Work Plans to Plug and Abandon Wells and Boreholes at Los Alamos National Laboratory

1.0 INTRODUCTION

This report contains 13 work plans for the plugging and abandonment of 29 wells and boreholes at Los Alamos National Laboratory (LANL or the Laboratory) and one well located slightly north of the Laboratory boundary. The work plans have been prepared in response to the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), requesting that the wells or boreholes be plugged and abandoned to prevent potential contaminant migration into the subsurface.

The work plans describe plugging and abandonment procedures that comply with Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent for the Laboratory, as well as the New Mexico Office of the State Engineer (NMOSE) well or borehole abandonment regulations. In addition to these work plans, plugging plans for the wells or boreholes that penetrate groundwater will be submitted to NMOSE before abandonment.

A separate report entitled "Information on Wells and Boreholes, Los Alamos National Laboratory and Surrounding Areas" (LANL 2009, 107626) describes in detail the history of the wells/boreholes, construction details, and proximity to known water-bearing zones. It provides the background detail for the work plans contained herein. Before abandonment activities begin, field reconnaissance will be conducted at the wells and boreholes to check for the presence of water and possible obstructions.

This report includes 13 standalone work plans and associated figures as shown in Table 1.0-1. References for the work plans are provided at the end of this report.

Table 1.0-1
Organization of Work Plans

Table 1.0-1 (continued)

2.0 WORK PLAN TO PLUG AND ABANDON WELL H-19

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for well H-19 located in Los Alamos Canyon. Well abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order), and the New Mexico Office of the State Engineer (NMOSE) regulations. A plugging plan will be submitted to NMOSE before abandonment.
Construction	Well H-19 was drilled by the cable tool method in 1949 to 2000 ft below ground surface (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 the well is constructed as follows: • 0−10 ft bgs—12-in. surface casing • 10−2000 ft bgs—open
Abandonment Methods	The existing surface casing and any exterior appurtenances will be removed from the well before abandonment begins. The borehole will be drilled out to approximately 525 ft bgs to seal off an intermediate perched zone encountered at the base of the Bandelier Tuff from 450−472 ft bgs during initial well drilling. The borehole will be backfilled with 3/8-in. bentonite chips to within 10 ft of the ground surface. Neat cement will be placed above the bentonite to within 2 ft of ground surface. Figure 2.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of the borehole and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad. A brass marker will be embedded in the surface pad. It will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the borehole will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for both NMED and NMOSE detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

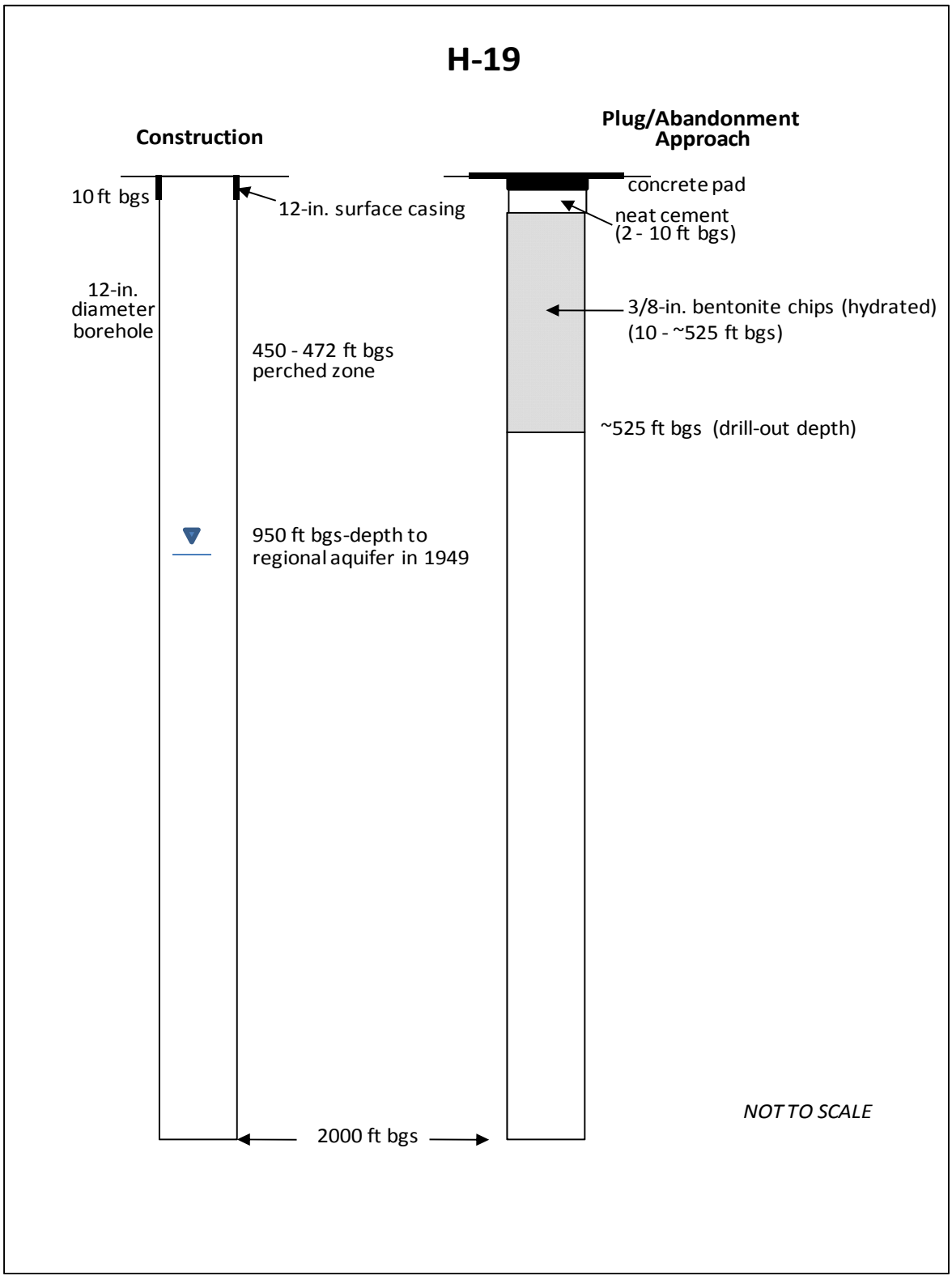

Figure 2.0-1 Well H-19 abandonment schematic

3.0 WORK PLAN TO PLUG AND ABANDON LAYNE WESTERN WELL

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for the Layne Western Well located in Guaje Canyon. Well abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order), and the New Mexico Office of the State Engineer (NMOSE) regulations. A plugging plan will be submitted to NMOSE before abandonment.
Construction	The Layne Western Well was installed in 1950 to 157 ft below ground surface (bgs) (Purtymun 1995, 045344). The depth to water in 1960 was 105 ft bgs. The borehole is approximately 10 in. in diameter and the well is constructed as follows: • 0− ~10−12 ft bgs—12−14-in. surface casing (Purtymun and Swanton 1998, 099096) • 0−127 ft bgs—8-in. casing • 127−147 ft bgs—8-in. screen • 147−157 ft bgs—open
Abandonment Methods	Any interior and exterior appurtenances will be removed from the well when field work begins. The 12−14-in.-diameter surface casing will be removed. An attempt will be made to remove the 8-in. casing using a pull-back pressure of approximately 125% of the calculated casing weight. If the casing can be removed, the borehole will be filled with 3/8-in. bentonite chips to within 10 ft of ground surface and with neat cement above that to approximately 2 ft bgs. If the 8-in. casing cannot be removed, it will be perforated from approximately 125 to 90 ft bgs, and then the well screen and casing will be pressure-grouted to within 2 ft of ground surface. The annular space around the 8-in. casing will be filled with neat cement from a minimum of 20 ft bgs to 2 ft bgs; the casing will be cut off approximately 2 ft bgs. Figure 3.0-1 shows both abandonment alternatives.
Surface Completion	Concrete will be placed above the neat cement at the top of the borehole and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad. A brass marker will be embedded in the surface pad. It will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the well will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for both NMED and NMOSE detailing the abandonment methods and the quantities of backfill materials used. A location map and an abandonment schematic will also be included in the report.

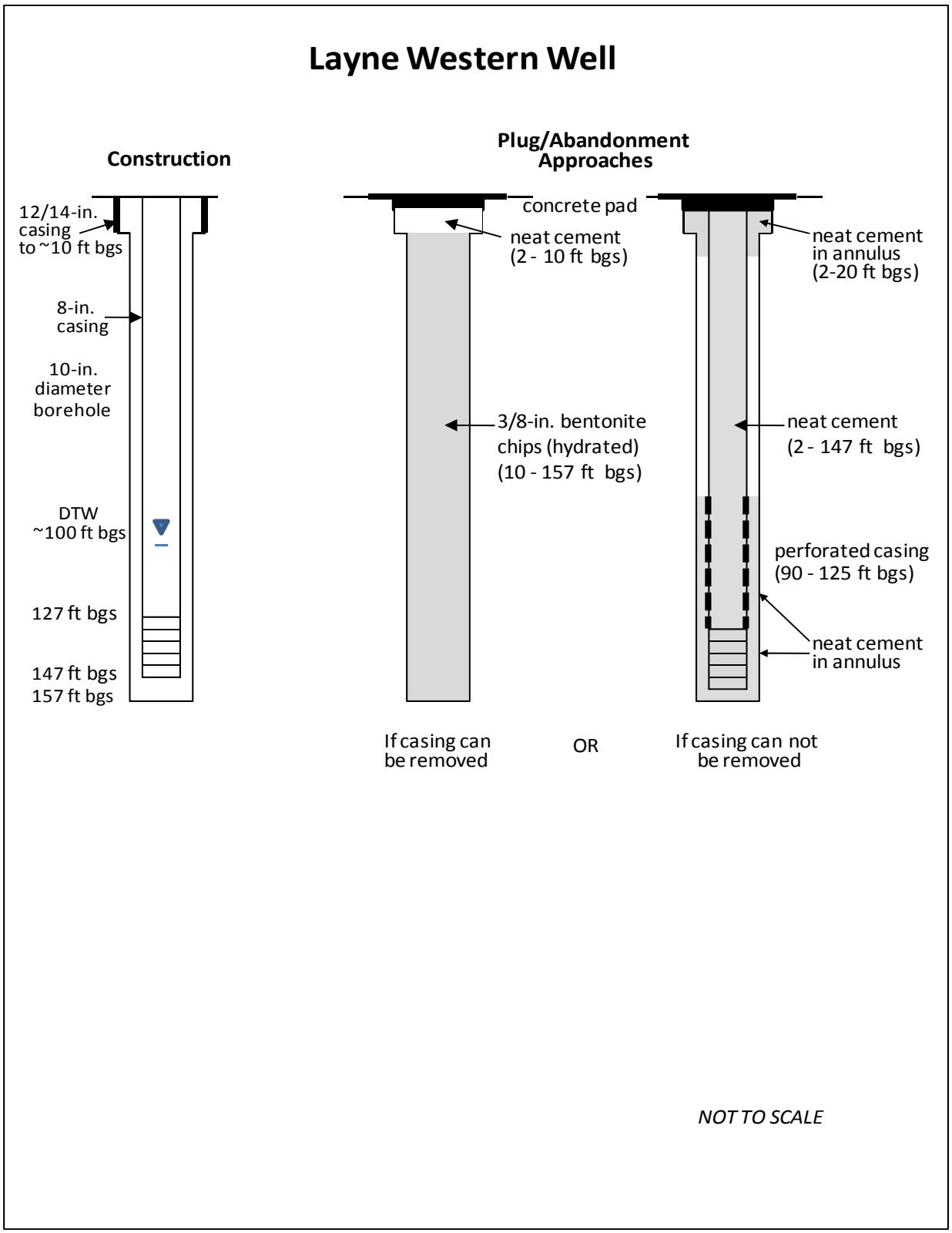

Figure 3.0-1 Layne Western Well abandonment schematic

4.0 WORK PLAN TO PLUG AND ABANDON SIGMA MESA WELL

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for the Sigma Mesa Well (EGH-LA-1) located on Sigma Mesa. Well abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order), and the New Mexico Office of the State Engineer (NMOSE) regulations. A plugging plan will be submitted to NMOSE before abandonment.
Construction	The Sigma Mesa Well was drilled with rotary drilling techniques in 1979 to 2292 ft below ground surface (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
Abandonment Methods	Any exterior appurtenances will be removed from the well before abandonment begins. The 20-in. well casing will be perforated between ~1425 and 1250 ft bgs and pressure-grouted from 1425 ft bgs to within 2 ft of ground surface. The 30-in. surface casing will be cut approximately 20 ft bgs and removed; the 20-in. well casing will be cut off approximately 2 ft bgs. The annulus between the well casing and the borehole wall will be cemented from 2 ft to 20 ft bgs. Figure 4.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of the borehole and then formed into a 4-ft × 4-ft × 0.5-ft-thick surface pad. A brass marker will be embedded in the surface pad. It will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the well will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for both NMED and NMOSE detailing the abandonment methods and the quantities of backfill materials used. A location map and an abandonment schematic will also be included in the report.

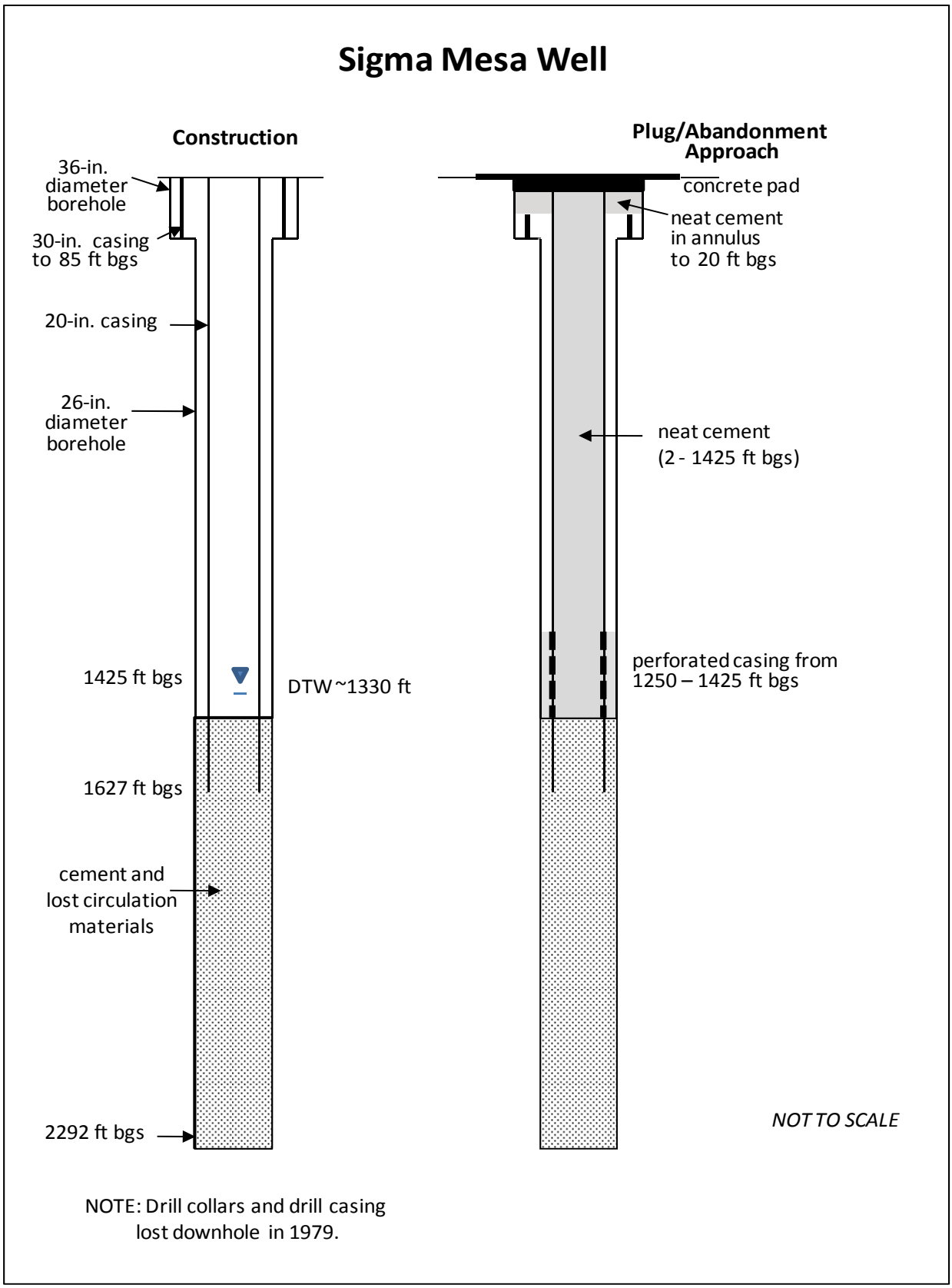

Figure 4.0-1 Sigma Mesa Well abandonment schematic

5.0 WORK PLAN TO PLUG AND ABANDON TEST HOLES 5 AND 6, PAJARITO CANYON

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for Test Holes 5 and 6 (TH-5 and TH-6) located in Pajarito Canyon. Well abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order), and the New Mexico Office of the State Engineer (NMOSE) regulations. A plugging plan will be submitted to NMOSE before abandonment.
Construction	TH-5 and TH-6 are investigation boreholes drilled in Pajarito Canyon in 1950; TH-5 was drilled to 263 ft below ground surface (bgs) and TH-6 was drilled to 300 ft bgs (Purtymun 1995, 045344; Purtymun and Swanton 1998, 099096). Surficial alluvial water (alluvium extended to approximately 25 ft bgs in both boreholes) was encountered and cased off in both boreholes; intermediate perched zone groundwater was not present in either borehole. TH-5 is 24 in. in diameter with 24-in. surface casing to 24 ft bgs and open to 263 ft bgs. TH-6 is 6 in. in diameter with 6-in. casing to 120 ft bgs and open to 300 ft bgs.
Abandonment Methods	Any exterior appurtenances will be removed from the boreholes before abandonment begins. TH-5: The 24-in. surface casing will be removed and the open borehole will be filled with 3/8-in. bentonite chips to within 10 ft bgs. Neat cement will be placed above the bentonite to approximately 2 ft bgs. TH-6: An attempt will be made to remove the 120-ft-long casing in TH-6 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 total depth 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 approximately 2 ft bgs. Figures 5.0-1 and 5.0-2 show the planned abandonment approaches for TH-5 and TH-6, respectively.
Surface Completion	Concrete will be placed above the neat cement at the top of the boreholes and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad at TH-6. At TH-5, a 3-ft × 3-ft × 0.5-ft-thick pad will be installed. Brass markers will be embedded in each surface pad. They will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the boreholes will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for both NMED and NMOSE detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematics will also be included in the report.

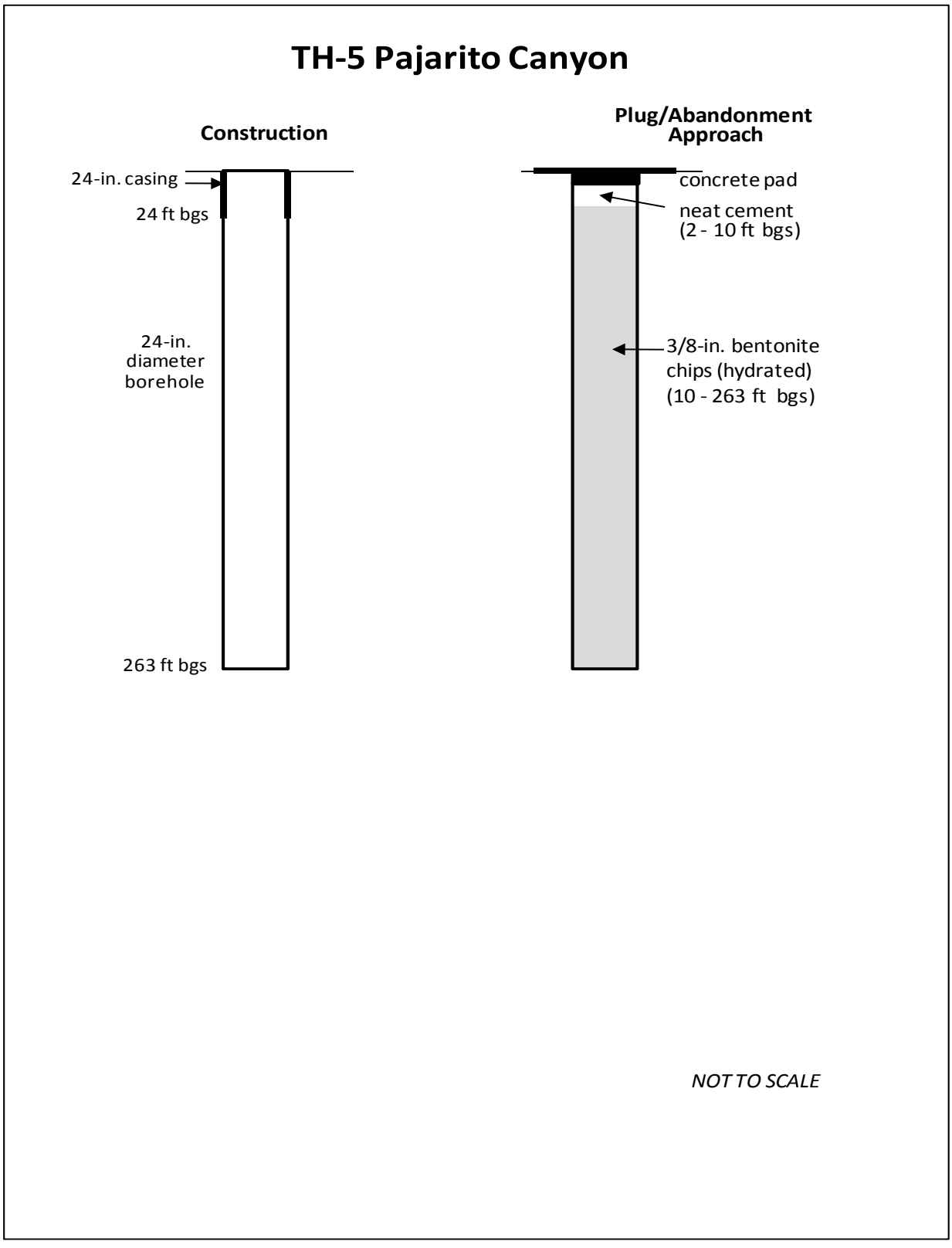

Figure 5.0-1 TH-5, Pajarito Canyon, abandonment schematic

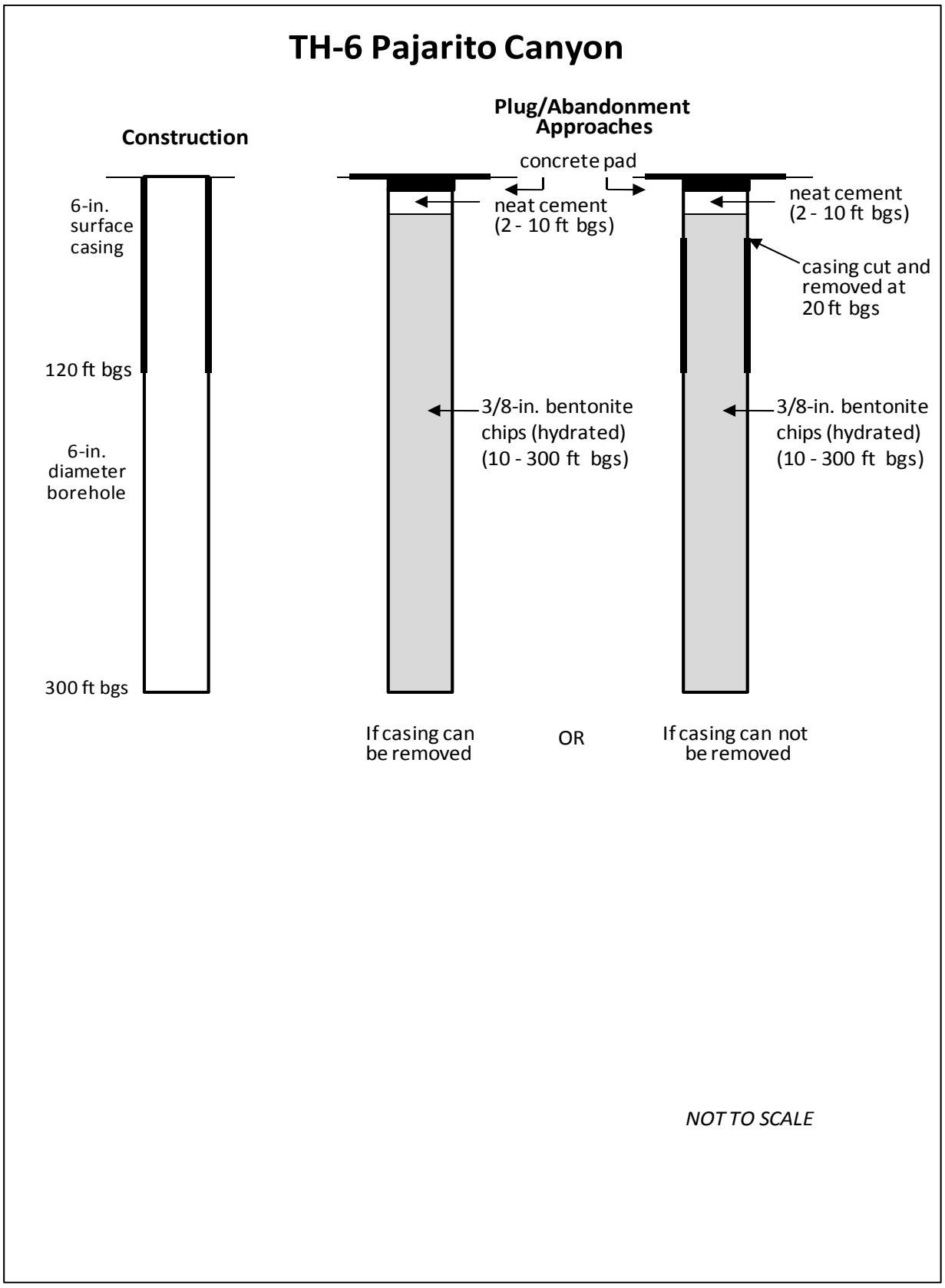

Figure 5.0-2 TH-6, Pajarito Canyon, abandonment schematic

6.0 WORK PLAN TO PLUG AND ABANDON SEISMIC HAZARD BOREHOLES 1, 3, AND 4

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for Seismic Hazard Boreholes 1, 3, and 4 (SHB-1, SHB-3, and SHB-4), located in Technical Area 55 (TA-55), TA-16, and TA-18, respectively. Well abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order), and the New Mexico Office of the State Engineer (NMOSE) regulations. Plugging plans for SHB-3 and SHB-4 will be submitted to NMOSE before abandonment.
Construction	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.
Abandonment Methods	Any exterior appurtenances will be removed from SHB-1, SHB-3, and SHB-4 before abandonment begins. The 2.8-in. PVC casings in the holes will be filled with neat cement to within 2 ft of ground surface; the casings will be cut off at approximately 2 ft bgs. Figures 6.0-1, 6.0-2, and 6.0-3 show the planned abandonment approaches for SHB-1, SHB-3, and SHB-4, respectively.
Surface Completion	Concrete will be placed above the neat cement at the top of each borehole and then formed into 2-ft × 2-ft × 0.5-ft-thick surface pads. Brass markers will be embedded in the surface pads. They will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the boreholes will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. Plugging reports for SHB-3 and SHB-4 will be submitted to NMOSE. Location maps and abandonment schematics will be included in the reports.

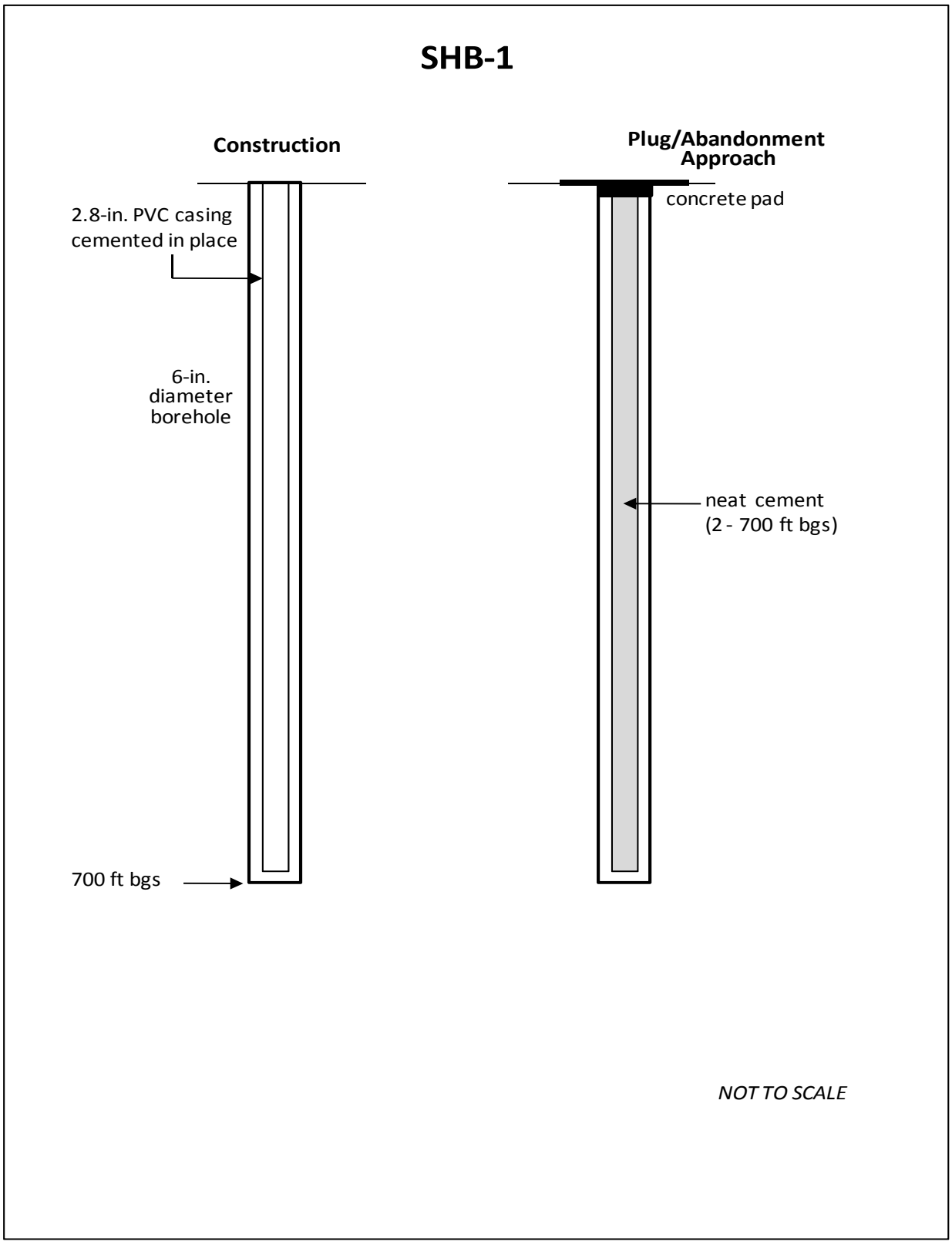

Figure 6.0-1 Borehole SHB-1 abandonment schematic

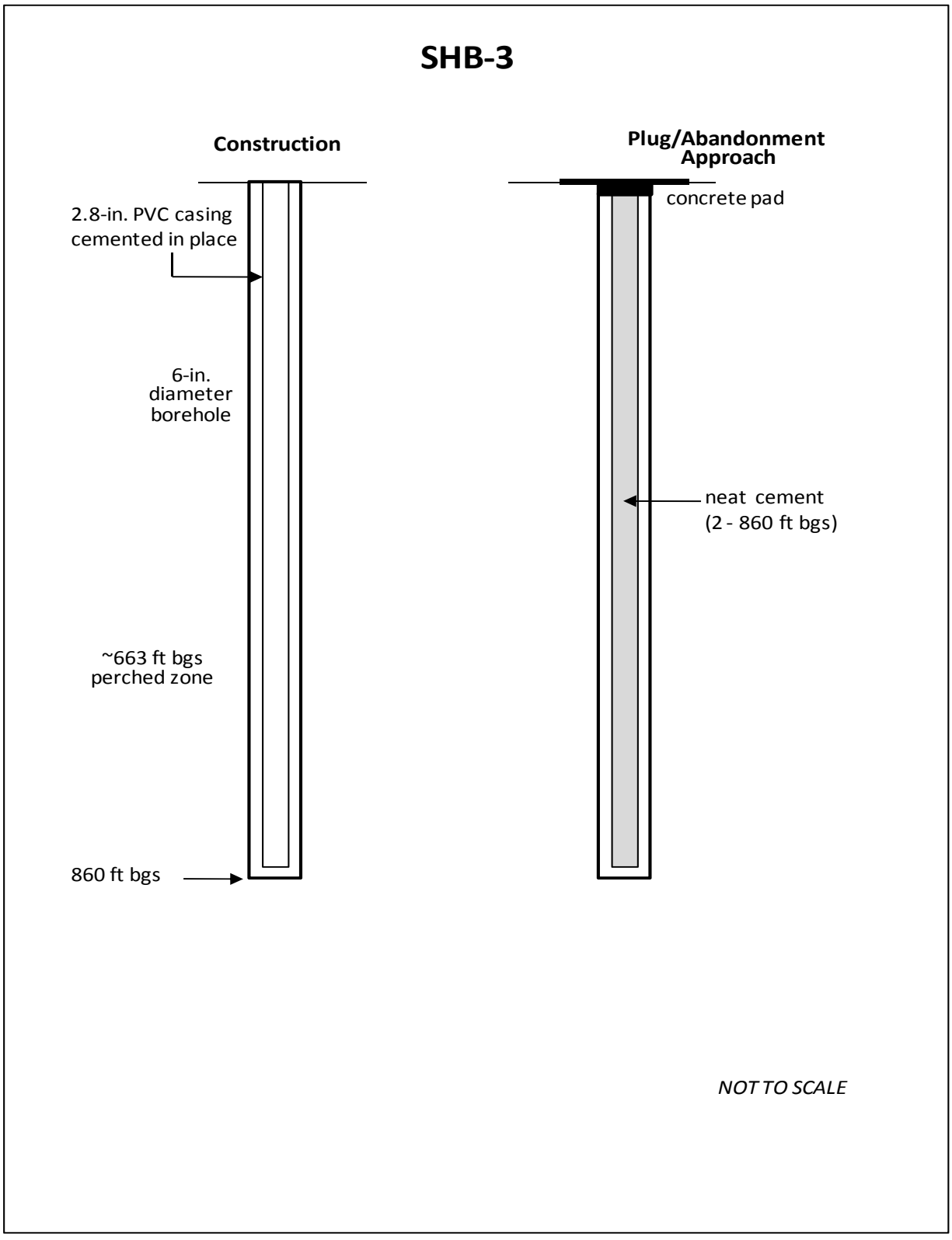

Figure 6.0-2 Borehole SHB-3 abandonment schematic

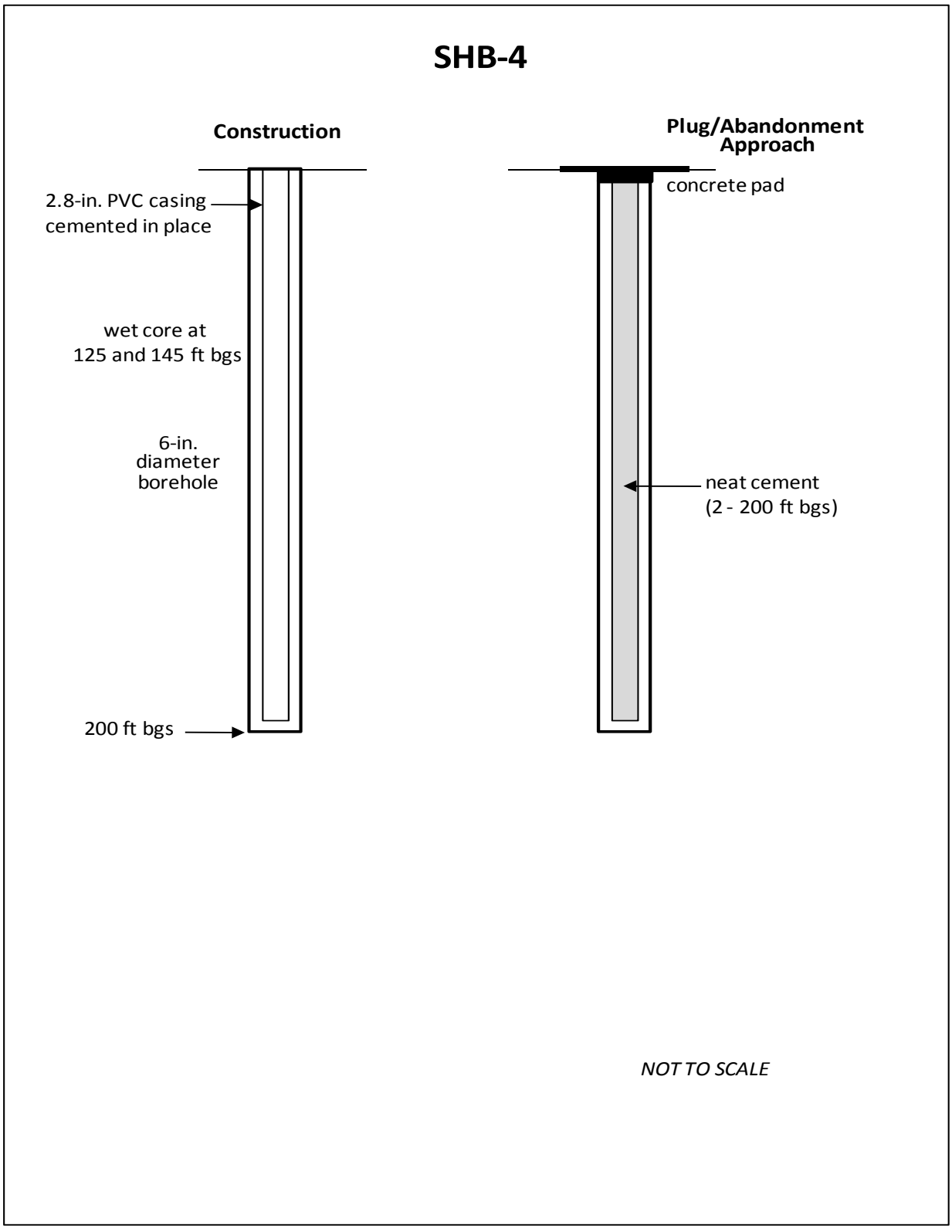

Figure 6.0-3 Borehole SHB-4 abandonment schematic

7.0 WORK PLAN TO PLUG AND ABANDON TECHNICAL AREA 21 DISTILLATION HOLE

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for the Technical Area 21 (TA-21) distillation hole. Hole abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	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 below ground surface (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 abovegrade. The hole has been covered to prevent water infiltration.
Abandonment Methods	Surface appurtenances will be removed from the distillation hole at TA-21. 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 within 2 ft of the ground surface. The well casing will be cut off approximately 2 ft bgs. Figure 7.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of the borehole and then formed into a 4-ft × 4-ft × 0.5-ft-thick surface pad. A brass marker will be embedded in the surface pad. It will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of wastes generated during abandonment. Materials removed from the borehole will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematics will also be included in the report.

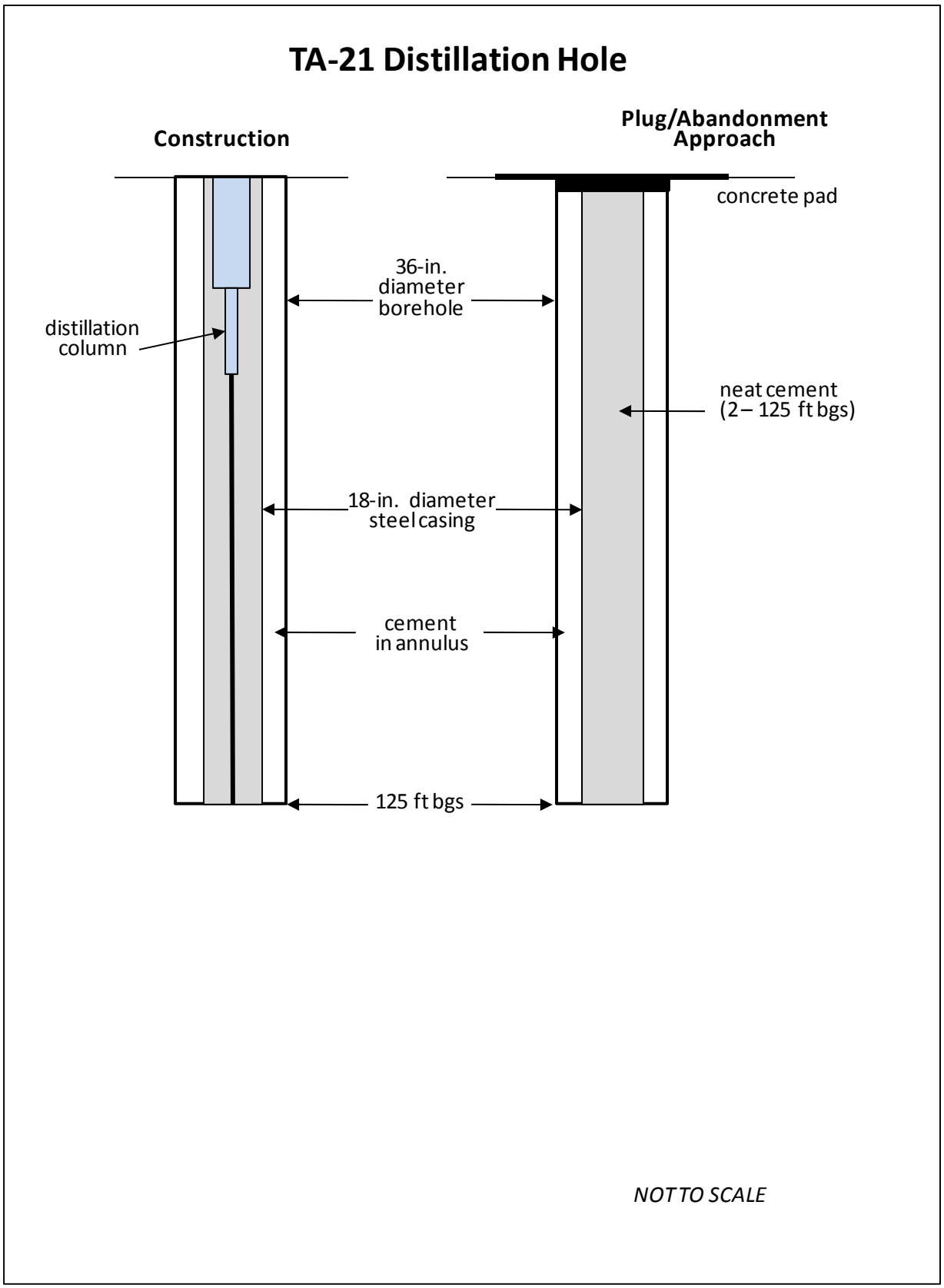

Figure 7.0-1 TA-21 distillation hole abandonment schematic

8.0 WORK PLAN TO PLUG AND ABANDON TECHNICAL AREA 46 DISTILLATION HOLES

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for the Technical Area 46 (TA-46) distillation holes in building 46-SM-88. Hole abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	The TA-46 distillation holes were drilled and instrumented in 1971 as part of a carbon isotope production plant. The exact number of distillation holes installed at TA-46 is uncertain. An engineering drawing was obtained that shows the locations of six 8-in.-diameter cased holes that were 747 ft deep (LASL 1971, 110888). The drawing notes indicate that the six cased holes were to be overdrilled to 18-in.-diameter holes with 14-in.-diameter casing installed to 747 ft below ground surface (bgs). Purtymun (1995, 045344) confirms the existence of the carbon isotope production plant but states that the overdrilled holes were 16-in. diameter. He also says 13 3/8-in. casing was cemented in place. The downhole configuration of the distillation columns is not known, but inferences may be drawn from the initial C-13 distillation column installed and instrumented at TA-21 in 1970 (Armstrong et al. 1970, 110889). Given that the TA-46 columns were installed 1 yr after the TA-21 column, similar designs would be likely. Based on the configuration of that 140-ft-long distillation column, and assuming that casing similarly protruded above the ground surface to allow the extensive piping and carbon recovery system used at TA-21 (Armstrong et al. 1970, 110889), the following inferred downhole configuration could be a rough approximation. Assume a total column length of 765 ft (745 ft bgs and 20 ft above ground surface [ags]). Based on the percentage lengths of the column components at the TA-21 distillation column, the following downhole configuration might be expected: • 745−305 ft bgs—1-in.-diameter column • 305−198 ft bgs—four 1-in.-diameter columns in parallel • 198 ft bgs−20 ft ags—twelve 1-in. columns As with the TA-21 distillation column, these components are likely encased in a 6-in.-diameter Dural vacuum jacket with machined Styrofoam spacers and aluminized Mylar film insulation.
Abandonment Methods	Surface coverings/plates will be removed from the high bay floor. An attempt will be made to remove as much of the distillation instrumentation as possible from the six holes. The cased holes will then be filled with neat cement to within 2 ft of the ground surface. The well casing will be cut off approximately 2 ft bgs. Figure 8.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of each borehole. Surface concrete pads approximately 2.5-ft × 2.5-ft × 0.5-ft thick with brass markers will then be installed flush with the existing high bay floor. The markers will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.

Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of wastes generated during abandonment. Materials removed from the boreholes will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematics will also be included in the report.

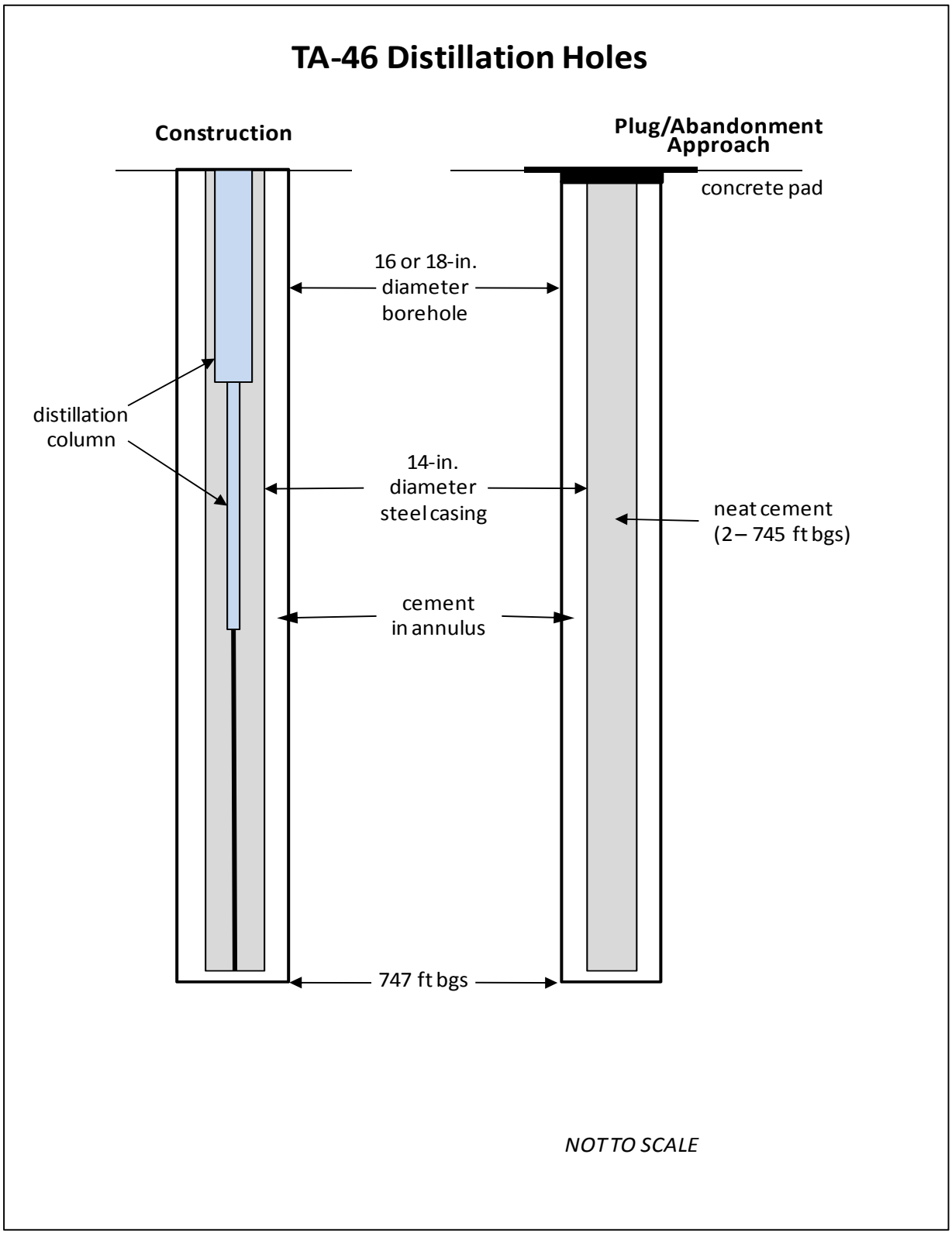

Figure 8.0-1 TA-46 distillation holes abandonment schematic

9.0 WORK PLAN TO PLUG AND ABANDON USGS TEST HOLE EAST OF MATERIAL DISPOSAL AREA C

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for the U. S. Geological Survey (USGS) Test Hole east of Material Disposal Area (MDA) C located at Technical Area 50 (TA-50). Well abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	The USGS Test Hole east of MDA C was drilled in 1983 to 210 ft below ground surface (bgs) (Purtymun 1995, 045344). The dry borehole is 4.5 in. in diameter, and casing was installed with six screens to conduct vadose zone monitoring tests. Screened intervals were installed at the following depths (bgs): • 25−30 ft • 50−55 ft • 78−83 ft • 105−110 ft • 140−145 ft • 190−195 ft The upper 22 ft of the annulus was sealed with cement; a mixture of cement and cuttings was placed in the annulus above and below each screen. In addition, heat dissipation probes were set in the annular space from 118 to 122 ft bgs.
Abandonment Methods	The existing exterior appurtenances will be removed from the borehole before abandonment begins. Any interior equipment or instrumentation remaining in the borehole will be removed and the 2-in. polyvinyl chloride casing will be filled with neat cement to approximately 10 ft bgs. Neat cement will then be placed in the casing to within 2 ft bgs. The casing will be cut off approximately 2 ft bgs. Figure 9.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of the borehole and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad. A brass marker will be embedded in the surface pad. It will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Waste samples of the annular fill materials may be required. Materials removed from the borehole will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

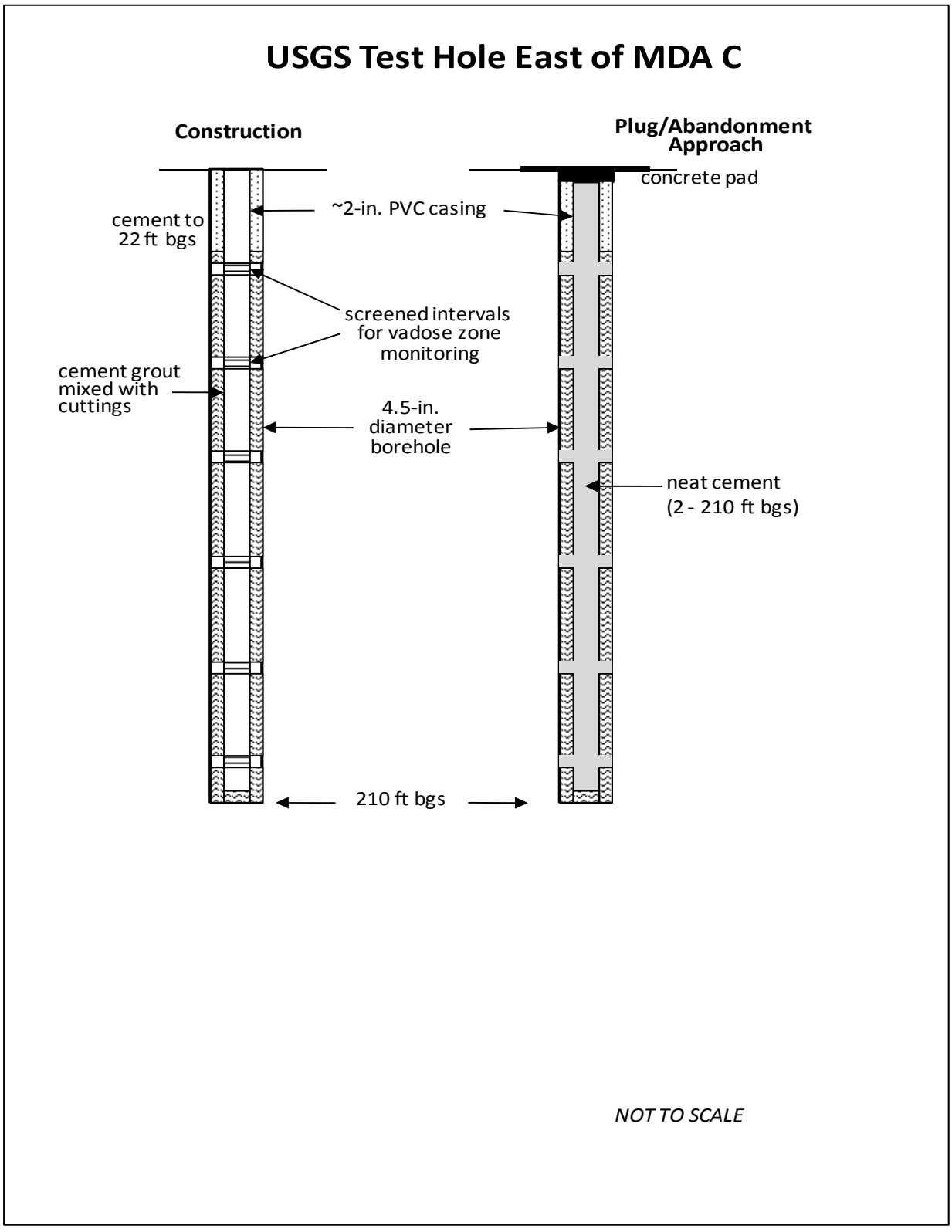

Figure 9.0-1 USGS Test Hole east of MDA C abandonment schematic

10.0 WORK PLAN TO PLUG AND ABANDON BETA HOLE

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for Beta Hole located in lower Water Canyon. Well abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	Beta Hole was drilled in 1950 with a bucket auger rig to 180 ft below ground surface (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.
Abandonment Methods	The corrugated metal surface casing and crumbling cement seal will be removed initially. Then the borehole will be backfilled with 3/8-in. bentonite chips to within 10 ft of the ground surface. Neat cement will then be placed in the borehole to within 2 ft bgs. Figure 10.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of the borehole and then formed into a 3-ft × 3-ft × 0.5-ft-thick surface pad. A brass marker will be embedded in the surface pad. It will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the borehole will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematic will also be included in the report.

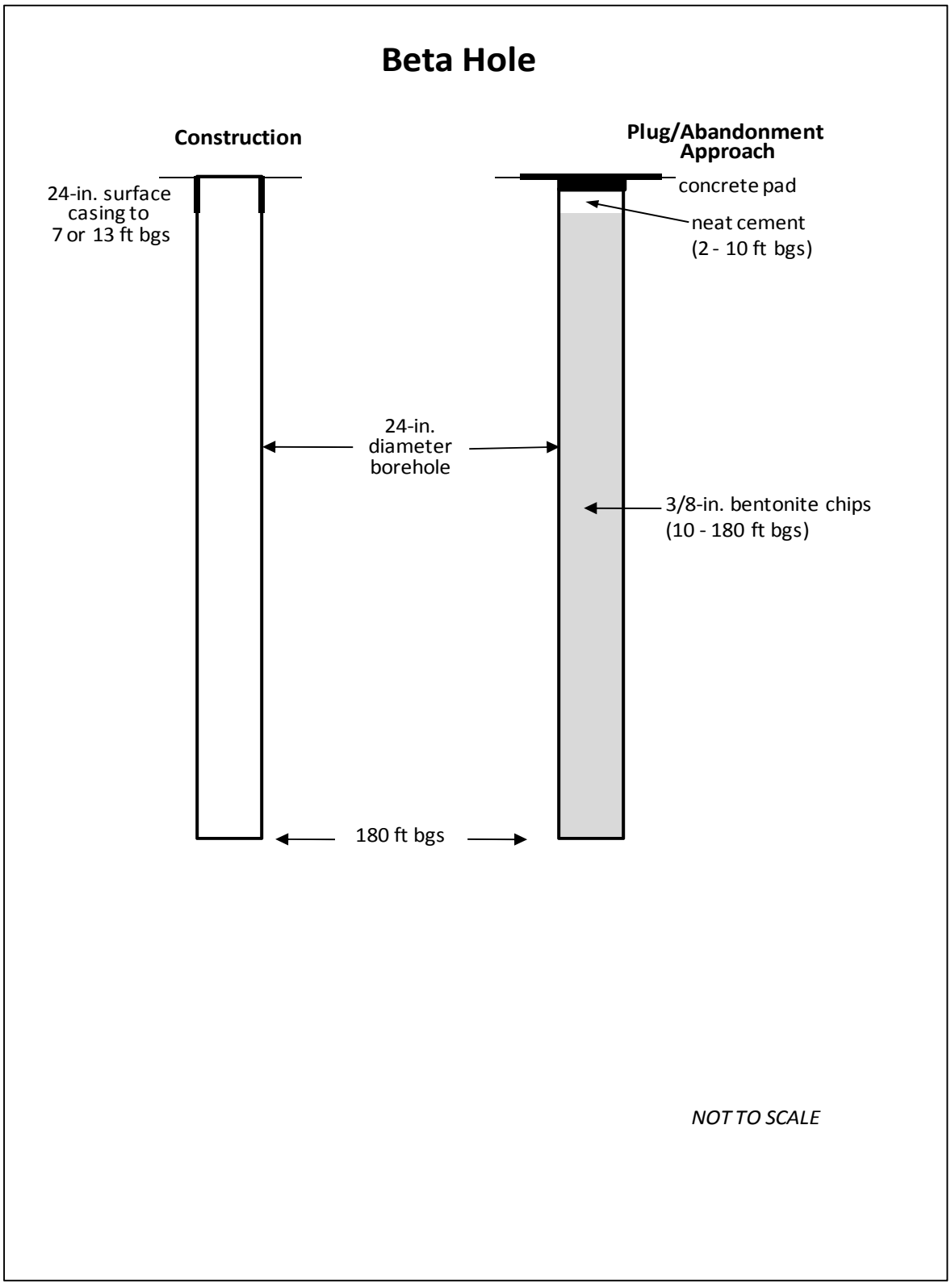

Figure 10.0-1 Beta Hole abandonment schematic

11.0 WORK PLAN TO PLUG AND ABANDON CORE HOLES 1, 3, AND 4 AT TECHNICAL AREA 49

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for core holes (CHs) 1, 3, and 4 located at Technical Area 49 (TA-49). Core hole abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	CH-1 was cored in 1959 to 501 ft below ground surface (bgs). CH-3 and CH-4 were cored in 1960 to 300 ft bgs and 303 ft bgs, respectively. The core holes are dry and are 4.5 in. in diameter (LANL 2008, 102215). They each contain 2-in. galvanized pipe to total depth (Purtymun 1995, 045344). The galvanized pipe is cemented in place.
Abandonment Methods	All aboveground and belowground appurtenances will be removed. The 2-in. galvanized pipe will be filled with neat cement to within 2 ft of ground surface. The casing will be cut off approximately 2 ft bgs. Figures 11.0-1, 11.0-2, and 11.0-3 show the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of each core hole and then formed into a 2-ft × 2-ft × 0.5-ft-thick surface pad. Brass markers will be embedded in the surface pads. They will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the holes will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematics will also be included in the report.

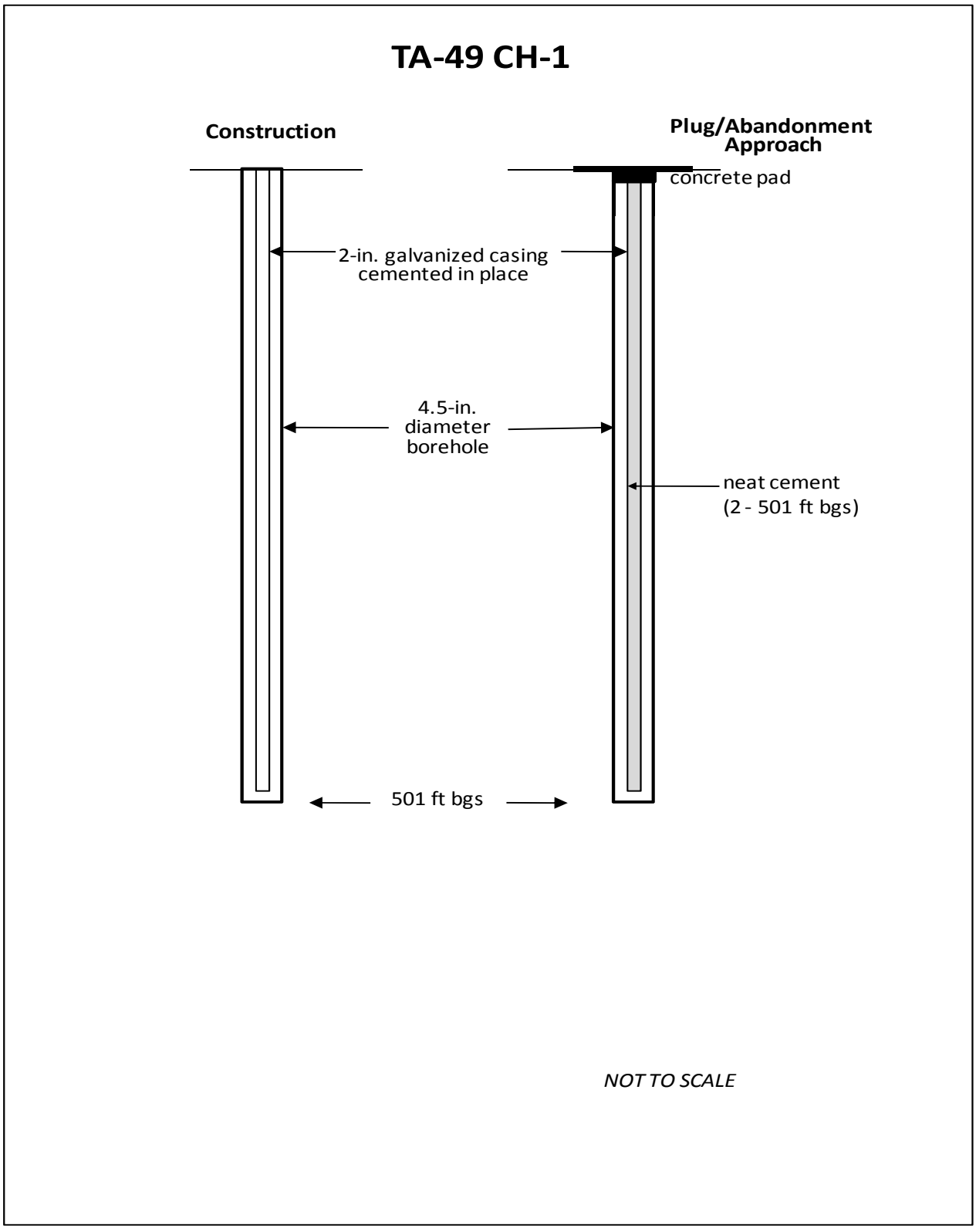

Figure 11.0-1 TA-49 CH-1 abandonment schematic

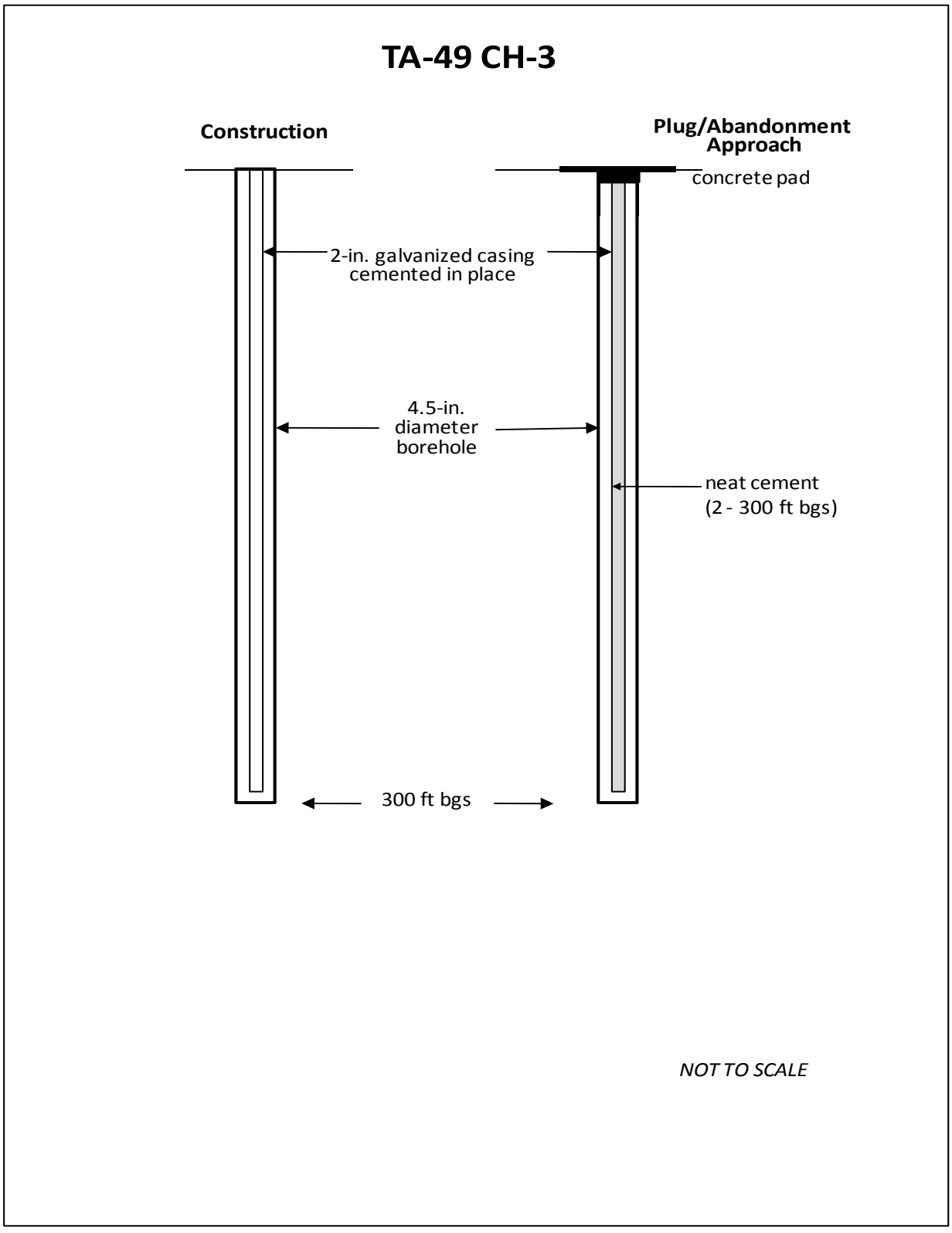

Figure 11.0-2 TA-49 CH-3 abandonment schematic

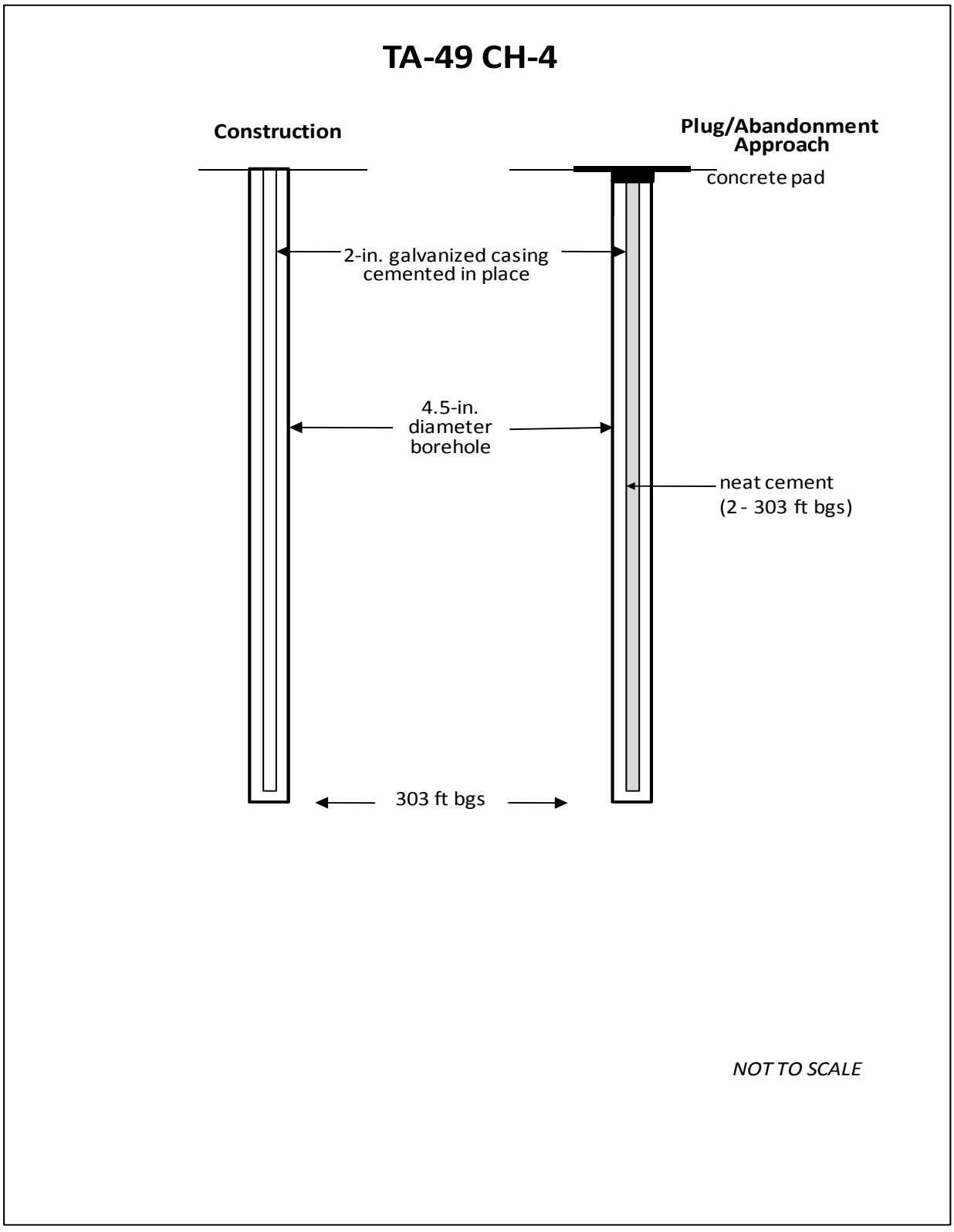

Figure 11.0-3 TA-49 CH-4 abandonment schematic

12.0 WORK PLAN TO PLUG AND ABANDON TEST HOLES 1, 2, 3, 4, AND 5 AT TECHNICAL AREA 49

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for Test Holes (THs) 1, 2, 3, 4, and 5 located at Technical Area 49 (TA-49). Borehole abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	TH-1, TH-2, TH-3, TH-4, and TH-5 were installed in 1980 to 123 ft below ground surface (bgs) for neutron moisture logging at Area 2 in TA-49. The dry boreholes are 5 in. in diameter with surface casing (presumed to be 5 in. in diameter) that extends to approximately 10 ft bgs.
Abandonment Methods	All aboveground and belowground appurtenances will be removed. The boreholes will be filled with 3/8-in. bentonite chips from total depth to within 10 ft of ground surface. The remainder of the boreholes will be filled with neat cement to within 2 ft of ground surface. The surface casing will be cut off approximately 2 ft bgs. Figure 12.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of each borehole and then formed into 2-ft × 2-ft × 0.5-ft-thick surface pads. Brass markers will be embedded in the surface pads. They will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the boreholes will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematics will also be included in the report.

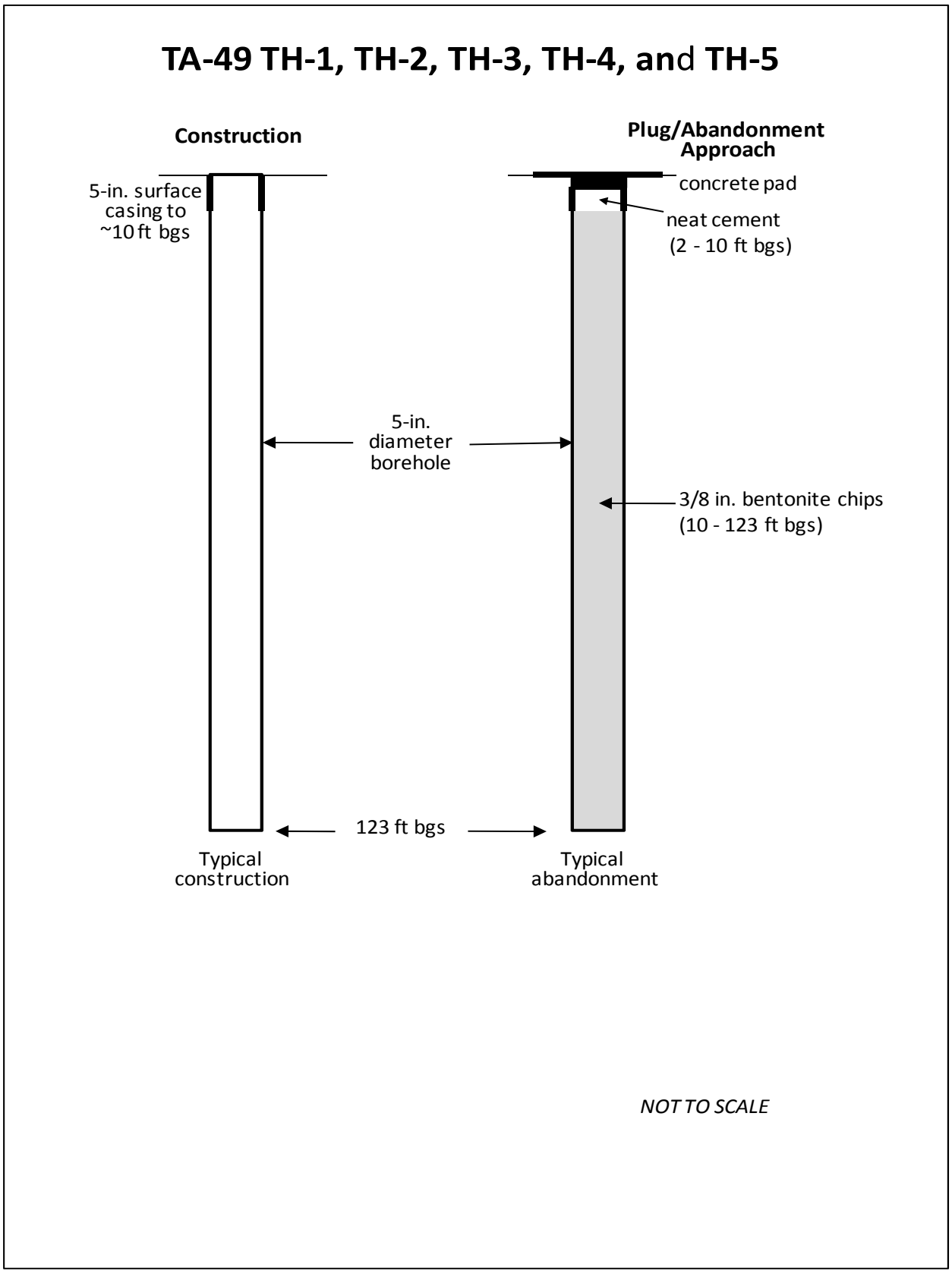

Figure 12.0-1 TA-49 TH-1, TH-2, TH-3, TH-4, and TH-5 abandonment schematic

13.0 WORK PLAN TO PLUG AND ABANDON TEST HOLES TBM-1 AND TBM-2

Primary Purpose	This work plan summarizes the plugging and abandonment methods Los Alamos National Laboratory (LANL or the Laboratory) proposes for test holes TBM-1 and TBM-2 located at Technical Area 49 (TA-49). Abandonment will be consistent with the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	TBM-1 and TBM-2 are barometric measurement core holes that were drilled immediately adjacent to one another at TA-49 in 1993. TBM-1 was drilled to 139 ft below ground surface (bgs), and TBM-2 was drilled to 64 ft bgs (Purtymun 1995, 045344). Both core holes are 7.25 in. in diameter and dry. TBM-1 contains three 0.5-in.-diameter polyvinyl chloride (PVC) casings with 1-ft screened intervals at 19 ft bgs, 79 ft bgs, and 124 ft bgs, respectively (each 0.5-in. casing has one screened interval). Sand was placed around each screened zone, with cement above and below; the intervals between the screens are filled with cuttings. TBM-2 contains a single 4-in.-diameter PVC pipe set to 40 ft bgs with a biaxial tiltmeter at the bottom to measure tuff deformation. The annulus and open borehole beneath the pipe are filled with sand.
Abandonment Methods	Any exterior appurtenances and interior instrumentation will be removed from TBM-1 and TBM-2 before abandonment begins. TBM-1: Neat cement will be poured into the PVC piping in an attempt to seal off the 1-ft screened intervals. Then an auger rig will be used to remove the piping and annular materials to approximately 20 ft bgs. Neat cement will be placed from 20 ft bgs to ground surface. TBM-2: Neat cement will be placed in the 4-in. PVC casing to approximately 20 ft bgs. Then an auger rig will be used to remove the upper 20 ft of the 4-in. PVC pipe and sand backfill from the borehole. Neat cement will then be placed from 20 ft bgs to ground surface. Figure 13.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of both boreholes and then formed into a 3-ft × 3-ft × 0.5-ft-thick surface pad. A brass marker will be embedded in the surface pad. It will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the boreholes will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of backfill materials used. A location map and abandonment schematics will also be included in the report.

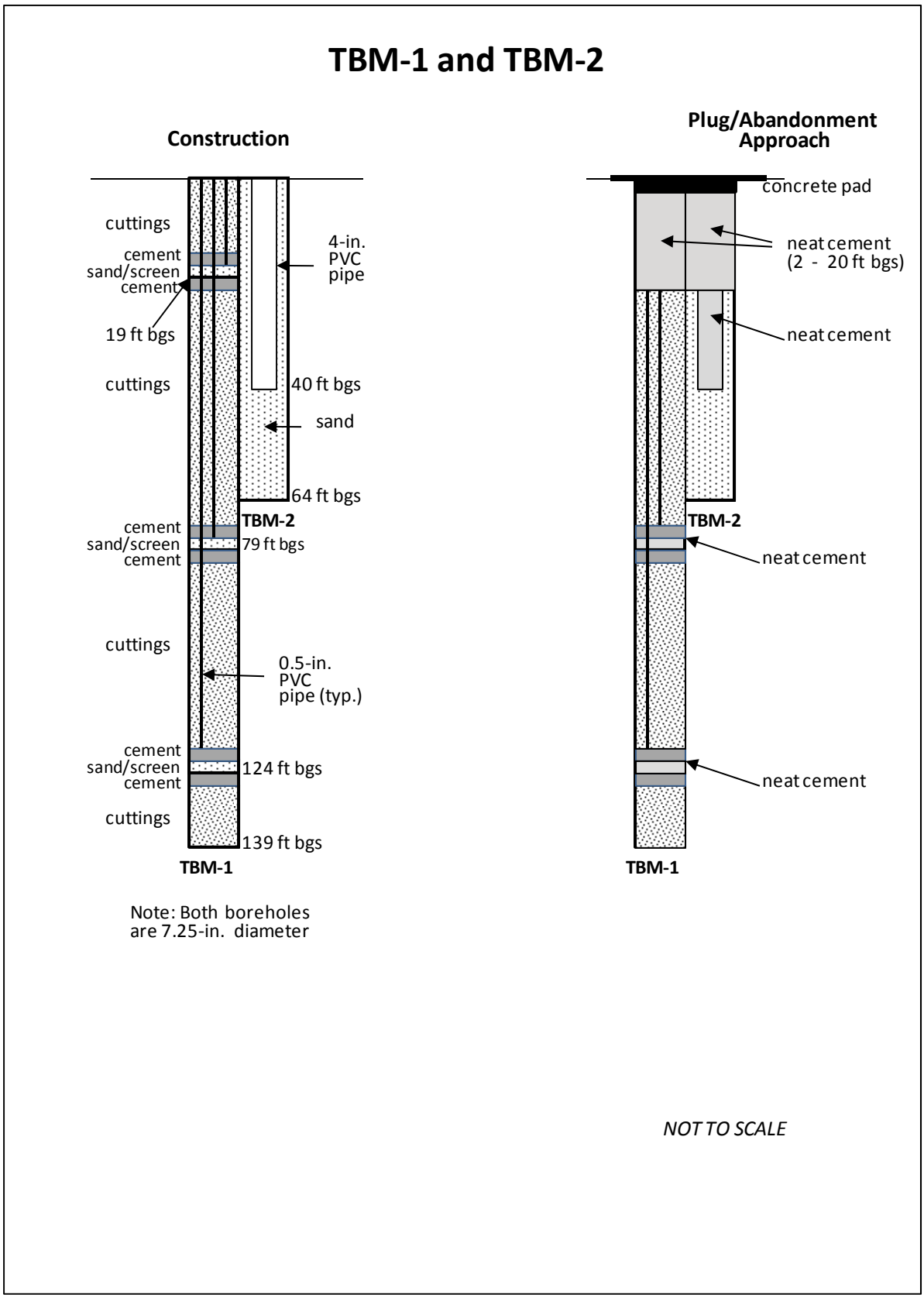

Figure 13.0-1 TBM-1 and TBM-2 abandonment schematic

14.0 WORK PLAN TO PLUG AND ABANDON BOREHOLES 49-10046, 49-10047, AND 49-10048

Primary Purpose	This work plan summarizes the methods Los Alamos National Laboratory (LANL or the Laboratory) proposes to use to plug and abandon boreholes 49-10046, 49-10047, and 49-10048 located at Technical Area 49 (TA-49). Borehole abandonment will be consistent with the requirements in the New Mexico Environment Department's (NMED's) letter of July 30, 2010 (NMED 2010, 110427), and Sections IV.B.1.b.v and X.D (Well Abandonment) of the Compliance Order on Consent (Consent Order).
Construction	Boreholes 49-10046, 49-10047, and 49-10048 were installed in 2000 as shallow (15-ft deep) cased neutron logging holes for moisture monitoring at Area 2 shafts at TA-49 (LANL 2008, 102215). The boreholes are 2 in. in diameter with polyvinyl chloride (PVC) casing to 15 ft below ground surface.
Abandonment Methods	All aboveground and belowground appurtenances, including the 2-in. PVC casings, will be removed. The boreholes will be filled with neat cement to within 2 ft of the ground surface. Figure 14.0-1 shows the planned abandonment approach.
Surface Completion	Concrete will be placed above the neat cement at the top of each borehole and then formed into 1.5-ft × 1.5-ft × 0.5-ft-thick surface pads. Brass markers will be embedded in the surface pads. They will be surveyed in accordance with Section IX.B.2.f of the Consent Order, which states that pertinent structures may be horizontally located with a global positioning system with an accuracy of +/− 0.5 ft.
Waste Disposal	A waste characterization strategy form (WCSF) will be prepared to guide disposal of any wastes generated during abandonment. Materials removed from the boreholes will be reused or recycled if possible. Nonrecyclable materials will be disposed in accordance with the WCSF.
Summary Report	A brief report will be prepared for NMED detailing the abandonment methods and the quantities of materials used. A location map and an abandonment schematic will also be included in the report.

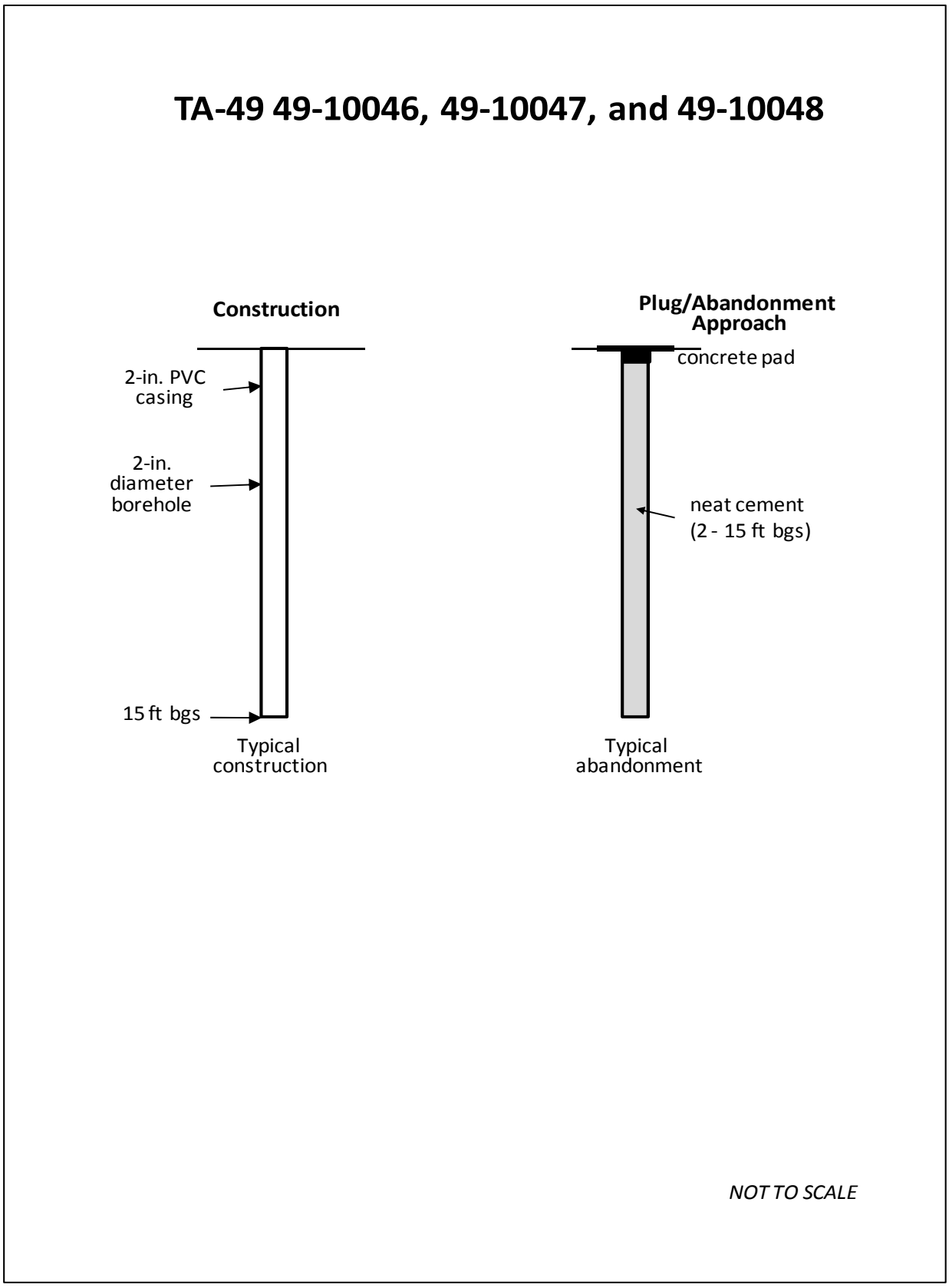

Figure 14.0-1 TA-49 49-10046, 49-10047, and 49-10048 abandonment schematic

15.0 REFERENCES

The following list includes documents cited in this plan. 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.

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