LA-UR-10-1752
April 2010
EP2010-0180

# Summary Report for Plugging and Abandonment of Test Well 1 and Test Well 1A

Los Alamos
NATIONAL LABORATORY
EST.1943

Prepared by the Environmental Programs Directorate

LA-UR-10-1752
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# Summary Report for Plugging and Abandonment of Test Well 1 and Test Well 1A

April 2010

Responsible project manager:

| Ted Ball | Mark Everett for | Project Manager | Environmental Programs | 4/26/10 |
|---|---|---|---|---|
| Printed Name | Signature | Title | Organization | Date |

Responsible LANS representative:

| Bruce Schappell | for BS | Executive Director | Environmental Programs | 4/26/10 |
|---|---|---|---|---|
| Printed Name | Signature | Title | Organization | Date |

Responsible DOE representative:

| Everett Trollinger | for | Federal Project Director | DOE-LASO | 4/26/10 |
|---|---|---|---|---|
| Printed Name | Signature | Title | Organization | Date |

## EXECUTIVE SUMMARY

This report describes the methods Los Alamos National Laboratory used to plug and abandon groundwater-monitoring Test Well 1 (TW-1) and Test Well 1A (TW-1A). The test wells are located on Los Alamos County land in Pueblo Canyon, Los Alamos, New Mexico.

TW-1 and TW-1A were plugged and abandoned in accordance with direction from NMED.

Plugging and abandonment activities at the TW-1 and TW-1A occurred from March 11, 2010, to March 23, 2010, using a Foremost DR-24HD drill rig and ancillary equipment.

TW-1A was abandoned first, followed by TW-1. In each well, as many of the internal casing strings as possible were removed in order to gain access to outer casing strings for the purpose of perforating and sealing the boreholes via grouting. TW-1A was grouted to 2.0 ft below ground surface on March 15, 2010. TW-1 was grouted to 3.0 ft below ground surface on March 23, 2010. The boreholes were plugged and abandoned in staged intervals via tremie pipe with 3/8-in. bentonite chips and Portland Type I/II/V cement.

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## 1.0 INTRODUCTION

This report summarizes the methods Los Alamos National Laboratory (LANL or the Laboratory) used to plug and abandon Test Well 1 (TW-1) and Test Well 1A (TW-1A). Well abandonment was consistent with the requirements and guidelines in sections IV.B.1.b.v and X.D (Well Abandonment) of the New Mexico Environment Department (NMED) Compliance Order on Consent (the Consent Order). Additionally, the plugging and abandonment procedures complied with 19.27.4 New Mexico Administrative Code Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Well. The following documents helped guide the implementation of the scope of work for the TW-1 and TW-1A plugging and abandonment project: "Work Plan to Plug and Abandon Well TW-1," (LANL 2009, 107691), "Work Plan to Plug and Abandon Well TW-1A" (LANL 2009, 107689), and "Field Work Plan to Plug and Abandon Test Wells TW-1 and TW-1a," (TerranearPMC 2010, 109124).

## 2.0 BACKGROUND

TW-1 and TW-1A are located in Pueblo Canyon, Los Alamos, New Mexico (Figure 2.0-1). TW-1 was installed in 1950 to monitor the water in the regional aquifer in Pueblo Canyon downgradient of the waste water treatment plant at Technical Area 45 (TA-45) (Purtymun and Swanton 1998, 099096). TW-1A was installed in 1950 in the same area to monitor the potential perched-intermediate groundwater encountered while drilling TW-1 (Purtymun and Swanton 1998, 099096).

### 2.1 Well History

TW-1 was completed to 642.0 ft below ground surface (bgs), with a slotted 6-in.-diameter screen section swaged into the bottom of an 8-in.-inside-diameter (I.D.) steel casing string (Figure 2.1-1). The 8-in. casing was hung in the well from 0 to 627 ft bgs. The surface casing consists of 16-in.-I.D. steel casing from surface to 52.0 ft bgs. A 12-in.-I.D. steel casing string was hung in the well from surface to 241.0 ft bgs. Completion notes indicate that TW-1 has an annular cement seal around the 12-in. casing from ground surface to 241.0 ft bgs. Based on the available well completion notes, TW-1 did not have an annular seal or a filter pack around the screen. Drilling and installation of the test wells was performed using a cable tool rig.

TW-1A was completed to 225.0 ft bgs, with a 6-in.-diameter slotted screen section from 215.0 to 225.0 ft bgs swaged into the bottom of a 6-in.-I.D. steel casing string (Figure 2.1-2). The 6-in. casing was hung in the well from surface to 215.0 ft bgs. The surface casing consists of 16-in.-I.D. steel casing from surface to 39.0 ft bgs. A 12-in.-I.D. steel casing string was hung in the well from surface to 100.0 ft bgs. Based on the available well completion notes, TW-1A did not have an annular seal or a filter pack around the screen.

Prior to plugging and abandonment, a groundwater-level measurement at TW-1 of 493.9 ft bgs was recorded on video on February 1, 2010. On March 11, 2010, a manual groundwater-level measurement was recorded as 169.1 ft bgs at TW-1A. The well construction diagrams for the test wells prior to plugging and abandonment are presented in Figures 2.1-1 and 2.1-2 and are based on video logs and field observations.

### 2.2 Rationale for Plugging and Abandonment

TW-1 and TW-1A were abandoned in accordance with direction from NMED as communicated in the Consent Order.

## 3.0 SCOPE OF ACTIVITIES

The plugging and abandonment approach, logging activities and abandonment activities for TW-1 and TW-1A are presented below.

### 3.1 Plug and Abandonment Design and Approach

Plugging plans for TW-1 and TW-1A were filed with the New Mexico Office of the State Engineer (NMOSE) and are included in Appendix A. The abandonment approach implemented at both wells was to remove as many of the internal casing strings as possible in order to gain access to outer casing strings for the purpose of perforating and sealing the boreholes via grouting. Pneumatic casing cutters and perforators were run in the hole on drill rods, requiring the use of a rotary drilling rig and compressed air.

Plugging occurred at the test wells in stages. Hydrated bentonite chips were used with alternating intervals of neat Portland Type I/II/V cement as described in section 3.3.

### 3.2 Borehole Logging

TW-1 and TW-1A were video and gamma logged before well abandonment to document screen conditions and locations, total depths (TDs) of the wells, and to verify static water levels. A second video logging was conducted at TW-1 and is described below.

#### 3.2.1 Video Logging

Downhole video logs were run in TW-1 on February 1, 2010, and in TW-1A on February 2, 2010. The logs were run to document screen conditions prior to abandonment, confirm well screen depths, measure static water levels before plugging and abandonment, and to confirm the TDs of the wells. A second video was run in well TW-1 on March 17, 2010, to document borehole conditions after the 8-in. casing string was removed. The video log showed the open borehole from approximately 627 ft to 241 ft bgs (the depth of the 12-in. casing) and is included in Appendix B. The Laboratory's video camera was used to complete the logging.

#### 3.2.2 Geophysical Logging

Gamma logging was conducted before plugging and abandonment activities in order to document well conditions, verify casing string lengths, and to assess lithologic contacts. Gamma logs were collected in TW-1 on February 1, 2010, and in TW-1A on February 2, 2010. The Laboratory's geophysical trailer and logging equipment were used to complete the logging.

### 3.3 Plugging and Abandonment

Plugging and abandonment activities included mobilization, casing removal, casing perforation, pressure-grouting/sealing, and demobilization. All activities were performed following appropriate standard operating procedures and Laboratory-approved health and safety documents. TW-1 and TW-1A were plugged and abandoned in accordance with the NMED-approved work plans. Figures 3.3-1 and 3.3-2 show the final well configurations after plugging and abandonment.

#### 3.3.1 Field Activities

**Plugging and Abandonment of TW-1A**

Mobilization of the dual-rotary drill rig and ancillary equipment to TW-1A was performed on March 11, 2010. The video log of February 2, 2010 showed slough inside the casing to 213.2 ft bgs. After video

logging an attempt was made to remove the 6-in.-I.D. steel casing that extended from ground surface to 225.0 ft bgs. Approximately 125% of the casing string weight was exerted on the 6-in. casing, but the casing did not move.

On March 12, the inside of the 6-in. well casing was sealed from 213.2 to 120.3 ft bgs with approximately 14.4 $ft^3$ of 3/8-in. bentonite chips. The volume and type of abandonment materials used to abandon TW-1A are presented in Table 3.3-1. The 6-in. casing was then cut at 105.0 ft bgs and the upper portion of the casing string was removed from the well. After the upper portion of the 6-in. casing was removed from the well, the 12-in.-I.D. steel casing was perforated from 70.0 to 40.0 ft bgs.

From March 13 to March 14, approximately 260.7 $ft^3$ of cement grout was used to plug the annulus around the 6-in. casing. Several attempts were made to measure the grout as it was being emplaced in the annulus; however, measurements were deemed to be unreliable due to interference between the tape and the top of the cut 6-in. casing, and the difficulty of trying to measure in the open annular space.

On March 15, the top of the cement grout was measured at approximately 123.6 ft bgs in the annulus, and an additional 28.1 $ft^3$ of cement grout was used to plug the open annular space from that depth to approximately 119.5 ft bgs. Due to significant grout loss in the annulus of the 6-in. casing below approximately 119.5 ft bgs, the Laboratory sought and received permission from the NMOSE to abandon a portion of the borehole with bentonite chips instead of cement grout (Myers 2010, 109104). Approximately 38.9 $ft^3$ of 3/8-in. bentonite chips were used to plug the remaining 6-in. casing, open annular space, 6-in. open borehole, and 12-in. casing from 119.5 to 70.9 ft bgs. On March 15, approximately 94.8 $ft^3$ of cement grout was used to plug the remaining 12-in. casing from 70.9 to 2.0 ft bgs, including the perforated zone between 70.0 and 40.0 ft bgs. The final borehole configuration is shown in Figure 3.3-2.

**Plugging and Abandonment of TW-1**

On March 16, the drill rig was moved off of TW-1A and was staged over TW-1. The entire string of 8-in.-I.D. steel casing from ground surface to approximately 627 ft bgs was removed after exerting 125% string weight. On March 17 a video log was run in the well to document borehole conditions.

No attempt was made to fish out the 6-in. screen/casing that remained in the bottom of the borehole from 622.0 to 642.0 ft bgs. From March 18 to March 21, 309.5 $ft^3$ of 3/8-in. bentonite chips were used to plug the 6-in. casing/screen, open annulus, and open 8-in. borehole from the TD of 642.0 to 290.0 ft bgs. The volume and type of abandonment materials used to abandon TW-1 are presented in Table 3.3-1.

Approximately 162.8 $ft^3$ of cement grout was used on March 22 to plug the 8-in. open borehole and 12-in. casing from 290.0 to 189.3 ft bgs. On March 23, 90.5 $ft^3$ of 3/8-in. bentonite chips were used to plug the 12-in. casing from 189.3 to 51.5 ft bgs.

On March 23, approximately 38.0 $ft^3$ of cement grout was used to plug the remaining 12-in. casing from 51.5 to 3.0 ft bgs. The final borehole configuration is shown in Figure 3.3-2.

Observations were made at both wells that indicated borehole diameters were larger than those documented in available well completion records. The video logs and documented observations in the field indicated that casing strings were set in large-diameter boreholes (typical for cable tool drilling). For instance, 6-in. casing strings appear to have been set in borehole diameters of 8 in. or larger, with annular spaces of 1 in. or more between the casing strings and borehole walls. The theoretical volumes calculated to fill the boreholes were generally less than the actual volumes that were used, which seems to support these observations. While grout losses to the formation certainly occurred, especially in TW-1A

around 120.0 ft bgs, in general grout losses are not as substantial as the strict calculated volumes versus actual volumes make them appear.

### 3.3.2 Surface Completion

The wells were cement-grouted to near-surface, and 2-ft × 2-ft × 2-ft (deep) and 2-ft × 2-ft × 3-ft (deep) concrete surface pads were installed at TW-1A and TW-1, respectively. Brass survey markers will be surveyed in accordance with section IX.B.2.f of the Consent Order.

## 4.0 POSTABANDONMENT ACTIVITIES

Postabandonment activities are described below.

### 4.1 Well Site Restoration

Plugging and abandonment activities at TW-1 and TW-1A did not disturb site conditions and no restoration efforts were required.

### 4.2 Waste Management

Contact waste was generated during the plugging and abandonment of TW-1 and TW-1A. Los Alamos National Security (LANS) removed the concrete surface pads at the former well sites. All contact waste will be recycled by LANS.

## 5.0 DEVIATIONS FROM PLANNED ACTIVITIES

The Laboratory sought and received permission from the NMOSE to abandon the interval from 119.5 to 70.9 ft bgs in TW-1A with bentonite chips instead of cement grout, which was necessitated due to cement loss to the formation (Myers 2010, 109104).

## 6.0 SUMMARY

TW-1 and TW-1A were plugged and abandoned in accordance with the NMED-approved work plans. Before abandonment activities, all aboveground appurtenances were removed. As many of the internal casing strings as possible were removed from the wells in order to gain access to outer casing strings for the purpose of perforating and sealing via grouting. The boreholes were abandoned in staged intervals using hydrated bentonite chips and Portland Type I/II/V cement mixed with municipal water.

## 7.0 REFERENCES

*The following list includes all documents cited in this report. Parenthetical information following each reference provides the author(s), publication date, and ER ID. This information is also included in text citations. ER IDs are assigned by the Environmental Programs Directorate's Records Processing Facility (RPF) and are used to locate the document at the RPF and, where applicable, in the master reference set.*

*Copies of the master reference set are maintained at the NMED Hazardous Waste Bureau and the Directorate. The set was developed to ensure that the administrative authority has all material needed to review this document, and it is updated with every document submitted to the administrative authority. Documents previously submitted to the administrative authority are not included.*

LANL (Los Alamos National Laboratory), December 2009. "Work Plan to Plug and Abandon Well TW-1," Los Alamos National Laboratory document LA-UR-09-8074, Los Alamos, New Mexico. (LANL 2009, 107691)

LANL (Los Alamos National Laboratory), December 2009. "Work Plan to Plug and Abandon Well TW-1A," Los Alamos National Laboratory document LA-UR-09-8058, Los Alamos, New Mexico. (LANL 2009, 107689)

Myers, K., March 15, 2010. RE: Request for Deviation due to Excessive Grout Loss at TW-1A. E-mail message to M. Everett (LANL) from K. Myers (NMED), Santa Fe, New Mexico. (Myers 2010, 109104)

Purtymun, W.D., and A.S. Swanton, February 5, 1998. "Engineering, Geology, and Construction Data of Twenty-Five Test Holes and Test Wells on and Adjacent to the Pajarito Plateau," draft, Los Alamos National Laboratory, Los Alamos, New Mexico. (Purtymun and Swanton 1998, 099096)

TerranearPMC, February 2010. "Field Work Plan to Plug and Abandon Test Wells TW-1 and TW-1a," plan prepared for Los Alamos National Laboratory, Los Alamos, New Mexico. (TerranearPMC 2010, 109124)

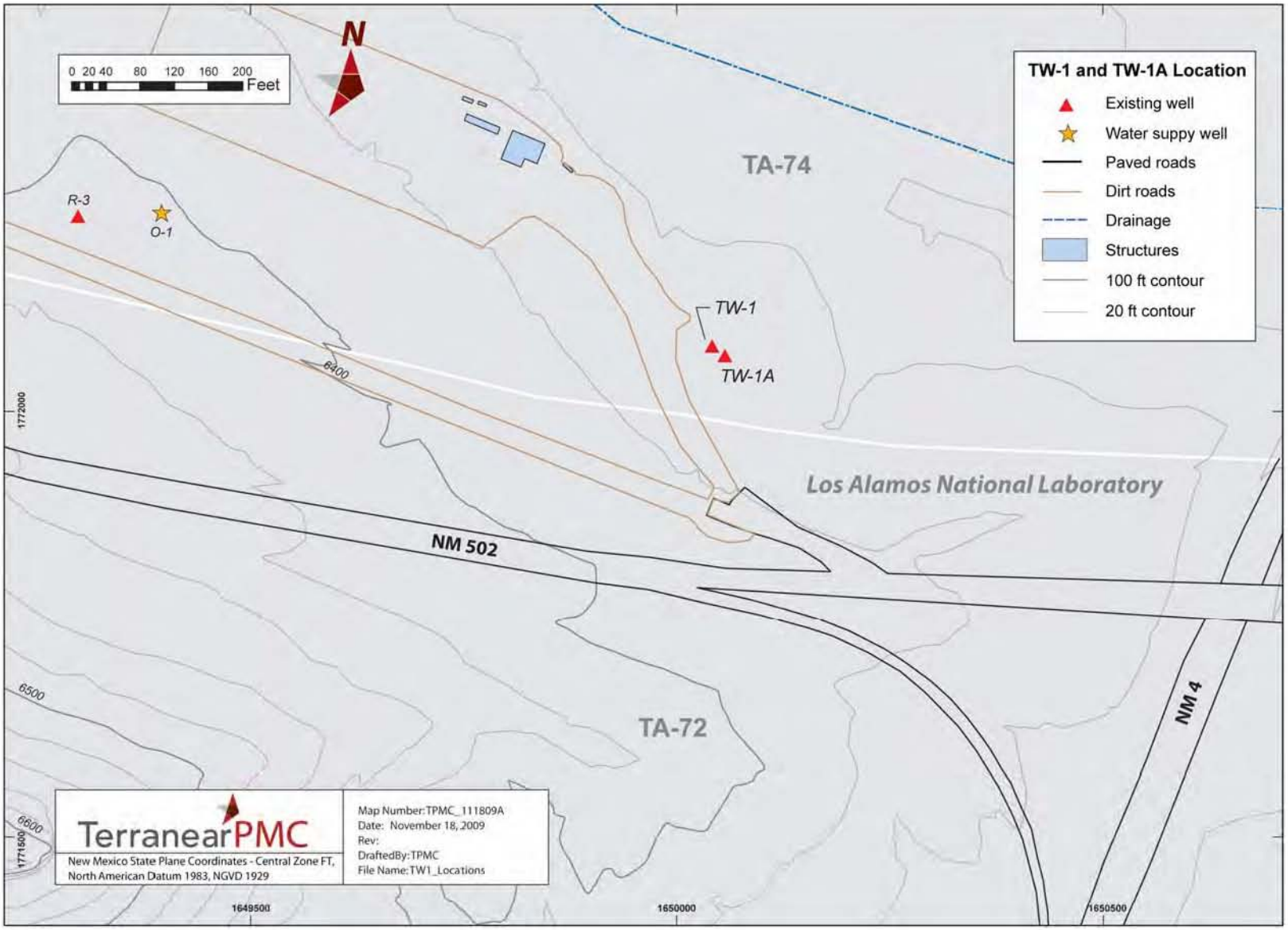


**Figure 2.0-1 Locations of TW-1 and TW-1A**

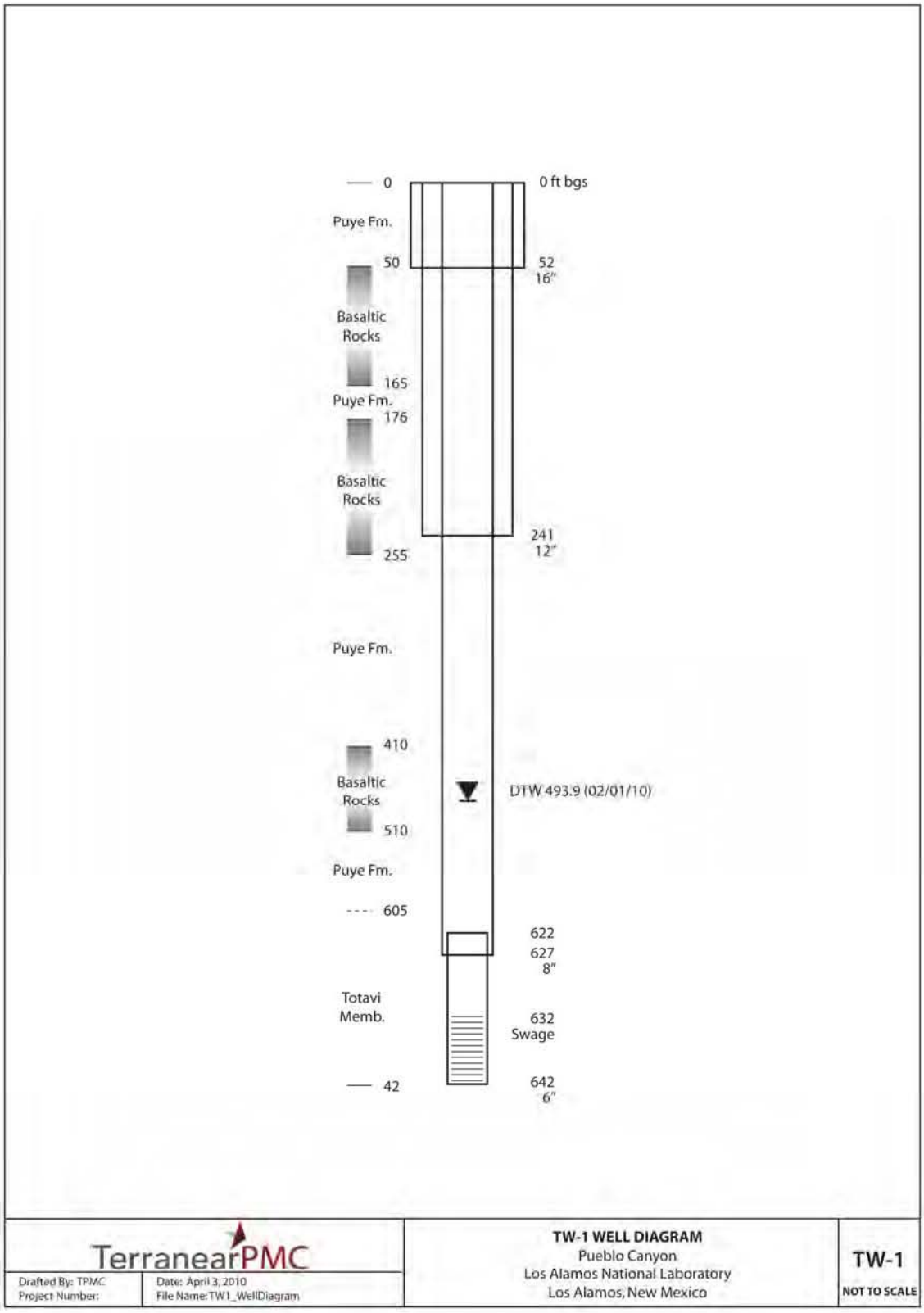


**Figure 2.1-1 TW-1 well construction diagram**

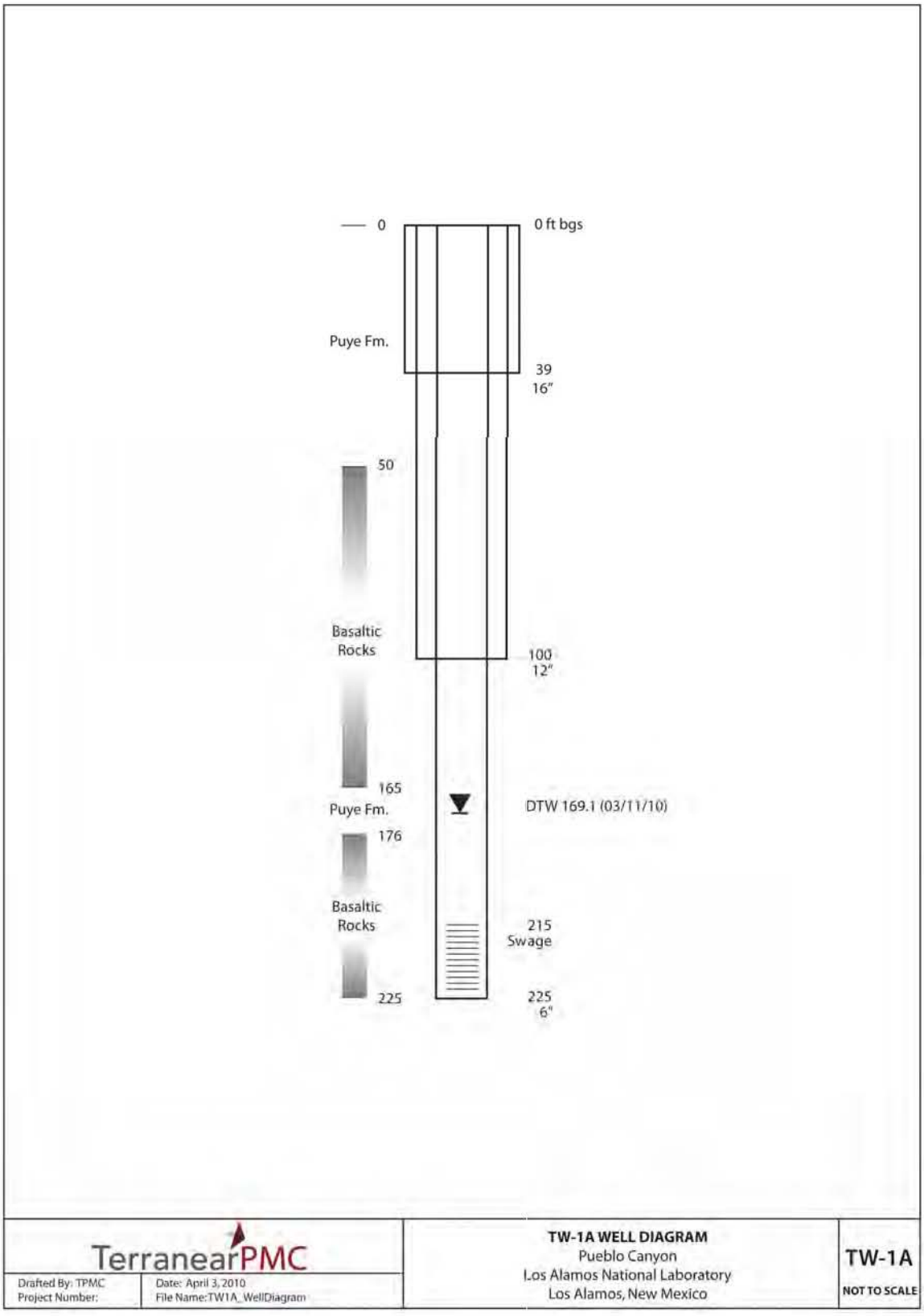


**Figure 2.1-2 TW-1A well construction diagram**

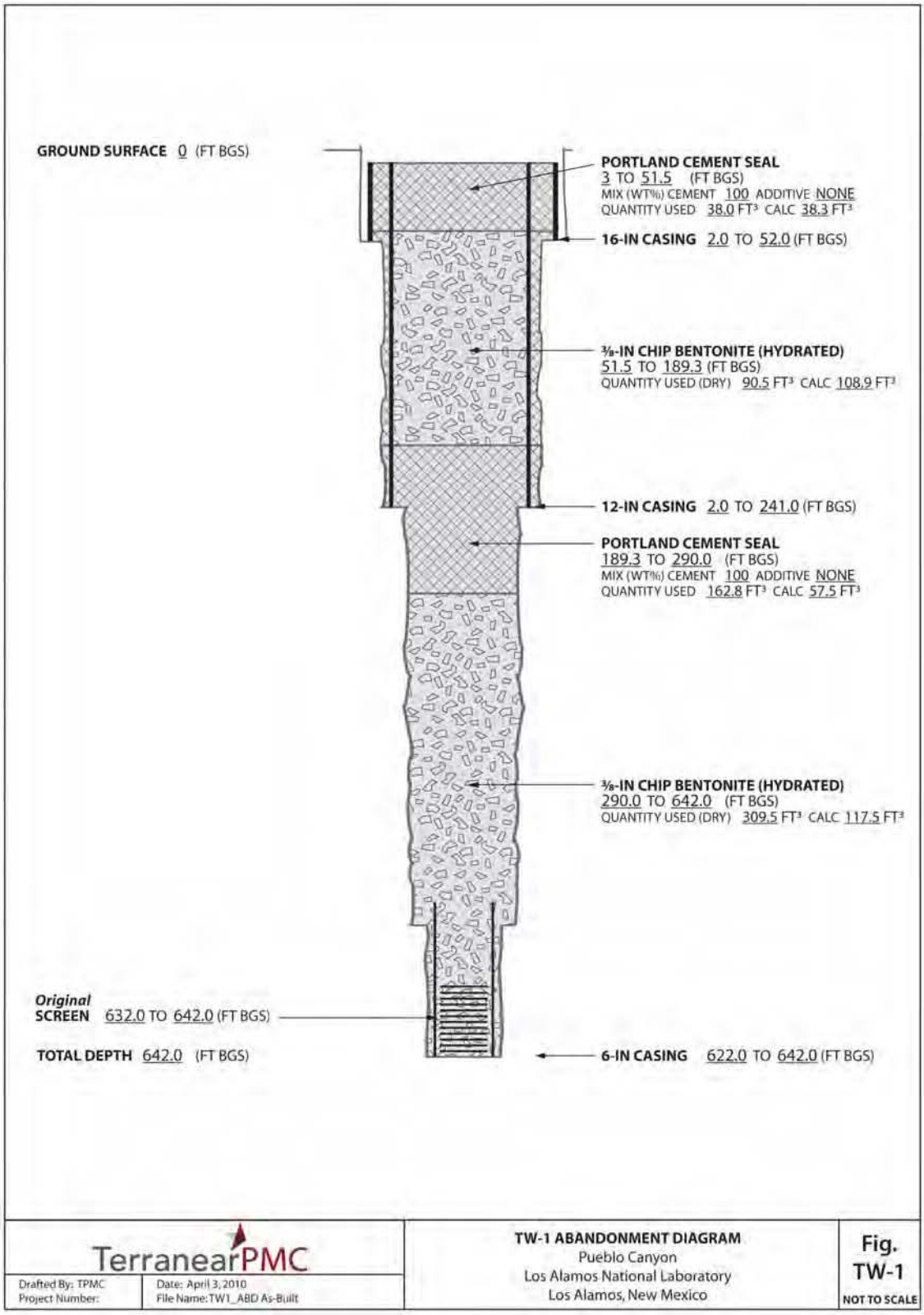


**Figure 3.3-1 TW-1 well abandonment diagram**

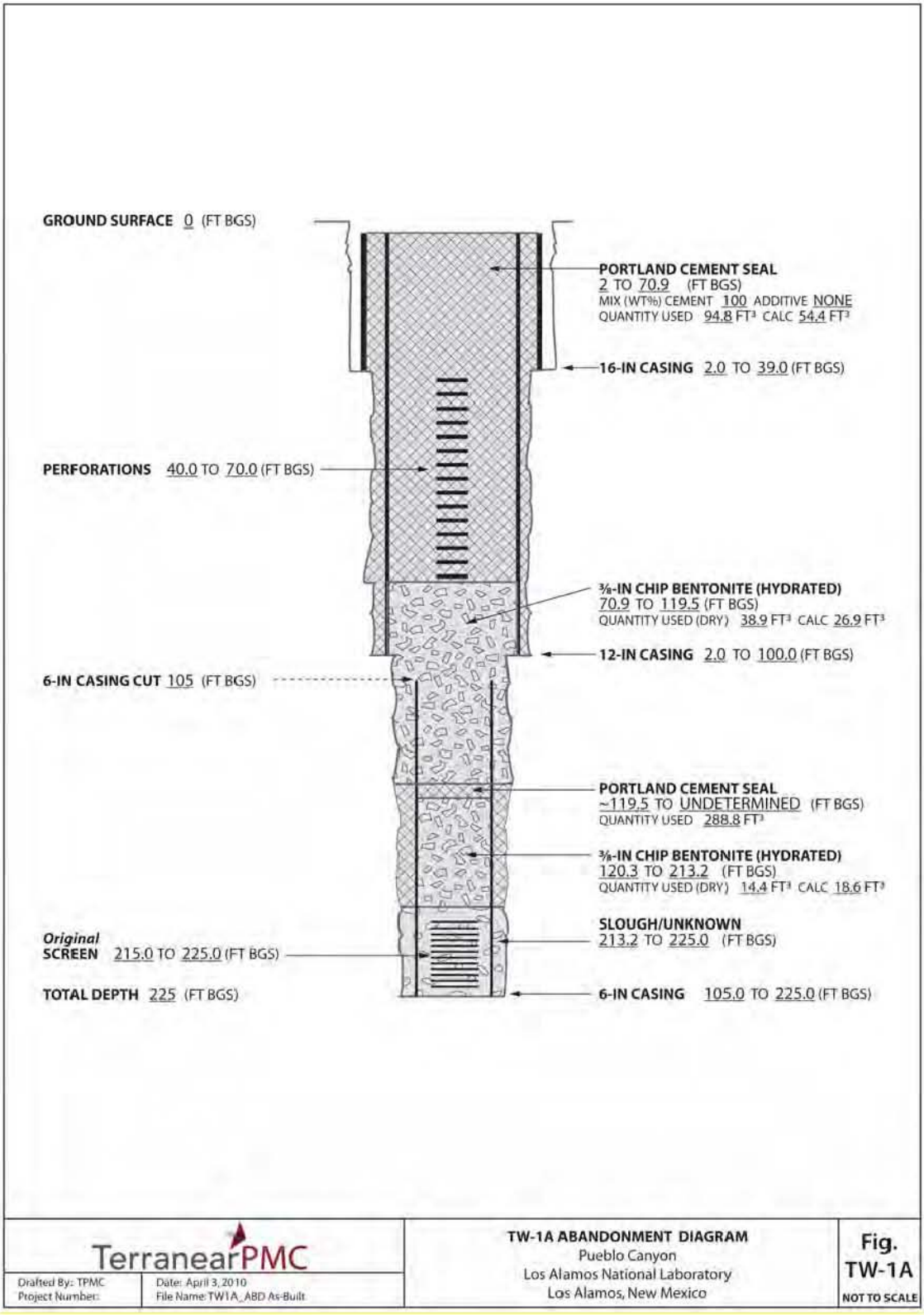


**Figure 3.3-2 TW-1A well abandonment diagram**

# Appendix A

*New Mexico Office of the State Engineer Plugging Records*

# PLUGGING RECORD

**NOTE: A Well Plugging Plan of Operations shall be approved by the State Engineer prior to plugging - 19.27.4 NMAC**

## I. GENERAL / WELL OWNERSHIP:

State Engineer Well Number: Test Well (TW)-1

Well owner: U.S. Department of Energy/Los Alamos National Laboratory Phone No.: 505-667-5931

Mailing address: P.O. Box 1663

City: Los Alamos State: New Mexico Zip code: 87545

## II. WELL PLUGGING INFORMATION:

1) Name of well drilling company that plugged well: Boart Longyear

2) New Mexico Well Driller License No.: WD-1664 Expiration Date: 1/31/2011

3) Well plugging activities were supervised by the following well driller(s)/rig supervisor(s): Terranear PMC, LLC

4) Date well plugging began: March 16, 2010 Date well plugging concluded: March 23, 2010

5) GPS Well Location (BRASS CAP): East: 493940.6
North: 1777226.0

*Well coordinates are New Mexico State Plane Grid Coordinates, Central Zone (North American Datum, 1983[NAD 1983]).*

6) Depth of well confirmed at initiation of plugging as: 642.0 ft below ground level (bgl), by the following manner: video log

7) Static water level measured at initiation of plugging: 493.9 ft bgl

8) Date well plugging plan of operations was approved by the State Engineer: February 11, 2010

9) Were all plugging activities consistent with an approved plugging plan? No If not, please describe differences between the approved plugging plan and the well as it was plugged (attach additional pages as needed):

The entire 8-in. casing string was removed from surface to 627.0 ft bgs. No attempt was made to fish out the 6-in. casing and screen that remained at the bottom of the borehole from 622.0 to 642.0 ft bgs (TD). Bentonite chips were used to plug the 6-in. casing/screen, open annulus, and 8-in. open borehole from 642.0 ft bgs (TD) to 290.0 ft bgs. Portland Type I/II/V cement was used to plug the 8-in. open borehole from 290.0 to 241.0 ft bgs and the 12-in. casing from 241.0 to 189.3 ft bgs. Bentonite chips were used to plug the 12-in. casing from 189.3 to 51.5ft bgs. Portland Type I/II/V cement was used to plug the remaining 12-in. casing from 51.5 to 2.0 ft bgs. A 2-ft X 2-ft X 2-ft (deep) concrete surface pad will be installed at ground surface with a brass survey marker and will be surveyed.

10) Log of Plugging Activities - Label vertical scale with depths, and indicate separate plugging intervals with horizontal lines as necessary to illustrate material or methodology changes. Attach additional pages if necessary.

**For each interval plugged, describe within the following columns:**

| Depth (ft bgl) | Plugging Material Used (include any additives used) | Volume of Material Placed (gallons) | Theoretical Volume of Borehole/ Casing (gallons) | Placement Method (tremie pipe, other) | Comments ("casing perforated first", "open annular space also plugged", etc.) |
|---|---|---|---|---|---|
| 3.0 | **Portland Type I/II/V** | **284.2 gallons** | **286.5 gallons** | **Tremie pipe** | **12-in. casing sealed from 3.0 to 51.5 ft bgs.** |
| 51.5 | **3/8-in. Bentonite Chips** | **676.9 gallons** | **814.6 gallons** | **Tremie pipe** | **12-in. casing sealed from 51.5 to 189.3 ft bgs.** |
| 189.3 | **Portland Type I/II/V** | **1217.7 gallons** | **430.1 gallons** | **Tremie pipe** | **12-in. casing sealed from 189.3 to 241.0 ft bgs.**<br>**8-in. open borehole sealed from 241.0 to 290.0 ft bgs** |
| 290.0 | **3/8-in. Bentonite Chips** | **2315.1 gallons** | **878.9 gallons** | **Tremie pipe** | **8-in casing removed from surface to 627.0 ft bgs.**<br>**8-in. open borehole sealed from 290.0 to 622.0 ft bgs.**<br>**6-in. casing/screen and open annular space sealed from 622.0 to 642.0 ft bgs.** |
| 642.0 | | | | | |

| MULTIPLY | | BY | | AND OBTAIN |
|---|---|---|---|---|
| cubic feet | x | 7.4805 | = | gallons |
| cubic yards | x | 201.97 | = | gallons |

**III. SIGNATURE:**

I, Mark Everett , say that I am familiar with the rules of the Office of the State Engineer pertaining to the plugging of wells and that each and all of the statements in this Plugging Record and attachments are true to the best of my knowledge and belief.

Original with signature on file at the NMOSE. _____

Signature of Well Driller Date

# PLUGGING RECORD

**NOTE: A Well Plugging Plan of Operations shall be approved by the State Engineer prior to plugging - 19.27.4 NMAC**

## I. GENERAL / WELL OWNERSHIP:

State Engineer Well Number: Test Well (TW)-1A

Well owner: U.S. Department of Energy/Los Alamos National Laboratory Phone No.: 505-667-5931

Mailing address: P.O. Box 1663

City: Los Alamos State: New Mexico Zip code: 87545

## II. WELL PLUGGING INFORMATION:

1) Name of well drilling company that plugged well: Boart Longyear

2) New Mexico Well Driller License No.: WD-1664 Expiration Date: 1/31/2011

3) Well plugging activities were supervised by the following well driller(s)/rig supervisor(s): Terranear PMC, LLC

4) Date well plugging began: March 11, 2010 Date well plugging concluded: March 15, 2010

5) GPS Well Location (BRASS CAP): East: 509812.7
North: 1772003.7

*Well coordinates are New Mexico State Plane Grid Coordinates, Central Zone (North American Datum, 1983[NAD 1983]).*

6) Depth of well confirmed at initiation of plugging as: 213.2 ft below ground level (bgl), by the following manner: video log, manual tag

7) Static water level measured at initiation of plugging: 169.1 ft bgl

8) Date well plugging plan of operations was approved by the State Engineer: February 11, 2010

9) Were all plugging activities consistent with an approved plugging plan? No If not, please describe differences between the approved plugging plan and the well as it was plugged (attach additional pages as needed):

An attempt was made to remove the 6-in. casing and screen, but the string was unable to be removed at 125% string pull back weight. Bentonite chips were used to plug the 6-in. casing from 213.2 ft bgs (TD) to 120.3 ft bgs. The 6-in. casing string was then cut at 105.0 ft bgs and the upper portion of the casing string was removed from the well. The 12-in. casing string was then perforated from 70.0 to 40.0 ft bgs. The remaining 6-in. casing and open annular space were pressure grouted with Portland Type I/II/V cement to 119.5 ft bgs. Bentonite chips were used to plug the remaining 6-in. casing, open annular space, 6-in. open borehole, and 12-in. casing from 119.5 to 70.9 ft bgs. Portland Type I/II/V cement was used to plug the remaining 12-in. casing from 70.9 to 2.0 ft bgs. A 2-ft X 2-ft X 2-ft (deep) concrete surface pad will be installed at ground surface with a brass survey marker and will be surveyed.

10) Log of Plugging Activities - Label vertical scale with depths, and indicate separate plugging intervals with horizontal lines as necessary to illustrate material or methodology changes. Attach additional pages if necessary.

**For each interval plugged, describe within the following columns:**

| Depth (ft bgl) | Plugging Material Used (include any additives used) | Volume of Material Placed (gallons) | Theoretical Volume of Borehole/ Casing (gallons) | Placement Method (tremie pipe, other) | Comments ("casing perforated first", "open annular space also plugged", etc.) |
|---|---|---|---|---|---|
| 2.0 | **Portland Type I/II/V** | **709.1 gallons** | **406.9 gallons** | **Tremie pipe** | **12-in. casing perforated first from 40.0 to 70.0 ft bgs. 12-in. casing sealed from 2.0 to 70.9 ft bgs.** |
| 70.9 | **3/8-in. Bentonite Chips** | **291.0 gallons** | **201.2 gallons** | **Tremie pipe** | **6-in. casing first removed from surface to 105.0 ft bgs. 12-in. casing sealed from 70.9 to 100.0 ft bgs. 6-in. open borehole plugged from 100.0 to 105.0 ft bgs. 6-in. casing and open annular space plugged from 105.0 to 119.5 ft bgs.** |
| 119.5<br>120.3 | **Portland Type I/II/V** | **2160.2 gallons** | **Volume undetermined. (Borehole diameter unknown.)** | **Tremie pipe** | **6-in. casing and open annular space plugged from 119.5 ft bgs to undetermined depth in annular space (unreliable measurements due to annulus and cut casing). Annular space was not measured.** |
| | **3/8-in. Bentonite Chips** | **107.7 gallons** | **139.1 gallons** | **Tremie pipe** | **6-in. casing/screen sealed from 120.3 to 213.2 ft bgs.** |
| 213.2 | | | | | |

| MULTIPLY | | BY | | AND OBTAIN |
|---|---|---|---|---|
| cubic feet | x | 7.4805 | = | gallons |
| cubic yards | x | 201.97 | = | gallons |

**III. SIGNATURE:**

I, Mark Everett , say that I am familiar with the rules of the Office of the State Engineer pertaining to the plugging of wells and that each and all of the statements in this Plugging Record and attachments are true to the best of my knowledge and belief.

Original with signature on file with the NMOSE.

Signature of Well Driller

Date

# Appendix B

*Video Logging of TW-1 Borehole*
*(on DVD included with this document)*