
Description of Decommissioning Process	
Date Decommissioning Started	
TD Measured Prior to Decommissioning, feet btoc	
Well Stickup (TOC to ground surface) feet	
Date Decommissioning Finished	
Final Information Stamped on Brass ID Marker	

First Lift of Sealing Material	
Depth Range, feet bgs	
Manufacturer and Type of Sealing Material	
How Material Installed (tremie pipe, etc.)	
Volume of Sealing Material, gals	
Amount of sealing material, lbs and/or bags	

Second Lift of Sealing Material, if used	
Depth range, feet bgs	
Manufacturer and Type of Sealing Material	
How Material Installed (tremie pipe, etc.)	
Volume of Sealing Material, gals	
Amount of Sealing Material, lbs and/or bags	

Third Lift of Sealing Material, if used	
Depth Range, feet bgs	
Manufacturer and Type of Sealing Material	
How Material Installed (tremie pipe, etc.)	
Volume of Sealing Material, gals	
Amount of Sealing Material, lbs and/or bags	

Form completed by:		
Printed Name	Signature	Date

Attachment 6
Groundwater Monitoring Well Data Sheet

Well Data for _____
 Location/SWMU _____ Sandia National Laboratories/New Mexico

Items Required by the Order^a Section VIII.D	Comments
1. Well name/number	
2. Date of well construction	Installation completed on -- Development completed on --
3. Drilling method	
4. Drilling contractor and name of driller	
5. Borehole diameter and well casing diameter	Borehole: Well casing:
6. Well depth	
7. Casing length	
8. Casing materials	
9. Casing and screen joint type	
10. Screened interval(s)	
11. Screen materials	
12. Screen slot size and design	
13. Filter pack material and gradation	Primary: Secondary:
14. Filter pack volume (calculated and actual) ^b	Calculated: Actual:
15. Filter pack placement method	
16. Filter pack interval(s)	Primary: Secondary:
17. Annular sealant composition	
18. Annular sealant placement method	
19. Annular sealant volume (calculated and actual)	Calculated: Actual: Chips:
20. Annular sealant interval(s)	
21. Surface sealant composition	
22. Surface seal placement method	
23. Surface sealant volume (calculated and actual)	Calculated: Actual:
24. Surface sealant interval	
25. Surface seal and well apron design and construction	
26. Well development procedure and turbidity measurements	

SNL/NM Well Installation Table (concluded)

Items Required by the Order^a Section VIII.D	Comments
27. Well development purge volume(s) and stabilization parameter measurements	
28. Type and design and construction of protective casing	
29. Well cap and lock	
30. Ground surface elevation	
31. Survey reference point elevation on well casing	
32. Top of monitoring well casing elevation	
33. Top of protective steel casing elevation	
34. Name of geologist	
35. Initial water level	
36. Final water level	
37. Date of well development	

^aNew Mexico Environment Department, April 2004. "Compliance Order on Consent Pursuant to the New Mexico Hazardous Waste Act," § 74-4-10, New Mexico Environment Department, Santa Fe, New Mexico.

^bFilter pack volume is defined as the total volume of the primary sand pack placed in annulus adjacent to the well casing, screen, sump, and if applicable below the sump.

amsl = above mean sea level.

bgs = below ground surface.

cfm = cubic feet per minute

ft = foot (feet).

ft³ = cubic foot (feet).

ID = inside diameter.

MW = monitoring well.

OD = outside diameter.

psi = pounds per square inch

PVC = polyvinyl chloride.

SWMU = Solid Waste Management Unit