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Field Implementation Plan to Plug and Abandon Wells and Boreholes SHB 1, SHB 3, SHB 4, TH 5, TH 6, Beta Hole, Sigma Mesa Well, H-19, and TA-21 Distillation Hole

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1.0 INTRODUCTION

This field work plan provides technical guidance for field activities associated with the plugging and abandonment of Task Order 2 wells and boreholes located in Los Alamos, New Mexico as shown in Figure 1.0-1. The wells and boreholes associated with this task order are as follows: Seismic Hazard Borehole (SHB) 1, SHB 3, SHB 4, Test Hole (TH) 5, TH 6, the Beta Hole, the Sigma Mesa Well, borehole H-19, and the TA-21 Distillation Hole. Abandonment of these locations will be consistent with the requirements and guidelines of Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (the Consent Order).

Specific details including pre-abandonment activities and well construction and abandonment details of the locations are presented below.

2.0 PRE-ABANDONMENT ACTIVITIES

The following activities will be conducted prior to mobilizing well abandonment crews and equipment onsite.

2.1 Removal of Appurtenances

All aboveground and belowground appurtenances will be removed, including pumps, transducers, data loggers, control panels, concrete surface pads, etc.

2.2 Inspection and Geophysical Data Collection

The wells will be inspected with a downhole video camera to document the existing conditions. Final water-level measurements will also be collected.

3.0 WELL CONSTRUCTION, CURRENT CONDITIONS, AND ABANDONMENT

This section describes the location, construction, current disposition, and the methods that will be employed to plug and abandon each well/borehole.

3.1 Well Construction and Current Conditions

3.1.1 SHB-1, SHB-3, and SHB-4

SHB-1, SHB-3, and SHB-4 are seismic investigation boreholes that were drilled in 1950. SHB-1 was drilled in upper Pajarito Canyon to 700 ft below ground surface (bgs), SHB-3 was drilled to 860 ft bgs in upper Water Canyon, and SHB-4 was drilled to 200 ft bgs in lower Pajarito Canyon (Gardner et al. 1993, 012582). Intermediate perched zone groundwater was encountered in SHB-3 at approximately 663 ft bgs (Robinson et al. 2005, 091682). In SHB-4, core and cuttings samples were damp from 32 to 125 ft bgs, and samples were noted to be wet at 125 and 145 ft bgs. The SHB holes are 6-in. in diameter and contain 2.8-in. polyvinyl chloride (PVC) casing to total depth; the PVC casings were cemented in place in the boreholes.

Current Conditions

SHB-1 is open to 676 ft bgs with no water present. Total depth and lack of water were verified with a water level meter. No video log was collected at SHB-1.

SHB-3 was video logged in 2004. At that time the well was open to 750.5 ft bgs and a water level of 662.7 was observed.

SHB-4 has a damaged surface completion indicative of being struck by an automobile. No video log has been collected.

Figures 3.1-1, 3.1-2, and 3.1-3 are well construction diagrams that depict the construction details and current conditions of SHB-1, SHB-3, and SHB-4, respectively.

3.1.2 TH-5 and TH-6

TH-5 and TH-6 are investigation boreholes drilled in Pajarito Canyon in 1950; TH-5 was drilled to 263 ft bgs and TH-6 was drilled to 300 ft bgs (Purtymun 1995, 045344; Purtymun and Swanton 1998, 099096). TH-5 is 24-in. in diameter with 24-in. surface casing to 24 ft bgs and open to 33 ft bgs. TH-6 is 6-in. in diameter with 6-in. casing to 120 ft bgs and open to 293 ft bgs.

Current Conditions

TH-5 was video logged in June of 2011. The borehole is open to 33 ft bgs with no water present. High voltage power lines have been installed immediately above the borehole since the time it was drilled.

TH-6 was video logged in June of 2011. The borehole is open to 292 ft bgs with no water present. Video logging revealed that the casing in TH-6 is in poor condition due to corrosion.

Figures 3.1-4 and 3.1-5 are well construction diagrams that depict the construction details and current conditions of TH-5 and TH-6, respectively.

3.1.3 Beta Hole

The Beta Hole was drilled in 1950 with a bucket auger rig to 180 ft bgs (Purtymun 1995, 045344). The borehole is 24-in. in diameter and is uncased. It has been dry since it was drilled (Purtymun and Swanton 1998, 099096). Surface casing (corrugated metal) is reported as extending to either 7 ft bgs or 13 ft bgs.

Current Conditions

No video log has been collected at the Beta Hole. Conditions are expected to be as reported above.

Figure 3.1-6 is a well construction diagram that depicts the construction details of the Beta Hole.

3.1.4 Sigma Mesa Well

The Sigma Mesa Well was drilled with rotary techniques in 1979 to 2292 ft bgs (Purtymun 1995, 045344). The depth to water in 1979 was 1330 ft bgs. The borehole is 36-in. in diameter from 0 to 85 ft bgs and 26-in. in diameter from 85 to 2292 ft bgs. The well is constructed as follows:

- 0−85 ft bgs: 30-in. surface casing
- 0−1627 ft bgs: 20-in. casing
- ~1425 ft bgs − total depth; hole plugged with cement
- >1627 ft bgs: drill stem, drill collars, and bit lost in bottom of hole

Current Conditions

The Sigma Mesa Well is a partially abandoned borehole and was video logged in June 2011 to 630 ft bgs. A static water level was recorded at 585.8 ft bgs. The video was terminated at 630 ft bgs due to loss of visibility.

Figure 3.1-7 is a well construction diagram that depicts the construction details and current conditions of the Sigma Mesa Well.

3.1.5 H-19

The H-19 borehole was drilled by the cable tool method in 1949 to 2000 ft bgs (Purtymun 1995, 045344). The depth to water (DTW) in 1949 was 950 ft bgs. The current DTW cannot be determined because the well bore is obstructed near the surface: water was observed to be several feet below grade in the borehole in 1992. The borehole is approximately 12-in. in diameter and is constructed as follows:

- 0-10 ft bgs: 12-in. surface casing
- 10-2000 ft bgs: open hole

Current Conditions

H-19 was video logged in June of 2011. The video was terminated at 60 ft bgs due to a tree limb in the hole blocking access. Video logging revealed that the casing in H-19 is in poor condition due to corrosion.

Figure 3.1-8 is a well construction diagram that depicts the construction details and current conditions of the H-19 borehole.

3.1.6 TA-21 Distillation Hole

The TA-21 distillation hole was drilled and instrumented in 1969 as part of an experimental carbon isotope production experiment. The 36-in. diameter borehole was drilled to 125 ft bgs, and 140 ft of 18-in. diameter casing was cemented in place to total depth (it protruded 15 ft above ground surface [ags]). The 140-ft-long distillation column was fitted with the following equipment, beginning from the bottom of the column (Armstrong et al. 1970, 110889):

- 125−45 ft bgs: 1-in. diameter column
- 45−25 ft bgs: four 1-in. diameter columns in parallel
- 25 ft bgs−15 ft ags: twelve 1-in. columns in parallel

The columns are encased in a 6-in. diameter Dural vacuum jacket with machined Styrofoam spacers and aluminized Mylar film insulation. Apparently, the part of the distillation column that extended 15 ft ags has been removed, and some pipe is extending above grade. The hole has been covered to prevent water infiltration.

Current Conditions

No video log has been collected at the TA-21 Distillation Hole. Conditions are expected to be as reported above.

Figure 3.1-9 is a well construction diagram that depicts the construction details of the TA-21 Distillation Hole.

3.2 Plugging and Abandonment

The locations will be plugged and abandoned per the direction of the New Mexico Environment Department (NMED). The locations may be plugged and abandoned in any order.

A total depth and depth to water measurement will initially be made and recorded at all locations.

3.2.1 SHB 1, SHB 3, and SHB 4 Abandonment

SHB-1 will be abandoned by placing neat cement in the well from the bottom at 676 ft bgs to 2 ft bgs by means of a tremie pipe. The PVC casing will be cut off at 2 ft bgs and the remaining hole will be filled with concrete as part of the surface completion.

Before initiating abandonment activities at SHB-3, a temporary pump will be installed in order to collect a sample. A minimum of three casing volumes of water will be purged before sample collection.

SHB-3 will be abandoned by reaming the PVC well and original borehole with a 6-in. drill bit to the original total depth of 860 ft bgs. The borehole will be filled with 3/8-in. bentonite chips to 10 ft bgs. Neat cement will be placed above the bentonite chips to 2 ft bgs. The remaining hole will be filled with concrete as part of the surface completion.

SHB-4 will be abandoned by reaming the PVC well and original borehole with a 6-in. drill bit to the original total depth of 200 ft bgs. The borehole will be filled with 3/8-in. bentonite chips to 10 ft bgs. Neat cement will be placed above the bentonite chips to 2 ft bgs. The remaining hole will be filled with concrete as part of the surface completion.

3.2.2 TH-5 and TH-6 Abandonment

High voltage power lines present clearance issues at TH-5 and make set-up of any sort of rig impossible. TH-5 will be abandoned by placing neat cement from 33 to 2 ft bgs at 100% of the theoretical volume of the borehole (97.5 cubic ft. or 730 gallons). The placement of the cement will allow evaluation of the nature of the current bottom of the borehole at 33 ft bgs. If the borehole is bridged, the cement may dislodge the bridge or flow around. If this should be the case, the borehole will be measured to determine the depth. If the depth should increase (indicating a bridge was dislodged), the remainder of the borehole will be filled with bentonite chips to 10 ft bgs and neat cement will be placed above the bentonite chips to 2 ft bgs. If little to no subsidence is observed in the cement, the borehole will be topped-off to 2 ft bgs with neat cement and no bentonite chips will be used. The remaining hole will be filled with concrete as part of the surface completion.

TH-6 will be abandoned by first backfilling the bottom of the borehole from 292 ft bgs to near the bottom of the 6-in. casing at 120 ft bgs. An attempt will be made to remove the 120-ft-long string of 6-in. casing using a pull-back pressure equal to 125% of the calculated casing weight. If the casing can be removed, bentonite chips will be placed in the borehole from 120 ft bgs to approximately 10 ft bgs. The remainder of the borehole will be cemented to within 2 ft bgs. If the 120-ft-long casing cannot be removed, it will be cut off and removed from 20 ft bgs. The borehole will be backfilled with 3/8-in. bentonite chips that extend from total depth to approximately 10 ft bgs. Neat cement will be placed above the bentonite to 2 ft bgs. The remaining hole will be filled with concrete as part of the surface completion.

3.2.3 Beta Hole Abandonment

The Beta Hole will be backfilled with 3/8-in. bentonite chips to within 2 ft of the bottom of the corrugated surface casing before attempting to remove the surface casing. Neat cement will then be placed in the borehole to 2 ft bgs. The remaining hole will be filled with concrete as part of the surface completion.

3.2.4 Sigma Mesa Well Abandonment

The 20-in. well casing will be perforated in four intervals: between approximately 1425 to 1250, 1050 to 875, 675 to 500, and 300 to 125 ft bgs. The lower two intervals (1425 to 1250 and 1050 to 875 ft bgs) will be perforated initially and the lowermost interval (1425 to 1250 ft bgs) will be pressure-grouted from 1425 ft bgs to 1200 ft bgs first in order to reduce any potential damage to the lower part of the 20-in. casing. After placing the lowermost interval of cement, the upper two intervals of perforations will be made (675 to 500 and 300 to 125 ft bgs). The top of the previously placed cement will be measured and the borehole will be pressure grouted to within 30 ft of ground surface. Grouting will take place in multiple stages. The 20-in. well casing will be cut off at approximately 25 ft bgs and removed. The 30-in. surface casing will be cut off at approximately 20 ft bgs and removed. The remaining borehole will be filled with neat cement from 30 ft bgs to 2 ft bgs. The remaining hole will be filled with concrete as part of the surface completion.

3.2.5 H-19 Abandonment

H-19 will be drilled out to a minimum of 525 ft bgs with air rotary methods in order to seal off an intermediate perched zone encountered at the base of the Bandelier Tuff from 450 to 472 ft bgs identified during initial drilling. Currently, there is an obstruction at approximately 60 ft bgs. It is possible that the bottom of the borehole extends below 525 ft bgs. Whatever the case, whether it is drilled out to 525 ft bgs or the bottom is found to be below 525 ft bgs, the borehole will be backfilled with 3/8-in. bentonite chips to within 10 ft of ground surface. The 12-in surface casing will be extracted before filling the borehole with neat cement to 2 ft bgs. The remaining hole will be filled with concrete as part of the surface completion.

3.2.6 TA-21 Distillation Hole Abandonment

An attempt will be made to remove as much of the distillation instrumentation as possible. The cased hole will then be filled with neat cement to 2 ft bgs. The well casing will be cut off approximately 2 ft bgs and the remaining hole will be filled with concrete as part of the surface completion.

4.0 SURFACE COMPLETION

The holes will be cement-grouted to within 2.0 ft of ground surface. A 2-ft X 2-ft X 2-ft concrete surface pad will be installed at ground surface with a brass survey marker and will be surveyed in accordance with the Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global-positioning system to within 0.5 ft.

5.0 WASTE

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

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

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

6.0 REPORTING

A brief report will be prepared detailing the methods used, presenting borehole logs (video and natural gamma), quantities of materials used, and providing the final abandonment details. Figures depicting the location of the abandoned well and backfill completion will also be included in the report.

7.0 REFERENCES

Gardner, J.N., T. Kolbe, and S. Chang, January 1993. "Geology, Drilling, and Some Hydrologic Aspects of Seismic Hazards Program Core Holes, Los Alamos National Laboratory, New Mexico," Los Alamos National Laboratory report LA-12460-MS, Los Alamos, New Mexico. (Gardner et al. 1993, 012582)

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LANL (Los Alamos National Laboratory), November 2010. "Work Plans to Abandon Wells and Boreholes at Los Alamos National Laboratory," Los Alamos National Laboratory document LA-UR-10-6972, Los Alamos, New Mexico (LANL 2010, 111131)

NMED (New Mexico Environment Department), July 30, 2010. "Requirement to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory," New Mexico Environment Department letter to G.J. Rael (DOE-LASO) and M. Graham (LANL) from J.P. Bearzi (NMED-HWB), Santa Fe, New Mexico. (NMED 2010, 110427)

Purtymun, W.D., January 1995. "Geologic and Hydrologic Records of Observation Wells, Test Holes, Test Wells, Supply Wells, Springs, and Surface Water Stations in the Los Alamos Area," Los Alamos National Laboratory report LA-12883-MS, Los Alamos, New Mexico. (Purtymun 1995, 045344)

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)

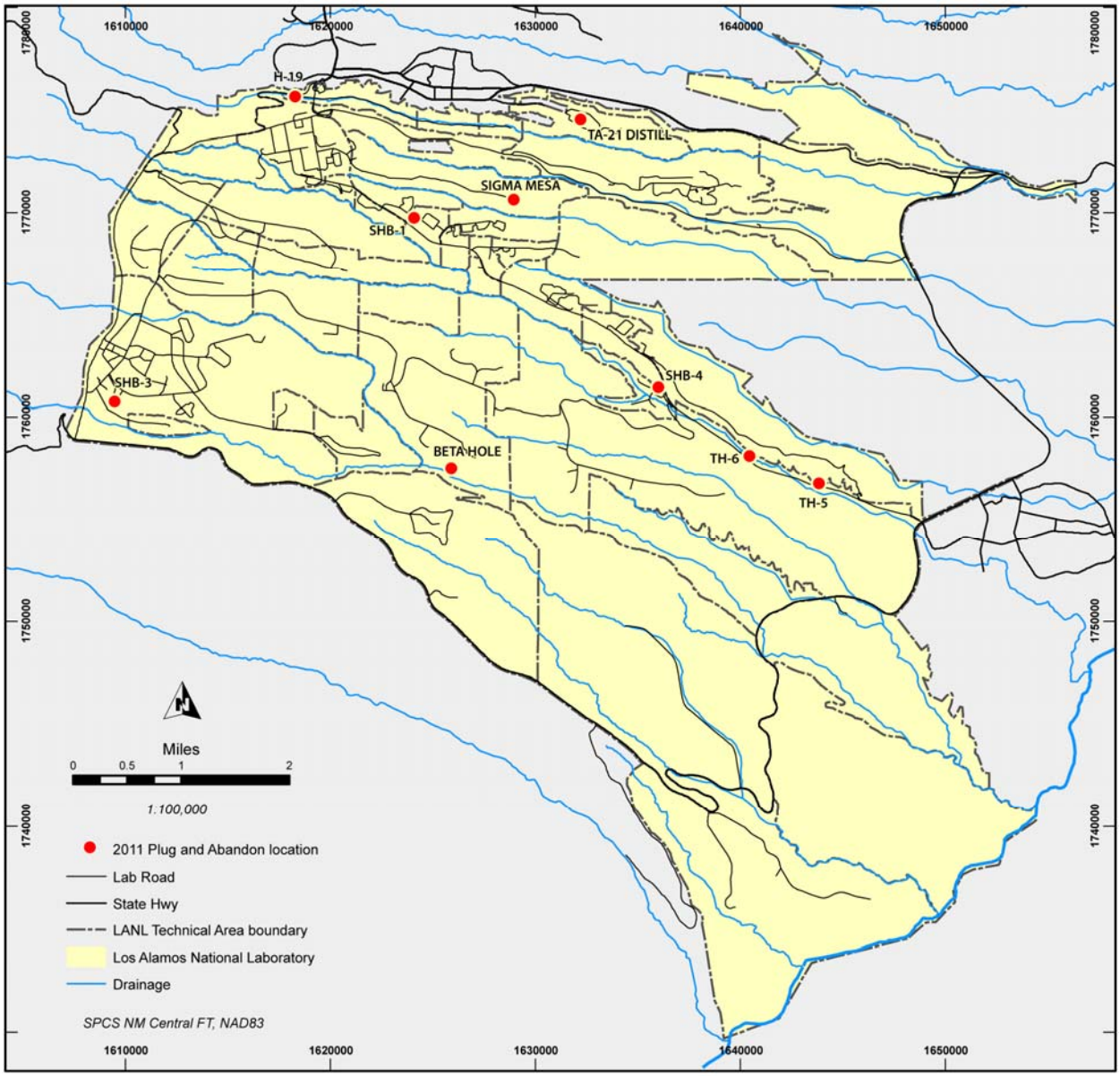

Figure 1.0-1 General location of P & A wells

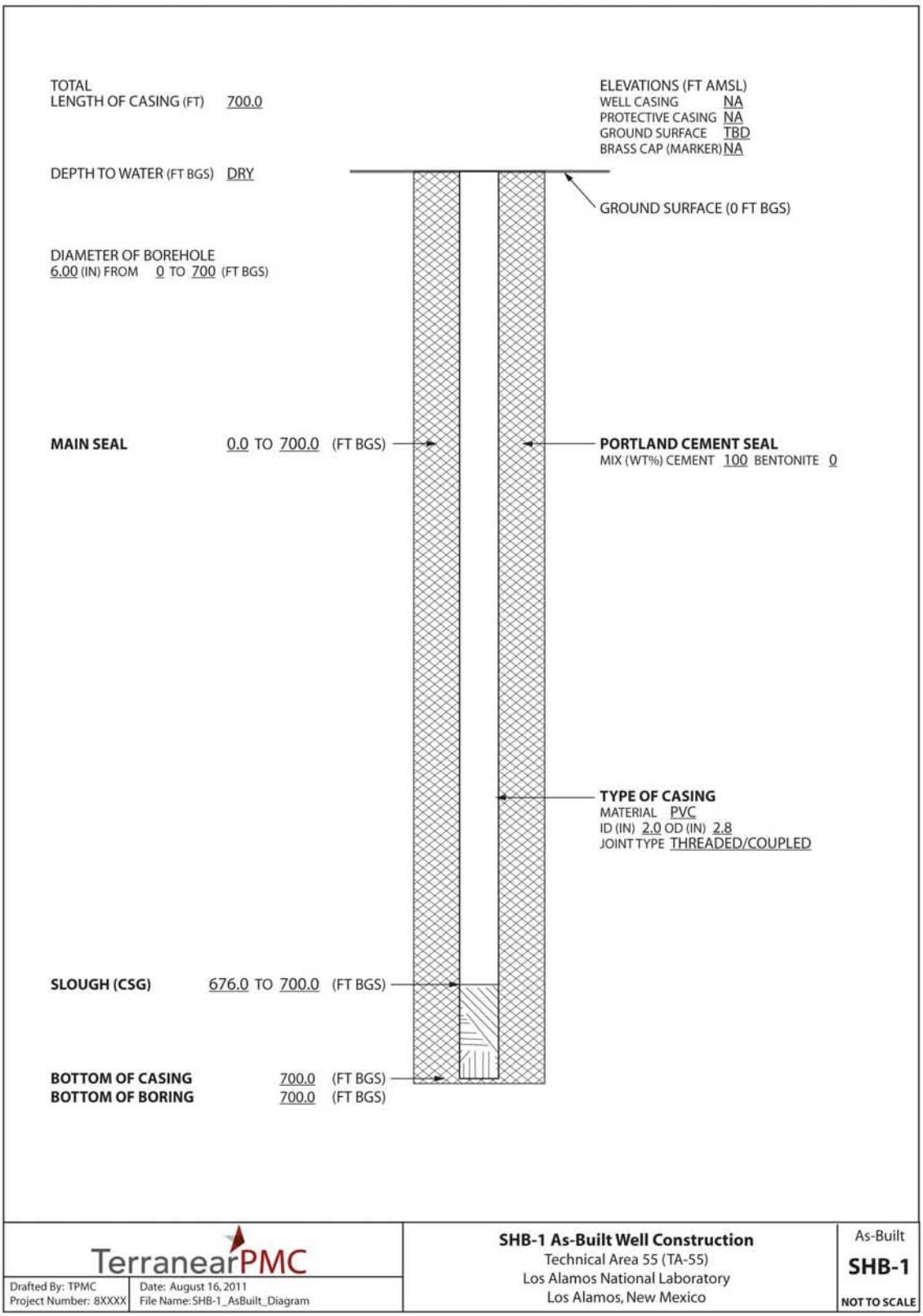

Figure 3.1-1 Well SHB-1 as-built construction diagram

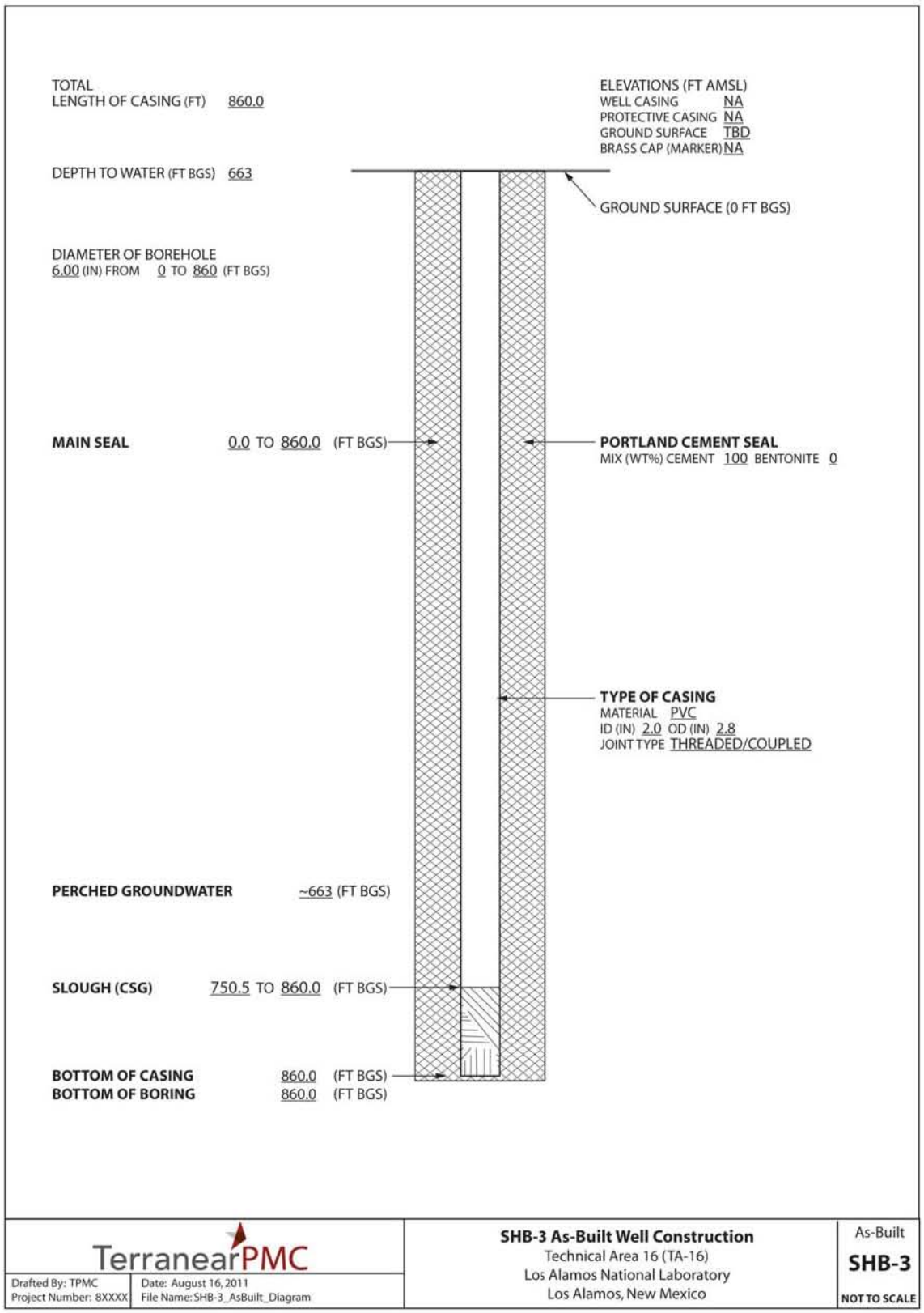

Figure 3.1-2 Well SHB-3 as-built construction diagram

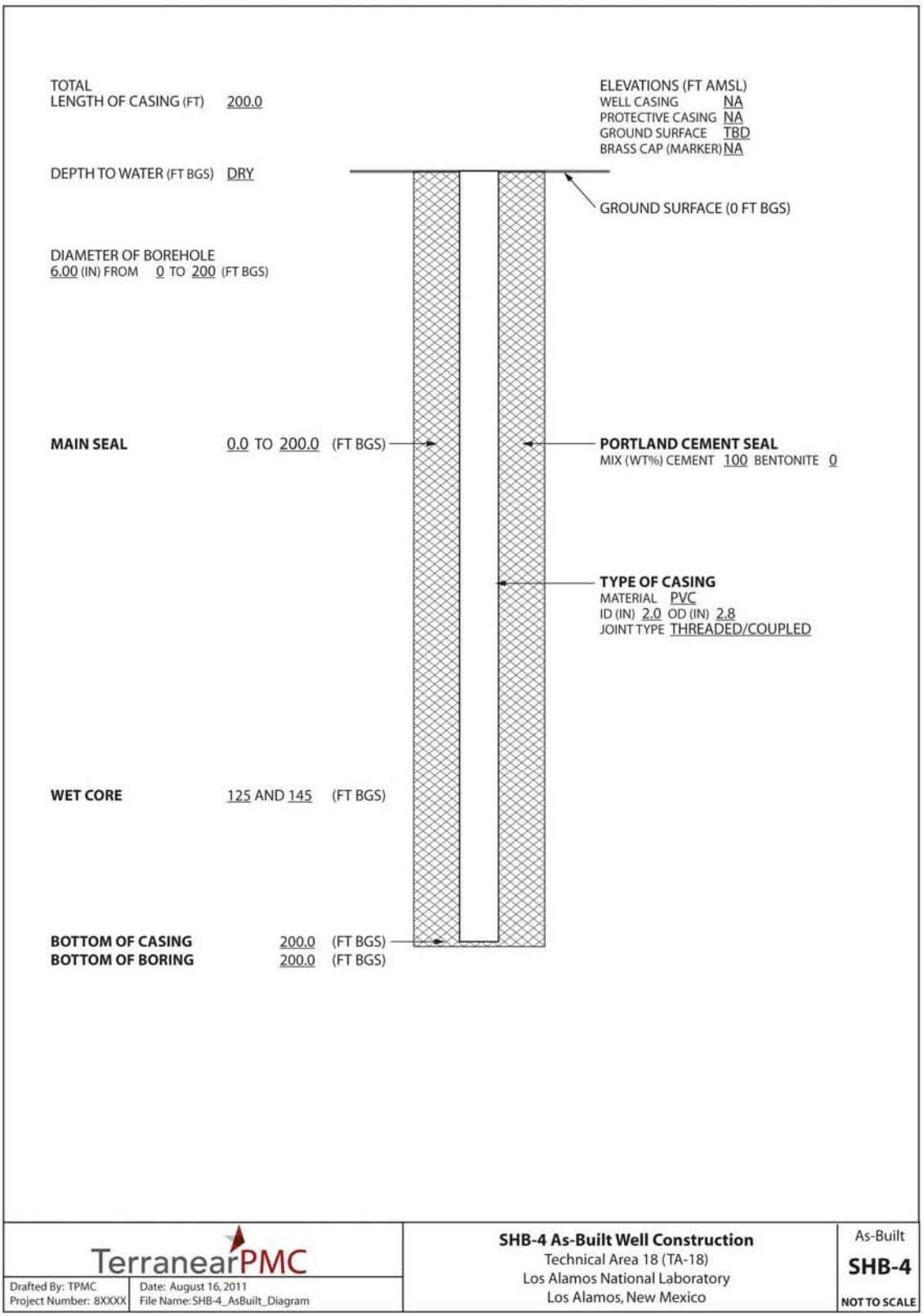

Figure 3.1-3 Well SHB-4 as-built construction diagram

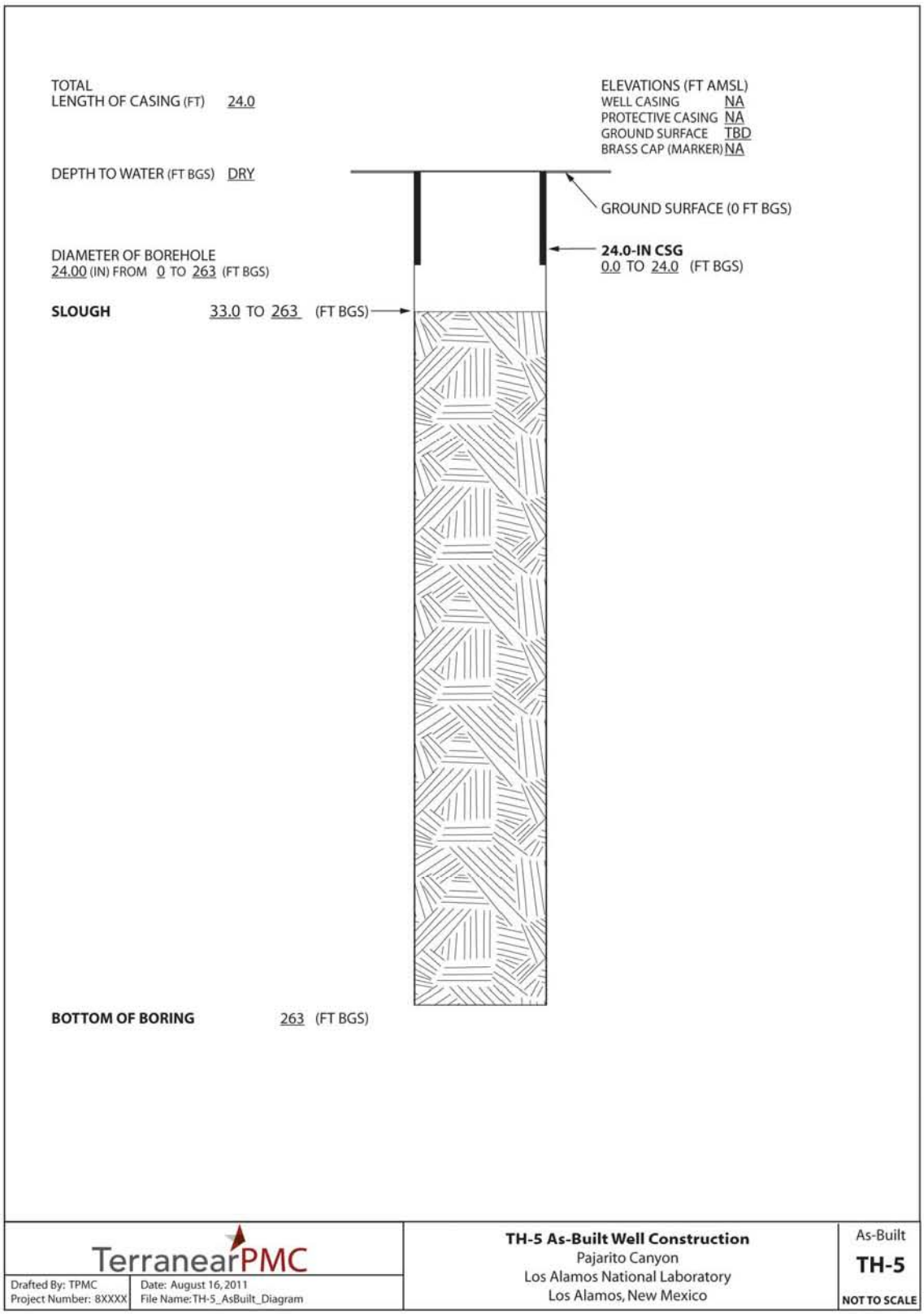

Figure 3.1-4 Well TH-5 as-built construction diagram

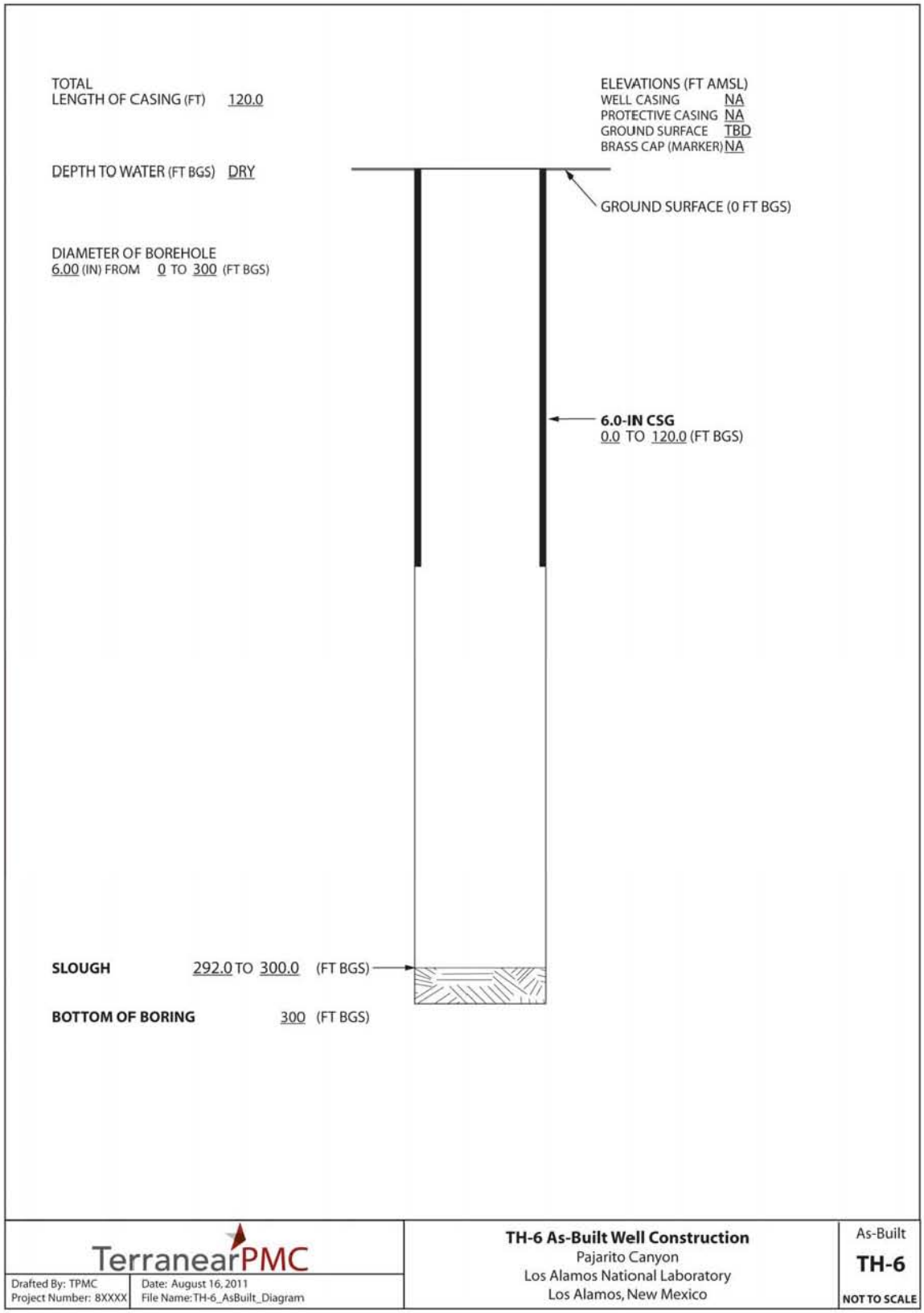

Figure 3.1-5 Well TH-6 as-built construction diagram

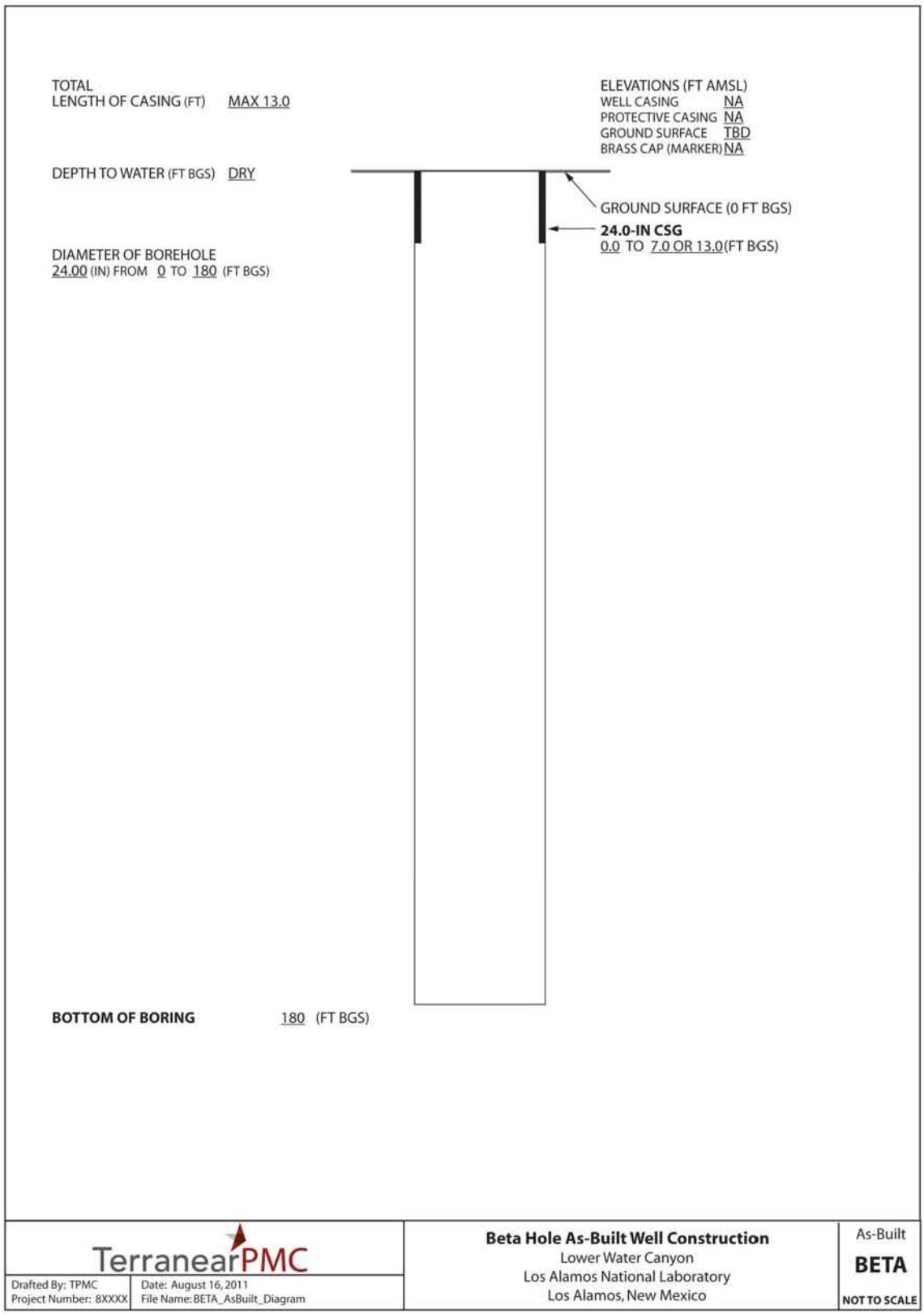

Figure 3.1-6 Well Beta Hole as-built construction diagram

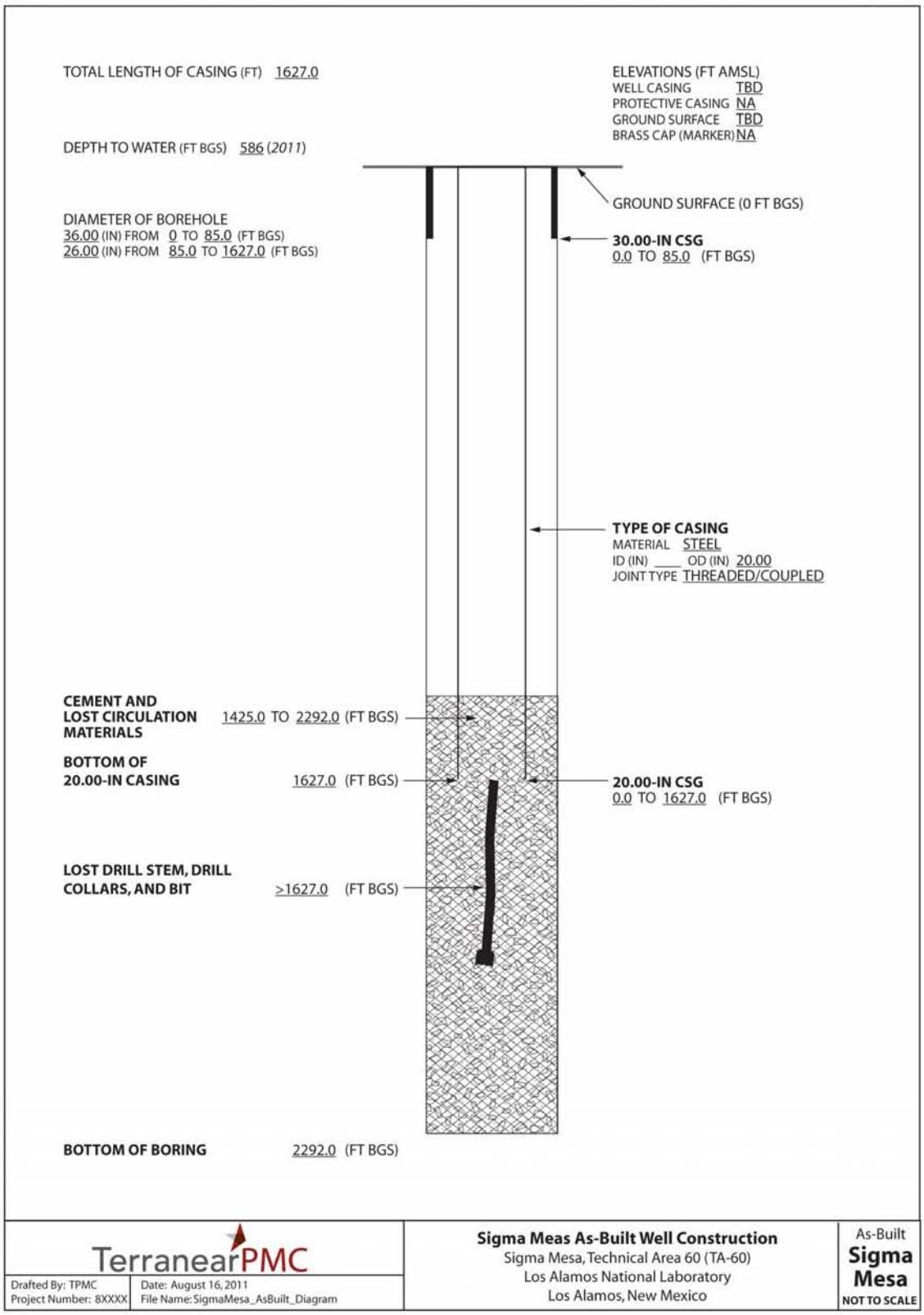

Figure 3.1-7 Sigma Mesa well as-built construction diagram

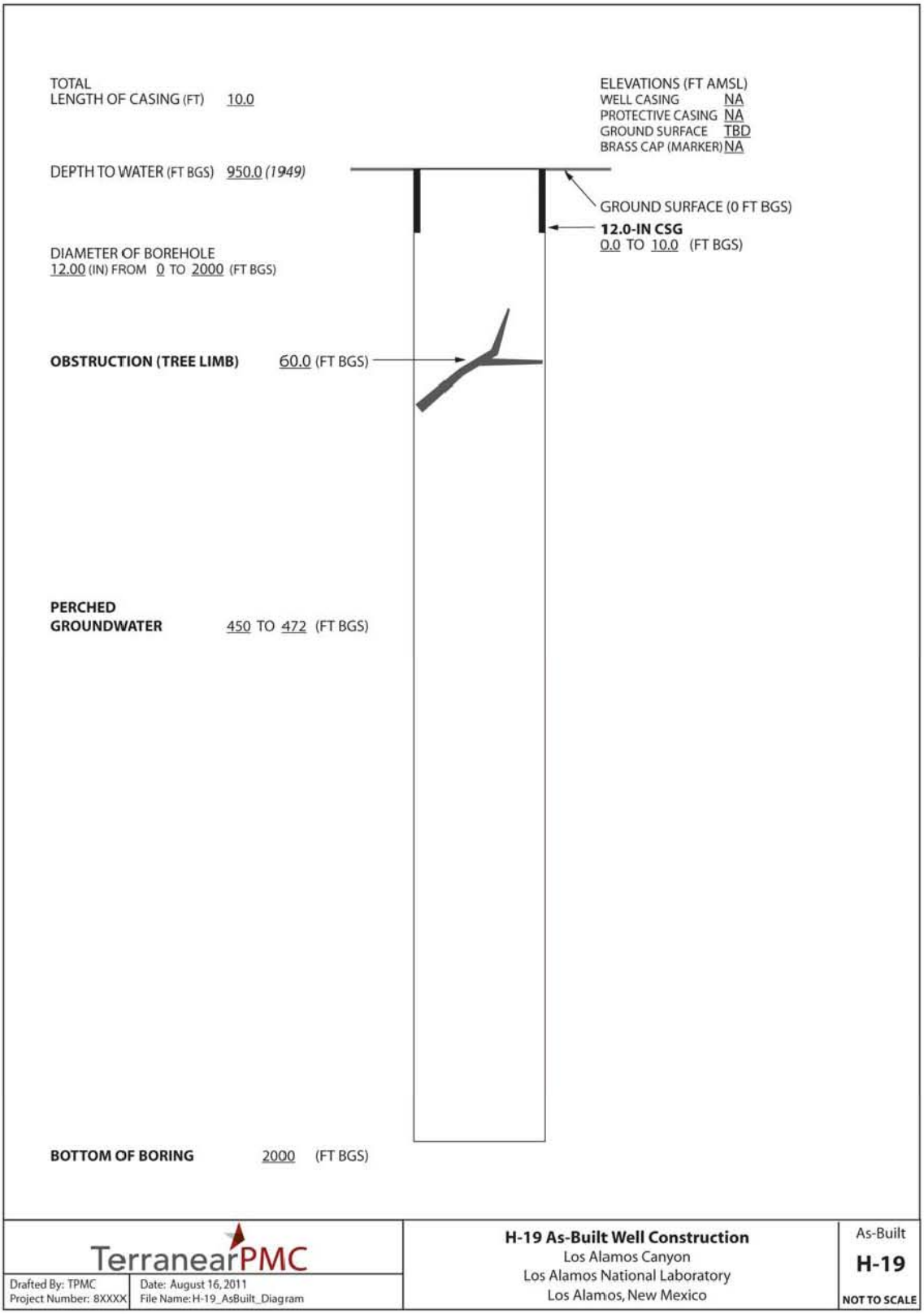

Figure 3.1-8 Well H-19 as-built construction diagram

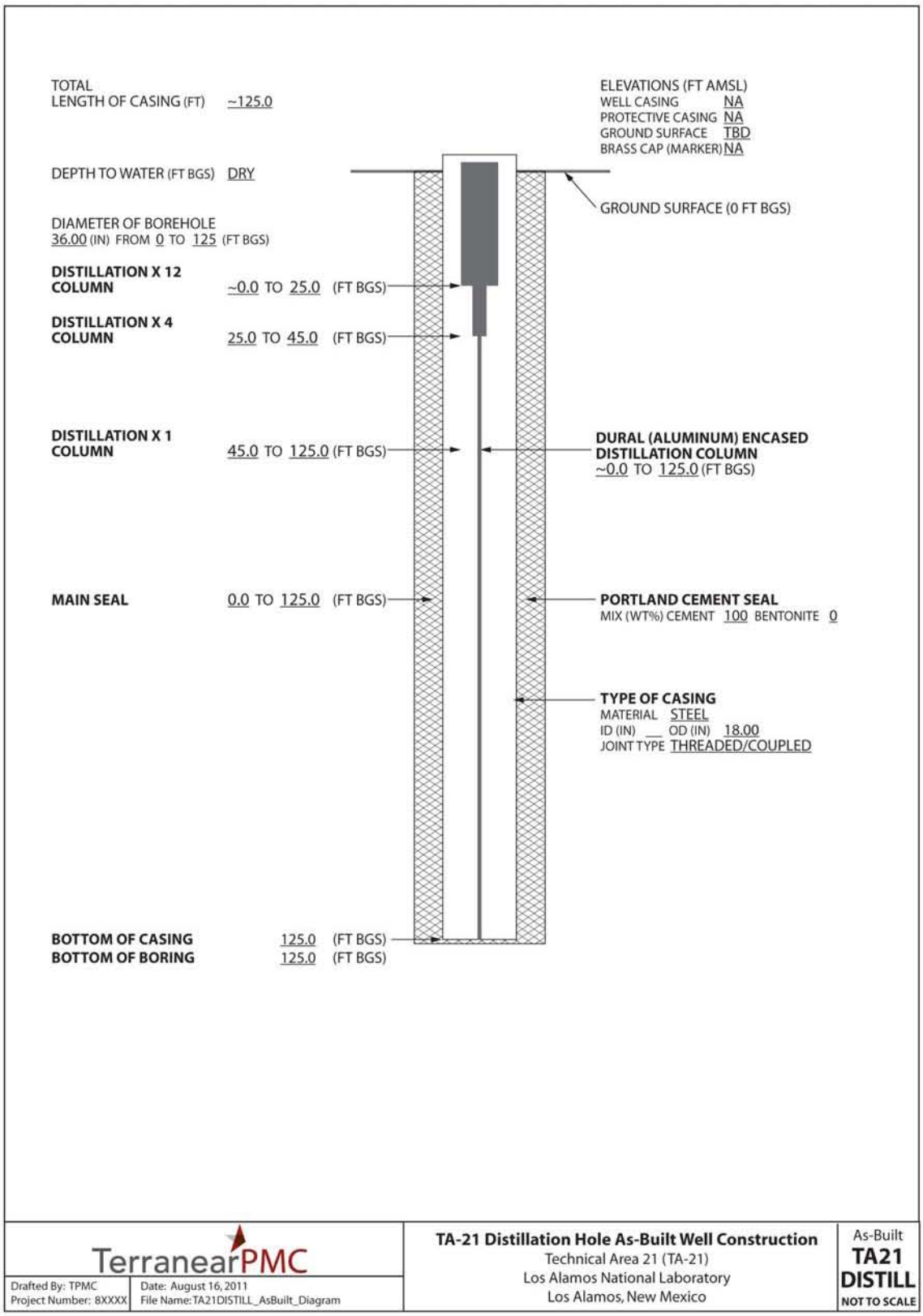

Figure 3.1-9 TA-21 Distillation Hole as-built construction diagram