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Sandia National Laboratories/New Mexico Environmental Restoration Project

SUMMARY REPORT FOR MIXED WASTE LANDFILL MONITORING WELL PLUG AND ABANDONMENT AND INSTALLATION

Decommissioning of Groundwater Monitoring Wells MWL-MW1, MWL-MW2, and MWL-MW3

Installation of Groundwater Monitoring Wells MWL-MW7, MWL-MW8, and MWL-MW9

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United States Department of Energy
Sandia Site Office

Sandia is a multiprogram laboratory managed and operated by Sandia Corporation, a wholly-owned subsidiary of Lockheed Martin Corporation, for the United States Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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ACRONYMS AND ABBREVIATIONS

ARG	ancestral Rio Grande
bgs	below ground surface
DOE	U.S. Department of Energy
ER	Environmental Restoration
FOP	field operating procedure
ID	inside diameter
Jet West	Jet West Geophysical Services
MWL	Mixed Waste Landfill
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
NTU	nephelometric turbidity unit
OD	outside diameter
P&A	plug and abandonment
PVC	polyvinyl chloride
Sandia	Sandia Corporation
SNL/NM	Sandia National Laboratories/New Mexico
TA	Technical Area
TD	total depth
WDC	WDC Exploration and Wells

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1.0 INTRODUCTION

This report documents the activities for plug and abandonment (P&A) and installation of groundwater monitoring wells at the Mixed Waste Landfill (MWL) at Sandia National Laboratories/New Mexico (SNL/NM). SNL/NM is managed and operated by Sandia Corporation (Sandia), a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy (DOE).

The activities were performed from April through June 2008 by SNL/NM Environmental Restoration (ER) Project personnel and the SNL/NM drilling contractor WDC Exploration and Wells (WDC).

1.1 Regulatory Action

On July 2, 2007, the DOE/Sandia received a letter from the New Mexico Environment Department (NMED)/Hazardous Waste Bureau entitled, "Replacement of Mixed Waste Landfill Groundwater Monitoring Wells MWL-MW1 and MWL-MW3" (Bearzi July 2007). The NMED letter required that DOE/Sandia replace these two groundwater monitoring wells. The letter also stated that DOE/Sandia shall submit to the NMED within 60 days a plan for approval describing how the wells are to be replaced and a schedule for implementation of this work. On July 31, 2007, the DOE/Sandia submitted the work plan to the NMED entitled, "Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Wells MWL-MW1 and MWL-MW3; Installation of Replacement Groundwater Monitoring Wells MWL-MW7 and MWL-MW8" (SNL/NM July 2007).

On October 30, 2007, the NMED issued a Notice of Approval of the work plan with conditions on the well locations (Bearzi October 2007). The well locations were negotiated over the next several months, and on February 12, 2008, the NMED issued a letter approving the plan and the negotiated locations (Bearzi February 2008).

Also included in the February 2008 NMED letter was a request for a work plan for P&A of MWL-MW2 and installation of a third well (MWL-MW9). The DOE/Sandia submitted the work plan to the NMED entitled, "Monitoring Well Plug and Abandonment Plan and Replacement Well Construction Plan; Decommissioning of Groundwater Monitoring Well MWL-MW2; Installation of Replacement Groundwater Monitoring Well MWL-MW9," (SNL/NM February 2008). The NMED approved the work plan in March 2008 (Bearzi March 2008).

The two work plans (SNL/NM July 2007 and SNL/NM February 2008) will be referred to collectively as the Plan in subsequent sections of this report.

The installation of groundwater monitoring wells MWL-MW7, MWL-MW8, and MWL-MW9 constitutes the installation of new wells, as defined during a meeting held on August 16, 2007 (SNL/NM August 2007) between NMED and DOE/Sandia representatives. A new well is defined as a well installed at a distance of greater than 30 feet from an existing well. As the newly installed wells described in this report are considered new wells, they will be sampled accordingly (eight consecutive quarters for a defined suite of parameters) as required by the NMED Compliance Order on Consent (the Order) (NMED April 2004).

1.2 Site Description and History

The MWL is designated as a Solid Waste Management Unit at SNL/NM. SNL/NM is located within the boundaries of Kirtland Air Force Base, immediately south of the city of Albuquerque in Bernalillo County, New Mexico (Figure 1-1).

The MWL is located approximately 4 miles south of SNL/NM central facilities and approximately 5 miles southeast of Albuquerque International Sunport. The landfill is a fenced, 2.6-acre site in the north-central portion of Technical Area (TA)-III. The MWL was established in 1959 as a disposal area for low-level radioactive waste generated by SNL/NM research facilities. Low-level radioactive and minor amounts of mixed waste were disposed of at the MWL from March 1959 through December 1988. Approximately 100,000 cubic feet of low-level radioactive and mixed waste containing approximately 6,300 curies of activity (at the time of disposal) were disposed of in the landfill.

Currently, the MWL groundwater monitoring well network consists of seven wells completed within interfingering alluvial fan deposits of the Santa Fe Group (Goering et al. 2002). The network (Figure 1-2) includes one background well (MWL-BW2), one on-site well (MWL-MW4), and five downgradient monitoring wells (MWL-MW5, MWL-MW6, MWL-MW7, MWL-MW8, and MWL-MW9). All seven wells are constructed of nominal 5-inch, Schedule 80 polyvinyl chloride (PVC) casing and have screens composed of slotted Schedule 80 PVC. Because of declining groundwater levels in the regional aquifer, the three monitoring wells that were plugged and abandoned (MWL-MW1, MWL-MW2, and MWL-MW3) were no longer useful for sampling purposes.

1.3 Geologic Setting

The MWL is located within the eastern flank of the Albuquerque basin and the uplifted basin margins comprising the Rio Grande rift (SNL/NM September 2002). The basin is a complex trough 90 miles long and 30 miles wide, bordered by the major uplifted fault blocks to the west. The eastern boundary is marked by the Sandia, Manzanita, and Manzano mountains. The western boundary is marked by the Lucero uplift, with the Ladron Mountains to the south and the Nacimiento Mountains to the northwest.

Erosion and sediment transport from the surrounding uplifts has filled the Albuquerque basin with up to 14,000 feet of deposits that comprise the late Pliocene to Pleistocene Santa Fe Group. The Santa Fe Group thins toward the basin edges and is truncated by the bounding uplifts. The Santa Fe Group is a diverse suite of alluvial gravel, sand, and silt, as well as fluvial sand, silt, and clay. The upper Santa Fe Group consists of two first-order sediment types: (1) an alluvial fan sequence derived from uplifts on the basin flanks, and (2) a fluvial sequence derived from the north and deposited by an axial river, the ancestral Rio Grande (ARG). The alluvial fan deposits are characterized by poorly sorted conglomerates and coarse sand at the top of the sequence that are underlain by silty and clayey sand. The upper ARG lithofacies of the Santa Fe Group is characterized by coarse- to fine-grained sand, generally poor in silt and clay, and locally rich in clasts (occasionally volcanic pumice).

The MWL is underlain by approximately 50 feet of late Pleistocene post-Santa Fe Group alluvial gravel, sand, and silt followed by the Santa Fe Group deposits at depth (SNL/NM September 2002). These collective deposits are characterized by great internal variability. A detailed

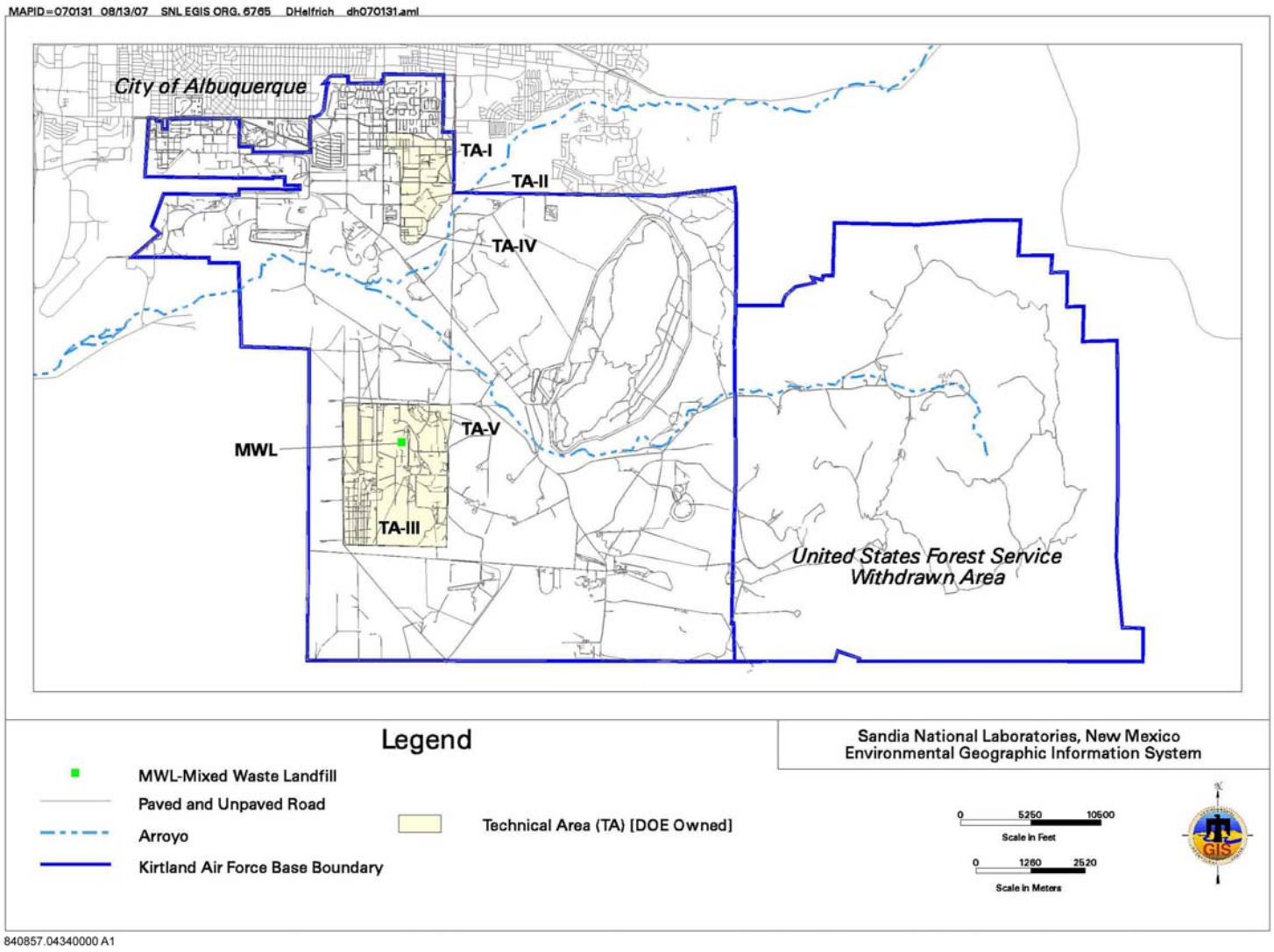

Figure 1-1
Location Map of the Mixed Waste Landfill, Technical Area III
Sandia National Laboratories, New Mexico

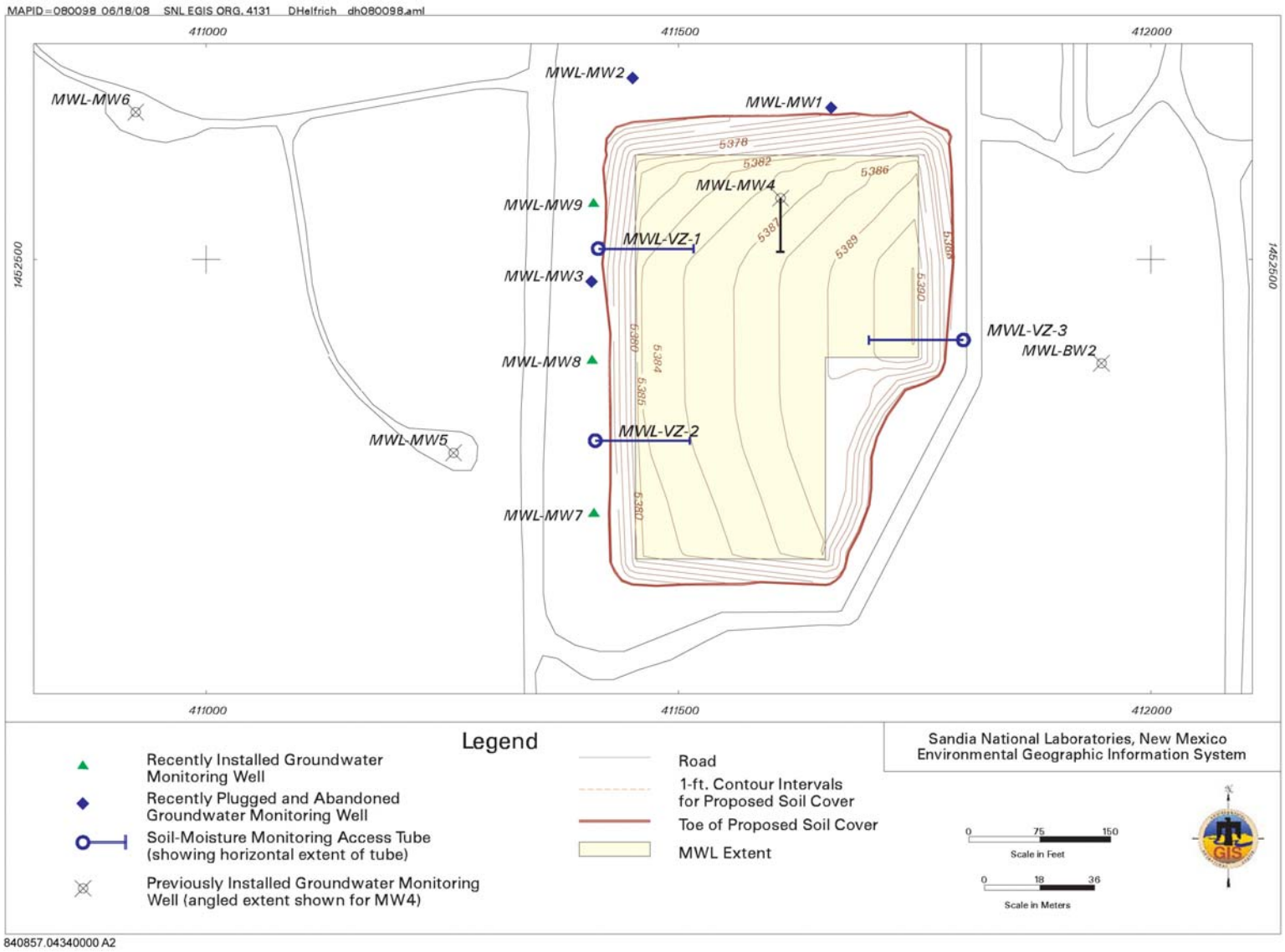

Figure 1-2
Location of Recently Plugged and Abandoned Groundwater Monitoring Wells and Recently Installed Groundwater Monitoring Wells at the Mixed Waste Landfill

correlation of individual lithologic units within and between boreholes is difficult (SNL/NM September 2002). The coarse and fine alluvial fan deposits of the upper Santa Fe Group have been identified at the MWL. Over the past 10 to 15 years, the presence of upper ARG fluvial deposits at the MWL has been questioned. Most recently, the ARG fluvial deposits have been interpreted as being present at the MWL based upon a reinterpretation of the geophysical log of MWL-MW2 (SNL/NM June 2003).

1.4 Objective

The objectives of this project were to perform successful P&A of three groundwater monitoring wells (MWL-MW1, MWL-MW2, and MWL-MW3) by grouting the wells in situ and to install three new, downgradient, groundwater monitoring wells (MWL-MW7, MWL-MW8, and MWL-MW9). This report is organized in chronological order of the activities conducted as follows: (1) the P&A of MWL-MW1, MWL-MW2, and MWL-MW3; (2) drilling and installation of MWL-MW7, MWL-MW8, and MWL-MW9; and (3) development of MWL-MW7, MWL-MW8, and MWL-MW9.

This report meets the reporting requirements of both the NMED and New Mexico Office of the State Engineer (NMOSE). The Order specifies the required elements for reporting installation of monitoring wells (NMED April 2004). The NMOSE requirements and guidance are provided in "Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells" (NMOSE August 2005). Appendix A presents the required NMED well data for the newly installed MWL groundwater monitoring wells.

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2.0 MONITORING WELL PLUGGING AND ABANDONMENT

Monitoring Wells MWL-MW1, MWL-MW2, and MWL-MW3 were plugged in situ on April 23 and April 24, 2008. All P&A activities were performed by WDC and supervised by SNL/NM ER Project personnel. Groundwater well abandonment diagrams are presented in Appendix B, and the field notes for the P&A are provided in Appendix C.

A bentonite grout (Quick-Grout™) was placed in the well with a portable grout plant (i.e., the grout was pumped through tubing placed at the bottom of the well and pulled up as the well was filled). Each well was grouted from the bottom of the well to the surface and allowed to set overnight. The concrete pad and steel guard posts were removed from the surface of the wellhead.

At MWL-MW2 and MWL-MW3, the protective casing consisted of approximately 3 feet of steel casing that was welded to a length of conductor casing that extended below ground. The conductor casing was required for the mud-rotary drilling technique used to advance the borehole and was left in place during the installation of the wells to serve as the protective casing. As the annulus between the conductor casing and the PVC well casing was firmly cemented during well installation, it was not possible to remove the 20-foot length of conductor casing. Approximately 14 inches of the steel casing protruded aboveground, and the PVC well casing extended another foot above it. The PVC casing was cut flush with the steel casing. A concrete plug was placed from the top of the grout plug (approximately 12 feet below ground surface [bgs]) to the top of the two casings (approximately 14 inches aboveground). The well monument was built over the two casings.

At MWL-MW1, the well and open portion of the annulus were filled to near the surface by mixing bentonite grout in a tub and pumping it into the well. The existing 5-foot length of protective conductor casing, concrete well pad, and steel guard posts were then removed from the surface of the wellhead at that time. The well and annulus were filled to within approximately 5 feet of the surface with coarse bentonite chips. The final 5 feet of the well and annulus were then filled with concrete, and a 3- by 3-foot concrete well monument was constructed over the location of the former well.

For all three P&A wells, a brass marker was placed in the monument. The marker was stamped with the abandoned well name, date of P&A, and well depth.

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3.0 DRILLING AND MONITORING WELL INSTALLATION

All drilling and monitoring well installation operations were performed by WDC and supervised by SNL/NM ER Project personnel. Geophysical logging services were performed by Jet West Geophysical Services (Jet West). The boreholes for all three wells were drilled using the air-rotary casing hammer method with a Speedstar 50K drilling rig and associated equipment.

The following sections describe the borehole drilling, lithologic and geophysical logging, and well construction. Field notes are provided in Appendix C. Lithologic logs based upon the cuttings returned from the boreholes were generated by the ER Project geologists. Appendix D presents the lithologic logs, and Appendix E presents combination diagrams showing lithologic and geophysical logs and well construction details. The well construction diagrams are provided in Appendix F. Complete field documentation, field forms, daily driller reports, and lithologic and geophysical logs, as well as the Jet West reports (Jet West April 2008 and May 2008a and b) are on file at the SNL/NM Customer-Funded Records Center.

3.1 Well MWL-MW7

Drilling of the borehole for MWL-MW7, located west of the MWL (Figure 1-2), commenced on April 24, 2008.

3.1.1 Drilling Operations

The drilling equipment was decontaminated at the ER Project decontamination pad in TA-III prior to the start of drilling operations. The first 200 feet of borehole was advanced with a tricone bit and 11 3/4-inch outside diameter (OD) drive casing to accommodate drilling through caliche and gravel zones. At 200 feet bgs, the bit and drive casing were switched to 9 5/8-inch OD and the smaller drive casing was telescoped into the borehole. The borehole was advanced to a total depth (TD) of 498.8 feet bgs on April 28, 2008. The drilling was suspended at 498.8 feet bgs to allow for geophysical logging of the borehole (Section 3.1.3).

3.1.2 Lithologic Logging

The lithology of the borehole consisted of unconsolidated deposits of sand and gravel. From the surface to approximately 250 feet bgs, a heterogeneous mixture of sand and gravel of the upper Santa Fe Group alluvium was encountered. From approximately 250 to 420 feet bgs, the sediment decreased in average particle size with depth. Intermittent layers of sand (sometimes with a trace of gravel) and silt (also with some sand and gravel) were present. At approximately 420 to 460 feet bgs, a significant change in lithology occurred, characterized by sand and coarse gravel of varied lithologies that may represent fluvial deposits of the upper ARG. At approximately 460 to 498.8 feet bgs (borehole TD), a silt and sand unit was encountered.

3.1.3 Downhole Geophysical Logging

On April 29, 2008, the cased borehole was logged with downhole wireline geophysical tools supplied by Jet West to help determine the lithologic characteristics of sediments penetrated by the borehole. Geophysical logs run in the borehole included combination natural gamma ray, thermal neutron, and 1-arm caliper. Although the caliper instrument is located on the same tool, the caliper log is not informative as the logging was completed within the steel drive casing.

The neutron log shows a significant signal increase at 200 feet bgs for the telescoped drill casing. The gamma ray and neutron readings are attenuated approximately 30 percent by the steel casing and approximately 50 to 60 percent in dual casing. A notable shift in the neutron signal occurs at 484 feet bgs, indicating the level of groundwater in the borehole at the time of the logging. The neutron logging continued another 12 feet below the water. (The gamma signal is unaffected by the presence of water in the borehole.)

The interpretation of the log indicates that the formation is composed of interbedded clay, silt, and sand. The lithology from 200 feet bgs to TD consisted of "dirty" sand bounded by clay layers and silt (Jet West April 2008). Dirty sand refers to sediment with relatively coarse sand grains mixed with silt and clay that have relatively low hydraulic conductivity and low transmissivity. Sand lenses were present at 200 to 345, 429 to 436, and 456 to 496 feet bgs. Clay and silt were encountered from 345 to 429 and 436 to 456 feet bgs. The region of concern, from the groundwater level (approximately 484 feet bgs) downward, is predominately comprised of saturated sand with interbedded silt and clay.

3.1.4 Initial Groundwater Level and Well Construction

On April 29, 2008, the initial groundwater level in the cased borehole was approximately 487 feet bgs. During the geophysical logging (occurring later that same day), the groundwater level was measured at approximately 484 feet bgs within the steel drive casing.

Well installation began on April 29, 2008, and was completed on May 1, 2008. The well was constructed of nominal 5-inch-diameter (inside diameter [ID] of 4.767 inches and OD of 5.563 inches); Schedule 80 PVC, flush-threaded, blank casing; and a 30-foot length of 0.010-inch slot, Schedule-80 PVC screen. This screen slot size was specified in the Plan to accommodate the fine-grained sand, silt, and clay encountered in the borehole. The sump consisted of a 5-foot length of nominal 5-inch-diameter, Schedule 80 PVC, flush-threaded, blank casing with a threaded end cap placed at the bottom. PVC centralizers were placed above and below the screen section and subsequently every 100 feet along the blank casing (Figure 3-1).

The bottom of MWL-MW7 was placed at approximately 498.75 feet bgs, and the nominal 30-foot screen section was placed from 464.65 to 493.99 feet bgs. Colorado Silica Sand (#20-40) was used as the primary sand pack in the annulus around the screen and extended approximately 10.85 feet above the top of the screen to 453.8 feet bgs. A secondary sand pack using #60 Colorado Silica Sand was placed from 448.6 to 453.8 feet bgs (the #40-60 sand specified in the Plan is no longer commercially available). A 31.2-foot volclay coarse chip (3/8-inch) plug was placed from 417.4 to 448.6 feet bgs. The chips were hydrated with 20 gallons of water three times during the chip placement and then with 100 gallons of water and allowed to set approximately 30 minutes.

Figure 3-1
Installation of a Groundwater Monitoring Well with a PVC Centralizer

A bentonite grout (SmoothGrout20™ One Step Grouting System) mixture was used to fill the remainder of the annulus (12 to 417 feet bgs). The first lift of approximately 110 feet of grout was placed and allowed to set for 24 hours. The subsequent lifts of grout were placed in approximate 100-foot lifts and allowed to set for one hour. The final grout lift was brought to approximately 12 feet bgs. The water level in the well on May 1, 2008 (following installation) was approximately 489.5 feet bgs.

3.1.5 Discussion with the NMED

Following the installation of MWL-MW7, DOE/Sandia and NMED personnel discussed the anomalously low groundwater elevations. It was anticipated that the static water level in MWL-MW7 would have been approximately 467 feet bgs (based upon the water level from MWL-MW3 approximately 250 feet away). The actual water level of approximately 498 feet bgs may reflect the strong downward vertical gradient in the Santa Fe Group units in the area. Although it was known that a gradient in this area existed, the magnitude of the gradient was not anticipated. The 30-foot screen section in MWL-MW7 was set to the depth proposed in the Plan; therefore, only approximately 4 to 5 feet of water-bearing strata is exposed in the screen section.

DOE/Sandia discussed this situation with the NMED, and the NMED directed DOE/Sandia to set the two remaining wells (MWL-MW8 and MWL-MW9) as proposed in the Plan regardless of the water level encountered during drilling and installation.

3.2 Well MWL-MW8

Drilling of the borehole for MWL-MW8, located west of the MWL (Figure 1-2), commenced on May 2, 2008.

3.2.1 Drilling Operations

The drilling equipment was decontaminated at the ER Project decontamination pad in TA-III following the installation of MWL-MW7 and prior to the start of drilling operations at MWL-MW8. The first 200 feet of borehole was advanced with a tricone bit and 11 3/4-inch OD drive casing. At 200 feet bgs, the bit and drive casing were switched to 9 5/8-inch OD and the smaller drive casing was telescoped into the borehole. The borehole was advanced to a TD of 535 feet bgs on May 7, 2008. The drilling was suspended at 535 feet bgs to allow for geophysical logging of the borehole (Section 3.2.3).

3.2.2 Lithologic Logging

The lithology of the borehole consisted of unconsolidated alluvial deposits of the late Pleistocene post-Santa Fe Group alluvium and late Pliocene to Pleistocene upper Santa Fe Group.

From the surface to approximately 38 feet bgs, a sand and gravel mixture of the late Pleistocene post-Santa Fe Group alluvium was encountered. From approximately 38 to

370 feet bgs, a heterogeneous mixture of silt, sand, and gravel of the upper Santa Fe Group was present. From approximately 370 to 518 bgs, the sediments decreased in average particle size with depth. Intermittent layers of sand (sometimes with a trace of gravel) and clayey sand and silt were encountered. At approximately 518 to 535 feet bgs, a significant change in lithology occurred, characterized by sand and coarse gravel of varied lithologies that may represent fluvial deposits of the upper ARG. A silt and clay unit was encountered at approximately 535 feet bgs (borehole TD).

3.2.3 Downhole Geophysical Logging

On May 8, 2008, the cased borehole was logged with downhole wireline geophysical tools supplied by Jet West to help determine the lithologic characteristics of sediments penetrated by the borehole. Geophysical logs run in the borehole included combination natural gamma ray, thermal neutron, and 1-arm caliper. Although the caliper instrument is located on the same tool, the caliper log is not informative as the logging was completed within the steel drive casing.

The neutron log reveals a significant signal increase at 200 feet bgs for the telescoped drill casing. A notable shift in the neutron signal occurs at 521.5 feet bgs indicating the level of groundwater in the borehole at the time of the logging. The neutron logging continued another 11 feet below the water. (The gamma signal is unaffected by the presence of water in the borehole.)

The interpretation of the log indicates that the formation is composed of interbedded clay, silt, and sand. The lithology from 200 feet bgs to TD consisted of dirty sand bounded by clay layers and silt (Jet West May 2008a). Sand lenses were predominant at 200 to 367, 413 to 430, 438 to 443, 487 to 497, and 508 to 535 feet bgs. Clay and silt were encountered from 367 to 413, 430 to 438, 443 to 487, and 497 to 508 feet bgs. From the groundwater level at the time of logging (approximately 521 feet bgs) downward, the formation is predominately comprised of saturated sand with interbedded clay.

3.2.4 Initial Groundwater Level and Well Construction

On May 8, 2008, the initial groundwater level in the cased borehole was approximately 530 feet bgs. During the geophysical logging (occurring later that same day), the groundwater level was measured at approximately 521 feet bgs within the steel drive casing. These preliminary water levels do not reflect equilibrium conditions, as the expected static groundwater level was approximately 20 to 30 feet higher. However, the low transmissivity of the local aquifer material and steel casing prevented equilibrium conditions from being achieved until after the well materials were installed.

Well installation began on May 8, 2008, and was completed on May 12, 2008. The well was constructed of nominal 5-inch-diameter (ID of 4.767 inches and OD of 5.563 inches), Schedule 80 PVC, flush-threaded, blank casing and a 30-foot length of 0.010-inch slot, Schedule-80 PVC screen. This screen slot size was specified in the Plan to accommodate the fine-grained sand, silt, and clay encountered in the borehole. The sump consisted of a 5-foot length of nominal 5-inch-diameter, Schedule 80 PVC, flush-threaded, blank casing with a threaded end cap placed at the bottom. PVC centralizers were placed above and below the screen section and subsequently every 100 feet along the blank casing (Figure 3-1).

A volclay coarse chip (3/8-inch) plug was used to backfill the borehole from 506.5 to 535 feet bgs. Colorado Silica Sand (#20-40) was used to backfill the borehole from 500 to 506.5 feet bgs.

The bottom of MWL-MW8 was placed at approximately 500 feet bgs, and the nominal 30-foot screen section was placed from 465 to 495 feet bgs. The #20-40 Colorado Silica Sand was used as the primary sand pack in the annulus around the screen and extended approximately 7 feet above the top of the screen to 458 feet bgs. A secondary sand pack using #60 Colorado Silica Sand was placed from 453 to 458 feet bgs (the #40-60 sand specified in the Plan is no longer commercially available). A 28.8-foot volclay coarse chip (3/8-inch) plug was placed from 424.2 to 453 feet bgs. The chips were hydrated with water continuously during the chip placement and then allowed to set overnight.

A bentonite grout (SmoothGrout20™ One Step Grouting System) mixture was used to fill the remainder of the annulus (12 to 424 feet bgs). The first lift of approximately 100 feet of grout was placed and allowed to set for 24 hours. The subsequent lifts of grout were placed in approximate 100-foot lifts and allowed to set for one hour. The final grout lift was brought to approximately 12 feet bgs.

3.3 Well MWL-MW9

Drilling of the borehole for MWL-MW9, located west of the MWL (Figure 1-2), commenced on May 13, 2008.

3.3.1 Drilling Operations

The drilling equipment was decontaminated at the ER Project decontamination pad in TA-III following the installation of MWL-MW8 and prior to the start of drilling operations at MWL-MW9. The first 200 feet of borehole was advanced with a tricone bit and 11 3/4-inch OD drive casing. At 200 feet bgs, the bit and drive casing were switched to 9 5/8-inch OD and the smaller drive casing was telescoped into the borehole. The borehole was advanced to a TD of 535 feet bgs on May 14, 2008. The drilling was suspended at 535 feet bgs to allow for geophysical logging of the borehole (Section 3.3.3).

3.3.2 Lithologic Logging

The lithology of the borehole consisted of unconsolidated deposits of sand and gravel. From the surface to approximately 240 feet bgs, a heterogeneous mixture of sand and gravel of the upper Santa Fe Group alluvium was encountered. From approximately 240 to 416 feet bgs, the sediments decreased in average particle size with depth. Intermittent layers of sand (sometimes with a trace of gravel) and silt (also with some sand and gravel) were present. At approximately 416 to 440 feet bgs, a significant change in lithology occurred, characterized by sand and coarse gravel of varied lithologies that may represent fluvial deposits of the upper ARG. At approximately 440 to 515 feet bgs, silt, sand, and clay units were encountered. From approximately 515 to 535 bgs (borehole TD), a sand and gravel unit was again encountered, with a thin silt and clay unit at approximately 528 feet bgs.

3.3.3 Downhole Geophysical Logging

On May 15, 2008, the cased borehole was logged with downhole wireline geophysical tools supplied by Jet West to help determine the lithologic characteristics of sediments penetrated in the borehole. Geophysical logs run in the borehole included combination natural gamma ray, thermal neutron, and 1-arm caliper. Although the caliper instrument is located on the same tool, the caliper log is not informative as the logging was completed within the steel drive casing.

The neutron log reveals a significant signal increase at 200 feet bgs for the telescoped drill casing. A notable shift in the neutron signal occurs at 494 feet bgs indicating the level of groundwater in the borehole at the time of the logging. The neutron logging continued another 41 feet below the water. (The gamma signal is unaffected by the presence of water in the borehole.)

The interpretation of the log indicates that the formation is composed of interbedded clay, silt, and sand. The lithology from 200 feet bgs to TD consisted of dirty sand bounded by clay layers and silt (Jet West May 2008b). Sand lenses with interbedded clay layers were present at 200 to 362, 410 to 427, 435 to 444, 488 to 495, and 502 to 535 feet bgs. Clay and silt with interbedded sand were present from 362 to 410, 427 to 435, 444 to 488, and 495 to 502 feet bgs. From the groundwater level at the time of logging (approximately 494 feet bgs) downward, the formation is predominately comprised of saturated sand with interbedded clay.

3.3.4 Initial Groundwater Level and Well Construction

On May 15, 2008, the initial groundwater level in the cased borehole was approximately 499 feet bgs. During the geophysical logging (occurring later that same day), the groundwater level was measured at approximately 494 feet bgs within the steel drive casing.

Well installation began on May 15, 2008, and was completed on May 19, 2008. The well was constructed of nominal 5-inch-diameter (ID of 4.767 inches and OD of 5.563 inches), Schedule 80 PVC, flush-threaded, blank casing and a 30-foot length of 0.010-inch slot, Schedule-80 PVC screen. This screen slot size was specified in the Plan to accommodate the low transmissive sand, silt, and clay encountered in the borehole. The sump consisted of a 5-foot length of nominal 5-inch-diameter, Schedule 80 PVC, flush-threaded, blank casing with a threaded end cap placed at the bottom. PVC centralizers were placed above and below the screen section and subsequently every 100 feet along the blank casing (Figure 3-1).

A volclay coarse chip (3/8-inch) plug was used to backfill the borehole from 500.5 to 535 feet bgs. Colorado Silica Sand (#20-40) was used to backfill the borehole from 500 to 500.5 feet bgs.

The bottom of MWL-MW9 was placed at approximately 500 feet bgs, and the nominal 30-foot screen section was placed from 465 to 495 feet bgs. The #20-40 Colorado Silica Sand was used as the primary sand pack in the annulus around the screen and extended approximately 6.3 feet above the top of the screen to 458.7 feet bgs. A secondary sand pack using #60 Colorado Silica Sand was placed from 452.5 to 458.7 feet bgs (the #40-60 sand specified in the Plan is no longer commercially available). A 32.9-foot volclay coarse chip (3/8-inch) plug was placed from 419.6 to 452.5 feet bgs. The chips were hydrated with water continuously during the chip placement and then allowed to set overnight.

A bentonite grout (SmoothGrout20™ One Step Grouting System) mixture was used to fill the remainder of the annulus (12 to 419.6 feet bgs). The first lift of approximately 100 feet of grout was placed and allowed to set for 24 hours. The subsequent lifts of grout were placed in approximate 100-foot lifts and allowed to set for one hour. The final grout lift was brought to approximately 12 feet bgs.

3.4 Wellhead Construction

The wellhead construction for all three groundwater monitoring wells (MWL-MW7, MWL-MW8, and MWL-MW9) was similar and followed procedures proposed in the Plan. A 10-foot length of nominal 12-inch-diameter steel casing was used as the protective casing at the surface. The casing, equipped with a hinged locking cap, was placed approximately 7 feet bgs and 3 feet aboveground. A fitted locking well cap was also placed on the PVC casing. Concrete was poured into the annulus from the top of the grout (approximately 12 feet bgs in each borehole) to the surface. A 3- by 3-foot pad was built around the casing, and a brass marker cap was placed in the pad denoting the well name. Three steel guard posts were placed around the pad, and the posts and protective casing were painted yellow.

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4.0 WELL DEVELOPMENT

From May 27 through June 30, 2008, well development of MWL-MW7, MWL-MW8, and MWL-MW9 was performed in accordance with the Well Development Field Operating Procedure (FOP) 94-41 (SNL/NM November 1994). Due to the low water yield of the wells, two phases of development were required. Initially, the wells were developed with the WDC development rig. ER Project personnel performed the second phase of development by purging the wells with a submersible pump.

The following water quality parameters were measured and recorded during well development:

- Temperature (degrees Celsius)
- Specific Conductivity (micromhos/centimeter)
- pH
- Turbidity (measured in nephelometric turbidity units [NTUs])

The Well Development Forms are provided in Appendix G.

4.1 Phase 1 Well Development

The predevelopment water level readings and the calculated saturated wellbore volumes, which includes pore spaces in the annular sand pack, are presented in Table 4-1. Because the wellheads had not been surveyed at the time of development, all measurements and volumes are estimated and rounded to the nearest tenth of a foot and whole gallon, respectively. A minimum of 5 saturated wellbore volumes (also shown in Table 4-1) represents the target volume to be removed from a borehole drilled without mud or water, as defined in the FOP (SNL/NM November 1994). The FOP defines the completion of well development at the point where the minimum wellbore volumes have been removed and representative water is obtained (representative water is obtained when pH, temperature, turbidity, and specific conductivity measurements are within 10 percent for three consecutive wellbore volumes).

Well development at MWL-MW7 began by swabbing the well screen with the surge block. A stainless steel bailer was used to begin evacuating the well. Although turbid, the water did not contain much coarse sediment. The well was dry after bailing approximately 5 to 10 gallons of water. The well was bailed throughout the day, allowing time for recovery. Approximately 10 saturated wellbore volumes (a total of 140 gallons of water) were removed from the well with the bailer. Stable water quality parameters were not achieved for MWL-MW7 during Phase 1 well development activities.

Well development of MWL-MW8 began by swabbing the well screen followed by evacuating the well with a stainless steel bailer. Although turbid, the water did not contain much coarse sediment. Approximately 5 to 10 gallons of water were bailed before the well was dry. Another 15 gallons of water were bailed before the well was dry again. The following day, the well was repeatedly swabbed, bailed dry, and allowed to recover. Approximately 11 wellbore volumes (a total of 138 gallons of water) were removed from the well with the bailer. Stable water quality parameters were not achieved for MWL-MW8 during Phase 1 well development activities.

Table 4-1
Calculated Saturated Wellbore Volumes
MWL-MW7, MWL-MW8, and MWL-MW9 Well Development

Well	Date	Water Level (ft BTOC)	Saturated Wellbore Volume (gal.)	Target Volume
Phase 1				5 Saturated Wellbore Volumes (gal.)
MWL-MW7	05-27-08	488.9	13	46
MWL-MW8	05-28-08	490.4	12	63
MWL-MW9	05-28-08	490.6	12	62
Phase 2				3 Saturated Wellbore Volumes (gal.)
MWL-MW7	06-24-08	489.9	12	35
MWL-MW8	06-25-08	490.6	12	36
MWL-MW9	06-26-08	491.4	11	33

BTOC = Below top of casing.
ft = Foot (feet).
gal. = Gallons.

Well development at MWL-MW9 began by swabbing the well followed by evacuating the well with a stainless steel bailer. Although turbid, the water did not contain much coarse sediment. Approximately 12 gallons of water were bailed before the well was dry. The following day, the well was repeatedly swabbed, bailed dry, and allowed to recover. Approximately 7 wellbore volumes (a total of 89 gallons of water) were removed from the well with the bailer. Stable water quality parameters were not achieved for MWL-MW9 during Phase 1 well development activities.

4.2 Phase 2 Well Development

Water quality parameters did not stabilize during Phase 1 well development (bailing and swabbing). ER Project personnel continued well development activities during Phase 2 by purging each well with a submersible pump (Bennett™) at approximately 1/3 gallon per minute (lowest possible flow rate). The pump was set at the bottom of the screen section in each well. Each well was purged with the pump for an additional three consecutive, saturated wellbore volumes, as specified in the FOP (SNL/NM November 1994). Table 4-2 summarizes the water quality parameters measured during Phase 2 of well development.

Well development continued in MWL-MW7 on June 24, 2008. Approximately 14 gallons of water were purged before the water level in the well was too low to continue pumping. The well was allowed to recover, repeatedly pumped throughout the day, and allowed to recover. Approximately 4 wellbore volumes (52 gallons of water) were pumped from the well, in addition to the 10 wellbore volumes removed during Phase 1. Specific conductivity and pH were stable within 10 percent in the last three wellbore volumes. Temperature and turbidity fluctuated each time the well was pumped to a low level. Turbidity was generally less than 5 NTUs.

Table 4-2
Summary of Water Quality Parameters for MWL-MW7, MWL-MW8, and MWL-MW9
During Phase 2 Well Development, June 2008

Time	Gallons Pumped[a]	Water Level (BTOC)	Temperature (°C)	Specific Conductivity (μmho/cm)	pH	Turbidity (NTU)
MWL-MW7 (June 24, 2008)						
0840	0	489.9	--	--	--	--
0901	2	491.4	23.87	586	7.16	2.11
0906	4	492.0	22.66	592	7.29	2.22
0911	6	492.7	22.48	586	7.31	1.47
0917	8	492.8	22.61	595	7.36	2.14
0924	10	492.8	22.93	594	7.36	1.41
0931	12	492.8	23.19	593	7.43	1.66
0936	14	493.4[b]	22.31	588	7.40	0.89
1017	--	490.5	--	--	--	--
1027	18	492.5	22.50	586	7.30	0.54
1032	20	493.2	22.82	586	7.36	7.36
1034	21	493.5[b]	22.96	587	7.39	6.40
1112	--	490.6	--	--	--	--
1121	25	492.3	23.53	592	7.31	1.69
1126	27	492.9	23.72	589	7.38	1.57
1131	29	493.3	23.92	589	7.39	6.34
1134	30	493.4[b]	23.87	588	7.38	9.16
1258	--	489.5	--	--	--	--
1310	34	491.3	25.85	592	7.31	0.84
1319	36	491.7	26.44	590	7.29	3.57
1326	38	492.0	26.51	590	7.36	4.25
1334	40	492.3	25.91	589	7.36	2.35
1341	42	492.6	25.84	589	7.37	1.61
1349	44	492.8	25.73	589	7.36	1.36
1356	46	492.9	25.67	589	7.36	1.02
1404	48	493.1	25.67	589	7.34	0.39
1411	50	493.3	25.47	590	7.34	0.30
1415	51	493.4	25.36	589	7.34	0.40
1419	52	493.4[b]	25.39	590	7.34	0.33
MWL-MW8 (June 25 through June 26, 2008)						
0851	0	490.6	--	--	--	--
0907	2	494.6	23.57	606	7.13	0.81
0912	4	495.8	22.94	604	7.30	1.65
0915	5	496.3	22.78	611	7.34	1.97
0918	6	496.9	22.68	615	7.36	1.69
0921	7	497.4[b]	22.71	621	7.37	1.59
1133	--	491.9	--	--	--	--
1142	11	494.8	23.90	623	7.30	4.05
1144	12	495.5	23.53	615	7.32	1.86
1146	13	496.1	23.48	614	7.24	1.45
1148	14	496.7	23.41	614	7.24	6.57
1150	15	497.4[b]	23.41	613	7.26	15.6
1348	--	492.2	--	--	--	--

Refer to footnotes at end of table.

Table 4-2 (Continued)
Summary of Water Quality Parameters for MWL-MW7, MWL-MW8, and MWL-MW9
During Phase 2 Well Development, June 2008

Time	Gallons Pumped[a]	Water Level (BTOC)	Temperature (°C)	Specific Conductivity (μmho/cm)	pH	Turbidity (NTU)
MWL-MW8 (June 25 through June 26, 2008) (Continued)						
1401	19	494.8	25.69	619	7.28	14.0
1403	20	495.4	25.24	619	7.22	2.30
1406	21	496.1	25.06	618	7.24	2.24
1409	22	496.6	25.11	617	7.25	9.37
1412	23	497.1	25.18	615	7.28	19.4
1415	24	497.5[b]	25.14	615	7.30	22.4
0810	--	490.6	--	--	--	--
0823	28	493.7	21.32	610	7.42	7.25
0825	29	494.1	21.42	612	7.37	3.26
0828	30	494.8	21.74	613	7.35	2.24
0830	31	495.4	21.90	613	7.36	5.05
0833	32	496.0	21.95	613	7.37	12.1
0835	33	496.7	22.02	613	7.38	19.1
0837	34	497.4[b]	22.04	613	7.38	21.4
MWL-MW9 (June 26 through June 30, 2008)						
0928	0	491.4	--	--	--	--
0946	1	495.5	26.82	579	6.63	1.11
0949	2	496.1	26.12	571	6.96	0.93
0952	3	496.8	25.33	562	7.17	1.44
0954	4	497.2	24.98	558	7.27	1.26
0955	4	497.5	24.74	559	7.29	1.33
0957	5	497.7[b]	24.56	557	7.32	1.81
1252	--	491.7	--	--	--	--
1301	9	495.6	25.22	576	7.20	6.78
1303	10	496.3	24.69	580	7.17	1.87
1305	11	497.1	24.56	579	7.17	2.09
1307	12	497.7[b]	24.39	579	7.18	2.57
0819	--	491.4	--	--	--	--
0828	16	495.2	19.95	574	7.35	10.9
0831	17	496.0	20.35	577	7.30	1.28
0834	18	496.6	20.80	578	7.30	0.90
0837	19	497.3	20.95	578	7.31	0.87
0840	20	497.8[b]	21.07	578	7.32	1.09
1250	--	491.5	--	--	--	--
1300	24	495.1	22.52	575	7.31	8.07
1303	25	495.8	22.31	578	7.28	1.74
1305	26	496.5	22.38	578	7.26	2.58
1308	27	497.4	22.42	578	7.27	2.26
1310	28	497.7[b]	22.47	578	7.28	2.25
0814	--	491.6	--	--	--	--
0823	32	495.6	19.88	575	7.41	5.75
0825	33	496.3	20.34	575	7.34	0.91
0827	34	497.1	20.74	569	7.33	1.02

Table 4-2 (Concluded)
Summary of Water Quality Parameters for MWL-MW7, MWL-MW8, and MWL-MW9
During Phase 2 Well Development, June 2008

Time	Gallons Pumped[a]	Water Level (BTOC)	Temperature (°C)	Specific Conductivity (μmho/cm)	pH	Turbidity (NTU)
MWL-MW9 (June 26 through June 30, 2008) (Continued)						
0829	35	497.8[b]	20.94	559	7.34	1.07
1245	--	491.7	--	--	--	--
1258	39	495.1	23.84	565	7.35	6.25
1300	40	495.9	23.20	578	7.25	2.30
1303	41	496.5	23.13	578	7.25	1.14
1306	42	497.3	22.98	579	7.26	1.30
1309	43	497.8	22.86	577	7.29	1.93

[a]Phase 2 pumping followed the Phase 1 evacuation by bailing. Stable water quality parameters were not achieved during Phase 1.
[b]Well purged dry then allowed to recover to approximately 80% of the initial Phase 2 water level before development continued.
BTOC = Below top of casing.
°C = Degrees Celsius.
μmho/cm = Micromho(s)/centimeter.
NTU = Nephelometric turbidity unit.
-- = Parameter not measured during well recovery.

Development of MWL-MW8 continued on June 25, 2008. The well was repeatedly pumped dry and allowed to recover. Approximately 3 wellbore volumes (34 gallons of water) were pumped from the well, in addition to the 11 wellbore volumes removed during Phase 1. Specific conductivity and pH were stable within 10 percent in the last three wellbore volumes. Temperature and turbidity fluctuated each time the well was pumped to a low level.

Development of MWL-MW9 continued on June 26, 2008. The well was repeatedly pumped dry and allowed to recover. Approximately 4 wellbore volumes (43 gallons of water) were pumped from the well, in addition to the 7 wellbore volumes removed during Phase 1. Stable water quality parameters were achieved during pumping of the last three saturated wellbore volumes. Specific conductivity and pH were stable within 10 percent in the last three wellbore volumes. Temperature and turbidity fluctuated each time the well was pumped to a low level. Turbidity was generally below 5 NTUs.

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5.0 VARIANCES

All FOPs and administrative operating procedures cited in the Plan were followed. Several variances from the Plan occurred during the 2008 P&A, drilling, installation, and well development activities.

Variance 1 occurred during the P&A of groundwater monitoring well MWL-MW3. The Plan specified removing the surface protective casing to approximately 5 feet bgs. This was not possible as MWL-MW3 had been installed with mud-rotary drilling techniques, and a 20-foot length of conductor casing had been left in place at the wellhead. This construction method had not been identified in the Plan. The well was abandoned as described in Chapter 2.0.

Variance 2 occurred during the drilling of the boreholes for MWL-MW8 and MWL-MW9. The Plan specified that the boreholes would be drilled to approximately 500 feet bgs. The boreholes were each advanced to 535 feet bgs in order to observe the lithology (recorded on the lithology logs provided in Appendices D and E). The boreholes were then backfilled with bentonite pellet plugs to approximately 500 feet bgs.

Variance 3 occurred in the installation of the well casing. The Plan specified that the 30-foot screen sections be placed such that approximately 5 feet of screen is above the static groundwater level and 25 feet of screen is submerged. This varied for each of the wells and the screens were set as described in Chapter 3.0. Each well was set to the depth specified in the Plan, yet the static groundwater elevation was lower than anticipated. This condition was discussed with the NMED following the installation of MWL-MW7, and the NMED specified that DOE/Sandia should set the wells to the depth as described in the Plan.

Variance 4 occurred in the installation of the bentonite plug above the secondary sand filter pack for each of the three wells. The Plan specified a 10-foot seal to be placed above the sand pack. WDC, the drilling contractor, preferred to place a 30-foot seal. Previously, DOE/Sandia had consulted with a different contractor who preferred a 10-foot seal. The placement of the seal also varied from what was specified in the Plan. The seal was to be placed in 5-foot lifts, hydrating between the lifts. The plug in each well was installed as described in Chapter 3.0.

Variance 5 occurred in the installation of the secondary sand filter pack (placed above the primary filter pack) in groundwater monitoring wells MWL-MW7 and MWL-MW8. The Plan specified the use of #40-60 sand. This combination of screen size fractions is no longer commercially available. A sand filter pack of single size fraction 60 was used.

Variance 6 occurred during the development of each of the wells. The required volumes were achieved, yet the primary target of field parameter agreement within 10 percent was not achieved for turbidity and temperature. This may be due to the low water levels and low-yielding nature of the units within the Santa Fe Group at these depths. Each of the wells was repeatedly bailed/pumped to the lowest level possible and then required a recovery period. Water quality parameters fluctuated during these cycles (Table 4-2). The secondary target for turbidity (less than 5 NTUs) was achieved during development for each of the wells.

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6.0 REFERENCES

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APPENDIX A
Well Data for MWL-MW7, MWL-MW8, and MWL-MW9

Table A-1
Well Data for MWL-MW7
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-MW7
2. Date of well construction	June 24, 2008 (construction and development done)
3. Drilling method	Air-rotary casing hammer
4. Drilling contractor and name of driller	WDC Exploration and Wells, Mark Green
5. Borehole diameter and well casing diameter	Borehole: 11 3/4 inches, 0 to 200 ft bgs; 9 5/8 inches, 200 to 498.8 ft bgs
	Well casing: 5.563 inches OD, 4.767 inches ID
6. Well depth	498.8 ft bgs
7. Casing length	501.2 ft total (498.8 ft bgs, 2.40 ft aboveground)
8. Casing materials	Schedule 80 PVC
9. Casing and screen joint type	Flush thread
10. Screened interval(s)	464.7 to 494 ft bgs
11. Screen materials	Schedule 80 PVC
12. Screen slot size and design	0.010-inch slotted screen
13. Filter pack material and gradation	Primary: #20-40 Colorado Silica Sand
	Secondary: #60 Colorado Silica Sand
14. Filter pack volume (calculated and actual)[b]	Calculated: 17.1 ft^3, 34 bags (50-lb)
	Actual: 18.5 ft^3, 37 bags (50-lb)
15. Filter pack placement method	Gravity feed through drive casing
16. Filter pack interval(s)	Primary: 453.8 to 498.8 ft bgs
	Secondary: 448.6 to 453.8 ft bgs
17. Annular sealant composition	Volclay (bentonite) chip plug, bentonite grout
18. Annular sealant placement method	Gravity feed through drive casing
19. Annular sealant volume (calculated and actual)	Calculated: Plug 11.9 ft^3, (16 bags [50-lb] bentonite chips) Grout 1st 100-ft lift, 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~883 gallons total (brought to ~12 ft bgs)
	Actual: Plug: 8.7 ft^3, (13 buckets [5-gallon] of chips) Grout 1st 100-ft lift (not tagged), 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,186 gallons total (brought to ~12 ft bgs)
20. Annular sealant interval(s)	Plug: 417.4 to 448.6 ft bgs
	Grout: 7 to 417.4 ft bgs
21. Surface sealant composition	Concrete
22. Surface seal placement method	Gravity fed into annulus
23. Surface sealant volume (calculated and actual)	Calculated: 5.25 ft^3
	Actual: not recorded, placed concrete 0 to 12 ft bgs
24. Surface sealant interval	0 to 12 ft bgs
25. Surface seal and well apron design and construction	3- by 3-ft by ~4-inch-deep concrete pad
26. Well development procedure and turbidity measurements	Bennett™ pump (see Table 4-2 for turbidity measurements)
27. Well development purge volume(s) and stabilization parameter measurements	Total of 192 gallons (see Table 4.2 for parameter measurements)

Refer to footnotes at end of table.

Table A-1 (Concluded)
Well Data for MWL-MW7
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
28. Type and design and construction of protective casing	10-ft length of 12-inch-diameter steel casing with hinged cap (7 ft bgs and 3 ft aboveground)
29. Well cap and lock	Hinged cap on protective casing with padlock and locking well cap with padlock on well casing
30. Ground surface elevation	5378.23 ft amsl
31. Survey reference point elevation on well casing	5380.63 ft amsl
32. Top of monitoring well casing elevation	5380.63 ft amsl
33. Top of protective steel casing elevation	5380.95 ft amsl (locking cover removed)
34. Name of geologist	Mike Skelly
35. Initial water level	485.9 ft bgs (predevelopment water level, May 1, 2008)
36. Final water level	488.89 ft bgs (postdevelopment water level, May 27, 2008)
37. Date of well development	May 27 to June 24, 2008

[a]New 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.
[b]Filter pack volume defined as the total volume of filter pack sand placed in well, both adjacent to the well casing, screen, and sump and below the sump (if applicable).
amsl = Above mean sea level.
bgs = Below ground surface.
ft = Foot (feet).
ft^3 = Cubic feet.
ID = Inside diameter.
lb = Pound(s).
MWL = Mixed Waste Landfill
OD = Outside diameter.
PVC = Polyvinyl chloride.

Table A-2
Well Data for MWL-MW8
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-MW8
2. Date of well construction	June 26, 2008 (construction and development done)
3. Drilling method	Air-rotary casing hammer
4. Drilling contractor and name of driller	WDC Exploration and Wells, Mark Green
5. Borehole diameter and well casing diameter	Borehole: 11 3/4 inches, 0 to 200 ft bgs; 9 5/8 inches, 200 to 535 ft bgs
	Well casing: 5.563 inches OD, 4.767 inches ID
6. Well depth	500 ft bgs
7. Casing length	502.28 ft total (500 ft bgs, 2.28 ft aboveground)
8. Casing materials	Schedule 80 PVC
9. Casing and screen joint type	Flush thread
10. Screened interval(s)	465 to 495 ft bgs
11. Screen materials	Schedule 80 PVC
12. Screen slot size and design	0.010-inch slotted screen
13. Filter pack material and gradation	Primary: #20-40 Colorado Silica Sand
	Secondary: #60 Colorado Silica Sand
14. Filter pack volume (calculated and actual)[b]	Calculated: 19.5 ft^3, 39 bags (50-lb)
	Actual: 18 ft^3, 36 bags (50-lb)
15. Filter pack placement method	Gravity feed through drive casing
16. Filter pack interval(s)	Primary: 458 to 506.5 ft bgs
	Secondary: 453 to 458 ft bgs
17. Annular sealant composition	Volclay (bentonite) chip plug, bentonite grout
18. Annular sealant placement method	Gravity feed through drive casing
19. Annular sealant volume (calculated and actual)	Calculated: Plug 10.9 ft^3, (14.5 bags [50-lb] bentonite chips) Grout 1st 100-ft lift, 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,205 gallons total (brought to ~12 ft bgs)
	Actual: Plug: 12.8 ft^3, (17 bags [50-lb] of bentonite chips) Grout 1st 100-ft lift (not tagged), 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,205 gallons total (brought to ~12 ft bgs)
20. Annular sealant interval(s)	Plug: 424.2 to 453 ft bgs
	Grout: 12 to 424.2 ft bgs
21. Surface sealant composition	Concrete
22. Surface seal placement method	Gravity fed into annulus
23. Surface sealant volume (calculated and actual)	Calculated: 5.25 ft^3
	Actual: not recorded, placed concrete 0 to 12 ft bgs
24. Surface sealant interval	0 to 12 ft bgs
25. Surface seal and well apron design and construction	3- by 3-ft by ~4-inch-deep concrete pad
26. Well development procedure and turbidity measurements	Bailer, Bennett™ pump (see Table 4-2 for turbidity measurements)
27. Well development purge volume(s) and stabilization parameter measurements	Total of 171.5 gallons (see Table 4.2 for parameter measurements)

Refer to footnotes at end of table.

Table A-2 (Concluded)
Well Data for MWL-MW8
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
28. Type and design and construction of protective casing	10-ft length of 12-inch-diameter steel casing with hinged cap (7 ft bgs and 3 ft aboveground)
29. Well cap and lock	Hinged cap on protective casing with padlock and locking well cap with padlock on well casing
30. Ground surface elevation	5379.72 ft amsl
31. Survey reference point elevation on well casing	5382.0 ft amsl
32. Top of monitoring well casing elevation	5382.0 ft amsl
33. Top of protective steel casing elevation	5382.76 ft amsl (locking cover removed)
34. Name of geologist	Stacy Griffith
35. Initial water level	486.7 ft bgs (predevelopment water level, May 9, 2008)
36. Final water level	490.4 ft bgs (postdevelopment water level, May 28, 2008)
37. Date of well development	May 28 to June 26, 2008

[a]New 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.
[b]Filter pack volume defined as the total volume of filter pack sand placed in well, both adjacent to the well casing, screen, and sump and below the sump (if applicable).
amsl = Above mean sea level.
bgs = Below ground surface.
ft = Foot (feet).
ft^3 = Cubic feet.
ID = Inside diameter.
lb = Pound(s).
MWL = Mixed Waste Landfill.
OD = Outside diameter.
PVC = Polyvinyl chloride.

Table A-3
Well Data for MWL-MW9
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
1. Well name/number	MWL-MW9
2. Date of well construction	June 30, 2008 (completion)
3. Drilling method	Air-rotary casing hammer
4. Drilling contractor and name of driller	WDC Exploration and Wells, Mark Green
5. Borehole diameter and well casing diameter	Borehole: 11 3/4 inches, 0 to 200 ft bgs; 9 5/8 inches, 200 to 535 ft bgs
	Well casing: 5.563 inches OD, 4.767 inches ID
6. Well depth	500 ft bgs
7. Casing length	502.60 ft total (500 ft bgs, 2.60 ft aboveground)
8. Casing materials	Schedule 80 PVC
9. Casing and screen joint type	Flush thread
10. Screened interval(s)	465 to 495 ft bgs
11. Screen materials	Schedule 80 PVC
12. Screen slot size and design	0.010-inch slotted screen
13. Filter pack material and gradation	Primary: #20-40 Colorado Silica Sand
	Secondary: #60 Colorado Silica Sand
14. Filter pack volume (calculated and actual)[b]	Calculated: 16.0 ft^3, 32 bags (50-lb)
	Actual: 22 ft^3, 44 bags (50-lb)
15. Filter pack placement method	Gravity feed through drive casing
16. Filter pack interval(s)	Primary: 458.7 to 500.5 ft bgs
	Secondary: 452.5 to 458.7 ft bgs
17. Annular sealant composition	Volclay (bentonite) chip plug, bentonite grout
18. Annular sealant placement method	Gravity feed through drive casing
19. Annular sealant volume (calculated and actual)	Calculated: Plug 12.5 ft^3, (16.7 bags [50-lb] bentonite chips) Grout 1st 100-ft lift, 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,192 gallons total (brought to ~12 ft bgs)
	Actual: Plug: 13.5 ft^3, (18 bags [50-lb] of bentonite chips) Grout 1st 100-ft lift (not tagged), 38 ft^3, 284 gallons Grout 2nd through 4th ~100-ft lifts, ~1,192 gallons total (brought to ~12 ft bgs)
20. Annular sealant interval(s)	Plug: 419.6 to 452.5 ft bgs
	Grout: 12 to 419.6 ft bgs
21. Surface sealant composition	Concrete
22. Surface seal placement method	Gravity fed into annulus
23. Surface sealant volume (calculated and actual)	Calculated: 5.25 ft^3
	Actual: not recorded, placed concrete 0 to 12 ft bgs
24. Surface sealant interval	0 to 12 ft bgs
25. Surface seal and well apron design and construction	3- by 3-ft by ~4-inch-deep concrete pad
26. Well development procedure and turbidity measurements	Bailer, Bennett™ pump (see Table 4-2 for turbidity measurements)

Refer to footnotes at end of table.

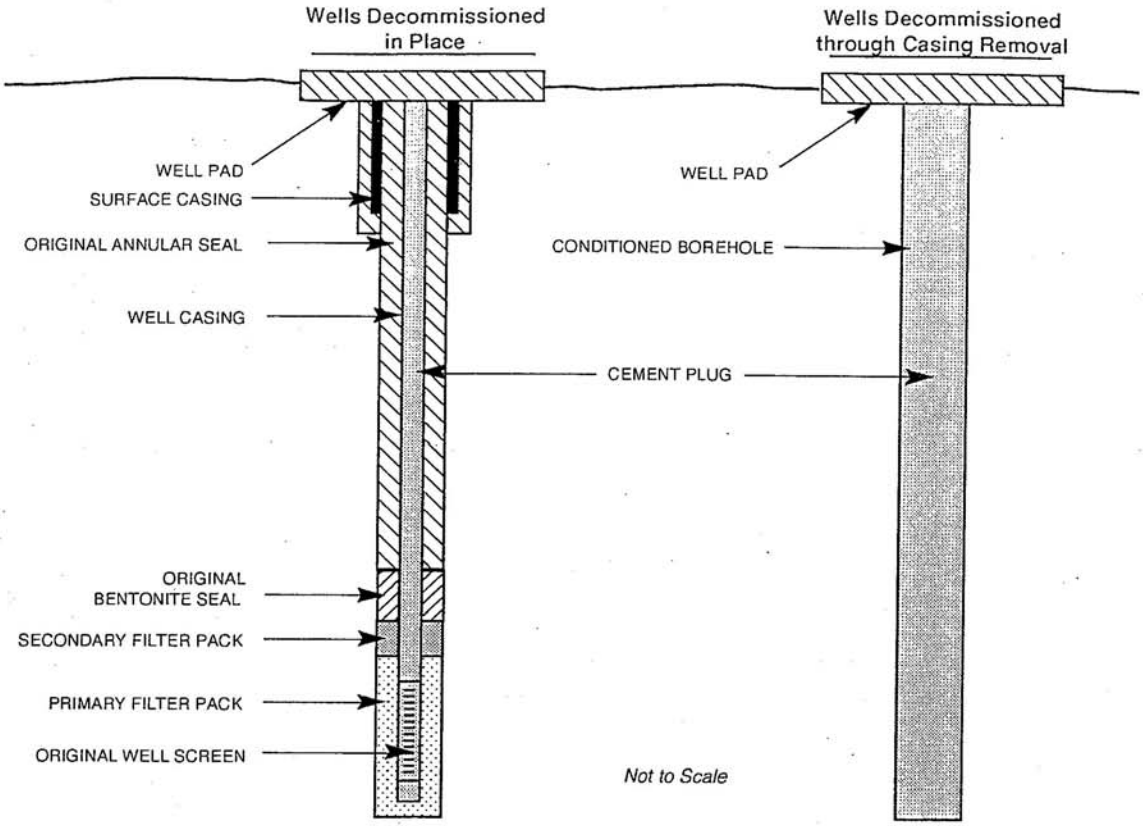
Table A-3 (Concluded)
Well Data for MWL-MW9
Mixed Waste Landfill, Sandia National Laboratories, New Mexico

Items Required by the Order[a] Section VIII.D	Comments
27. Well development purge volume(s) and stabilization parameter measurements	Total of 131.5 gallons (see Table 4.2 for parameter measurements)
28. Type and design and construction of protective casing	10-ft length of 12-inch-diameter steel casing with hinged cap (7 ft bgs and 3 ft aboveground)
29. Well cap and lock	Hinged cap on protective casing with padlock and locking well cap with padlock on well casing
30. Ground surface elevation	5376.64 ft amsl
31. Survey reference point elevation on well casing	5379.24 ft amsl
32. Top of monitoring well casing elevation	5379.24 ft amsl
33. Top of protective steel casing elevation	5379.83 ft amsl (locking cover removed)
34. Name of geologist	Mike Skelly
35. Initial water level	489.5 ft bgs (predevelopment water level, May 19, 2008)
36. Final water level	490.4 ft bgs (postdevelopment water level, May 28, 2008)
37. Date of well development	May 28 to June 30, 2008

[a]New 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.
[b]Filter pack volume defined as the total volume of filter pack sand placed in well, both adjacent to the well casing, screen, and sump and below the sump (if applicable).
amsl = Above mean sea level.
bgs = Below ground surface.
ft = Foot (feet).
ft^3 = Cubic feet.
ID = Inside diameter.
lb = Pound(s).
MWL = Mixed Waste Landfill.
OD = Outside diameter.
PVC = Polyvinyl chloride.

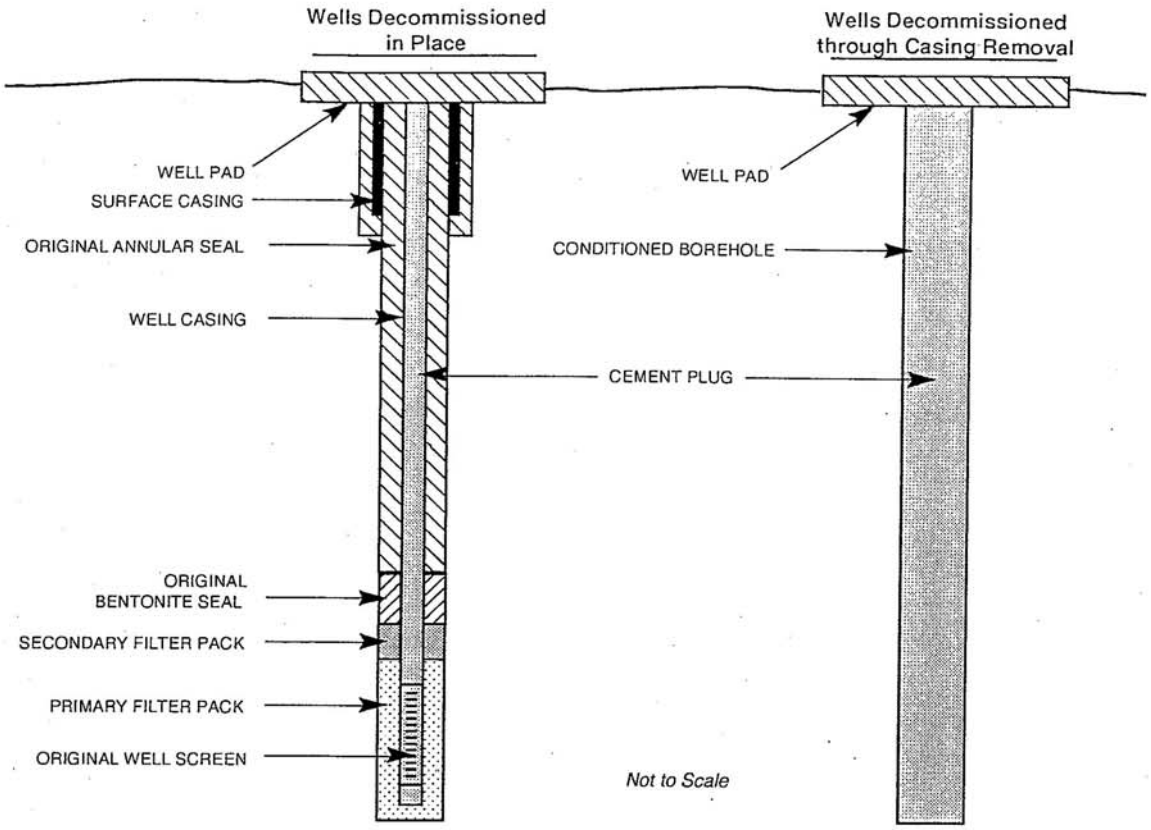
APPENDIX B
Groundwater Well Abandonment Diagrams for
MWL-MW1, MWL-MW2, and MWL-MW3

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



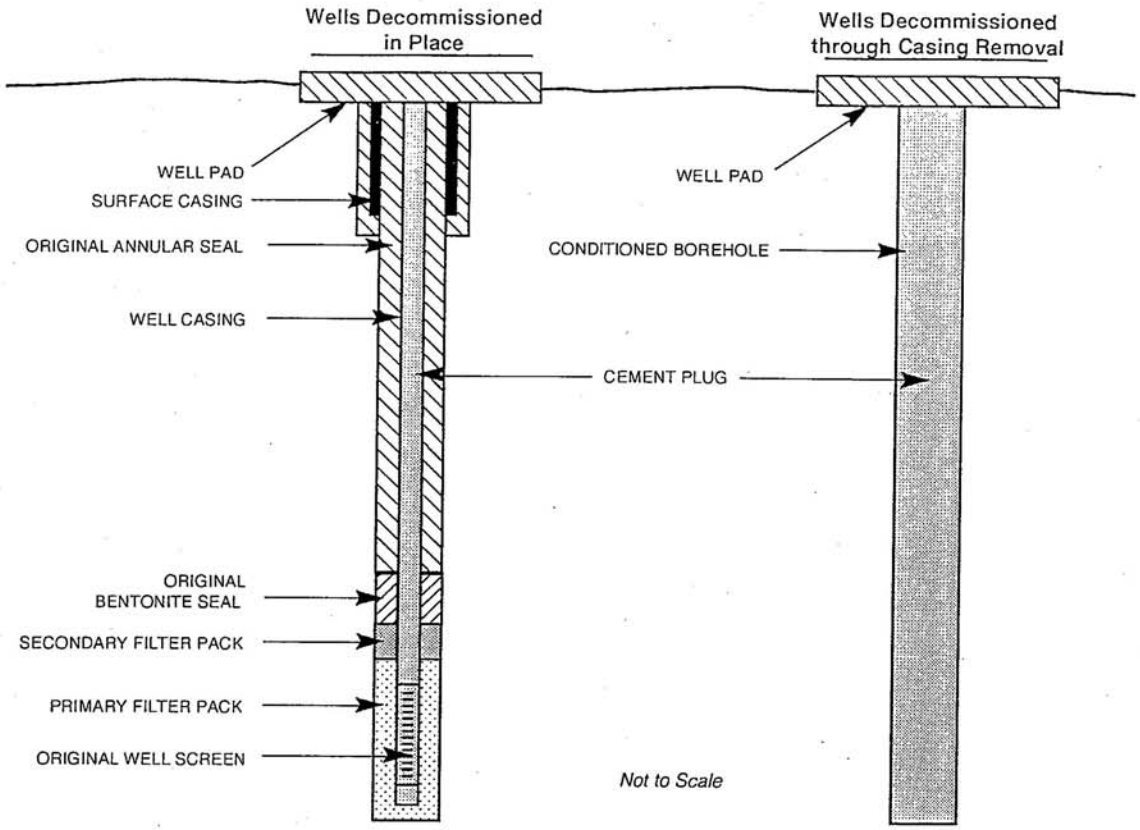
Well Name	MWL-MW1
Location	Mixed Waste Landfill
N.M. State Plane Coordinate X	411661.747
N.M. State Plane Coordinate Y	1452661.099
Surface Casing Type	steel conductor casing
Surface Casing Length	5 feet
ID Well Casing	4.75 inches
Well Casing Depth	478 feet below ground surface
Screen Interval	456 to 476 feet below ground surface
Plugging Grout Type	Quick-Grout™ (bentonite grout)
Grout Volume Used	approximately 550 gallons
Date of Decommissioning	23-Apr-08

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



Well Name	MWL-MW2
Location	Mixed Waste Landfill
N.M. State Plane Coordinate X	411451.366
N.M. State Plane Coordinate Y	1452692.592
Surface Casing Type	steel conductor casing
Surface Casing Length	20 feet
ID Well Casing	4.75 inches
Well Casing Depth	477 feet below ground surface
Screen Interval	452 to 472 feet below ground surface
Plugging Grout Type	Quick-Grout™ (bentonite grout)
Grout Volume Used	approximately 500 gallons
Date of Decommissioning	24-Apr-08

SNL/NM ER PROJECT
GROUNDWATER MONITORING WELL ABANDONMENT DIAGRAM



Well Name	MWL-MW3
Location	Mixed Waste Landfill
N.M. State Plane Coordinate X	411407.995
N.M. State Plane Coordinate Y	1452476.617
Surface Casing Type	steel conductor casing
Surface Casing Length	20 feet
ID Well Casing	4.75 inches
Well Casing Depth	476.3 feet below ground surface
Screen Interval	451.3 to 471.3 feet below ground surface
Plugging Grout Type	Quick-Grout™ (bentonite grout)
Grout Volume Used	approximately 500 gallons
Date of Decommissioning	24-Apr-08

APPENDIX C
Field Notes for 2008 Activities at the Mixed Waste Landfill

Well Plug and Abandonment

P+A MW1, 2, 3

Michael Shelby 16APR08

1044 Travel with Don Helfrich + Stacy Griffith to MWL to stake locations of MW1 - MW7, MW8, + MW9.

1105 at MWL, place large wood stakes at each of the proposed well locations. Locations based on the coordinates used by ERGIS to generate Figure 1 of the NMED-approved Plug and abandonment/Replacement plan for MWL - MW2/9.

1146 Back at ER Office.

22APR08

1015 Gather equipment into red truck.

1142 Go to IPOC/Badge Office to meet drillers.

1204 add Badge office

Mark A Olsen	CT51602
Hector M Leon	CT51603
Tarvicio J Leon	CT51604
Casey G Heath	CT51605

1227 Email Frank Stibeck badge numbers for PA-III access for B4 crew members

1250 At ERFO, discuss scope of work, H+S training requirements, logistics, minimizing impact to surface soils/vegetation, watch out for migratory birds (mourning dove nests), clearing well pad areas, volume calculations, bag counts, HotWork/Welding Permits.

1317 New crew (Hector + Tervie) watch Video training. Go to decon pad with Mark and Casey to offload equipment

1425 Review SNL HASP with crew, get signatures on HASP

1444 Crew leaves ERFO to go to WDC yard for more gear.

1515 Fax Badge Requests (4) to badge office.

P+A MW1, 2, 3

Michael Stella

22 April 08

1609 Call Mark Green, the drill rig is on its way to Abq. He's still gathering equipment in the yard. He'll continue mobilizing equipment tomorrow morning.
1640 at ERMO, secure gear for the evening.

---

23 April 08

0709 at ERMO, pack gear, head to MWL
Weather: clear, cool, calm, pred hi ~80 w/ high wind
0733 at MWL, prepare trailer/gear. WDC crew mobilizing equipment from yard to TA-III decon pad staging area. Pipe truck/trailer got stuck between the gates at entrance to TA-III. Security was called to override the gates
0911 Leave decon pad to get another load of equipment at WDC yard. Talk to Mark Green about completions: protective casing = 10" (ID) steel, 3 Bollards. Also, pick P+A Debris for pick up by ERFO
1203 at ERFO pick up caution tape, drinking water and other supplies
1225 at Decon pad, WDC finishing up up loading gear. Take Mark Green to drill site locations and discuss logistics P+A MWL-MW1, MW2, MW3 then start drilling MWL-MW7. Some site prep work required at MW7.
1258 at MWL, flag roped area with Caution Streamers. WDC water truck goes for a load.
1339 Open Well MWL-MW1, WDC crew onsite give Tailgate safety briefing. Prep to insert Tremie (black plastic for fluid) mix + pump grout.
1408 Mike Sanders onsite to discuss operations.

Michael Shell 23 April 08

1424 Mike Sanders offsite
Calculate volume of grout for 478 ft hole (4.7" ID) at 430 gallons
1452 Pumped ~550 gals of grout (20 bags) clean out pump/hose. WDC crew needs to replace hose. Ready site for leaving.
1507 Secure Trailer, head to ERMO.
1610 Mark Green calls, still fetching part. Will Resume operations in morning.
1715 Go to site for ER Checklist, make copy for Franz Lauffer and ship.
1751 Finish for the day.

0750 at ERMO Gather equipment 24 April 08
head to the site
0811 On site, drill crew readying equipment
Onsite personel:
Mike Shell
Mark Green
Casey Heath
Hector Leon
Javier Leon
Give tailgate safety briefing, WDC swaps out battery in fork left. Prepare to grout (top off MW1 then MW2).
0941 Finish topping off MW1 using ~50 gals and 2 bags of bentonite.
0950 Set up on MW1 - MW2, prep to grout.
1034 Plug MW1 - MW2 to within a few feet of the top of casing
Calculate volume of grout for 477 ft hole (4.7" ID) at 500 gallons. Pumped ~ 500 gals of grout (18 bags). Clean out pump house, mobilize to MW1 - MW3
1056 Call Craig Hauber, leave message re: inspection.

4

P+A MW1, 2, 3

Michael/Shelley 24 April 08

1057 Lower pipe down MWL-MW3 mix and pump grout. Calculated volume = 500 gal.

1131 Topped off MW3, clean out hose and grout plant. Placed ~ 500 gals (18 bags) grout.

1142 Pull grout plant + water truck off of MW3. WDC crew goes to decon pad to decon equipment/pipe, stab pipe, etc. Go to ERMO, check on WLD100, rig inspection, etc.

1219 Recieved call from Craig Hauber. He'll come out monday to perform rig inspection. He said we don't have to wait on his inspection to start our drilling

1250 Call Debra Gallegos re: WLD100 certs, go to site. WDC still decon/stabbing pipe. Remove rope fence from MWL-BW1 drill site to use at MWL-MW7 drill site

1433 Drill rig is deconned, moved to MW7 location

1519 Spud @ MWL-MW7 with 11 3/4" Drive Casing hammered in casing seved fat to set bit.

1633 Set up exclusion zone around drill site with posts + rope from BW2 well site

1721 Secure site. WDC crew off site,

1802 Leave ERMOs for day.

Well Installation and Development

Michael Stelle 25 April 08
0711 at ERMO, pack gear
0729 at MW1, WDC crew onsite warming up equipment. Conduct tailgate safety briefing. Top off MW1, 2, 3 with grout, pull bollards.
0846 All bollards + steel pipes removed, stashed on pallets near MW1 - MW2
0852 Begin drilling to 20' on MW1 - MW7
0913 With bit at ~ 17 ft bgs add another joint.
0928 Bit at ~ 37 ft bgs add another joint.
0944 Bit at ~ 57 ft bgs add another joint.
1012 Mike Sanders + Brenda Langkopf onsite.
1017 Bit at ~ 77 ft bgs, add another joint.
1028 Sanders and Langkopf offsite.
1045 Bit at ~ 97 ft bgs, add another joint.
1059 Bit at ~ 117 ft bgs, add another joint.
1113 Bit at ~ 137 ft bgs, add another joint.
1130 Bit at ~ 157 ft bgs, add another joint.
1145 Bit at ~ 177 ft bgs, add another joint.
1209 Bit at ~ 197 ft bgs, or deeper (drilled ahead of the drive casing. Crew to lunch. Go to ERFO.
1240 Crew onsite, trip drill stem + bit, attach 4' length of 11 3/4" drive casing. Drive 11 3/4" casing to a depth of 200 ft (drive shoe) with ~ 1 ft of stick up above ground surface after removal of 4' length. Crew to decon pad to load more drive casing (smaller diameter).
1441 WDC Crew back on site with 9 5/8" drive casing. Prepare to double trip casing/drill stem.
1508 Trip 9 5/8" inside of 11 3/4" drive casing
1600 Finish installing 9 5/8"; Trip bit and drill stem.

6

MW1 - MW7

Michael Shelby 25 April 08

1652 Finish installing drill stem. WDC crew fuels rig, loads/unloads equip, and secures site. Secure trailer head to ERMO.

1728 Provided update to ER Folks, leave site.

Michael Shelby 28 April 08

0715 at ERMO, send email to Mick Peterson (FortWest) re: Health and Safety documents. Pack gear head to site

0735 Onsite, crew is warming up equipment and preparing to drill. Tailgate Safety briefing

0753 Begin drilling 200-220 ft w/ 9 5/8" drive casing

0808 Bit at ~217' bgs, add another joint.

0829 Bit at ~237' bgs, add another joint.

0852 Bit at ~257' bgs, add another joint.

0917 Bit at ~277' bgs, add another joint; Honey dipper on site to service port-o-let.

0924 Talked to Schofield - Facilities crew is supposed to do some dirt work on the berm.

0936 Bit @ ~297' bgs, add another joint.

1002 Bit @ ~317' bgs, add another joint; Schofield on site w/ bird survey. Road grader crew onsite.

1022 Bit @ ~337' bgs, add another joint.

1043 Bit @ ~357' bgs, add another joint.

1105 Bit @ ~377' bgs, add another joint.

1117 Stacy Griffith onsite, Road crew working berm.

1125 Frantz Lawyer onsite

1137 Bit @ ~397' bgs, add another joint. Stacy heads offsite.

1202 Bit @ ~417' bgs, add another joint.

1211 Take lunch break.

1243 Fire up rig. Road crew back on site.

1259 Bit @ ~437' bgs, add another joint.

1325 Bit @ ~457' bgs, add another joint. Cuttings are damp to wet, sticking inside discharge line and cyclone. Not adding water (air only).

1404 Discharge line clogged at cyclone. Disconnect and clean out cuttings.

1427 Bit @ ~477' bgs, add another joint. Re-attach discharge line to cyclone.

MWL - MW7

Michael Shelby 28 April 08

1456 at 495 ft bgs, discharge line is plugged due to very wet cuttings. Disconnect and clean out.
1505 Begin tripping out drill stem and bit.
1537 Tripped out; drill pipe had a lot of slough fall off during trip. Tag top of slough at ~7 ft above TD of borehole. Tagger came out dry -- no water at top of slough. Trip drill stem and bit back in to remove slough.
1640 Clean out slough; add ~100 gallons of water to clean out drill stem / drive casing; blow all water out of drive casing.
1653 Trip out drill stem and bit; pipe relatively clean.
1721 Finish tripping drill stem and bit. WDC crew Ready's rig for the night.
1735 Unload gear at trailer pt. ERMO
1802 Leave ERMO for the night.

Michael Skelly 29 April 08

0655 at ERMO gather gear head to MWL
0710 at MWL, WDC crew onsite warming up rig. Conf tailgate safety briefing
0738 Measure WL in MWL - MW7:
492.4 ft below drill rig table
~5.0 ft table to ground surface
487.4 ft below ground surface.
Unable to tag TD of borehole with water level tagger, but had drilled down to 495 ft bgs. Currently only 7.6 ft of water in borehole.
0751 Call Stacy Griffith to discuss water level. She'll call geophysical logger re: their availability.
0803 Tell Mark Green to standby, awaiting on decision to run geophysics or not. Crew builds monuments
0915 Fax Badge request into Badge office for Al Henderson's access.
0921 Call Mark Green, schedule geophysics for ~ 12 noon.
0940 Call Badge Office, Al's badge is being processed.
1138 Measured WL at 487.6' bgs. Check surface completion at 3 plugged and abandoned wells (MWL-MW1, MW2, MW3) concrete is setting up, brass markers are placed in center of concrete.
1153 Stacy calls Jet West at IPOC.
1215 Pick up Al Henderson (Jet West) at IPOC + escort him onsite
1231 at MWL, give tailgate H+S briefing to Al. WDC crew rigs up to run geophysical tool.
1305 Run geophysical log. Schofield + DOE/NV folks onsite to look at berm.

MWL – MW7

Michael Fuller 29 April 08
1317 Craig Hauber on site, give tailgate briefing
1322 Stacy Griffith and Nikki Sanders on site. Need inspection stickers on eyewash station.
1333 Finish running geophysical log, remove tool from MWL + MW7, Craig Hauber performs drill rig inspection.
1409 Craig Hauber finished inspection received Corp H+S plan from Jet West.
1425 Got print outs of geophysical logs. A few sand layers in the proposed screen interval No major sand horizons. Fluid level at 484 ft bgs inside casing. Based on conversation with Sanders and Griffith We'll complete the well as proposed in the P+A/R plan.
1431 Jet West, Sanders + Griffith off site. WDC on site to get long-term badges at POC. Design well from P+A/R plan (see page 11)
1512 WDC crew onsite, prep to install well materials
1527 Begin installing well materials
- End cap 0.45' (w/ inert well bung inside to protect from Baiber, bung = 0.32' nylon plug)
- Sump 4.76' blank 5" PVC w/ PVC Centralizer
- Screen 9.78' of which 0.23' blank + 0.55' blank on each end (threads), Centralizer 2' below
- Screen 9.78'
- Screen 9.78' with PVC centralizer above (2')

1537 Install first 100 ft of blank:
19.78' + 19.82 + 19.84 + 19.80 + 19.80 = 99.01'
1551 Install second 100 ft of blank:
19.78' (w/ SS centralizer) + 19.82' + 19.78' + 19.79' + 19.81' = 98.9
1603 Install third 100 ft of blank:
19.80' (w/ SS centralizer) + 19.77' + 19.80' + 19.80' + 19.81 = 98.98'
1617 Install fourth 100 ft of blank:
19.81' + 19.82' + 19.76 + 19.78 + 19.81 = 98.98'
(SS centralizer)

[signature] 29 april 08

MWL - MW7
Well completion

Planned	Actual
stickup 30"	Stick up ~ 28"
Ground Surface	Ground surface
320'-420' "First Lift" of slurry	307' - 417.4' "First Lift" of slurry
420'-450' 3/8" bentonite chips	417.4' - 448.6' 3/8" bentonite chips
450'-455' 40-60 Silica sand	448.6'-453.8' 60 Silica sand
455'-496.2' 20-40 silica sand	453.8 - 498.75' 20-40 silica sand
461.2'-491.2' 0.10" slot screen	464.65' - 493.99' screen interval 0.10" slot
491.2'-496.2' = sump	493.99'-498.75' = sump
TD=496.2'	TD = 498.75'

MWL - MW7

Michael Skelly 29 April 08

1629 Add remaining blank:
19.78 (w/ss centralizer) + 19.80 + 19.80 + 9.76 = 69.14'
(temporarily add 4.78' for well construction ease, will remove when completed)

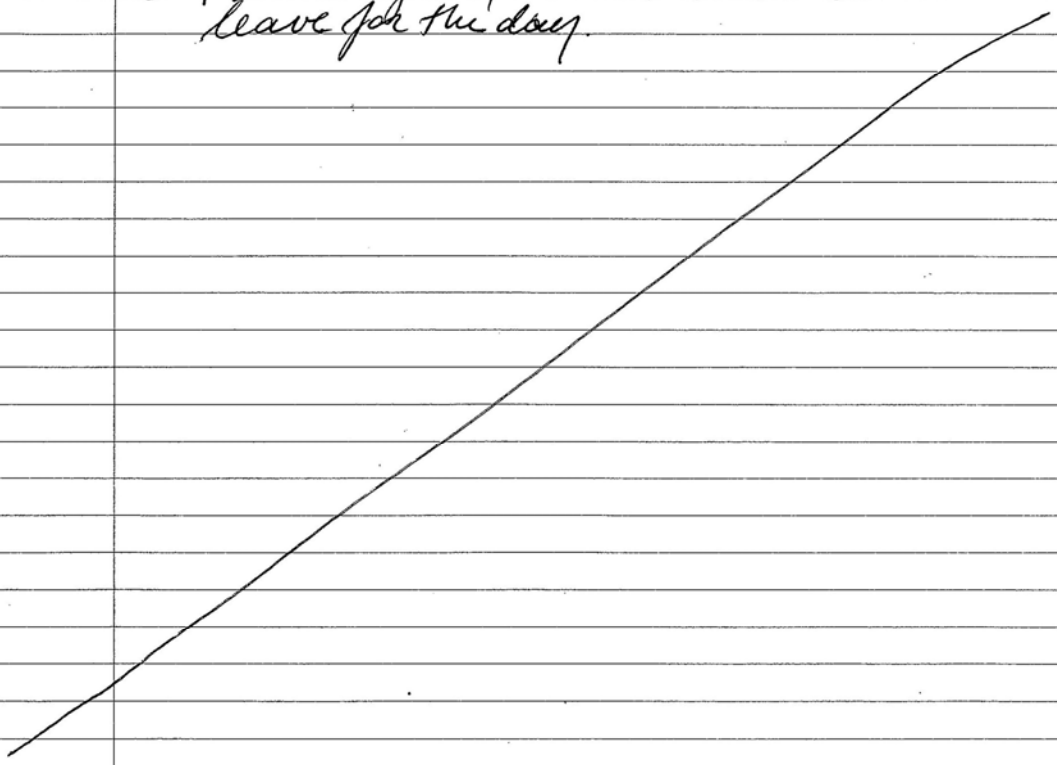
1637 Tag inside of well materials with WDC, tagged at 497.87', should leave 2.56' of stick up at completion.

1641 Finished adding well materials (PVC + centralizers) prep rig for pulling drive casing: mast down, liseit hydraulic pullers, move well materials into place.

1721 Pullers in place, mast back up.

1738 Secure site, WDC shut down rig

1804 Secure gear (truck at ERM) leave for the day.



Michael Skelly 30 Sept 08

0708 at ERM, pick up gear head to MW2
0729 at MW2, WDC crew warming up rig and preparing to continue well construction. Give tailgate safety briefing. Add 10 bags (50lb) of 20-40 sand Pull 10ft of drive casing.
0753 Add 10 bags of 20-40 sand, tag to ensure 5' to 10' of sand remains in drive casing, pull 10' of drive casing (DC).
0809 Add 7 bags of 20-40 sand, tag, pull 10' DC.
0826 Add 5 bags of 20-40 sand, tag, pull 10' DC
0842 Add 5 bags of 20-40 sand, tag, pull 10' DC.
0901 Measure water level: 491.2' TOC, 3.4' stickup = 487.8' bgs
0909 Begin swabbing borehole/well
0928 Finish swabbing well, 20-40 sand settled + foot. Pull DC up several feet
0938 Tag top of 20-40 sand at 453.8' bgs in annulus.
0951 Add 2 x 100 lb sacks of 60 sand, pull casing. Tag top of 60 sand at 448.6' bgs in annulus.
1003 Add 4 x 5 gal buckets of 3/8" bentonite chips, raise casing, hydrate with ~20 gal H_2O
1011 Minor repair of hydraulic line on puller, Mark Green goes for part.
1125 Mark Green returns with part, install
1138 Remove 10' of D.C.
1143 Add 5 buckets, raise D.C., add 2 buckets
1149 Remove 10' of D.C., hydrate with ~20 gal H_2O.
1215 Add 2 buckets of bentonite chips
1221 Remove 10' of D.C.
1226 Final tag top of 3/8" bentonite chips = 417.4' bgs Hydrate with 160 gallons of H_2O. Pull 20 ft of D.C. Allow chips to hydrate.

14

MW1 – MW7

Michael Shelley 30 April 2008

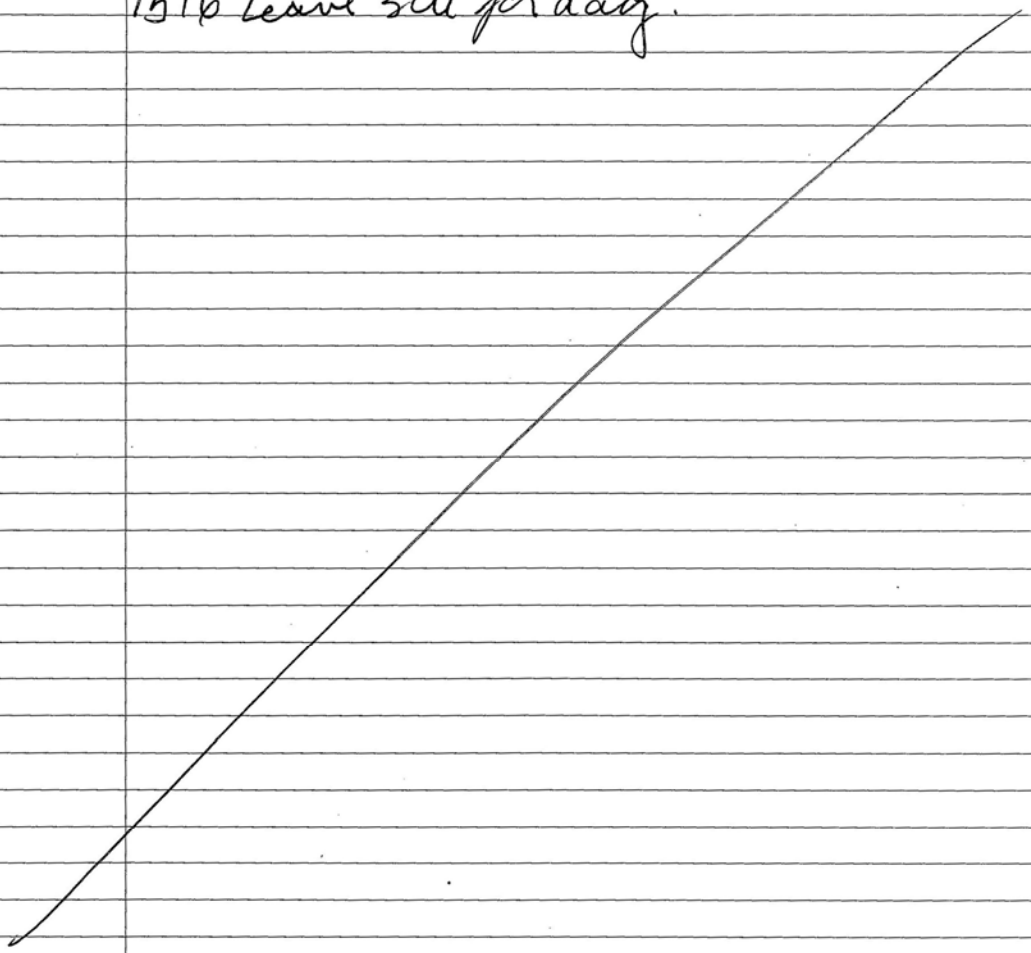
1300 Begin mixing Volclay grout: mix 6 bags of Volclay with 280 gallons of water, backfill ~ 110 ft of annulus.

1313 Trip out 120 ft of D.C.

1358 Finish trip. DDC mobs equipment, drill stem/driven casing to decon pad. Will stand by until 4pm Thursday to allow for grout to set 24 hrs.

1420 at ERMO, stash gear.

1516 Leave site for day.



Michael Skelly 01/04/08
0835 at ERHOs. Still waiting on 100 ft lift of grout. Return badge for Jet West logger, gas up truck, pick up drilling fluid from HWHMF pick up brass caps from ERFO etc.
1203 at MWL, org files in trailer, prep for day.
1228 WDC crew onsite, warm up rig/equip. Conf tailgate safety briefing. Prepare to mix grout/pump/pull DC
1253 Mix 6 bags Volclay grout with ~280 gallons of water. Pump into annulus.
1304 Begin pulling D.C.
1355 Removed 260' of 9 5/8" D.C. Switch over pullers to remove remaining 11 3/4" D.C.
1423 Pipe truck and fork lift go to decon pad to remove the 9 5/8" D.C. and make room for the 11 3/4" D.C. on pipe truck.
1506 Pipe truck and fork lift back on site.
1525 Mix and pump 2 batches of grout, each ~300 gallons and 6 bags Volclay.
1533 Begin pulling 11 3/4" D.C. Mark Green had trouble with badge swipe @ TH III. Need to get on access list with new badge numbers:

Mark A. Green	CT 52334
Hector M. Leon	CT 52335
Tarvicio I. Leon	CT 52337
Casey G. Heath	CT 52336

1553 Pulled 140' of 11 3/4" D.C. Mix and pump two more batches of grout, each ~300 gallons and 6 bags volclay.
1613 Continue pulling 11 3/4" D.C.
1632 Finish pulling casing, mix and pump ~1100 gallons of grout (22 bags)
1640 Measure water level at 485.9 ft bgs.
1708 Run bailer down well, traveled easily

MWL – MW7

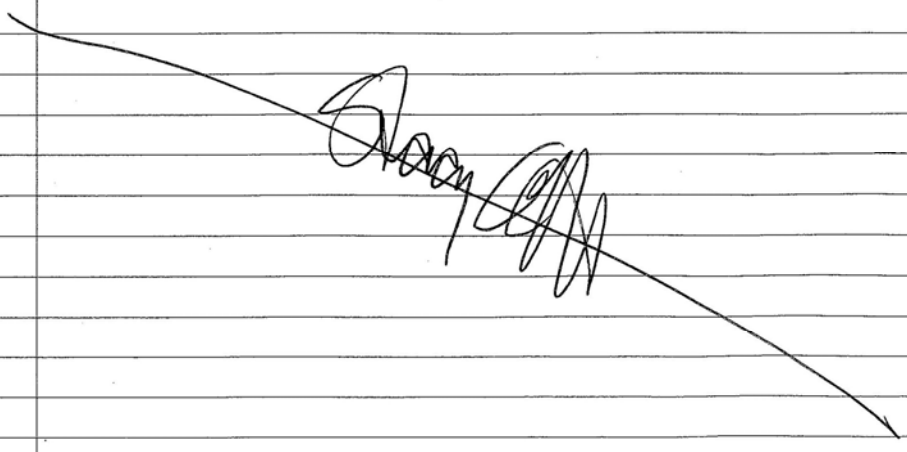
263-3442

01MAY08

Michael Shelby
to the bottom of the well. Removed ~ 5 gals of water, very dark reddish brown. No sign of volclay grout.
1717 Mast down pull the rig forward to remove the hydraulic pullers.
1733 WPC Crew is demobing off of MWL – MW7 taking gear to the decon pad.
1739 Secure trailer head to ERMO.
1804 Leave for the day.

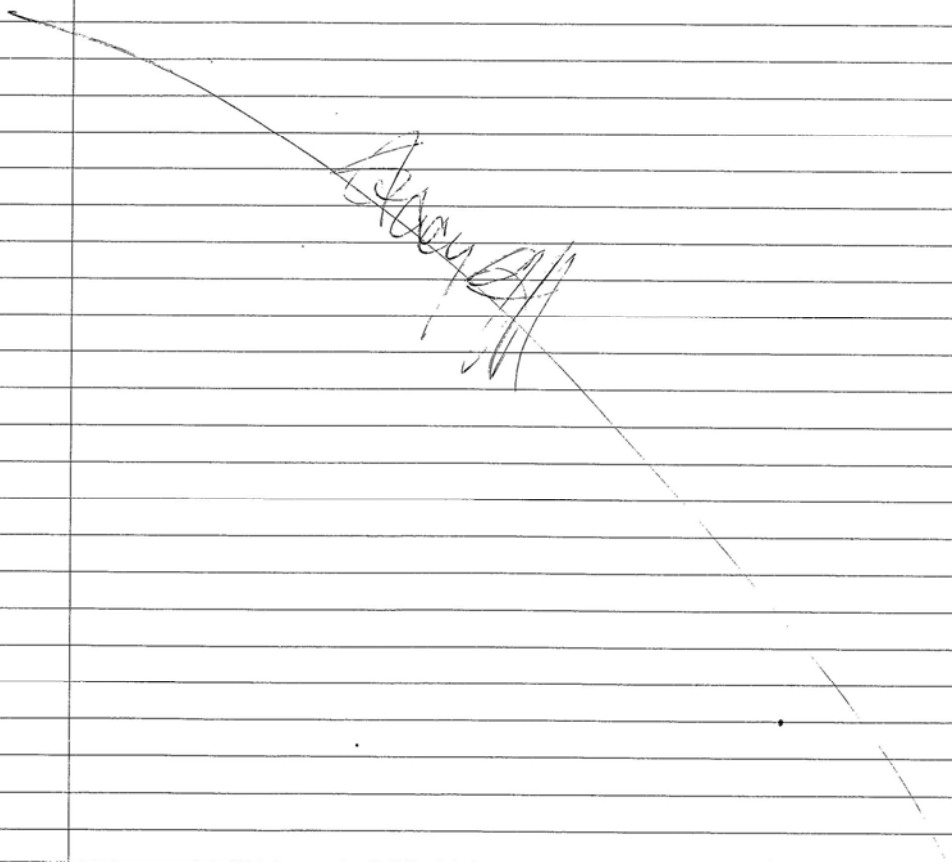
02 MAY 08
Task: Install MWL - MW8
Personnel: S. Griffith - GRAM
Mark Green
Hector Leon
Tarvicio Leon
Casey Heath
} WDC
Weather: 60°s w/ 10-20 mph wind

0730: S. Griffith (SRG) @ ERMQs. WDC crew @ decon pad in TA-III. Mark Green off-site for materials to build well pad @ MW7.
1100: SRG on-site @ MW8. Crew setting up rig.
Conduct H&S tailgate mtg.
1235: All personnel on site. Start building well pad.
485181' BGS in MW7
1240: Start drilling MW8 borehole w/ 11 3/4" drill casing 12" shoe, 200' of 20' x 11 5/8 on truck
1300: add 20' → 40'
Mark Green Dodge CT52693
1430: Drill rig broke down
shut down for day. Arrange for mechanic.
1500: S. Griffith off site



05 May 08
Task: Drilling at MWL
Personnel: S. Griffith, M. Skelly, Mark Green
Weather: clear expected high 80's

0800: Mechanics still working on rig
1022: WL in MWL-MW7 488.67 BTOC
stick up on well:
top of protective casing 32"
top of protctive to inner casing 4"
∴ stick up ~ 28"
1100: Continue working of rig. Griffith & Skelly offsite.



06 May 08
Task: Drilling @ MWL-MW8
Personnel: S. Griffith
Mark Gran
Hector Leon
Tarvicio Leon
} WDC
Weather: Clear, expected high 80's, breezy

0630: SRG @ ERMO, mob to site.
0700: Conduct tailgate mtg. Rig repairs completed. Resume drilling @ ~15' BGS.
0745: 15' to 40' sand & gravel. Add 20' → 60' on hole.
0820: Add 20' → 80' total
0850: Add 20' → 100' total
0920 Add 20' → 120' total
0940 Add 20' → 140' total
1000: Sample @ 120' BGS slightly moist
1015: Add 20' → ~~160' total~~ 140' total
1030: Add 20' → 160' total
1055: Add 20' → 180' total
1115: Add 20' → 200' of 11 3/4" drive casing in hole. trip drill stem out & switch to 9 5/8" drive case.
1335: Resum drilling @ 200'
1430: Add 20' → 220'
1515: Add 20' → 240'
Add 20' → 260'
1535 Add 20' → 280'
1610 Add 20' → 300'
Add 20' → 320'
1635 Add 20' → 340'
1645 Add 20' → 360' silts & clays
1705 Add 20' → 380'
1735 Stop for day @ ~ 375' BGS. All personnel off-site

07 May 08
Task: Drilling @ MWL: MWL-MW8
Personnel: S. Griffith
H. Leon > WDC
T. Leon
Weather: Partly cloudy, expected high 80's & breezy

0630: SRG @ ERMOs. Mob to site. Conduct tailgate mtg w/ Leon brothers.
0700: Resume drilling @ 380' bgs. Mark Green off-site for fuel. Plan to drill to ~535' bgs.
0800: Add 20' → 400' total
0845: Add 20' → 420' total
~405' silts & clays begin to plug cyclone line
0920 Add 20' → 440' total
0930 ~428' sand & gravel possible 'ARG B' unit. Skelly on-site
0945: ~435 well-rounded gravel & clay balls
Add 20' → 460' total
Sample @ ~440' clean sand
Sample of washed well rounded gravels collect ~435'
1010: Add 20' → 480', expect water table in this next interval (460'-480')
Skelly offsite. Skelly's discussion w/ Will Moats (NMED) this morning concerning setting the screen for this well. Will stated to set well as proposed in work plan. Work Plan stated 'screen interval
1035: ~465' bgs cyclone line plugs, cuttings moist (silty sand), same to ~475'
Cyclone & line plugged.
1100: Clear cyclone & line. resume drilling.
Add 20' → 500'
1130: Scho came by to notify me that fence contractors will be on-site next Monday.

SRG

07 May 08 cont'

1130: Add 20' → 520'
b/w 500' - 505' transition from fine silty sand to higher % of silt
Scale from 505 - 515'
1155: Add 20' → 540' Final length of drill casing.
1205 @ ~518' sand/gravel w/ some silt → ARG
drill to ~535'
~518' - 522' ARG type sand/gravel.
522' - 535' silty sand & clay
1220: Total Depth ~535' BGS
Begin injecting water to clear out casing. All added water will be blown-out. (~250 gallons)
1235: Trip out drill stem to ~460' bgs (above WL) & stand by for geophysical logging in am. Will check for heaving sand in am before tripping out all drill stem for the logging.
1300: WDC crew remain onsite to work on rig maintenance. Either trip out some drill stem @ end of day or raise ~20'.
Mark Green not concerned w/ heaving sands. Will check bottom in am & trip out then.
SRG back to ERMO.

08 May 08
Task: Drilling @ MWL: MWL-MW8
Personnel: S. Griffith
M. Green
H. Leon
T. Leon
} WDC
Weather: Partly cloudy, expected high 80°s, breezy

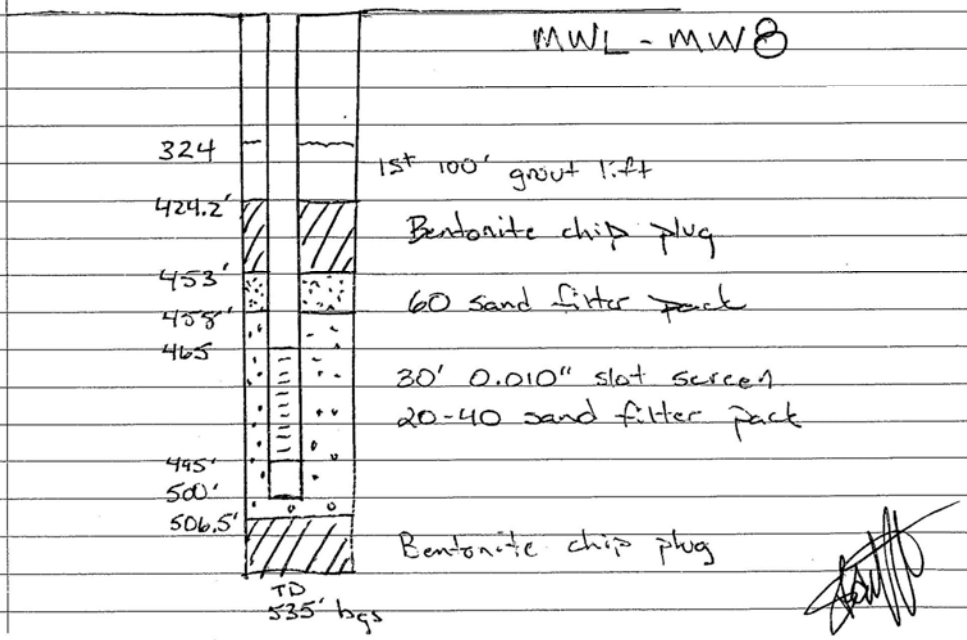
0645: SRG @ ERMO mob to site.
0700: Onsite, conduct tailgate mtg. Tag bottom of borehole w/ drill stem → No sand!
0730: Start tripping out drill stem.
0815: @ 535' BTOC - 4.7' Stick up
∴ 530.3' BGS. through drill casing.
Bottom of hole is stiff clay.
0930: Jet West Al Henderson onsite to log well.
1100: Jet West off-site. Start well construction.
Start plug 505' to 535'
Blackhills Bentonite, L.L.C, Pure Wyoming Bentonite 3/8" chip 34 50 lb bags on pallet.
Added 9 bags of chips to 506.5' bgs, all below water level. Take lunch + let hydrate.
1309 Start building well: Pulled 30' ~~18.5#~~ of casing.
Casing lengths

- ✓ 5.2' sump w/ cap
- ✓ 9.75 } centralizer, PVC screen
- ✓ 9.75 }
- ✓ 9.75 — centralizer, PVC
- ✓ 20.0
- ✓ 20.1
- ✓ 20.1
- ✓ 20.0
- ✓ 19.79 — centralizer, SS
- ✓ 20.0
- ✓ 20.1
- ✓ 20.1
- ✓ 20.1
- ✓ 20.2
- ✓ 19.91 centralizer, SS
- ✓ 19.91
- ✓ 21.1
- ✓ 20.0
- ✓ 20.1
- ✓ 19.82 cent. SS
- ✓ 19.94
- ✓ 20.1
- ✓ 19.79
- ✓ 20.2 cent. SS
- 19.95
- 19.80
- 19.80 — Total = 495.36'

08 May 08 cont'

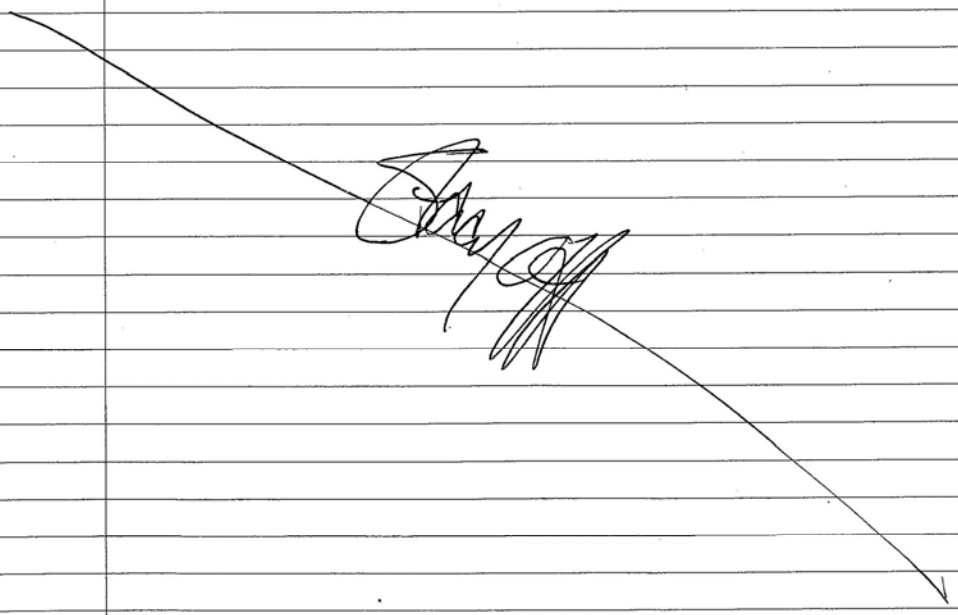
1355 Add ~~10'~~ to well → Total on string 505.33'
1420 9.97
1425 add 4.75' to string.
Mark's tagger tape measures 502.5' + 4.75 = 507.25' on string
Set well w/ ~7' of stick up
Add 20/40 Sand ~4' beneath well + 40' of annulus calc. ~~36~~ 50lb. bags.
Used 10.5 bags + 12 + 13.5 = 36 bags

1545 20/40 Sand to top of screen. Surge well screen w/ 10' bailer.
20/40 Sand to 458'. Secondary filter pack 5' 60 sand = 4,50lb bags
Add 60 sand to 453' → used 200lb.
Bentonite chip plug 30' → used 17 50lb. bags
Plug to 424.2'. Hydrated continuously while adding chips. Let plug sit overnight.
As-built well diagram



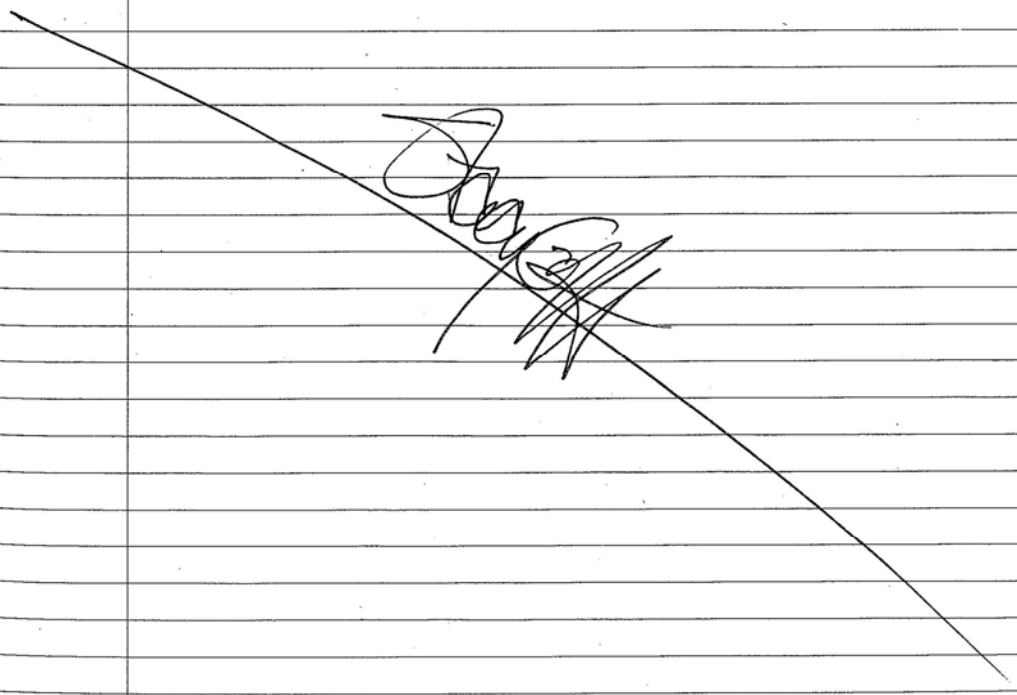
09 May 08
Task: Drilling @ MWL : MWL-MW8
Personnel: S. Griffith
M. Green
T. Leon
H. Leon
} WDC
Weather: Partly cloudy, expected 80's, windy

0630: SRG @ ERMO. Mob to site.
0700: Conduct tailgate meeting.
Ψ 486.70' bgs
0845: pulled pipe to 280' bgs
1st 100' lift of grout added. 263 gallons → 100'
Grout to ~325' BGS.
WDC crew prep site for next borehole
1100 SRG to ERMO!



12 May 08 Monday
Task: Drilling @ MWL: MWL-MW8
Personnel: S. Griffith
M. Green
T. Leon
H. Leon
} WDC
Weather: Partly cloudy, expected high 80's, windy

0645: SRG @ ERMO. Mob to site
0730: Conduct tailgate mtg.
0900: Mix batch of grout, add, pull casing.
M. Skelly on-site.
Continue mixing grout batches & pull casing.
1145: Brine grout to surface.
1330: SRG + M. Skelly off site to ERMO.
WDC crew @ decon pad & prep for next borehole.



MW2 - MW9

Michael Bullock 13 May 08

0635 at EKMO, gather gear, head to MW2
0702 on site, WDC crew (Mark Green, Hector Leon, Javier Leon) on site setting up on MW2 - MW9.
0715 Give tailgate safety briefing; set up exclusion zone around rig/equipment.
0749 Spud @ MW9 Drill 0 - 120' with 12" casing
0808 Drive shoe @ ~17', add pipe joint.
0843 Drive shoe @ ~37', add pipe joint.
0902 Drive shoe @ ~57', add pipe joint.
0926 Drive shoe @ ~77', make minor repair on drive hammer.
0942 Add pipe joint.
1001 Drive shoe @ ~97', add pipe joint.
1023 Drive shoe @ ~117', add pipe joint.
1041 Drive shoe @ ~137', add pipe joint.
1059 Drive shoe @ ~157', add pipe joint.
1119 Drive shoe @ ~177', add pipe joint. Mark Miller on site to view geoprobe work.
1131 Mark Miller off site.
1136 Drive shoe @ ~197', add 4' pipe joint to get 12" drive casing to ground surface. Trip out drill stem/bit.
1157 Drill stem/bit tripped out
1211 Drive shoe @ ~200' remove 4' pipe joint. Go to ERFO for supplies. Go to EKMO and call Bryan Nydoske re: Well Development. Look to start week of Memorial Day.
1411 Back at MW2, WDC crew is tripping in 10" Drive casing and drill stem
1429 Resume drilling 200 - 220' bgs.
1445 Drive shoe @ ~217', add pipe joint.
1504 Drive shoe @ ~237', add pipe joint.
1526 Drive shoe @ ~257' add pipe joint.
1549 Drive shoe @ ~277' add pipe joint.
1609 Drive shoe @ ~297', add pipe joint.

Michael Shelly 13 May 08

1643 Drive shoe @ ~313. Rubber gasket between 12" and 10" Drive casing failed.
1649 Gasket repaired, add pipe joint.
1705 Drive shoe @ ~337, add pipe joint.
1734 Drive shoe @ ~357, shut down for evening. Secure site
1750 At ERMO unload gear.
1815 Leave site for Tuesday.

MW2 - MW9

Michael Shelby 14 May 08

0641 at ERMO pick up gear
0702 Onsite, drill crew warming up rig.
0713 Brief tailgate safety meeting begin drilling 360-380
0757 Drive shoe @ ~397', add pipe joint. Fine grained sediments sticking in discharge line and cyclone.
0819 Drive shoe @ ~397', add pipe joint.
0841 Drill stem disconnected at bad threads, repair.
0913 Removed bad piece of drill stem, install different piece of drill stem and drive casing.
0921 Resume drilling 397'-417'.
0933 Drive shoe @ ~417', add pipe joint. ARB ~ 415'
1009 Drive shoe @ ~437, add pipe joint.
1041 Drive shoe @ ~457, clean out cyclone and discharge line. Stacy Griffith on site to cover.
1128 Add another joint.
1150 Sample @ 468' silty sand. Cyclone continues to plug
1200 Add 20' → 500' on rig
1220 Poor cuttings return 480-500', Cyclone plugged.
1320: Don Schofield, Barry Birch, Tom Stibinski onsite.
1345: Add 20' → 520' on rig @ 505' cobbles. Injecting water to prevent plugging.
1410: Visitors (above) go to watch soil-vapor sampling
Bottom 20' of borehole (~515 to 535') cobbles, gravels, some clay, sand. Mark cleans out hole & casing. Blows out all water. He will pull drill stem up ~20' inside casing tonight, and in morning can check for heaving sands.
1520: SRG offsite.

Michael Shelby 15 May 08

0644 at ERMO pack gear head to MWL

0704 onsite, WDC crew maintaining rig, warming up equipment

0717 brief tailgate safety briefing. Drill stem used to tag TD @ ~535' bgs. No flowing sands. Begin tripping out pipe.

0748 Drill stem tripped out. Small (<2') clay boot on drill bit.

0758 Tag water level inside casing 504.32' below table, table to ground surface = 4.75' = 499.57' bgs. Drill crew moves water truck etc out of way for geophysical log run.

0811 Stacy Griffith onsite

0815 Call from Sid Brandwein meet at TA3 gate at 0900

0817 Call from David Miller, need written communication from NMED on screen interval.

0818 Call from John Gould on screen interval

0821 Al Henderson of Jet West on site, set up on MW9 to run log.

0830 Run geophysical log

0903 Meet Sid Brandwein (NMED/HWB) on gate (TA-III) escort to MWL. Brief tailgate safety briefing to Sid, he visits logging truck

0941 Finish log of MWL-MW9. Will construct well same as MW8. Move to MW8 and run log in PVC well.

0950 Begin arranging equipment for building well.

1013 Begin pulling 10" drive casing and backfilling with bentonite chips to ~ 500 ft.

1044 Backfilled borehole to 500.5' bgs using 9 bags of bentonite chips

Michael Shull 15MAY08

1053 Begin running well materials:
- endcap w/ plug
- 5ft blank w/ PVC centralizer
- 30ft screen (10 x 3 pieces)
- 470 ft blank (20' x 23 pieces).

1113 Sid Bradwein offsite.

1153 Tag inside of well materials = 504.3'; Begin adding sand and pulling drive casing.

1225 Geophysical logging complete on MW-1, MW7 and MW8. Al Henderson offsite.

1409 With ~90% of coarse sand in place, swab the well.

1420 Tag top of 20/40 sand at 458.7' bgs after 44 bags (50 lbs) of sand. Begin pulling/adding sand.

1437 Tag top of 60 sand at 452.5' bgs after 4 buckets (50 lbs) of sand. Begin pulling and adding 3/8" bentonite chips

1455 Tag top of 3/8" bentonite chips at 419.6' bgs, Hydrate chips, 18 bags placed

1549 Pump grout (1st lift) and pull drive casing. Grout batch = 300 gallons and 7 bags of Volclay.

1633 Finish stripping out ~100 ft of 10" drive casing. Let 1st lift of grout set for 24 hrs. Drill crew ready's rig/equipment for the night. Go to ERMOs stash gear.

1652 Launch Daily update, leave site for the day

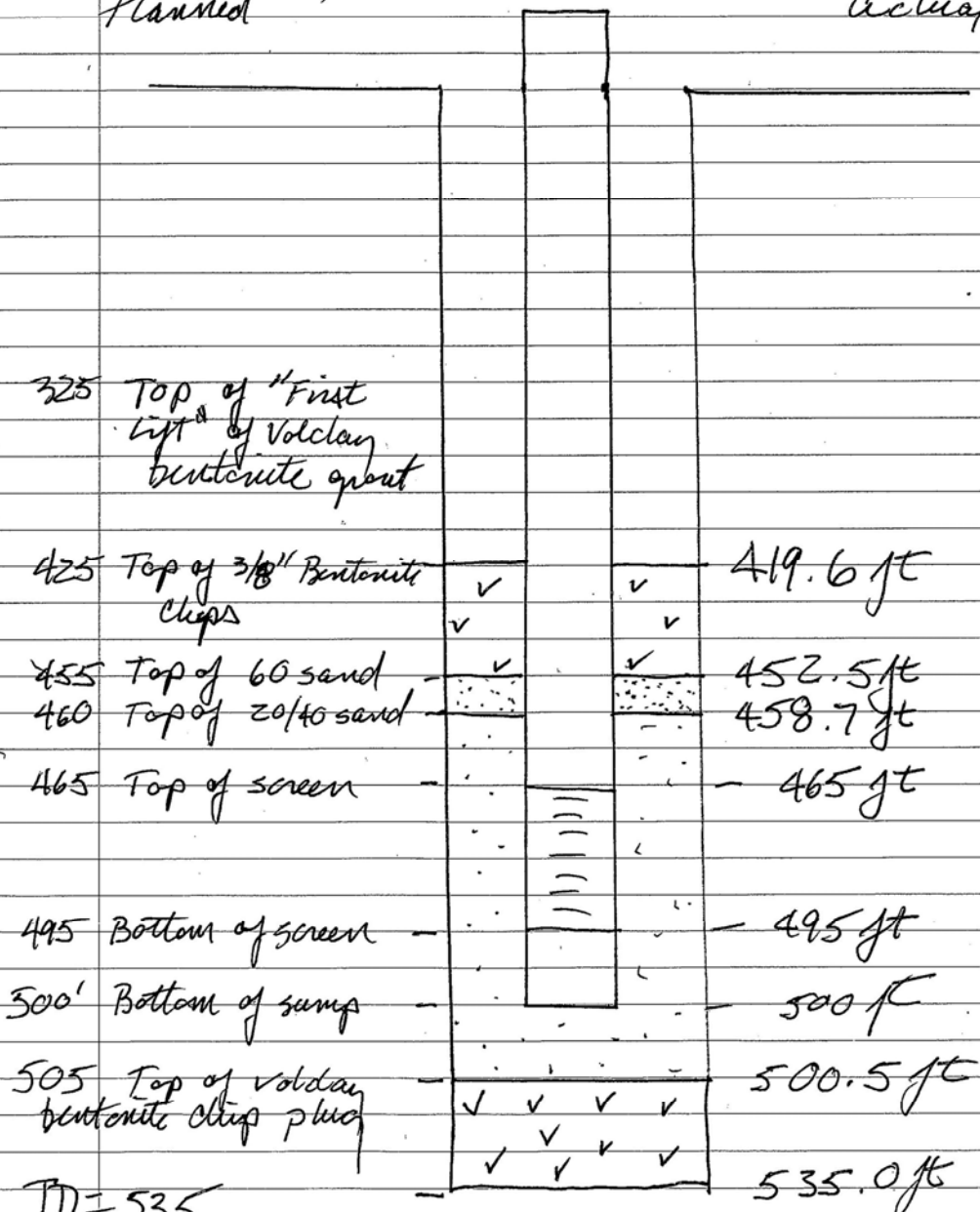
Michael Bailey

MW2 - MW9

15 MAY 08

Planned

Actual



MWL - MW9

Michael Shelly 19 MAY 08

0637 at ERMC, gather gear head to MWL.
0703 Onsite, WDC crew is warming up rig, getting load of water + preparing to continue backfilling the annulus. Brief tailgate safety briefing.
0719 Mix batch grout (6 bags, 300 gal) pull remainder of 10" Drive casing.
0804 Finish pulling 10" Drive casing, prepare to pull 12" Drive casing.
0821 Water truck takes load of 10" to the decon pad to make room for 12" drive casing.
0848 Water truck back on site. Prepare and pump batch of grout (8 bags & 400 gallons of water). Stacy Griffith onsite.
0921 Pulled 100 ft of 12" drive casing, prep and pump grout.
0939 Pulled remaining 12" drive casing, prep and pump grout.
1009 Finish pumping grout (11 batches 97 bags) Run bailer down the well. Muddy red-brown water was retrieved. No grout in the water.
1017 Prepare to pull rig and hydraulic pulleys off of well.
1046 Rig off of well to decon pad.
1107 Measured water level in MWL-MW9:

492.82' BTOC
Stick up 3.32' ags
489.50' Bgs

Tag total length of pipe (not with final stick up) = 583.11' less 0.5' with protective end plug.
1350 Steam cleaner broke down waiting on part. Crew prepares well pad forms and protective posts.
1504 Cut off PVC (0.75') to make ~30" of stick up. Install stove pipe (10 ft, with

Michael Sully 19 May 08
~3.5 ft of stick up and 5.5 ft below ground.
1525 Franz Lauffer onsite.
1603 Franz Lauffer offsite. WDC needs more concrete to finish off pad.
1622 Leave MW1 head to HKMOs.
1649 Leave site for the Day.

MW2 – MW9

Michael Shelly 20 May 08

0815 at ERMOs, tend to office work.
0923 Gather gear, head to MW2. WDC is a decon pad cleaning and loading. Run to ERFO for Sanders' supplies.
1015 Drill rig off site to WDC yard.
1028 Pipe truck and trailer loaded and heads to WDC yard.
1315 Check on WDC crew:
- at Decon pad loading/cleaning
- Will finish surface completion at MW9 when water truck is back.
- Should be offsite by 330 or 4.

1549 Check on WDC crew:
- Finished concrete pad
- Loaded gear and fork lift on flat bed trailer and water truck.

1643 WDC off site. Leave MW2 for ERMOs.
1702 Leave site for the day.

Michael Shelby 27 May 08

0653 at ERMO's, gather gear
0746 at IDOC meet Jim Ward (WDC) Badge CT 54860. Travel to ERFO
0817 brief safety class Video Training to Jim Ward. Load up drums and pallets.
0955 Finish H+S training, review HASP Tailgate safety briefing. Mobiling to MWL
1020 Set up over MWL - MW7, prepare to develop.
501.77' total depth to Top of Casing
488.89' WL to Top of casing.
1051 Insert surge block. Surge the screened interval.
1111 Switch over to bailing, change out gear + set up barrel.
1123 Begin bailing
1203 Stop bailing, well is recovering after bailing.
1256 Resume bailing WL had recovered to ~ 490' bgs
1313 Stacy Griffith on site pump 55 gal to Waste drum. Continue bailing.
1417 Allow well to recover some more.
1431 Stacy Griffith finished labeling purge water drum, leaves site.
1556 Pump another 100 gal to Waste drum, continue bailing
1639 Removed 140 gal (>10 bore volumes). Unable to get stable turbidity measurements < 5 NTUs. Will have to continue development with Bennett Pump (ERFO).
1647 Secure MWL Site go to ERMO.
1717 Unload bear leave for the day.

28 May 08 Wednesday
Task: Development @ MWL-MW8
Personnel: S Griffith - GRAM
Jim Ward - WDC
Weather: Clear & windy.

0630: SRG @ ERMO, mob to site
Jim Ward onsite. move trailer w/
WDC development equipment to MWL-MW8.
0715: Set up for development. Conduct tailgate
safety meeting.
0735 Water level 490.40 BTOC and
total depth 502.15 BTOC
decon surge tool & begin to surge well.
0815 Switch to bailer. Bail for ~30 min
& let recover. Water is very turbid.
0910 Begin bailing again. About 1st gal → slow recovery.
0945 Bail again. Bail ~7 gal. Let recover for 30 min
(till 10:30). Still very turbid.
1045 Bailed ~8 gals. Move to MWL-MW9 for
surge & bail.
1120 Water level MWL-MW9 490.56 BTOC
and total depth 502.50 BTOC
Begin to surge MW9.
1200 Switch to bailer. Bailed low @ 12 gals
Turbid. Break for lunch. Mike Skelly onsite
1300 Bailed ~3 gals. Move back over to MW8.
Skelly to ERMO for supplies.
1405 Skelly back to ERMO. Bailed ~12 gals from
MW8, still turbid.
1500 Bailed 6 more gal from MW8 ~50 gals. total
Labeled drum for MW8. Bailed ~6 more gals.
Still turbid.
1535 Move back to MW9. Bailed ~15 gals ~42 gal. total Still
turbid.
1620 WDC & SRG Off-site.

Michael Shelby 29 May 08

0642 at ERMO, pick up equipment + trucks and head to MWL.
0702 at MWL Jim Ward (WDC). Set up on MWL - MW9. Conf tailgate safety briefing
0721 WL in MW9 490.88 ft btoc. Resume bailing.
0744 Bailed ~ 12 gals out of MW9, purged dry.
0751 Set up on MWL - MW8. Water level in MW8 is 490.44 ft btoc.
0800 Resume bailing MW8.
0813 Bailed ~ 17 gals out of MW9, purged dry. allow wells to recover
0915 Chip Roma, Joe Mauser, Don Schofield onsite to inspect berm and discuss surface water features.
0937 Removed ~ 10gal from MW8 - ran dry re-locate to MW9.
0942 Surface Water/Berm inspection crew offsite.
0945 Resume bailing MW9.
0956 after 7 gal, MW9 bailed dry. allow wells to recover.
1106 Resume bailing MW9.
1117 Purged 9 gal, allow to recover, re-locate to MW8.
1121 Resume bailing MW8.
1142 Purged 12 gal, allow to recover.
1307 Resume bailing MW8.
1331 Purged 12 gal at MW8, allow to recover, re-locate to MW9.
1333 Stacy Griffith had re calculated 10 Bore volumes for MW7 (83 gal), MW8 (126 gal) and MW9 (124 gal).
1341 Resume bailing MW9
1354 Purged 11 gal @ MW9, allow to recover.

Michael Shelby 29 May 08

1456 Resume Bailing MW9.
1508 Removed 9 gal from MW9, allow to recover. Re-locate to MW8.
1515 Resume Bailing MW8.
1523 Removed 10 gal from MW8 allow to recover.
1624 Resume bailing MW8.
1629 Removed 8 gal from MW8 (total of 138 gal) purged dry. Done with this phase of development at MW8. Re-locate to MW9
1638 Resume Bailing MW9.
1653 Removed 9 gal from MW9 (total of 89 gal), purged dry. Done with this phase of development at MW9. Decon equipment. Secure drums, wells (locked) + de mob.
1711 Sign WDC paperwork, retrieve Jim Ward's badge. Secure trailer/equipment. Jim Ward off site. Go to ERMOs.
1735 Leave ERMOs for the day.

Michael Burke 24 June 08

0905 Head to MWL
0921 ERFO Crew onsite developing MWL-MW7
Initial water level = 489.90 btoc
Installed Bennett Pump at 493 btoc
Pump at ~ 0.3 gpm
0940 Purged dry after ~ 3/4 gallons
1013 Resume pumping after 80% recovery.
1034 Purged dry after ~ 7 gallons, pumping at ~ 0.5 gpm
1115 Leave MWL. ERFO crew continues to purge/recover at MWL-MW7. Will look to develop well all day long in a similar manner.
1430 Call Robert Lynch:
- Removed ~ 53 gal at MWL-MW7
- Parameters stabilized
- Turbidity finished off at < 1 NTU
- Collected waste sample of purge water.

Michael Shelly 25 JUN 08

0755 Leave for MWL
0813 at MWL - crew is handling purge water, decon equipment, etc. Water level in MWL-MW8 is 490.60 ft bgs.
0831 Move water truck to MWL-MW8 and set pump.
0851 Begin Purging MWL-MW8 at ~ 0.3 gpm
0921 Pumped 7 gallons, WL is 497.33 ft bgs,
1010 Well has not yet recovered to 80%. Crew will continue to develop as recovery permits. Leave MWL, go to Water pool for fuel.

Michael Kelly 26JUN08

0848 Call Robert Lynch:
- Crew purged MW1 - MW8 dry
- total of ~~26~~ 33.5 gal removed 33.5 gal
- Field parameters have stabilized
- currently decomming equip before mobilizing to MW1 + MW9

The crew will work on MW9 over the next several days. Depth to water in MW9 is 491.41 ft bgs. 89 gallons of water has been purged at MW9 by WDC (using bailer). To meet the 10 saturated volumes required by the FOP, 35 more gallons need to be removed.

1051 Talked to Robert Lynch:
- removed 4.5 gal from MW9 starting at ~ 930 AM.
- recovered ~ 3 ft in ~ 1 hour
- will purge again when they get back to 80% recovery.

42

Michael Stelly 03 July 08

0810 Call Randy Hewett (Survey Control Inc.): Will meet at MWL at ~0900 AM to survey MWL-MW 7, 8, + 9.

0941 Leave ERMOs, head to MWL

0958 Onsite, unlock wells for survey.

1007 Survey crew onsite, prep to run level loop from MWL-BW2 to the three new wells.

1125 Finish locating and running a level loop for elevations on 3 new MWL Wells! Lock well caps, travel to ERMOs.

APPENDIX D
Lithologic Logs

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
0	0-10, sand, pale yellowish brown (10YR 6/2) to grayish orange (10YR 7/4), predominantly fine to medium sand, some gravel (mostly limestone), dry		SW	
10	10-30, sand and gravel, sand as above (color and texture). Gravel mostly limestone, some granite, some metamorphics, dry		GP	
20				
30	30-60, sand, grayish orange (10YR 7/4) to dark yellowish orange, some silt, trace gravel (as above), dry to slightly damp		SW	
40				
50				
60	60-70, sand (as above at 30 FBGS), except moderate yellowish brown (10YR 5/4) and more silt, dry to slightly damp		SW	
70	70-80, sand and gravel (as above at 10 FBGS), dry		GP	
80	80-100, sand (as above at 30 FBGS), dry to slightly damp, trace gravel		SW	
90				
100	100-110, sand and gravel (as above at 70 FBGS), dry		GP	
110				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
110	110-120, sand (as above at 80 FBGS), dry to damp		SW	
120	120-130, sand and gravel, pale yellowish brown (10YR 6/2), mostly coarse sand and fine pea-size gravel, dry to damp		GP	
130	130-140, sand (as above at 80 FBGS), dry to damp, more gravel		SW	
140	140-150, sand (as above at 80 FBGS), dry to damp, occasional coarse gravel (> 1-inch)		SW	
150	150-160, sand and gravel (as above at 120 FBGS), dry		GP	
160	160-170, sand (as above at 80 FBGS)		SW	
170	170-180, sand and gravel (as above at 120 FBGS), considerable pea gravel, dry to damp		GP	
180	180-190, sand (as above at 80 FBGS), dry to damp		SW	
190	190-200, sand (as above at 80 FBGS), slightly paler color, dry to damp		SW	
200	200-220, sand and gravel (as above at 120 FBGS), dry to damp		GP	Reduction in borehole diameter at 200 FBGS
210				
220				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
220	220-250, sand (as above at 80 FBGS), dry to damp		SW	
250	250-260, sandy gravely silt, pale yellowish brown (10YR 6/2), silt balling up, gravel lithologies as above at 10 FBGS, damp		SM	
260	260-270, sand (as above at 80 FBGS), dry to damp		SW	
270	270-280, sand and gravel (as above at 120 FBGS), very coarse gravel (>2-inches), lithologies as above at 10 FBFS, dry to damp		GP	
280	280-320, sand (as above at 80 FBGS), dry to damp, occasional gravel at 310-320 FBGS		SW	
320	320-350, silty sand and gravel, pale yellowish brown (10YR 6/2), dry to damp, gravel to approximately 1-inch		SM	
330				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
330				
340			SM	
350	350-410, sand (as above at 80 FBGS), dry to damp		SW	
360				
370				
380				
390				
400				
410	410-420, silty sand and gravel (as above at 320 FBGS), damp		SM	
420	420-430, sand and gravel, dusky yellow (5YR 6/4) to pale yellowish brown (10YR 6/2), mostly coarse sand and pea gravel. Lithology of gravel much more varied than above, includes volcanics, chert/petrified wood, quartz, dry to damp		SP	
430	430-440, sand and gravel, (as above at 420 FBGS), mostly coarse gravel (approximately 1-inch), well rounded, lithologies as above at 420 FBGS, dry to damp		SP	
440				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW7	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 498.8 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 4/25/08
ELEVATION: 5378.23 FT	GWL: 4892.33 FT (FAMSL) on 5/01/08	DATE COMPLETED: 4/28/08
BOREHOLE DEPTH: 498.8 FT (FBGS)	DTW: 485.9 FT (FBGS) on 5/01/08	WELL INSTALLATION: 6/24/08
CASING DEPTH: 498.8 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW7 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
440	440-450, sand and gravel, (as above at 420 FBGS), with some silt balls, dry to damp		SP	
450	450-460, sand and gravel, (as above at 420 FBGS), mostly coarse sand and pea gravel, dry to damp		SP	
460	460-470, silty sand/sandy silt and gravel (as above at 320 FBGS), damp, considerable clay		SM	
470	470-480, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp		SM	
480 ▽	480-490, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp		SM	
490	490-498.8, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp, clay balls		SM	
500				
510				
520				
530				
540				
550				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 498.8 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.83/Northing: 1452230.18

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Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
0	0-38, sand, grayish orange (10YR 7/4), dry, medium to fine grained sand with trace coarse gravel. Gravel is subangular, mostly limestone (medium to dark grey, some metamorphics)		SW	
40	38-55, sand and gravel, grayish orange (10YR 7/4) to light brown (5YR 6/4), coarse to medium grained gravel. Gravel coarse to medium grained, angular, mostly limestone quartzite, some granite, dry		GP	
60	55-120, sand, grayish orange (10YR 7/4), dry, medium to fine grained sand with trace medium to coarse grained gravel		SW	
110				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

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Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
110			SW	
120	120-130, sand with fines. Sand fine grained, moderate yellowish brown (10 YR 5/4), some silt, moist		SM	
130	130-235, sand (10YR 6/2), fine grained with trace silt and gravel, moist		SW	Reduction in borehole diameter at 200 FBGS
140				
150				
160				
170				
180				
190				
200				
210				
220				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

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Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
220				
230			SW	
240	235-265, silt, moderate yellowish brown (10YR 5/4), trace sand. Sand fine grained, moist		SM	
250				
260				
270	265-370, sand (10YR 5/4), fine grained, trace gravel, dry			
280				
290				
300			SW	
310				
320				
330				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
330				
340				
350			SW	
360				
370				
380	370-386, sand and silt (10YR 5/4). Sand fine grained, moist		SM	
390	386-390, clayey sand (10YR 5/4). Sand fine grained, moist		SC	
	390-395, sand (10YR 5/4). Sand fine grained, some silt, moist		SM	
400	395-415, sand (10YR 5/4). Sand medium to fine grained, trace fine to medium grained gravel, trace silt, moist, caliche		SW	
410				
420	415-428, silt as above at 235 feet, some sand, moist		ML	
430	428-435, sand and gravel, dark yellowish brown (10YR 4/2), sand medium to coarse grained, trace fines, gravel fine to coarse grained, subangular to subrounded, varied lithologies		SP	
440	435-440, clayey sand (10YR 5/4) as above at 386 feet, moist		ML	

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW8	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/02/08
ELEVATION: 5379.72 FT	GWL: 4893.02 FT (FAMSL) on 5/12/08	DATE COMPLETED: 5/07/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 486.7 FT (FBGS) on 5/12/08	WELL INSTALLATION: 6/26/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Stacy Griffith	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW8 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
440	440-518, sand and silt (10YR 4/2), sand fine grained appreciable fines, moist. Trace of clay at times		SM	
520	518-535, sand and gravel (10YR 5/4). Sand fine to coarse grained. Gravel fine to coarse grained, subangular to subrounded, varied lithologies, caliche.		SP	
540	At 535 FBGS, silt and clay		SM	
550				

▽ 490

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411409.77/Northing: 1452394.58

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 1 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
0	0-10, sand, grayish orange (10YR 7/4), moarly fine to medium sand, trace to some gravel (to 2-inches). Gravel, subangular, mostly limestone (medium to dark grey, some metamorphic, some granite		SW	
10	10-20, sand, grayish orange (10YR 7/4), to light brown (5YR 6/4), as above, less gravel, dry		SW	
20	20-30, sand (as above at 10 FBGS), up to 30% gravel (as above at 0 FBGS), dry		GP	
30	30-40, sand, (as above at 20 FBGS), considerably more silt, trace of gravel (as above at 0 FBGS), dry		SW	
40	40-50, sand and gravel, mostly coarse sand/fine (pea) gravel, subangular, gravel lithologies mostly limestone, granite, quartzite, greenstone, dry		GP	
50	50-60, sand and gravel, (as above at 40 FBGS), mostly fine gavel, lithologies as above at 40 FBGS, dry		GP	
60	60-130, sand (as above at 10 FBGS), no gravel to some gravel (as above at 0 FBGS), trace to some silt, dry to damp		SW	
70				
80				
90				
100				
110				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 2 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
110				
120			SW	
130	130-140, sand and gravel (as above at 40 FBGS), mostly coarse sand, dry to damp		GP	
140	140-150, sand (as above), some coarse gravel, some silt, dry to damp		SW	
150	150-160, sand and gravel (as above at 40 FBGS), up to 40% gravel to 1-inch, damp		GP	
160	160-170, sand and gravel (as above at 40 FBGS), dry to damp		GP	
170	170-220, sand (as above), some coarse sand, no gravel to trace of fine gravel, no silt to trace silt, dry to damp		SW	Reduction in borehole diameter at 200 FBGS
180				
190				
200				
210				
220				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 3 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
220	220-230, sand and gravel (as above at 40 FBGS), with some silt/fine sand, dry to damp		GP	
230	230-240, sand and gravel (as above at 40 FBGS), some silt, trace of clay, dry to damp		GM	
240	240-250, silt, grayish orange (10YR 7/4) to pale yellowish brown (10YR 6/2), some clay, some sand up to coarse sand/fine gravel, silt/clay balls, damp		SM	
250	250-260, sand and gravel (as above at 40 FBGS), some fine sand and silt, dry to damp		GP	
260	260-310, sand (as above), trace of coarse sand/fine gravel, dry to damp		SW	
270				
280				
290				
300				
310	310-330, silt (as above at 240 FBGS), some clay, some sand, damp		SM	
320				
330				

NOTES:

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 4 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
330	330-340, sand (as above), some gravel to 1-inch, some silt, dry to damp		SW	
340	340-350, sand and gravel (as above at 40 FBGS), some silt, dry to damp		GP	
350	350-370, silt (as above at 240 FBGS), some clay, some sand, trace of fine gravel, dry to damp		SM	
370	370-400, sand (as above), some silt/clay, dry to damp		SW	
400	400-416, silt (as above at 240 FBGS), some sand, damp		SM	
420	416-420, sand and gravel, dark yellowish brown (10YR 4/2), mostly medium to coarse sand, no fines, damp		SP	
	420-430, sand and gravel (as above at 416 FBGS), gravels well rounded with lithologies more varied than above, well rounded, mostly coarse sand, damp		SP	
430	430-440, sand and gravel (as above at 416 FBGS), mostly medium sand, some silt, dry to damp		SP	
440				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

Sandia National Laboratories

Visual Classification of Soils

WELL NAME: MWL-MW9	PROJECT NAME: SNL/NM MIXED WASTE LANDFILL/TA-III	
WELL DEPTH: 500.0 FT (FBGS)	OWNER NAME: US DOE	DATE STARTED: 5/13/08
ELEVATION: 5376.64 FT	GWL: 4887.14 FT (FAMSL) on 5/19/08	DATE COMPLETED: 5/14/08
BOREHOLE DEPTH: 535.0 FT (FBGS)	DTW: 489.5 FT (FBGS) on 5/19/08	WELL INSTALLATION: 6/30/08
CASING DEPTH: 500.0 FT (FBGS)	ENGINEER/GEOLOGIST: Mike Skelly	PAGE: 5 of 5
DRILLING METHOD: Air Rotary Casing Hammer		

DEPTH (feet) bgs	MWL-MW9 DESCRIPTION	LITHOLOGIC SYMBOL	USCS SYMBOL	REMARKS
440	440-460, silt (as above at 400 FBGS), considerable clay, damp		ML	
460	460-470, silt (as above at 400 FBGS), damp to wet		SM	
470	470-515, silt and sand and clay (based upon driller comments), wet to saturated, no water produced (loss of drill cuttings)		SM/SC	
490 ▽				
500	515-535, silt and gravel (as above at 420 FBGS), some clay/silt balls, gravel to 2-inches, varied lithologies, saturated but little water produced		SP	
510				
520				
530	Clay, sand, and gravel mixture at 528 FBGS			
540				
550				

Drilling Contractor: WDC Exploration and Wells
Drilling Method: Air Rotary Casing Hammer
Completion Zone: Alluvial Fan Facies
Completion Formation: Santa Fe Group

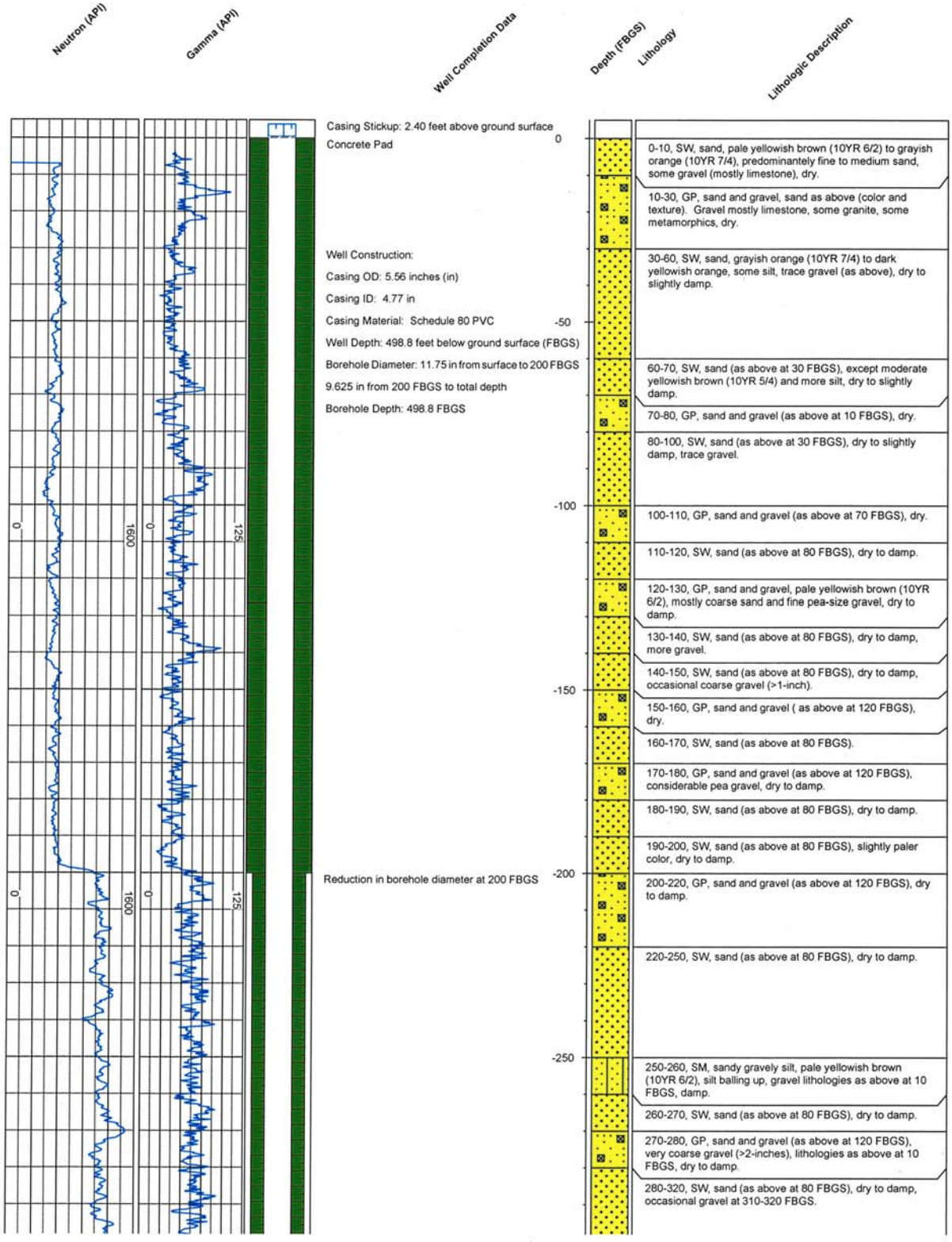
Borehole diameter is 11.75 in. to 200 FBGS and 9.625 in. from 200 FBGS to 535.0 FBGS

Elevation: Referenced to Ground, ft amsl
Coordinate System: SPC NM Central, NAD 83
Easting: 411405.51/Northing: 1452558.78

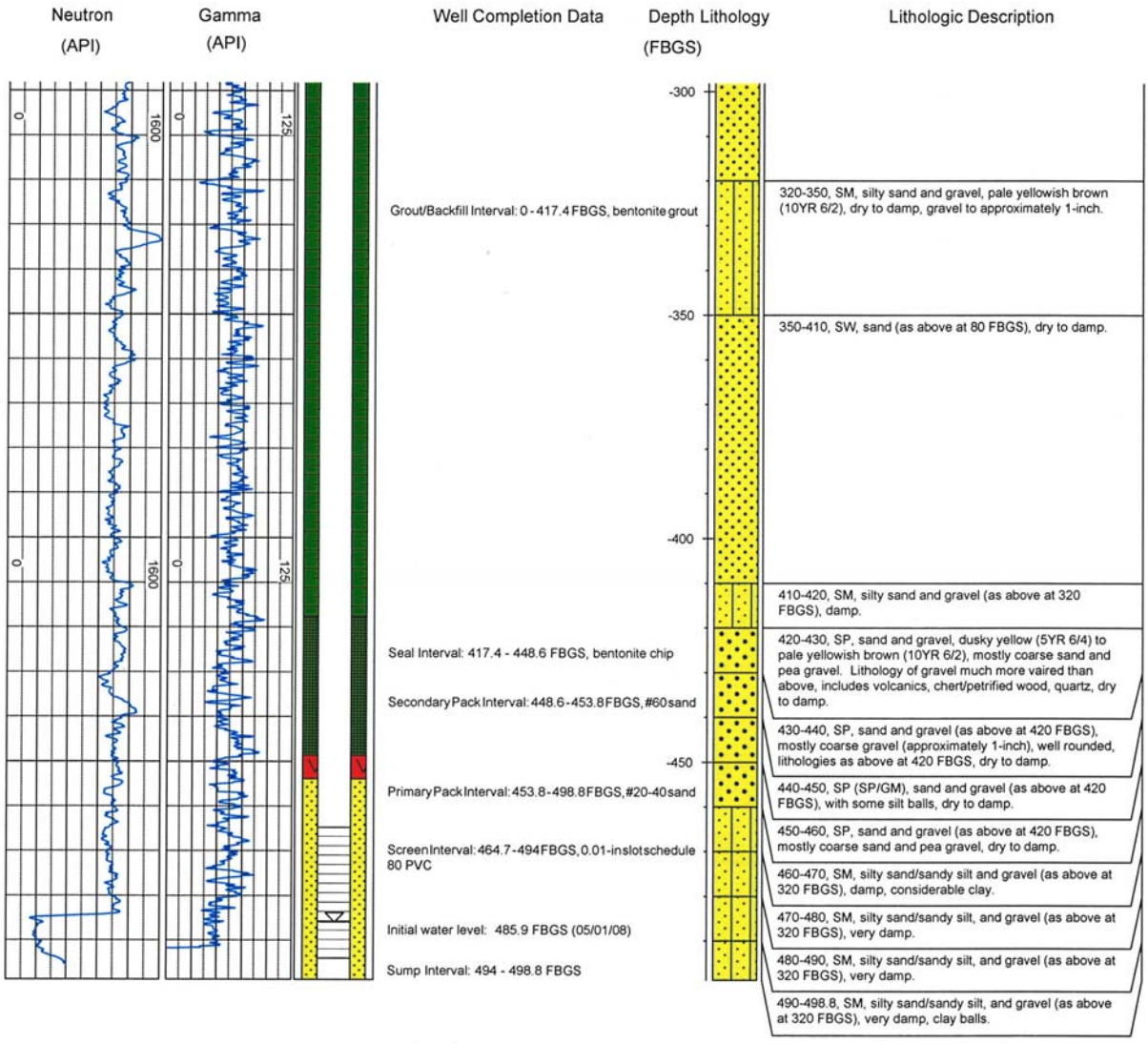
APPENDIX E
Combination Lithologic and Geophysical Logs with
Well Construction Details for MWL-MW7, MWL-MW8, and MWL-MW9

Sandia National Laboratories/New Mexico
Environmental Restoration Department
MWL-MW7

Geologist: *Mike Skelly*
Drilling Date: *April 25-28, 2008*
Well Installation Date: *June 24, 2008*

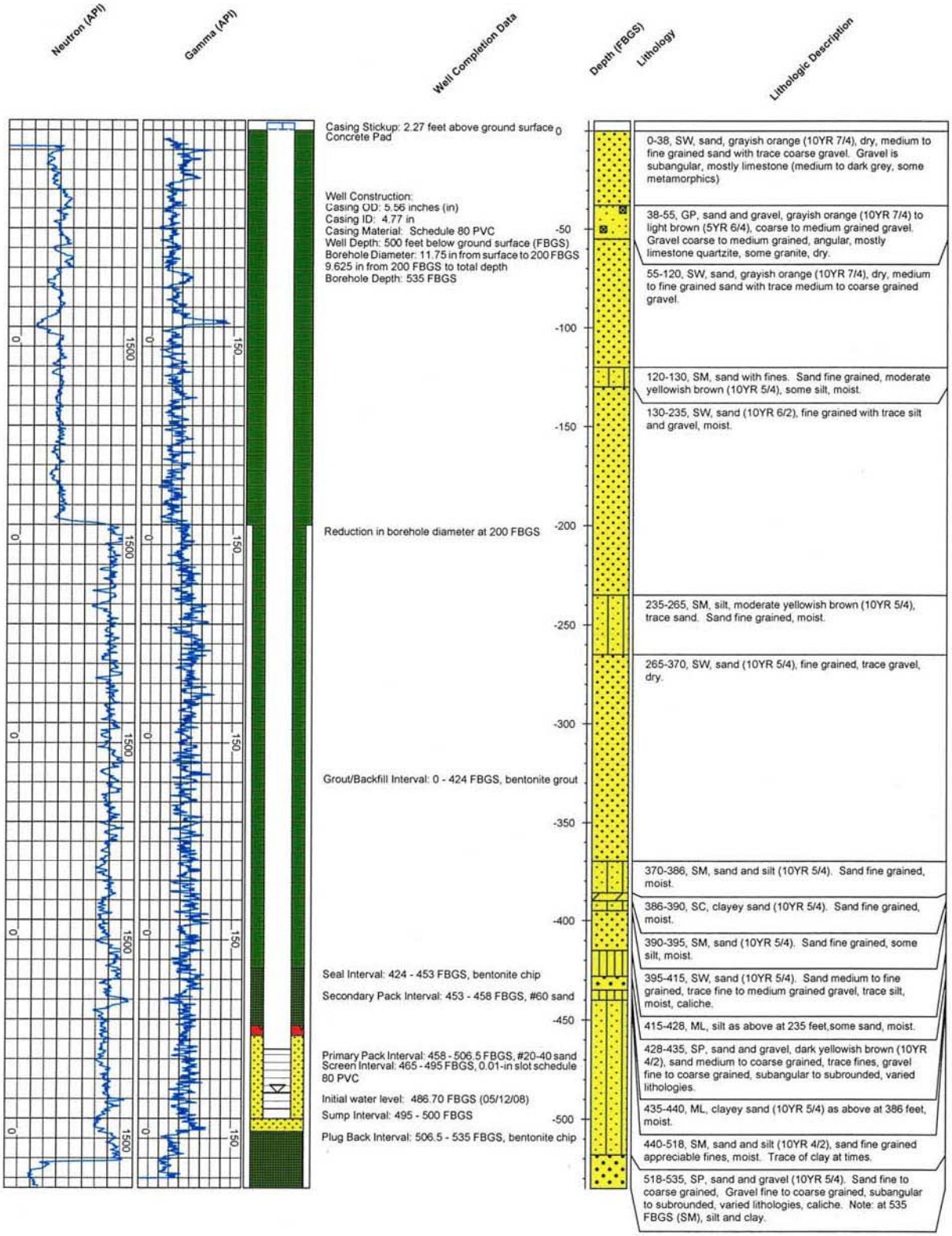


MWL-MW7


Neutron
(API)
Gamma
(API)
Well Completion Data
Depth Lithology
(FBGS)
Lithologic Description
0
1600
0
125
0
1600
0
125
-300
-350
-400
-450
Grout/Backfill Interval: 0 - 417.4 FBGS, bentonite grout
Seal Interval: 417.4 - 448.6 FBGS, bentonite chip
Secondary Pack Interval: 448.6 - 453.8 FBGS, #60 sand
Primary Pack Interval: 453.8 - 498.8 FBGS, #20-40 sand
Screen Interval: 464.7 - 494 FBGS, 0.01-in slot schedule 80 PVC
Initial water level: 485.9 FBGS (05/01/08)
Sump Interval: 494 - 498.8 FBGS
320-350, SM, silty sand and gravel, pale yellowish brown (10YR 6/2), dry to damp, gravel to approximately 1-inch.
350-410, SW, sand (as above at 80 FBGS), dry to damp.
410-420, SM, silty sand and gravel (as above at 320 FBGS), damp.
420-430, SP, sand and gravel, dusky yellow (5YR 6/4) to pale yellowish brown (10YR 6/2), mostly coarse sand and pea gravel. Lithology of gravel much more vaired than above, includes volcanics, chert/petrified wood, quartz, dry to damp.
430-440, SP, sand and gravel (as above at 420 FBGS), mostly coarse gravel (approximately 1-inch), well rounded, lithologies as above at 420 FBGS, dry to damp.
440-450, SP (SP/GM), sand and gravel (as above at 420 FBGS), with some silt balls, dry to damp.
450-460, SP, sand and gravel (as above at 420 FBGS), mostly coarse sand and pea gravel, dry to damp.
460-470, SM, silty sand/sandy silt and gravel (as above at 320 FBGS), damp, considerable clay.
470-480, SM, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp.
480-490, SM, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp.
490-498.8, SM, silty sand/sandy silt, and gravel (as above at 320 FBGS), very damp, clay balls.

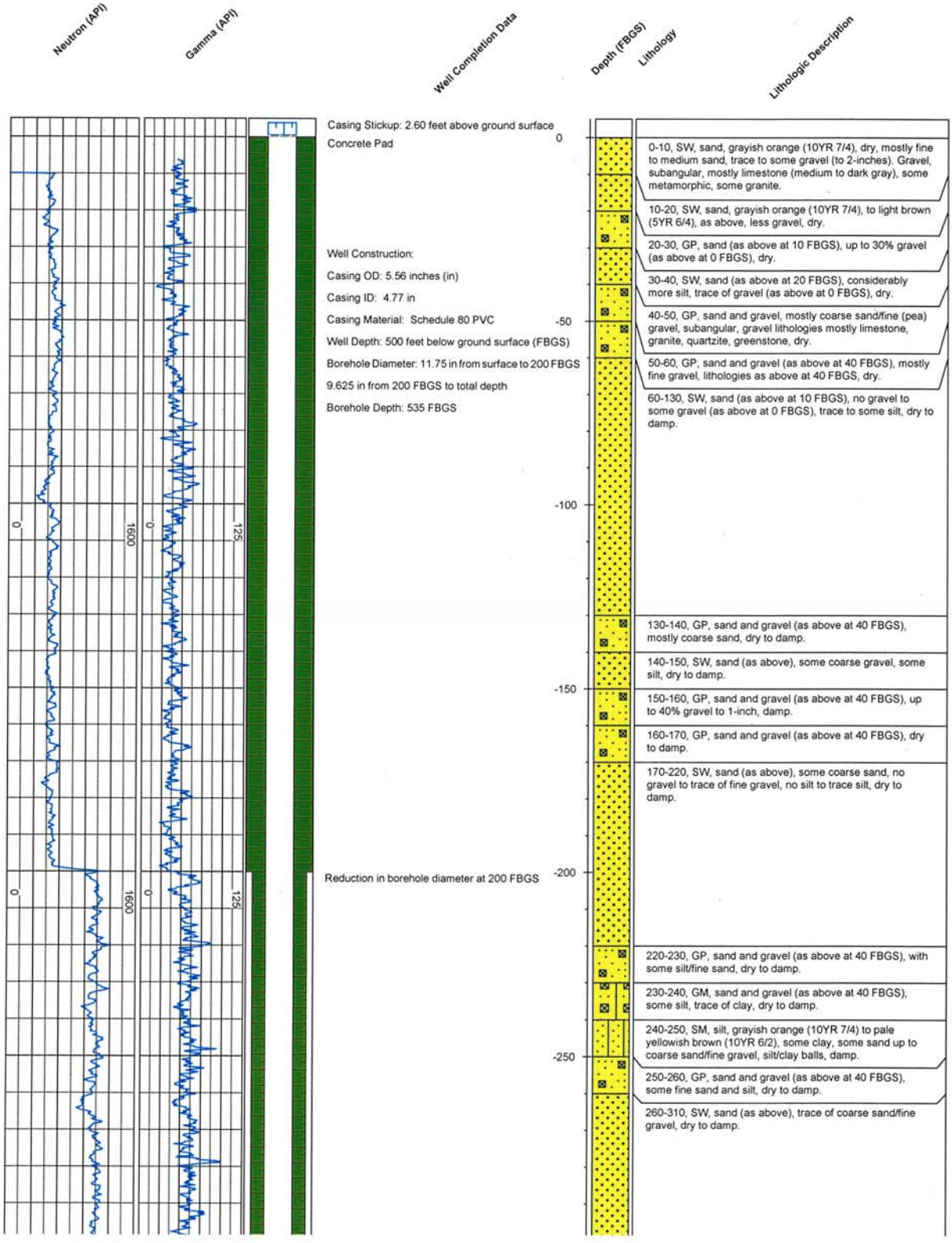
Sandia National Laboratories/New Mexico
Environmental Restoration Department
MWL-MW8

Geologist: ***Stacy Griffith***
Drilling Date: ***May 02-07, 2008***
Well Installation Date: ***June 26, 2008***

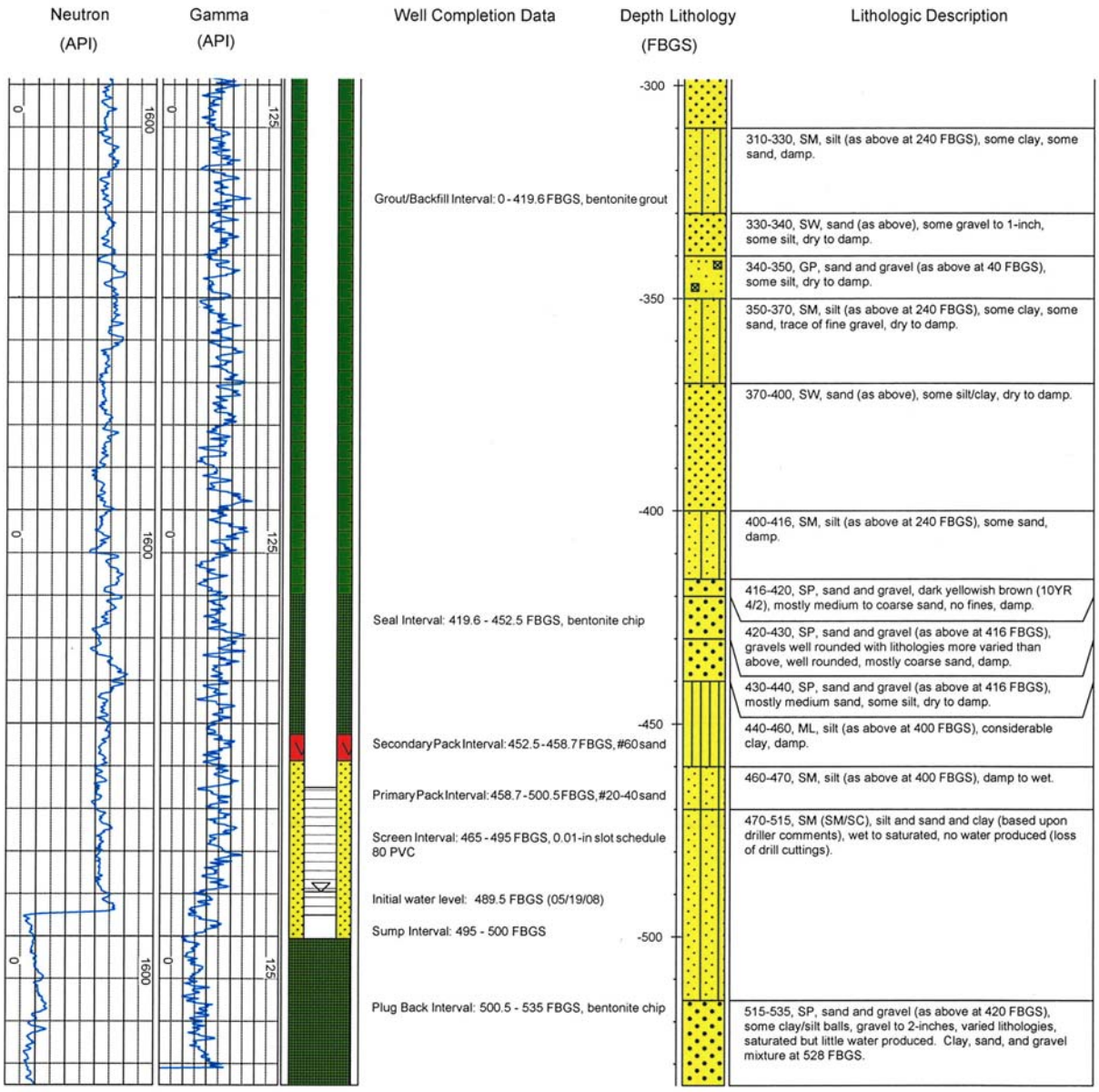


Sandia National Laboratories/New Mexico
Environmental Restoration Department
MWL-MW9

Geologist: *Mike Skelly*
Drilling Date: *May 13-14, 2008*
Well Installation Date: *June 30, 2008*



MWL-MW9


Neutron
(API)
Gamma
(API)
Well Completion Data
Depth Lithology
(FBGS)
Lithologic Description
0
1600
125
-300
-350
-400
-450
-500
Grout/Backfill Interval: 0 - 419.6 FBGS, bentonite grout
Seal Interval: 419.6 - 452.5 FBGS, bentonite chip
Secondary Pack Interval: 452.5 - 458.7 FBGS, #60 sand
Primary Pack Interval: 458.7 - 500.5 FBGS, #20-40 sand
Screen Interval: 465 - 495 FBGS, 0.01-in slot schedule 80 PVC
Initial water level: 489.5 FBGS (05/19/08)
Sump Interval: 495 - 500 FBGS
Plug Back Interval: 500.5 - 535 FBGS, bentonite chip
310-330, SM, silt (as above at 240 FBGS), some clay, some sand, damp.
330-340, SW, sand (as above), some gravel to 1-inch, some silt, dry to damp.
340-350, GP, sand and gravel (as above at 40 FBGS), some silt, dry to damp.
350-370, SM, silt (as above at 240 FBGS), some clay, some sand, trace of fine gravel, dry to damp.
370-400, SW, sand (as above), some silt/clay, dry to damp.
400-416, SM, silt (as above at 240 FBGS), some sand, damp.
416-420, SP, sand and gravel, dark yellowish brown (10YR 4/2), mostly medium to coarse sand, no fines, damp.
420-430, SP, sand and gravel (as above at 416 FBGS), gravels well rounded with lithologies more varied than above, well rounded, mostly coarse sand, damp.
430-440, SP, sand and gravel (as above at 416 FBGS), mostly medium sand, some silt, dry to damp.
440-460, ML, silt (as above at 400 FBGS), considerable clay, damp.
460-470, SM, silt (as above at 400 FBGS), damp to wet.
470-515, SM (SM/SC), silt and sand and clay (based upon driller comments), wet to saturated, no water produced (loss of drill cuttings).
515-535, SP, sand and gravel (as above at 420 FBGS), some clay/silt balls, gravel to 2-inches, varied lithologies, saturated but little water produced. Clay, sand, and gravel mixture at 528 FBGS.

APPENDIX F
Well Construction Diagrams for MWL-MW7, MWL-MW8, and MWL-MW9

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	SNL/NM TA-III
ER ADS #:	1289	**Well Completion Date:**	24-JUN-2008
Well Name:	MWL-MW7	**Completion Zone:**	ALLUVIAL FAN FACIES
Owner Name:	U.S. DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	25-APR-2008	**Well Comment:**	BOREHOLE DIAMETER IS 11 3/4 IN. TO 200 FBGS AND 9 5/8 IN. FROM 200 FBGS TO 498.8 FBGS.
Drilling Contractor:	WDC EXPLORATION & WELLS		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	498.8 FBGS		
Casing Depth:	498.8 FBGS		

Survey Data

Survey Date: 03-JUL-2008

Surveyed By: RANDOLPH C. HEWITT SURVEYING

State Plane Coordinates

(X) Easting: 411409.83

(Y) Northing: 1452230.18

Surveyed Elevations (FAMSL)

Protective Casing:	5380.95
Top of Inner Well Casing:	5380.63
Concrete Pad:	5378.29
Ground Surface:	5378.23

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4892.33
Initial Depth To Water: (FBGS)	485.9

Last measured water level was 4892.1 **FAMSL**
measured on 04-AUG-2008

Date Updated: 07-AUG-2008

Date Printed: 03-SEP-2008

Completion Data Measured Depths (FBGS)

Interval	Start	Stop
GROUT/BACKFILL	0 '	417.4 '
BENTONITE GROUT		
Interval	**Start**	**Stop**
BOREHOLE	0 '	498.8 '
Interval	**Start**	**Stop**
CASING	0 '	498.8 '
SCHEDULE 80 PVC		
Interval	**Start**	**Stop**
SEAL	417.4 '	448.6 '
BENTONITE CHIPS		
Interval	**Start**	**Stop**
SECONDARY PACK	448.6 '	453.8 '
#60 SAND		
Interval	**Start**	**Stop**
PRIMARY PACK	453.8 '	498.8 '
#20/40 SAND		
Interval	**Start**	**Stop**
SCREEN	464.7 '	494 '
SCHEDULE 80 PVC		
	Slot Size	.01"
Interval	**Start**	**Stop**
SUMP	494 '	498.8 '

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	SNL/NM TA-III
ER ADS #:	1289	**Well Completion Date:**	26-JUN-2008
Well Name:	MWL-MW8	**Completion Zone:**	ALLUVIAL FAN FACIES
Owner Name:	U.S. DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	02-MAY-2008	**Well Comment:**	BOREHOLE DIAMETER IS 11 3/4 IN. TO 200 FBGS AND 9 5/8 IN. FROM 200 FBGS TO 535 FBGS.
Drilling Contractor:	WDC EXPLORATION & WELLS		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	535 FBGS		
Casing Depth:	500 FBGS		

Survey Data

Survey Date: 03-JUL-2008

Surveyed By: RANDOLPH C. HEWITT SURVEYING

State Plane Coordinates

(X) Easting: 411409.77

(Y) Northing: 1452394.58

Surveyed Elevations (FAMSL)

Protective Casing:	5382.76
Top of Inner Well Casing:	5382
Concrete Pad:	5379.93
Ground Surface:	5379.72

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4893.02
Initial Depth To Water: (FBGS)	486.7

Last measured water level was 4891.78 **FAMSL**
measured on 04-AUG-2008

Date Updated: 07-AUG-2008

Date Printed: 03-SEP-2008

Completion Data Measured Depths (FBGS)

Interval	Start	Stop			
GROUT/BACKFILL	0 '	424.2 '			
BENTONITE GROUT					
Interval	**Start**	**Stop**			
CASING	0 '	500 '			
SCHEDULE 80 PVC			**I.D.**	4.767 "	**O.D.** 5.563 "
Interval	**Start**	**Stop**			
BOREHOLE	0 '	535 '			
Interval	**Start**	**Stop**			
SEAL	424.2 '	453 '			
BENTONITE CHIPS					
Interval	**Start**	**Stop**			
SECONDARY PACK	453 '	458 '			
#60 SAND					
Interval	**Start**	**Stop**			
PRIMARY PACK	458 '	506.5 '			
#20/40 SAND					
Interval	**Start**	**Stop**			
SCREEN	465 '	495 '			
SCHEDULE 80 PVC					
			Slot Size	.01 "	
Interval	**Start**	**Stop**			
SUMP	495 '	500 '			
Interval	**Start**	**Stop**			
PLUG BACK	506.5 '	535 '			
BENTONITE CHIPS					

WELL DATABASE SUMMARY SHEET

Project Name:	MIXED WASTE LANDFILL	**Geo Location:**	SNL/NM TA-III
ER ADS #:	1289	**Well Completion Date:**	30-JUN-2008
Well Name:	MWL-MW9	**Completion Zone:**	ALLUVIAL FAN FACIES
Owner Name:	U.S. DEPT. OF ENERGY	**Formation of Completion:**	SANTA FE GROUP
Date Drilling Started:	13-MAY-2008	**Well Comment:**	BOREHOLE DIAMETER IS 11 3/4 IN. TO 200 FBGS AND 9 5/8 IN. FROM 200 FBGS TO 535 FBGS.
Drilling Contractor:	WDC EXPLORATION & WELLS		
Drilling Method:	AIR ROTARY CASING HAMMER		
Borehole Depth:	535 FBGS		
Casing Depth:	500 FBGS		

Survey Data

Survey Date: 03-JUL-2008

Surveyed By: RANDOLPH C. HEWITT SURVEYING

State Plane Coordinates

(X) Easting: 411405.51

(Y) Northing: 1452558.78

Surveyed Elevations (FAMSL)

Protective Casing:	5379.83
Top of Inner Well Casing:	5379.24
Concrete Pad:	5377.03
Ground Surface:	5376.64

Calculated Depths and Elevations

Initial Water Elevation: (FAMSL)	4887.14
Initial Depth To Water: (FBGS)	489.5

Last measured water level was 4888.23 **FAMSL** **measured on** 04-AUG-2008

Date Updated: 07-AUG-2008

Date Printed: 03-SEP-2008

Completion Data Measured Depths (FBGS)

Interval	Start	Stop			
GROUT/BACKFILL	0'	419.6'			
BENTONITE GROUT					
Interval	**Start**	**Stop**			
CASING	0'	500'			
SCHEDULE 80 PVC			**I.D.**	4.767"	**O.D.** 5.563"
Interval	**Start**	**Stop**			
BOREHOLE	0'	535'			
Interval	**Start**	**Stop**			
SEAL	419.6'	452.5'			
BENTONITE CHIPS					
Interval	**Start**	**Stop**			
SECONDARY PACK	452.5'	458.7'			
#60 SAND					
Interval	**Start**	**Stop**			
PRIMARY PACK	458.7'	500.5'			
#20/40 SAND					
Interval	**Start**	**Stop**			
SCREEN	465'	495'			
SCHEDULE 80 PVC					
			Slot Size	.01"	
Interval	**Start**	**Stop**			
SUMP	495'	500'			
Interval	**Start**	**Stop**			
PLUG BACK	500.5'	535'			
BENTONITE CHIPS					

APPENDIX G
Well Development Forms for MWL-MW7, MWL-MW8, and MWL-MW9

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL	Project No.:
Well I.D.: MWL - MW7	Date: 27 MAY08
Weather Clear + Warm, hi in 80s	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

~~TOC~~ Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
488.89	1020	~~50~~ mg								
	1136	5	23.02	0.559	117.6	7.28		>E3	51.0	4.37
	1141	15	21.27	0.552	118.8	7.60		>E3	64.4	5.65
	1148	25	21.20	0.554	103.2	7.77		>E3	81.6	7.54
496.6	1156	35	21.38	0.539	99.8	7.91		>E3	68.3	6.04
	1305	40	22.00	0.533	89.5	7.82		84.5	72.7	6.31
	1310	45	21.24	0.537	92.7	7.64		>E3	70.1	6.11
	1330	65	21.52	0.538	91.8	7.68		116	74.7	6.57
	1351	70	21.17	0.539	84.1	7.44		191	80.0	7.10
	1359	75	21.52	0.540	80.1	7.63		184	83.9	7.33
	1410	80	21.49	0.544	80.1	7.67		124	77.4	6.79
	1455	85	21.23	0.545	89.3	7.54		595	80.8	7.14
	1553	95	21.48	0.552	89.3	7.44		>E3	85.4	7.58
	1609	110	21.58	0.556	85.5	7.73		243	87.6	7.64
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 21.6 ml/ft X____ (length of tubing) = _____ milliliters

ATTACHMENT A

page 2/2

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL	Project No.:
Well I.D.: MWL - MW 7	Date: 27MAY08
Weather Clear + Warm, 80s, slight breeze	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
	1618	120	21.49	0.555	82.3	7.78		84.8	82.5	7.22
	1627	140	21.15	0.559	79.7	7.71		80.0	84.7	7.45
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliileters
1/2" ODi: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliileters

ATTACHMENT A

Pg. 1

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL-GWM	Project No.:
Well I.D.: MWL-MW7	Date: 6-24-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 493'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
489.90	0840	— START +								
491.40	0901	2	23.87	586	188.4	7.16		2.11	60.8	5.09
492.03	0906	4	22.66	592	184.0	7.29		2.22	54.0	4.59
492.66	0911	6	22.48	586	203.1	7.31		1.47	74.0	6.47
492.84	0917	8	22.61	595	197.3	7.36		2.14	58.8	5.05
492.82	0924	10	22.93	594	196.9	7.36		1.41	54.0	4.62
492.82	0931	12	23.19	593	203.0	7.43		1.66	89.7	7.58
493.43	0936	14	22.31	588	208.8	7.40		0.89	90.0	7.80
493.43	0937	well	DRY							
490.50	1017	— start								
492.52	1027	4	22.50	586	209.7	7.30		0.54	83.3	7.04
493.22	1032	6	22.82	586	202.1	7.36		7.36	64.1	5.50
493.45	1034	~~8~~ 7	22.96	587	199.8	7.39		6.40	62.0	5.32
493.45	1034	well	DRY							
COC number(s):										
Sample number(s):										

Purge Volume Calculations

~4.75 gals purged from tubing 0854

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 21.6 ml/ft X____ (length of tubing) = _____ milliliters

Pg. 2

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.: MW-4 MW-3 cont.	Date: 6-24-08
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth: 493'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
490.56	1112		START							
492.30	1121	4	23.53	592	182.5	7.31		1.69	94.7	7.82
492.85	1126	6	23.72	589	181.9	7.38		1.57	62.1	5.25
493.25	1131	8	23.92	589	179.2	7.39		6.34	59.7	5.03
493.43	1134	9.0	23.87	588	179.7	7.38		9.16	60.0	5.06
493.43	1134	well	DRY							
489.52	1258		START							
491.28	1310	4	25.85	592	130.6	7.31		0.84	71.5	5.84
491.66	1319	6	26.44	590	150.7	7.29		3.57	55.7	4.46
492.03	1326	8	26.51	590	149.3	7.36		4.25	59.6	4.78
492.30	1334	10	25.91	589	150.2	7.36		2.35	57.1	4.64
492.55	1341	12	25.84	589	147.5	7.37		1.61	57.5	4.68
492.81	1349	14	25.73	589	153.1	7.36		1.36	56.0	4.55
492.92	1356	16	25.67	589	142.2	7.36		1.02	56.3	4.58
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliliters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

pg 3

Project Name:	Project No.:
Well I.D.: MWL-MW7 cont.	Date: 6-24-07
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
493.05	1404	18	25.67	589	141.9	7.34		0.39	54.0	4.40
493.31	1411	20	25.47	590	145.0	7.34		0.30	53.0	4.33
493.36	1415	21	25.36	589	144.1	7.34		0.40	52.7	4.32
493.43	1419	22	25.39	590	145.3	7.34		0.33	52.0	4.26
493.43	1420	well	DRY							
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 2 1.6 ml/ft X____ (length of tubing) = _____ milliliters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: Mixed Waste landfill	Project No.:
Well I.D.: MWL-MW8	Date: 28-May-08
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec ~~umho~~ mS/cm	ORP MV	pH	Flow L gls	Turb NTU	DO %	DO mg/L ~~Color and appearance~~
490.40	0833	~25	20.33	0.313	4.1	7.41	–	E3	72.8	6.56
	0950	~30	21.81	0.629	-20.8	8.12	–	E3	79.2	6.92
	1335	~45	22.24	0.600	-23.9	8.01	–	E3	84.8	7.36
	1445	~50	21.48	0.584	-20.1	7.93	–	E3	75.0	6.57
	1550	~65	21.78	0.578	-12.9	7.77	–	E3	80.9	7.08
29 May 490.44	0804	75	20.76	0.552	11.4	7.38	–	284	83.6	7.47
	0927	85	21.67	0.563	3.7	7.56		495	77.9	6.82
	1125	90	22.47	0.563	5.4	7.76	–	32.1	90.2	6.92
	1321	100	21.75	0.561	12.7	7.47		320	88.0	7.55
	1329	110	21.51	0.557	0.9	7.81		414	93.0	8.20
	1518	120	22.20	0.563	9.0	7.50	–	340	83.6	7.21
	1625	130	21.90	0.559	16.4	7.39		545	82.7	7.20
	1629	138	21.15	0.559	0.5	7.83		849	84.5	7.27

COC number(s):

Sample number(s):

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons

4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons

6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ millileters

3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ millileters

1/2" OD: 21.6 ml/ft X____ (length of tubing)) = _____ millileters

ATTACHMENT A

P. 1/3

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL-GWM	Project No.:
Well I.D.: MWL-MW8	Date: 6-25-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
490.60	0851		Start							
494.59	0907	2	23.57	606	267.9	7.13		0.81	33.7	2.85
495.75	0912	4	22.94	604	246.9	7.30		1.65	33.2	2.84
496.25	0915	5	22.78	611	239.7	7.34		1.97	31.5	2.71
496.86	0918	6	22.68	615	231.1	7.36		1.69	28.5	2.45
497.36	0921	7	22.71	621	225.9	7.37		1.59	26.0	2.23
497.33	0921	well	DRY							
491.90	1133		START							
494.82	1142	4	23.90	623	114.9	7.30		4.05	43.5	3.82
495.50	1144	5	23.53	615	131.2	7.32		1.86	60.0	4.51
496.06	1146	6	23.48	614	137.1	7.24		1.45	24.6	2.09
496.73	1148	7	23.41	614	137.6	7.24		6.57	23.2	1.97
497.38	1150	8	23.41	613	138.6	7.26		15.6	26.6	2.29
497.38	1150	well	DRY							
COC number(s):										
Sample number(s):										

~ 4.75 purge prior measurement. 0902

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliileters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliileters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.: MWL-MW8 cont.	Date: 6-25-08 / 6-26-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
492.24	1348		START							
494.78	1401	4	25.69	619	120.4	7.28		14.0	65.9	5.47
495.37	1403	5	25.24	619	141.5	7.22		2.30	75.3	6.19
496.12	1406	6	25.06	618	131.6	7.24		2.24	26.2	2.15
496.60	1409	7	25.11	617	127.1	7.25		9.37	25.4	2.12
497.12	1412	8	25.18	615	123.2	7.28		19.4	30.4	2.50
497.48	1415	8.5	25.14	615	126.2	7.30		22.4	35.1	2.89
497.48	1415		WELL	DRY	—	—	—	—	—	—
6/26 490.59	0810		START							
493.65	0823	4	21.32	610	140.2	7.42		7.25	60.7	5.41
494.12	0825	5	21.42	612	146.0	7.37		3.26	37.9	3.34
494.81	0828	6	21.74	613	144.3	7.35		2.24	25.4	2.26
495.38	0830	7	21.90	613	141.2	7.36		5.05	23.9	2.05
496.04	0833	8	21.95	613	138.7	7.37		12.1	25.0	2.20
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ millileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ millileters
1/2" OD: 2 1.6 ml/ft X____ (length of tubing)) = _____ millileters

Pg. 3/3

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name:	Project No.:
Well I.D.: MWL-MW8 cont.	Date: 6-26-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
496.72	0835	9	22.02	613	138.0	7.38		19.1	28.8	2.52
497.40	0837	10	22.04	613	137.7	7.38		21.4	31.8	2.78
497.40	0837	well	DRY	—	—	—	—	—	—	—
COC number(s):										
Sample number(s):										

33.5 total

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliileters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliileters

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: Mixed Waste Landfill	Project No.:
Well I.D.: MW-9	Date: 28-May 08
Weather	
Method: _____ Portable pump _____ Dedicated pump	Pump depth:

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol I gls	Temp °C	Ec ~~umho~~ mS/cm	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
	1215	12	21.62	0.545	-16.4	8.02	—	E3	58.2	7.75
	1305	1527	21.54	0.540	-14.3	7.74	—	E3	76.7	6.75
	1605	1542	21.68	0.534	-17.7	7.87	—	E3	82.9	7.25
49.88	0736	51	20.68	0.526	-0.8	7.47	—	~~269~~ E3	88.6	7.91
	0947	55	21.45	0.527	1.8	7.65	-	>E3	88.0	7.75
	1112	60	21.75	0.528	10.2	7.51	-	380	84.8	7.41
	1344	70	21.87	0.530	11.3	7.55	-	114	85.0	7.31
	1459	80	22.14	0.532	9.3	7.47	-	38.8	87.1	7.52
	1653	89	22.29	0.527	3.2	7.76		51.9	82.9	7.12

COC number(s):

Sample number(s):

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ millileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ millileters
1/2" OD: 21.6 ml/ft X____ (length of tubing) = _____ millileters

P. 1/3

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL- DEV.	Project No.:
Well I.D.: MWL-MW9	Date: 6-26-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497'

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
491.41	0928		START							
495.54	0946	1	26.82	579	320.0	6.63		1.11	29.5	2.36
496.09	0949	2	26.12	571	286.6	6.96		0.93	28.1	2.24
496.81	0952	3	25.33	562	260.4	7.17		1.44	33.7	2.73
497.21	0954	3.5	24.98	558	247.1	7.27		1.26	35.5	2.92
497.51	0955	4	24.74	559	243.0	7.29		1.33	36.6	3.04
497.71	0957	4.5	24.54	557	238.8	7.32		1.81	36.7	3.06
497.71	0957	well	DRY							
491.71	1252		START							
495.61	1301	4	25.22	576	137.4	7.20		6.78	104.0	8.96
496.33	1303	5	24.69	580	156.0	7.17		1.87	65.9	5.14
497.14	1305	6	24.56	579	154.6	7.17		2.09	37.2	3.09
497.74	1307	7	24.39	579	151.5	7.18		2.57	32.3	2.70
497.74	1307	well	DRY							
COC number(s):										
Sample number(s):										

492.67

~4.75 gals purged from tubing 0943

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliileters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliileters

ATTACHMENT A

P. 2/3

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL- DEV.	Project No.:
Well I.D.: MWL-MW9 cont.	Date: 6-27-08
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L gls	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
491.40	0819		START							
495.22	0828	4	19.95	574	163.3	7.35		10.9	78.6	7.49
495.95	0831	5	20.35	577	171.2	7.30		1.28	56.3	5.08
496.60	0834	6	20.80	578	169.8	7.30		0.90	30.0	2.77
497.32	0837	7	20.95	578	167.8	7.31		0.87	29.6	2.92
497.78	0840	8	21.07	578	165.8	7.32		1.09	27.1	2.44
497.78	0840	well	DRY							
491.51	1250		start							
495.08	1300	4	22.52	575	141.3	7.31		8.07	92.6	8.21
495.83	1303	5	22.31	578	156.3	7.28		1.74	75.6	6.26
496.54	1305	6	22.38	578	156.7	7.26		2.58	44.6	3.86
497.37	1308	7	22.42	578	156.9	7.27		2.26	38.2	3.31
497.70	1310	8	22.47	578	154.9	7.28		2.25	38.6	3.34
497.70	1310	well	DRY							
COC number(s):										
Sample number(s):										

Purge Volume Calculations

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliliters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliliters
1/2" OD: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliliters

Pg. 3/3

ATTACHMENT A

FIELD MEASUREMENT LOG FOR GROUNDWATER SAMPLE COLLECTION

Project Name: MWL- DEV.	Project No.:
Well I.D.: MWL-MW9 cont.	Date: 6-3008
Weather	
Method: X Portable pump _____ Dedicated pump	Pump depth: 497

PURGE MEASUREMENTS

DO mg/L

Depth to Water (FT)	Time 24 hr	Vol. L (gls)	Temp °C	Ec µmho	ORP MV	pH	Flow L gls	Turb NTU	DO %	~~Color and appearance~~
491.61	0814		START							
495.56	0823	4	19.88	575	145.4	7.41		5.75	75.9	6.91
496.31	0825	5	20.34	575	149.7	7.34		0.91	42.7	3.85
497.08	0827	6	20.74	569	147.4	7.33		1.02	24.1	2.15
497.79	0829	7	20.94	559	146.6	7.34		1.07	33.8	3.01
497.79	0829		well	DRY						
491.67	1245		START							
495.10	1258	4	23.84	565	120.2	7.35		6.25	78.1	6.84
495.94	1300	5	23.20	578	142.7	7.25		2.30	80.4	6.41
496.46	1303	6	23.13	578	140.0	7.25		1.14	39.2	3.35
497.26	1306	7	22.98	579	137.9	7.26		1.30	31.4	2.69
497.82	1309	8	22.86	577	137.5	7.29		1.93	33.0	2.81
497.82	1309		well	DRY						
COC number(s):										
Sample number(s):										

Purge Volume Calculations

42.5 gal total purged

Well Diameter

2" well: 0.16 gal/ft X____ (height of water column) = _____ gallons
4" well: 0.65 gal/ft X____ (height of water column) = _____ gallons
6" well: 1.47 gal/ft X____ (height of water column) = _____ gallons

Tubing Diameter

1/4" OD: 2.4 ml/ft X____ (length of tubing) = _____ milliileters
3/8" OD: 9.7 ml/ft X____ (length of tubing) = _____ milliileters
1/2" ODl: 2 1.6 ml/ft X____ (length of tubing)) = _____ milliileters