*N3B-Los Alamos*
1200 Trinity Drive, Suite 150
Los Alamos, New Mexico 87544
(505) 257-7690

*Environmental Management*
Los Alamos Field Office
1200 Trinity Drive, Suite 400
Los Alamos, New Mexico 87544
(240) 562-1122

*Date*: December 21, 2022
*Refer To*: N3B-2022-0485

Ms. Ramona Martinez
Upper Pecos Basin Supervisor
Water Resource Allocation Program
Water Rights Division
New Mexico Office of the State Engineer
Bataan Memorial Building
407 Galisteo Street
Santa Fe, NM 87504-5102



**Subject: Submittal of the Revised Well Plugging Plan of Operations Forms for the Plugging and Abandonment of Monitoring Wells and Angled Geophysical Boreholes at Technical Area 39 North Ancho Canyon Aggregate Area**

Dear Ms. Martinez:

Enclosed please find two hard copies with electronic files of the revised Well Plugging Plan of Operations Forms (WD-08 forms) for the plugging and abandonment of monitoring wells and angled geophysical boreholes at Technical Area 39 North Ancho Canyon Aggregate Area (Enclosures 1 through 6). Revisions are based on comments received in New Mexico Office of the State Engineer (NMOSE) correspondence dated September 14, 2022, titled "Re: Well Plugging Plan of Operations for monitoring wells and boreholes at Technical Area 39 North Ancho Canyon Aggregate Area" and on discussions that occurred during the October 12, 2022, meeting between NMOSE, U.S. Department of Energy Environmental Management Los Alamos Field Office (EM-LA), and Newport News Nuclear BWXT-Los Alamos, LLC (N3B) staff. Responses to the September 14, 2022, comments are included as Enclosure 7. The documents requested in the September 14, 2022, comments, along with additional documents for your reference, are included with this submission as Enclosure 8.

EM-LA and N3B propose to use the guidelines attached to the forms while plugging and abandoning five vadose zone monitoring wells and 13 angled geophysical boreholes. An individual WD-08 form is included for each monitoring well. The 13 angled geophysical boreholes are included on one WD-08 form and a wr-08m attachment.

The plugging and abandonment forms are prepared in accordance with NMOSE regulations (19.27.4.30 New Mexico Administrative Code) and the 2016 Compliance Order on Consent, Appendix F (Sampling/Analytical/Field Method Regulatory Guidance). The copies of the final well

plugging and abandonment reports will be submitted to NMOSE following well abandonment activities.

This work continues the effort to plug and abandon unused penetrations on Los Alamos National Laboratory property. The North Ancho Canyon Aggregate Area Phase II investigation fieldwork began on July 26, 2022, and the plugging and abandonment of the monitoring wells and angled geophysical boreholes are currently scheduled to occur this winter/spring.

EM-LA and N3B propose to meet with NMOSE on January 11, 2023, to address any additional comments NMOSE may have regarding the revised WD-08 forms and attachments.

If you have any questions, please contact Christian Maupin at (505) 695-4281 (christian.maupin@em-la.doe.gov) or Cheryl Rodriguez at (505) 414-0450 (cheryl.rodriguez@em.doe.gov).

Sincerely,

Troy Thomson

Troy Thomson
Program Manager
Environmental Remediation
N3B-Los Alamos

Sincerely,

For M Lee Bishop

Digitally signed by For M Lee Bishop
Date: 2022.12.16 16:01:58 -07'00'

Arturo Q. Duran
Compliance and Permitting Manager
U.S. Department of Energy
Environmental Management
Los Alamos Field Office

Enclosure(s):

1. Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DMB-1 at Technical Area 39 North Ancho Canyon Aggregate Area
2. Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DM-2 at Technical Area 39 North Ancho Canyon Aggregate Area
3. Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DM-4 at Technical Area 39 North Ancho Canyon Aggregate Area
4. Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DM-6 at Technical Area 39 North Ancho Canyon Aggregate Area
5. Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well UM-3 at Technical Area 39 North Ancho Canyon Aggregate Area
6. Well Plugging Plan of Operations Form for the Plugging and Abandonment of 13 Angled Geophysical Boreholes ASC-0, ASC-2, ASC-3, ASC-4, ASC-11, ASC-12, ASC-13, ASC-14, ASC-15, ASC-16, ASC-17, ASC-18, and ASC-19 at Technical Area 39 North Ancho Canyon Aggregate Area
7. Response to the New Mexico Office of the State Engineer Comments for Well Plugging Plan of Operations for Monitoring Wells and Boreholes at Technical Area 39 North Ancho Canyon Aggregate Area (August 2022), dated September 14, 2022 (EM2022-0873)
8. Supplemental Documents (on CD included with this document)

cc (letter and enclosure[s] emailed):
Patrick Longmire, NMED-GWQB
Neelam Dhawan, NMED-HWB
Rick Shean, NMED-HWB
Chris Catechis, NMED-RPD
M. Lee Bishop, EM-LA
John Evans, EM-LA
Thomas McCrory, EM-LA
Michael Mikolanis, EM-LA
David Nickless, EM-LA
Kenneth Ocker, EM-LA
Cheryl Rodriguez, EM-LA
Hai Shen, EM-LA
William Alexander, N3B
Kristi Beguin, N3B
Brenda Bowlby, N3B
Joseph Chandler, N3B
Michael Erickson, N3B
Debby Holgerson, N3B
Scott Hovlik, N3B
Kim Lebak, N3B
Joseph Legare, N3B
Dana Lindsay, N3B
Christian Maupin, N3B
Ryan McGuill, N3B
emla.docs@em.doe.gov
n3brecords@em-la.doe.gov
Public Reading Room (EPRR)
PRS website

# ENCLOSURE 1

# Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DMB-1 at Technical Area 39 North Ancho Canyon Aggregate Area

# WELL PLUGGING PLAN OF OPERATIONS

NOTE: A Well Plugging Plan of Operations shall be filed with and accepted by the Office of the State Engineer prior to plugging. This form may be used to plug a single well, or if you are plugging multiple monitoring wells on the same site using the same plugging methodology.

**Alert! Your well may be eligible to participate in the Aquifer Mapping Program (AMP)-NM Bureau of Geology geoinfo.nmt.edu/resources/water/cgmn/ if within an area of interest and meets the minimum construction requirements, such as there is still water in your well, and the well construction reflected in a well record and log is not compromised, contact AMP at 575-835-5038 or -6951, or by email nmbg-waterlevels@nmt.edu, prior to completing this prior form. Showing proof to the OSE that your well was accepted in this program, may delay the plugging of your well until a later date.**

**I. FILING FEE:** There is no filing fee for this form.

**II. GENERAL / WELL OWNERSHIP:** ☐ Check here if proposing one plan for multiple monitoring wells on the same site and attaching WD-08m

Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: DMB-1

Name of well owner: Department of Energy

Mailing address: Joseph Chandler 1200 Trinity Drive, Suite 150 County: Los Alamos

City: Los Alamos State: NM Zip code: 87544

Phone number: 505.257.7393 E-mail: joseph.chandler@em-la.doe.gov

**III. WELL DRILLER INFORMATION:**

Well Driller contracted to provide plugging services: Richard Leblanc, Yellow Jacket DRLG, Serv. LLC

New Mexico Well Driller License No.: WD-1458 Expiration Date: Oct 31, 2024

**IV. WELL INFORMATION:** ☐ Check here if this plan describes method for plugging multiple monitoring wells on the same site and attach supplemental form WD-08m and skip to #2 in this section.

Note: A copy of the existing Well Record for the well(s) to be plugged should be attached to this plan.

1) GPS Well Location: Latitude: 35 deg, 47 min, 27.489 sec
Longitude: -106 deg, 15 min, 5.191 sec, NAD 83

2) Reason(s) for plugging well(s):

See Well Plugging Plan of Operations-Expanded Text for Section IV, V, VI and VII.

3) Was well used for any type of monitoring program? Yes If yes, please use section VII of this form to detail what hydrogeologic parameters were monitored. If the well was used to monitor contaminated or poor quality water, authorization from the New Mexico Environment Department may be required prior to plugging.

4) Does the well tap brackish, saline, or otherwise poor quality water? NA If yes, provide additional detail, including analytical results and/or laboratory report(s): NA

5) Static water level: none detected feet below land surface / feet above land surface (circle one)

6) Depth of the well: 117 feet

7) Inside diameter of innermost casing: 4 inches.

8) Casing material: Stainless Steel

9) The well was constructed with:

[ ] an open-hole production interval, state the open interval:

[X] a well screen or perforated pipe, state the screened interval(s): Unknown. No well construction records of the well can be discovered.

10) What annular interval surrounding the artesian casing of this well is cement-grouted? NA

11) Was the well built with surface casing? No If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? If yes, please describe:

Visual inspection of the surface indicated no surface casing. No well construction information available.

12) Has all pumping equipment and associated piping been removed from the well? Yes If not, describe remaining equipment and intentions to remove prior to plugging in Section VII of this form.

## V. DESCRIPTION OF PLANNED WELL PLUGGING:

[ ] **If plugging method differs between multiple wells on same site, a separate form must be completed for each method.**

**Note: If this plan proposes to plug an artesian well in a way other than with cement grout, placed bottom to top with a tremie pipe, a detailed diagram of the well showing proposed final plugged configuration shall be attached, as well as any additional technical information, such as geophysical logs, that are necessary to adequately describe the proposal. Attach a copy of any signed OSE variance to this plugging plan.**

**Also, if this planned plugging plan requires a variance to 19.27.4 NMAC, attach a detailed variance request signed by the applicant.**

1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

2) Will well head be cut-off below land surface after plugging? There is no well head. The protective casing and pad will be removed.

## VI. PLUGGING AND SEALING MATERIALS:

**Note: The plugging of a well that taps poor quality water may require the use of a specialty cement or specialty sealant. Attach a copy of the batch mix recipe from the cement company and/or product description for specialty cement mixes or any sealant that deviates from the list of OSE approved sealants.**

1) For plugging intervals that employ cement grout, complete and attach Table A.

2) For plugging intervals that will employ approved non-cement based sealant(s), complete and attach Table B.

3) Theoretical volume of grout required to plug the well to land surface: 21 cu. ft.

4) Type of Cement proposed: 2% bentonite Type 1 Portland cement grout

5) Proposed cement grout mix: 6.5 gallons of water per 94 pound sack of Portland cement.

6) Will the grout be: batch-mixed and delivered to the site

X mixed on site

7) Grout additives requested, and percent by dry weight relative to cement:

2% bentonite to sack of 94 lb. cement
1.88 lbs/94 lb sack
1.36 cu. ft/sack
110 lbs/cu.ft
14.7 lbs/gal
6.5 gal/sk for 2% bentonite

8) Additional notes and calculations:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VII. ADDITIONAL INFORMATION:** List additional information below, or on separate sheet(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VIII. SIGNATURE:**

I, Joseph Chandler, say that I have carefully read the foregoing Well Plugging Plan of Operations and any attachments, which are a part hereof; that I am familiar with the rules and regulations of the State Engineer pertaining to the plugging of wells and will comply with them, and that each and all of the statements in the Well Plugging Plan of Operations and attachments are true to the best of my knowledge and belief.

Signature of Applicant — Date: 12-14-2022

**IX. ACTION OF THE STATE ENGINEER:**

This Well Plugging Plan of Operations is:

_____ Approved subject to the attached conditions.
_____ Not approved for the reasons provided on the attached letter.

Witness my hand and official seal this _____ day of _____, _____

_____., New Mexico State Engineer

By: _____

**TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of grout placement (ft bgl) | | | 0 to 2 ft bgs<br>20 to 2 ft bgs |
| Bottom of proposed interval of grout placement (ft bgl) | | | 117 ft to 20 ft bgs |
| Theoretical volume of grout required per interval (gallons) | | | • 97 ft = 0 0873 ft3/ft = 8 47 ft3 (117 ft to 20 ft bgs)<br>o 1 38 ft3/sack Total sacks @ 23 = 40 5 gal<br>• 10 5-in borehole 18 ft = 0 8015 ft3/ft = 10 82 ft3<br>o 1 38 ft3/sack Total sacks 7 98 = 51 74 gal<br>• 10 5-in borehole 2 ft = 0 8013 ft3/ft = 1 2 ft3 (lean cement)<br>o 1 18 ft3/sack Total sacks 1 02 = 1 sack = 5 2 gal |
| Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement | | | 6.5 gal/sk for 2% bentonite<br>5.2 gal/sk for lean |
| Mixed on-site or batch-mixed and delivered? | | | on site |
| Grout additive 1 requested | | | bentonite |
| Additive 1 percent by dry weight relative to cement | | | 2% bentonite, 1.88 lbs/94 lbs sack cement |
| Grout additive 2 requested | | | NA |
| Additive 2 percent by dry weight relative to cement | | | NA |

**TABLE B - For plugging intervals that will employ approved non-cement based sealant(s). Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of sealant placement (ft bgl) | | | NA |
| Bottom of proposed sealant of grout placement (ft bgl) | | | NA |
| Theoretical volume of sealant required per interval (gallons) | | | NA |
| Proposed abandonment sealant (manufacturer and trade name) | | | NA |

# Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

## Section and Subsection

### DMB-1 (39-01122) [SWMU 39-001(a)]

#### Guidelines for Plugging and Abandoning Monitoring Wells and Angled Geophysical Boreholes

Abandonment will be accomplished by filling the entire volume of the borehole or well with grout composed of 2% bentonite Type I Portland cement slurry, 1.88 lb of dry powdered bentonite, and a maximum of 6.5 gal. of approved water per 94-lb sack of dry cement. The approximate grout weight will be 12.0 to 15.0 lb per gal. All grout materials will be combined in an aboveground rigid container or mixer and mechanically blended on-site to produce a thick, lump-free mixture throughout the mixing vessel.

Overdrilling will be used to remove subsurface components. In the event that well construction materials remain in the borehole after all reasonable efforts have been made at removal, the casing and/or screen sections will be cut and the borehole will be grouted for the remaining length, as feasible. Each borehole will be sealed by grouting from the bottom of the borehole or well to the ground surface. All grouting will be accomplished by placing a tremie pipe to the bottom of the borehole (i.e., to the maximum depth drilled) and pumping grout through this pipe until undiluted grout is present at the ground surface or at the base of the surrounding concrete cover.

After 24 hr, the abandoned site will be checked for grout settlement. At that time, any settlement depression will be filled with grout. Additional grout will be added using a tremie pipe inserted to the top of the firm grout, unless the depth of the unfilled portion of the well or borehole is approximately 2 ft below ground surface (bgs) and this portion is dry. The ungrouted portions of the boreholes or wells will be filled to the ground surface with concrete or neat cement. This process will be repeated until firm neat cement or concrete remains at the ground surface.

In the event that thief zones (i.e., high-porosity or permeability zone or fracture zones) are encountered that prevent grouting to the ground surface, a bentonite plug or other industry-standard borehole sealant material (e.g., Flowseal) may be employed to bridge the thief zone and prevent loss of grout to the surrounding formation.

The New Mexico Office of the State Engineer (NMOSE) requires prehydrating the bentonite. Bentonite must be prehydrated before mixing with the cement. Mix bentonite first, and then mix the wet bentonite into the wet cement. A range of 6.5 to 7.3 lb/gal. is acceptable.

Before plugging and abandonment (P&A) operations, the water levels will be measured and documented. Any water in a well or borehole will be purged. Purge water from all boreholes/wells will be containerized and sampled for waste characterization purposes (LANL 2011). One week after purging, the water levels in each well and borehole will be checked to determine whether water levels have

recovered. If any of the wells or boreholes have recharged, the New Mexico Environment Department and NMOSE will be notified (LANL 2011).

For each abandoned monitoring well, an abandonment record will be prepared to include the following information:

- project and monitoring well designation;
- location of monitoring well (northing and easting, New Mexico State Plane 1983);
- depth of well before grouting (ft bgs);
- casing or items left in the borehole by depth, description, composition, and size (if applicable);
- copy of the original borehole log, if available;
- copy of the construction diagram for the abandoned well, if available;
- reason for abandonment;
- description and total quantity of grout used initially;
- description and daily quantities of grout used to compensate for settlement;
- dates of grouting; and
- water level before grouting and date measured (if applicable).

**Section IV: Well information (2):** Reason(s) for plugging well(s)

39-01122 (DMB-1): DMB-1 was one of five vertical monitoring wells/continuously cored boreholes drilled in 1994 to varying depths to investigate potential migrations from Solid Waste Management Unit (SWMU) 39-001(a) (Landfill) and SWMU 39-001(b) (Disposal Pits). DMB-1 was a downgradient well to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways (ICF Kaiser 1994). No formation water has been observed in DMB-1, indicating that no perched-alluvial groundwater is present in these areas (LANL 2010). Additionally, the landfill and disposal pit were excavated in 2009–2010; therefore, the potential source for any contaminant migration has been removed.

The well is not being used and is a potential conduit for subsurface contamination (LANL 2011).

**Section V: Description of Planned Well Plugging (1):** Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well.

1. Rig up tremie pipe and install to approximate top of screen interval depth. Estimate 10 ft screen. Tremie pipe depth ~108 ft bgs.
2. Calculate amount of grout needed to fill the screen interval and casing and to 20 ft bgs within 4-in. casing.
3. Pump calculated amount of 2% bentonite Type I Portland cement.
4. Grout to 20 ft bgs.
5. Allow grout to cure for minimum of 24 hr.

6. Measure top of cement. Note depth for depth bgs.
7. Rig up 6.25-in. inside diameter (I.D.) hollow-stem augers (outside diameter [O.D.] 10.5 in.) to overdrill the 4-in.-ID stainless-steel well.
8. Overdrill to 20 ft bgs true vertical depth (TVD).
9. After the well has been overdrilled, remove well casing. Place well segments and pieces on plastic sheeting at the surface.
10. Calculate the estimated amount of 2% bentonite Type I Portland cement to fill the open hole, using 10.5-in.-OD borehole and 18 ft bgs TVD.
11. Install tremie pipe into the open borehole to ~3 ft from the bottom to pressure-grout to the ground surface, while removing the augers to ensure that the open borehole is grouted. After the grout has cured a minimum of 24 hr, tag top of cement from bgs.
12. Backfill the remaining hole (~2 ft) with concrete or neat cement to ensure a secure surface seal.
13. A neat-cement mound with a marker will be installed over the well at ground surface. The marker will be surveyed with Global Positioning System (GPS) with an accuracy of ±0.5 ft.
14. Dress well-surface location to contour of the local area.

If well casing and screen cannot be removed, or if the casing is cut in two by the augers, or field conditions will not allow removal of the well casing, contact NMOSE for guidance to proceed with P&A operations (Christopher Thornburg [NMOSE]: 505-629-8978).

**Section VI: Plugging and Sealing Materials (8):** Additional notes and calculations

- 97 ft × 0.0873 $ft^3$/ft = 8.47 $ft^3$ (117 ft to 20 ft bgs)
    - 1.36 $ft^3$/sack: Total sacks = 6.23
- 10.5-in. borehole: 18 ft × 0.6013 $ft^3$/ft = 10.82 $ft^3$
    - 1.36 $ft^3$/sack: Total sacks = 7.96
- 10.5-in. borehole: 2 ft × 0.6013 $ft^3$/ft = 1.2 $ft^3$ (lean cement)
    - 1.18 $ft^3$/sack: Total sacks: 1.02 = 1 sack
- Total $ft^3$: 20.49 = 21
- Total sacks: 15.21 = 16 sacks

Assumption: 3-ft filter pack above the screen. No information available.

**Section VII: Additional Information**

DMB-1 was used to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways from the landfill at SWMU 39-001(a) and the disposal pits at SWMU 39-001(b). No water has been observed, indicating that no perched groundwater is present in the area, or that the observations are of limited aerial extent.

**References**:

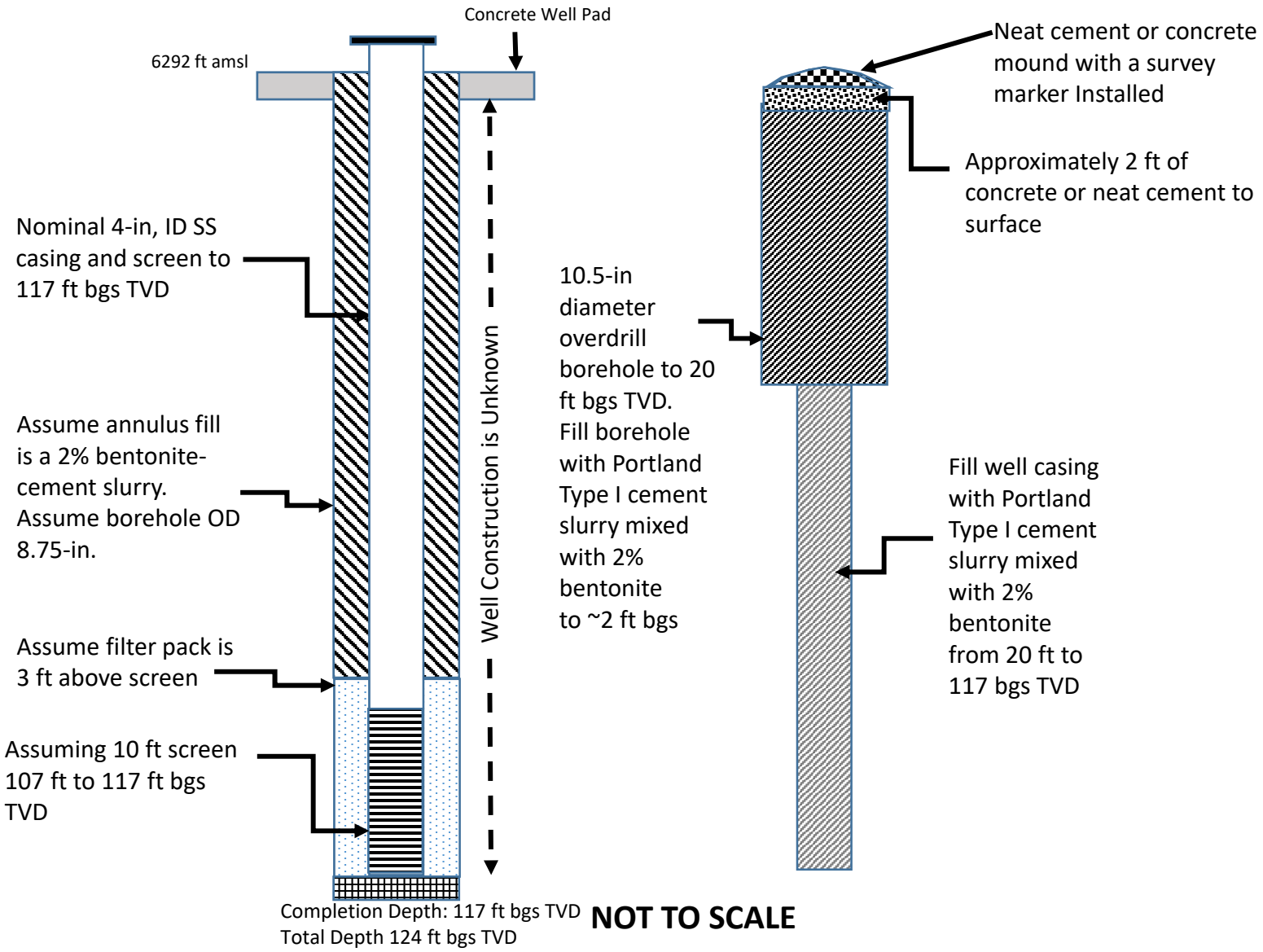
ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia. (ICF Kaiser 1994)

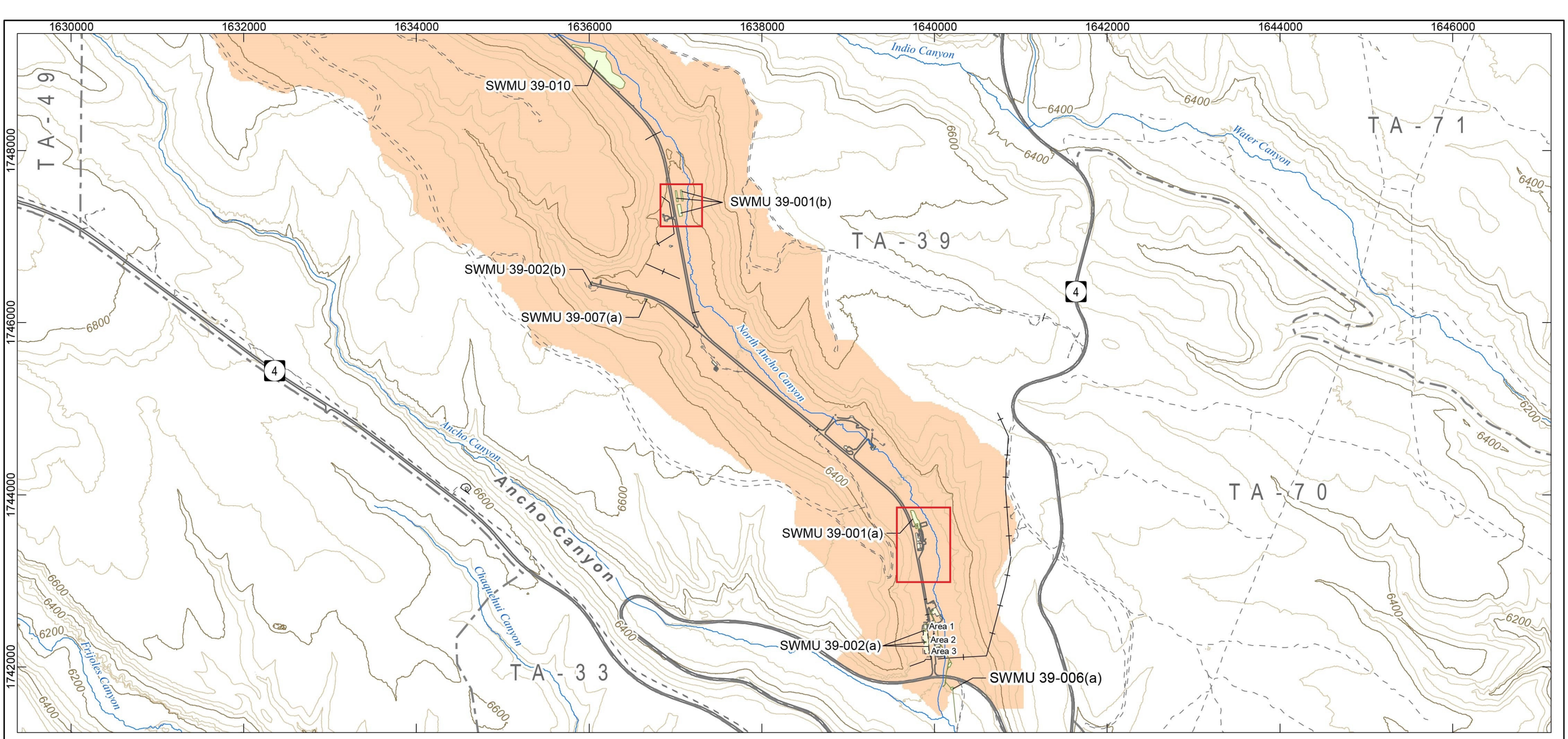
LANL (Los Alamos National Laboratory), January 2010. “Investigation Report for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-10-0125, Los Alamos, New Mexico. (LANL 2010)

LANL (Los Alamos National Laboratory), March 2011. “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011)

Morrison Knudsen Corporation, May 30, 1995. “Monitor Well Inspection at TA-39,” letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho. (Morrison Knudsen Corporation 1995)

# DMB-1 (39-01122)






North Ancho Canyon Aggregate Area
SWMU or AOC
Structure
Former structure
Drainage channel

TA boundary
Fence
Unpaved road
Paved road

Index contour, 200-ft interval
Terrain contour, 50-ft interval
P&A Locations

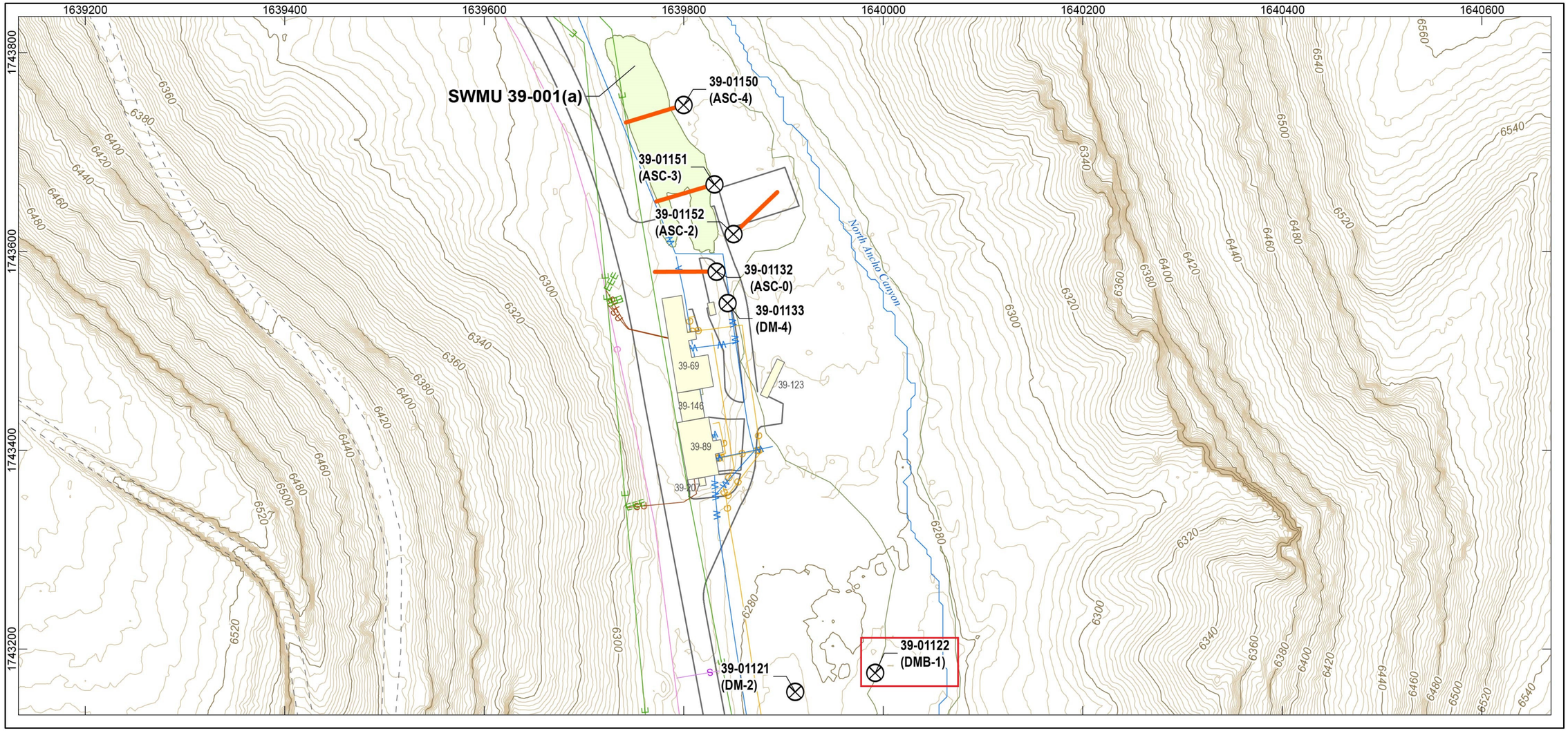
**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 0.125 0.25 0.5
Miles

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-49_north_ancho_phase_II_sites
1/13/2022 DFRANK

**Locations of plug and abandoning of monitoring wells and angled geophysical boreholes at TA-39**




Borehole, vertical or angled
Angled borehole drilling vector
Structure
SWMU or AOC
Drainage channel

Water line
Gas line
Electric line
Sewer line
Communication line

Secondary utility
Unpaved road
Paved road
Index contour, 20-ft interval
Terrain contour, 2-ft interval

**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 25 50 100
FEET

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-43_39-001(a)_angled_borehole
4/15/2022 DFRANK

**Location of SWMU 39-001(a) wells and boreholes**

## Well and Borehole Installation and Construction Details for SWMU 39-001(a)

| Unit No. | Well/ Borehole | Location ID | Casing Diameter (in.) | Casing Type | Orientation | Year Drilled | Drilling Method | Water Present | Top of Water (MD ft bgs)[a] | Top of Water (TVD ft bgs)[b] | Well/Borehole Total Depth (MD ft bgs) | Well/Borehole Total Depth (TVD ft bgs) | Status | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-001(a) | DMB-1[c] | 39-01122 | 4 | Stainless Steel | Vertical | 1994 | HSA[d] | NW[e] | n/a[f] | n/a | 117 | 117 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-2[h] | 39-01121 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 30.2 | 30.2 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-4[i] | 39-01133 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 22.56 | 22.56 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-0[j] | 39-01132 | 2 | PVC[k] | 45 degrees | 1994 | HSA | Yes | 78.85 | 41.42 | 81.05 | 42.58 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-1[l] | 39-01153 | 2 | PVC | 45 degrees | 1994 | HSA | —[m] | — | — | — | — | Abandoned when casing broke during installation. | Borehole completion documentation not found. |
| | ASC-2[n] | 39-01152 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 80.41 | 42.24 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-3[o] | 39-01151 | 2 | PVC | 45 degrees | 1994 | HSA | — | — | — | — | — | PVC casing cut by heavy equipment during 2009 excavation[p] | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-4[q] | 39-01150 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 75.41 | 39.61 | 81.4 | 42.76 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |

Notes: Total depth (TD) and field measurements were taken March 21, 2022. Well TD is field-measured feet below ground surface (ft bgs).

[a] MD = Measured depth.

[b] TVD = True vertical depth.

[c] Los Alamos National Laboratory, June 27, 1994–July 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DMB-1,” Los Alamos, New Mexico.

[d] HSA = Hollow-stem auger.

[e] NW = No water detected.

[f] n/a = Not applicable (no water detected).

[g] ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia.

[h] Los Alamos National Laboratory, July 12, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-2,” Los Alamos, New Mexico.

[i] Los Alamos National Laboratory, July 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-4,” Los Alamos, New Mexico.

[j] Los Alamos National Laboratory, June 23, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-0,” Los Alamos, New Mexico.

[k] PVC = Polyvinyl chloride.

[l] Los Alamos National Laboratory, June 15, 1994–June 21, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-1 (abandoned),” Los Alamos, New Mexico.

[m] — = Damaged and abandoned geophysical monitoring borehole.

[n] Los Alamos National Laboratory, June 13, 1994–June 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-2,” Los Alamos, New Mexico.

[o] Los Alamos National Laboratory, June 7, 1994–June 8, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-3,” Los Alamos, New Mexico.

[p] Los Alamos National Laboratory, October 20, 2009. “Subcontract Technical Representative Daily Activity Report for North Ancho Canyon Implementation,” Subcontract Number 66170, Los Alamos, New Mexico.

[q] Los Alamos National Laboratory, June 1, 1994–June 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-4,” Los Alamos, New Mexico.

# ENCLOSURE 2

# Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DM-2 at Technical Area 39 North Ancho Canyon Aggregate Area

# WELL PLUGGING PLAN OF OPERATIONS

NOTE: A Well Plugging Plan of Operations shall be filed with and accepted by the Office of the State Engineer prior to plugging. This form may be used to plug a single well, or if you are plugging multiple monitoring wells on the same site using the same plugging methodology.

Alert! Your well may be eligible to participate in the Aquifer Mapping Program (AMP)-NM Bureau of Geology geoinfo.nmt.edu/resources/water/cgmn/ if within an area of interest and meets the minimum construction requirements, such as there is still water in your well, and the well construction reflected in a well record and log is not compromised, contact AMP at 575-835-5038 or -6954, or by email nmbg-waterlevels@nmt.edu, prior to completing this prior form. Showing proof to the OSE that your well was accepted in this program, may delay the plugging of your well until a later date.

**I. FILING FEE:** There is no filing fee for this form.

**II. GENERAL / WELL OWNERSHIP:** ☐ Check here if proposing one plan for multiple monitoring wells on the same site and attaching WD-08m

Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: DM-2

Name of well owner: Department of Energy

Mailing address: Joseph Chandler, 1200 Trinity Drive, County: Los Alamos

City: Los Alamos Suite 150 State: NM Zip code: 87544

Phone number: 505.257.7393 E-mail: joseph.chandler@em-la.doe.gov

**III. WELL DRILLER INFORMATION:**

Well Driller contracted to provide plugging services: Richard Leblanc, Yellow Jacket DRLG, Serv. LLC

New Mexico Well Driller License No.: WD-1458 Expiration Date: Oct 31, 2024

**IV. WELL INFORMATION:** ☐ Check here if this plan describes method for plugging multiple monitoring wells on the same site and attach supplemental form WD-08m and skip to #2 in this section.

Note: A copy of the existing Well Record for the well(s) to be plugged should be attached to this plan.

1) GPS Well Location: Latitude: 35 deg, 47 min, 27.30059 sec
Longitude: -106 deg, 15 min, 6.1622 sec, NAD 83

2) Reason(s) for plugging well(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

3) Was well used for any type of monitoring program? Yes If yes, please use section VII of this form to detail what hydrogeologic parameters were monitored. If the well was used to monitor contaminated or poor quality water, authorization from the New Mexico Environment Department may be required prior to plugging.

4) Does the well tap brackish, saline, or otherwise poor quality water? NA If yes, provide additional detail, including analytical results and/or laboratory report(s): NA

5) Static water level: none detected feet below land surface / feet above land surface (circle one)

6) Depth of the well: 30.2 feet

7) Inside diameter of innermost casing: 4 inches.

8) Casing material: Stainless Steel

9) The well was constructed with:

[ ] an open-hole production interval, state the open interval: _____

[X] a well screen or perforated pipe, state the screened interval(s): Unknown. No well construction records of the well can be discovered.

10) What annular interval surrounding the artesian casing of this well is cement-grouted? NA

11) Was the well built with surface casing? No If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? _____ If yes, please describe:

Visual Inspection of the surface indicated no surface casing. No well construction available.

12) Has all pumping equipment and associated piping been removed from the well? Yes If not, describe remaining equipment and intentions to remove prior to plugging in Section VII of this form.

## V. DESCRIPTION OF PLANNED WELL PLUGGING:

[ ] **If plugging method differs between multiple wells on same site, a separate form must be completed for each method.**

**Note: If this plan proposes to plug an artesian well in a way other than with cement grout, placed bottom to top with a tremie pipe, a detailed diagram of the well showing proposed final plugged configuration shall be attached, as well as any additional technical information, such as geophysical logs, that are necessary to adequately describe the proposal. Attach a copy of any signed OSE variance to this plugging plan.**

**Also, if this planned plugging plan requires a variance to 19.27.4 NMAC, attach a detailed variance request signed by the applicant.**

1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

2) Will well head be cut-off below land surface after plugging? There is no well head. The protective casing and pad will be removed

## VI. PLUGGING AND SEALING MATERIALS:

**Note: The plugging of a well that taps poor quality water may require the use of a specialty cement or specialty sealant Attach a copy of the batch mix recipe from the cement company and/or product description for specialty cement mixes or any sealant that deviates from the list of OSE approved sealants.**

1) For plugging intervals that employ cement grout, complete and attach Table A.

2) For plugging intervals that will employ approved non-cement based sealant(s), complete and attach Table B.

3) Theoretical volume of grout required to plug the well to land surface: 13 cu. ft

4) Type of Cement proposed: 2% bentonite cement grout

5) Proposed cement grout mix: 6.5 gallons of water per 94 pound sack of Portland cement.

6) Will the grout be: _____ batch-mixed and delivered to the site

X mixed on site

7) Grout additives requested, and percent by dry weight relative to cement:

2% bentonite to sack of 94 lb. cement
1.36 cu. ft./sack
110 lbs/cu.ft.
14.7 lbs/gal
6.5 gal/sk for 2% bentonite

8) Additional notes and calculations:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VII. ADDITIONAL INFORMATION:** List additional information below, or on separate sheet(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VIII. SIGNATURE:**

I, Joseph Chandler, say that I have carefully read the foregoing Well Plugging Plan of Operations and any attachments, which are a part hereof; that I am familiar with the rules and regulations of the State Engineer pertaining to the plugging of wells and will comply with them, and that each and all of the statements in the Well Plugging Plan of Operations and attachments are true to the best of my knowledge and belief.

Signature of Applicant

12-14-2022
Date

**IX. ACTION OF THE STATE ENGINEER:**

This Well Plugging Plan of Operations is:

_____ Approved subject to the attached conditions.
_____ Not approved for the reasons provided on the attached letter.

Witness my hand and official seal this _____ day of _____, _____

_____., New Mexico State Engineer

By: _____

**TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of grout placement (ft bgl) | | | 0 to 2 ft bgl<br>20 to 2 ft bgl |
| Bottom of proposed interval of grout placement (ft bgl) | | | 20 - 30.2 ft bgl |
| Theoretical volume of grout required per interval (gallons) | | | - 10.2 ft = 0.0873 ft3/ft = 0.89 ft3 (30.2 ft to 20 ft bgs)<br>o 1.38 ft3/sack Total sacks 0.65= 4.2 gal<br>- 10.75-in borehole 18 ft = 0.8013 ft3/ft = 10.82 ft3<br>o 1.38 ft3/sack, Total sacks 7.88= 51.74 gal<br>- 10.75-in borehole 2 ft = 0.8013 ft3/ft = 1.2 ft3 (lean cement)<br>o 1.18 ft3/sack Total sacks 1.02= 1 sack=5.2 gal |
| Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement | | | 6.5 gal/sk for 2% bentonite<br>5.2 gal/sk for lean |
| Mixed on-site or batch-mixed and delivered? | | | on site |
| Grout additive 1 requested | | | bentonite |
| Additive 1 percent by dry weight relative to cement | | | 2% bentonite, 1.88 lbs/94 lbs sack cement |
| Grout additive 2 requested | | | NA |
| Additive 2 percent by dry weight relative to cement | | | NA |

**TABLE B - For plugging intervals that will employ approved non-cement based sealant(s). Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of sealant placement (ft bgl) | | | NA |
| Bottom of proposed sealant of grout placement (ft bgl) | | | NA |
| Theoretical volume of sealant required per interval (gallons) | | | NA |
| Proposed abandonment sealant (manufacturer and trade name) | | | NA |

# Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

## Section and Subsection

### DM-2 (39-01121) [SWMU 39-001(a)]

#### Guidelines for Plugging and Abandoning Monitoring Wells and Angled Geophysical Boreholes

Abandonment will be accomplished by filling the entire volume of the borehole or well with grout composed of 2% bentonite Type I Portland cement slurry, 1.88 lb of dry powdered bentonite, and a maximum of 6.5 gal. of approved water per 94-lb sack of dry cement. The approximate grout weight will be 12.0 to 15.0 lb per gal. All grout materials will be combined in an aboveground rigid container or mixer and mechanically blended on-site to produce a thick, lump-free mixture throughout the mixing vessel.

Overdrilling will be used to remove subsurface components. In the event that well construction materials remain in the borehole after all reasonable efforts have been made at removal, the casing and/or screen sections will be cut and the borehole will be grouted for the remaining length, as feasible. Each borehole will be sealed by grouting from the bottom of the borehole or well to the ground surface. All grouting will be accomplished by placing a tremie pipe to the bottom of the borehole (i.e., to the maximum depth drilled) and pumping grout through this pipe until undiluted grout is present at the ground surface or at the base of the surrounding concrete cover.

After 24 hr, the abandoned site will be checked for grout settlement. At that time, any settlement depression will be filled with grout. Additional grout will be added using a tremie pipe inserted to the top of the firm grout, unless the depth of the unfilled portion of the well or borehole is approximately 2 ft below ground surface (bgs) and this portion is dry. The ungrouted portions of the boreholes or wells will be filled to the ground surface with concrete or neat cement. This process will be repeated until firm neat cement or concrete remains at the ground surface.

In the event that thief zones (i.e., high-porosity or permeability zone or fracture zones) are encountered that prevent grouting to the ground surface, a bentonite plug or other industry-standard borehole sealant material (e.g., Flowseal) may be employed to bridge the thief zone and prevent loss of grout to the surrounding formation.

The New Mexico Office of the State Engineer (NMOSE) requires prehydrating the bentonite. Bentonite must be prehydrated before mixing with the cement. Mix bentonite first, and then mix the wet bentonite into the wet cement. A range of 6.5 to 7.3 lb/ gal. is acceptable.

Before plugging and abandonment (P&A) operations, the water levels will be measured and documented. Any water in a well or borehole will be purged. Purge water from all boreholes/wells will be containerized and sampled for waste characterization purposes (LANL 2011). One week after purging, the water levels in each well and borehole will be checked to determine whether water levels have

recovered. If any of the wells or boreholes have recharged, the New Mexico Environment Department and NMOSE will be notified (LANL 2011).

For each abandoned monitoring well, an abandonment record will be prepared to include the following information:

- project and monitoring well designation;
- location of monitoring well (northing and easting, New Mexico State Plane 1983);
- depth of well before grouting (ft bgs);
- casing or items left in the borehole by depth, description, composition, and size (if applicable);
- copy of the original borehole log, if available;
- copy of the construction diagram for the abandoned well, if available;
- reason for abandonment;
- description and total quantity of grout used initially;
- description and daily quantities of grout used to compensate for settlement;
- dates of grouting; and
- water level before grouting and date measured (if applicable).

**Section IV: Well information (2)**: Reason(s) for plugging well (s)

39-01121 (DM-2): DM-2 was one of five vertical monitoring wells/continuously cored boreholes drilled in 1994 to varying depths to investigate potential migrations from Solid Waste Management Unit (SWMU) 39-001(a) (Landfill) and SWMU 39-001(b) (Disposal Pits). DM-2 was a downgradient well to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways (ICF Kaiser 1994). No formation water has been observed in DM-2, indicating that no perched-alluvial groundwater is present in these areas (LANL 2010). Additionally, the landfill and disposal pit were excavated in 2009–2010; therefore, the potential source for any contaminant migration has been removed.

The well is not being used and is a potential conduit for subsurface contamination (LANL 2011).

**Section V: Description of Planned Well Plugging (1):** Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well.

1. Rig up tremie pipe and install to approximate top of screen interval depth. Subtract stickup of well casing and measure from top of casing (TOC). Estimate 10-ft screen. Tremie pipe depth ~25 ft bgs.
2. Calculate amount of grout needed to fill the screen interval and casing to 20 ft bgs within 4-in. casing.
3. Pump calculated amount of 2% bentonite Type I Portland cement to 20 ft bgs true vertical depth (TVD).
4. Allow grout to cure for minimum of 24 hr.
5. Tag top of cement from TOC. Subtract stickup of well casing. Note depth for depth bgs.

6. Rig up 6.25-in. inside diameter (I.D.) hollow-stem augers (outside diameter [O.D. 10.5 in.) to overdrill the 4-in.-ID stainless steel well.
7. Overdrill to 20 ft bgs TVD.
8. After the well has been overdrilled, remove well casing. Place well segments and pieces on plastic sheeting at the surface.
9. Calculate the estimated amount of 2% bentonite Type I Portland cement to fill the open hole, using 10.5-in.-OD borehole and 18 ft bgs TVD.
10. Install tremie pipe into the open borehole to ~3 ft from bottom to pressure grout from the bottom of the borehole to the ground surface, while removing the augers to ensure that the open borehole is grouted. After the grout has cured a minimum of 24 hr, tag top of cement from TOC.
11. Backfill the remaining hole (~2 ft) with concrete or neat cement to ensure a secure surface seal.
12. A neat-cement mound with a marker will be installed over the well at ground surface. The marker will be surveyed with Global Positioning System (GPS) with an accuracy of ±0.5 ft.
13. Dress well-surface location to contour of the local area.

If well casing and screen cannot be removed, or if the casing is cut in two by the augers, or field conditions will not allow removal of the well casing, contact NMOSE for guidance to proceed with P&A operations (Christopher Thornburg [NMOSE]: 505-629-8978).

**Section VI: Plugging and Sealing Materials (8):** Additional notes and calculations

- 10.2 ft × 0.0873 $ft^3$/ft = 0.89 $ft^3$ (30.2 ft to 20 ft bgs)
    - 1.36 $ft^3$/sack: Total sacks = 0.65
- 10.75-in. borehole: 18 ft × 0.6013 $ft^3$/ft = 10.82 $ft^3$
    - 1.36 $ft^3$/sack: Total sacks = 7.96
- 10.75-in. borehole: 2 ft × 0.6013 $ft^3$/ft = 1.2 $ft^3$ (lean cement)
    - 1.18 $ft^3$/sack: Total sacks: 1.02 = 1 sack
- Total $ft^3$: 12.91 = 13
- Total sacks: 9.63 = 10 sacks

Assumption: 3-ft filter pack above the screen. No information available.

**Section VII: Additional Information**

DM-2 was used to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways from the landfill at SWMU 39-001(a) and the disposal pits at SWMU 39-001(b). No water has been observed, indicating that no perched groundwater is present in the area, or that the observations are of limited aerial extent.

**References:**

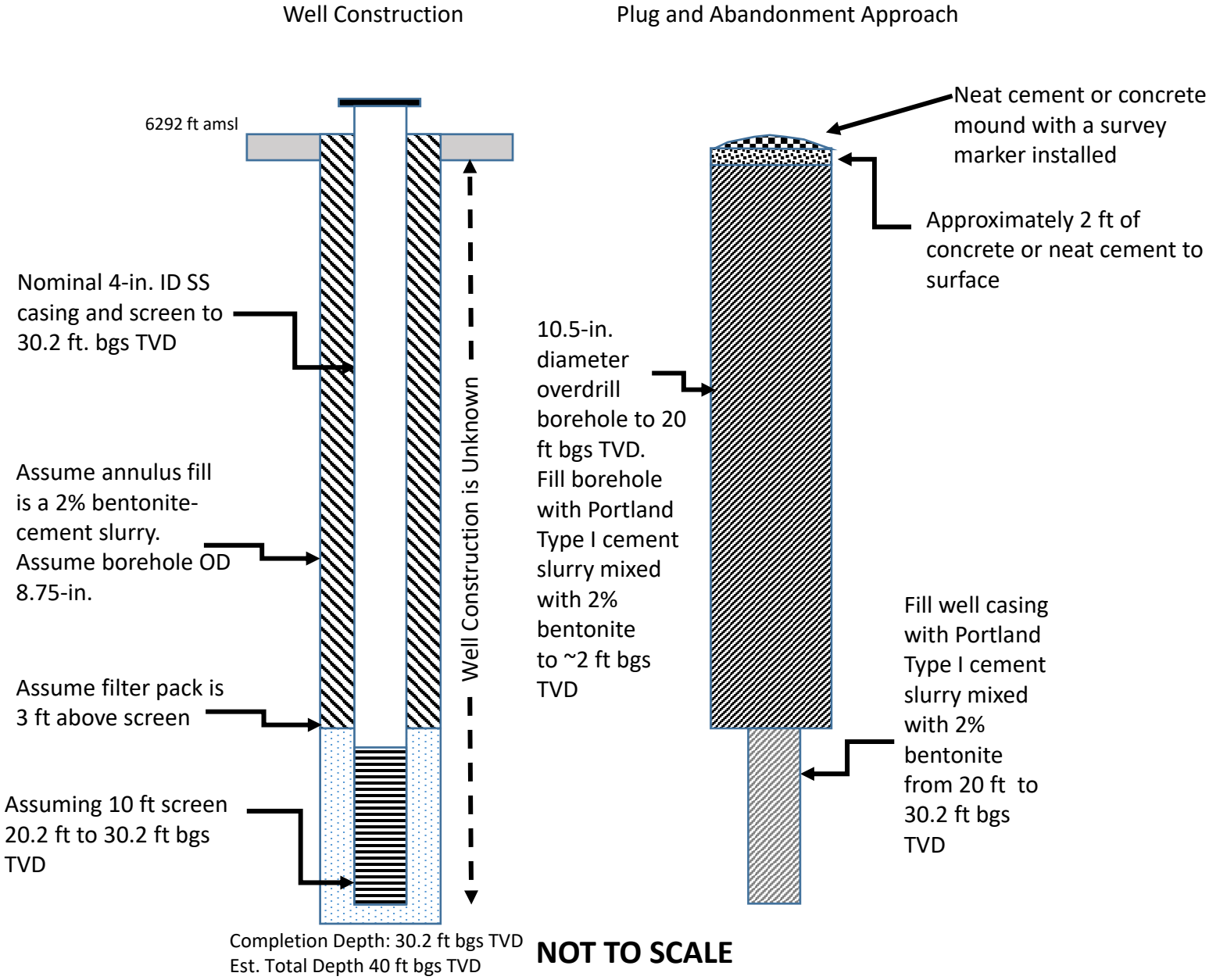
ICF Kaiser, May 1994. "Drilling Plan Operable Unit 1132, Revision B," Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia. (ICF Kaiser 1994)

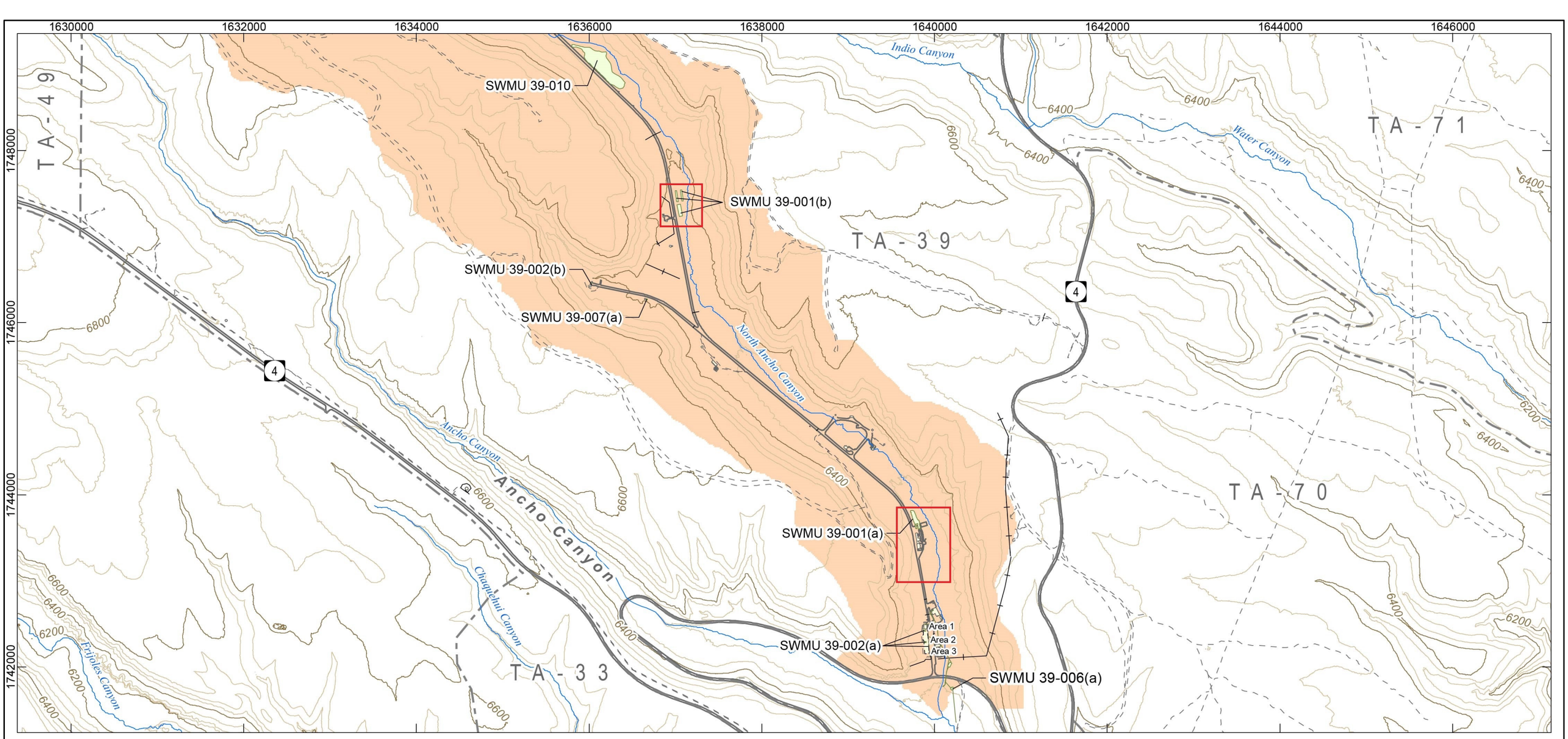
LANL (Los Alamos National Laboratory), January 2010. “Investigation Report for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-10-0125, Los Alamos, New Mexico. (LANL 2010)

LANL (Los Alamos National Laboratory), March 2011. “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011)

Morrison Knudsen Corporation, May 30, 1995. “Monitor Well Inspection at TA-39,” letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho. (Morrison Knudsen Corporation 1995)

# DM-2 (39-01121)


Well Construction
Plug and Abandonment Approach
6292 ft amsl
Nominal 4-in. ID SS casing and screen to 30.2 ft. bgs TVD
Assume annulus fill is a 2% bentonite-cement slurry. Assume borehole OD 8.75-in.
Assume filter pack is 3 ft above screen
Assuming 10 ft screen 20.2 ft to 30.2 ft bgs TVD
Well Construction is Unknown
Completion Depth: 30.2 ft bgs TVD
Est. Total Depth 40 ft bgs TVD
Neat cement or concrete mound with a survey marker installed
Approximately 2 ft of concrete or neat cement to surface
10.5-in. diameter overdrill borehole to 20 ft bgs TVD. Fill borehole with Portland Type I cement slurry mixed with 2% bentonite to ~2 ft bgs TVD
Fill well casing with Portland Type I cement slurry mixed with 2% bentonite from 20 ft to 30.2 ft bgs TVD
NOT TO SCALE




North Ancho Canyon Aggregate Area
SWMU or AOC
Structure
Former structure
Drainage channel

TA boundary
Fence
Unpaved road
Paved road

Index contour, 200-ft interval
Terrain contour, 50-ft interval
P&A Locations

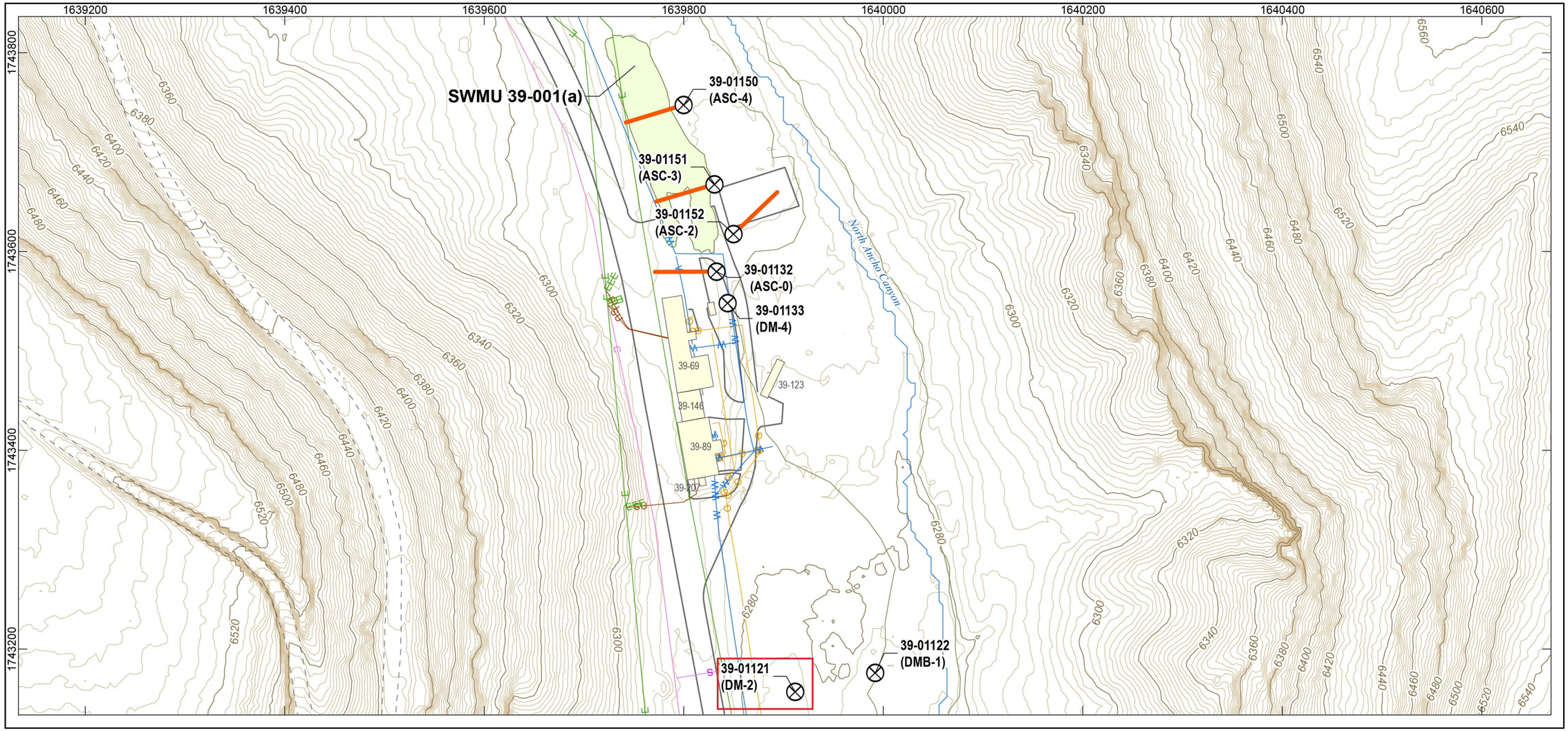
**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 0.125 0.25 0.5
Miles

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-49_north_ancho_phase_II_sites
1/13/2022 DFRANK

**Locations of plug and abandoning of monitoring wells and angled geophysical boreholes at TA-39**




Borehole, vertical or angled
Angled borehole drilling vector
Structure
SWMU or AOC
Drainage channel

Water line
Gas line
Electric line
Sewer line
Communication line

Secondary utility
Unpaved road
Paved road
Index contour, 20-ft interval
Terrain contour, 2-ft interval

**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 25 50 100
FEET

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-43_39-001(a)_angled_borehole
4/15/2022 DFRANK

**Location of SWMU 39-001(a) wells and boreholes**

## Well and Borehole Installation and Construction Details for SWMU 39-001(a)

| Unit No. | Well/ Borehole | Location ID | Casing Diameter (in.) | Casing Type | Orientation | Year Drilled | Drilling Method | Water Present | Top of Water (MD ft bgs)[a] | Top of Water (TVD ft bgs)[b] | Well/Borehole Total Depth (MD ft bgs) | Well/Borehole Total Depth (TVD ft bgs) | Status | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-001(a) | DMB-1[c] | 39-01122 | 4 | Stainless Steel | Vertical | 1994 | HSA[d] | NW[e] | n/a[f] | n/a | 117 | 117 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-2[h] | 39-01121 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 30.2 | 30.2 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-4[i] | 39-01133 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 22.56 | 22.56 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-0[j] | 39-01132 | 2 | PVC[k] | 45 degrees | 1994 | HSA | Yes | 78.85 | 41.42 | 81.05 | 42.58 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-1[l] | 39-01153 | 2 | PVC | 45 degrees | 1994 | HSA | —[m] | — | — | — | — | Abandoned when casing broke during installation. | Borehole completion documentation not found. |
| | ASC-2[n] | 39-01152 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 80.41 | 42.24 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-3[o] | 39-01151 | 2 | PVC | 45 degrees | 1994 | HSA | — | — | — | — | — | PVC casing cut by heavy equipment during 2009 excavation[p] | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-4[q] | 39-01150 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 75.41 | 39.61 | 81.4 | 42.76 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |

Notes: Total depth (TD) and field measurements were taken March 21, 2022. Well TD is field-measured feet below ground surface (ft bgs).

[a] MD = Measured depth.

[b] TVD = True vertical depth.

[c] Los Alamos National Laboratory, June 27, 1994–July 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DMB-1,” Los Alamos, New Mexico.

[d] HSA = Hollow-stem auger.

[e] NW = No water detected.

[f] n/a = Not applicable (no water detected).

[g] ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia.

[h] Los Alamos National Laboratory, July 12, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-2,” Los Alamos, New Mexico.

[i] Los Alamos National Laboratory, July 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-4,” Los Alamos, New Mexico.

[j] Los Alamos National Laboratory, June 23, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-0,” Los Alamos, New Mexico.

[k] PVC = Polyvinyl chloride.

[l] Los Alamos National Laboratory, June 15, 1994–June 21, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-1 (abandoned),” Los Alamos, New Mexico.

[m] — = Damaged and abandoned geophysical monitoring borehole.

[n] Los Alamos National Laboratory, June 13, 1994–June 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-2,” Los Alamos, New Mexico.

[o] Los Alamos National Laboratory, June 7, 1994–June 8, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-3,” Los Alamos, New Mexico.

[p] Los Alamos National Laboratory, October 20, 2009. “Subcontract Technical Representative Daily Activity Report for North Ancho Canyon Implementation,” Subcontract Number 66170, Los Alamos, New Mexico.

[q] Los Alamos National Laboratory, June 1, 1994–June 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-4,” Los Alamos, New Mexico.

# ENCLOSURE 3

# Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DM-4 at Technical Area 39 North Ancho Canyon Aggregate Area

# WELL PLUGGING PLAN OF OPERATIONS

NOTE: A Well Plugging Plan of Operations shall be filed with and accepted by the Office of the State Engineer prior to plugging. This form may be used to plug a single well, or if you are plugging multiple monitoring wells on the same site using the same plugging methodology.

Alert! Your well may be eligible to participate in the Aquifer Mapping Program (AMP)-NM Bureau of Geology geoinfo.nmt.edu/resources/water/cgmn/ if within an area of interest and meets the minimum construction requirements, such as there is still water in your well, and the well construction reflected in a well record and log is not compromised, contact AMP at 575-835-5038 or -6951, or by email nmbg-waterlevels@nmt.edu, prior to completing this prior form. Showing proof to the OSE that your well was accepted in this program, may delay the plugging of your well until a later date.

**I. FILING FEE:** There is no filing fee for this form.

**II. GENERAL / WELL OWNERSHIP:** ☐ Check here if proposing one plan for multiple monitoring wells on the same site and attaching WD-08m

Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: DM-4

Name of well owner: Department of Energy

Mailing address: Joseph Chandler, 1200 Trinity Drive, Suite 150 County: Los Alamos

City: Los Alamos State: NM Zip code: 87544

Phone number: 505.257.7393 E-mail: joseph.chandler@em-la.doe.gov

**III. WELL DRILLER INFORMATION:**

Well Driller contracted to provide plugging services: Richard Leblanc, Yellow Jacket DRLG. Serv. LLC

New Mexico Well Driller License No.: WD-1458 Expiration Date: Oct 31, 2024

**IV. WELL INFORMATION:** ☐ Check here if this plan describes method for plugging multiple monitoring wells on the same site and attach supplemental form WD-08m and skip to #2 in this section.

Note: A copy of the existing Well Record for the well(s) to be plugged should be attached to this plan.

1) GPS Well Location: Latitude: 35 deg, 47 min, 31.16773 sec
Longitude: -106 deg, 15 min, 6.98776 sec, NAD 83

2) Reason(s) for plugging well(s):

See Well Plugging Plan of Operations-Epxanded Text for Sections IV, V, VI and VII.

3) Was well used for any type of monitoring program? Yes If yes, please use section VII of this form to detail what hydrogeologic parameters were monitored. If the well was used to monitor contaminated or poor quality water, authorization from the New Mexico Environment Department may be required prior to plugging.

4) Does the well tap brackish, saline, or otherwise poor quality water? NA If yes, provide additional detail, including analytical results and/or laboratory report(s): NA

5) Static water level: none detected feet below land surface / feet above land surface (circle one)

6) Depth of the well: 22.56 feet

7) Inside diameter of innermost casing: 4 inches.

8) Casing material: Stainless Steel

9) The well was constructed with:

☐ an open-hole production interval, state the open interval: _____

☑ a well screen or perforated pipe, state the screened interval(s): Unknown. No well construction records of the well can be discovered.

10) What annular interval surrounding the artesian casing of this well is cement-grouted? NA

11) Was the well built with surface casing? No If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? _____ If yes, please describe:

Visual inspection of the surface indicated no surface casing. No well construction information available.

12) Has all pumping equipment and associated piping been removed from the well? Yes If not, describe remaining equipment and intentions to remove prior to plugging in Section VII of this form.

## V. DESCRIPTION OF PLANNED WELL PLUGGING:

☐ **If plugging method differs between multiple wells on same site, a separate form must be completed for each method.**

**Note: If this plan proposes to plug an artesian well in a way other than with cement grout, placed bottom to top with a tremie pipe, a detailed diagram of the well showing proposed final plugged configuration shall be attached, as well as any additional technical information, such as geophysical logs, that are necessary to adequately describe the proposal. Attach a copy of any signed OSE variance to this plugging plan.**

**Also, if this planned plugging plan requires a variance to 19.27.4 NMAC, attach a detailed variance request signed by the applicant.**

1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well:

See Well Plugging Plan of Operation-Expanded Text for Sections IV, V, VI and VII.

2) Will well head be cut-off below land surface after plugging? There is no well head. The protective casing and pad will be removed.

## VI. PLUGGING AND SEALING MATERIALS:

**Note: The plugging of a well that taps poor quality water may require the use of a specialty cement or specialty sealant. Attach a copy of the batch mix recipe from the cement company and/or product description for specialty cement mixes or any sealant that deviates from the list of OSE approved sealants.**

1) For plugging intervals that employ cement grout, complete and attach Table A.

2) For plugging intervals that will employ approved non-cement based sealant(s), complete and attach Table B.

3) Theoretical volume of grout required to plug the well to land surface: 14 cu. ft

4) Type of Cement proposed: 2% bentonite cement grout

5) Proposed cement grout mix: 6.5 gallons of water per 94 pound sack of Portland cement.

6) Will the grout be: _____ batch-mixed and delivered to the site

X mixed on site

7) Grout additives requested, and percent by dry weight relative to cement:

2% bentonite to sack of 94 lb. cement; 6.5 gal/sk for 2% bentonite
1.88 lbs/94 lb sack
1.36 cu. ft/sack
110 lbs/cu.ft
14.7 lbs/gal

8) Additional notes and calculations:

See Well Plugging Plan of Operations-Expanded Text for Section IV, V, VI and VII.

**VII. ADDITIONAL INFORMATION:** List additional information below, or on separate sheet(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

**VIII. SIGNATURE:**

I, Joseph Chandler, say that I have carefully read the foregoing Well Plugging Plan of Operations and any attachments, which are a part hereof; that I am familiar with the rules and regulations of the State Engineer pertaining to the plugging of wells and will comply with them, and that each and all of the statements in the Well Plugging Plan of Operations and attachments are true to the best of my knowledge and belief.

Signature of Applicant

12-14-2022
Date

**IX. ACTION OF THE STATE ENGINEER:**

This Well Plugging Plan of Operations is:

_____ Approved subject to the attached conditions.
_____ Not approved for the reasons provided on the attached letter.

Witness my hand and official seal this_____day of _____,_____

_____., New Mexico State Engineer

By:_____

**TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of grout placement (ft bgl) | | | 0 to 2 ft bgl |
| Bottom of proposed interval of grout placement (ft bgl) | | | 23 ft to 2 ft bgl |
| Theoretical volume of grout required per interval (gallons) | | | • 10 5-in borehole 21 ft × 0 6013 ft3/ft = 12 63 ft3<br>o 1 36 ft3/sack Total sacks 9 28 = 60 32 gal<br>• 10 5-in borehole 2 ft × 0 6013 ft3/ft = 1 2 ft3 (lean cement)<br>o 1 18 ft3/sack Total sacks 1 02 = 1 sack = 5 2 gal |
| Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement | | | 6.5 gal/sk for 2% bentonite<br>5.2 gal/sk for lean |
| Mixed on-site or batch-mixed and delivered? | | | on site |
| Grout additive 1 requested | | | bentonite |
| Additive 1 percent by dry weight relative to cement | | | 2% bentonite, 1.88 lbs/94 lbs sack cement |
| Grout additive 2 requested | | | NA |
| Additive 2 percent by dry weight relative to cement | | | NA |

**TABLE B - For plugging intervals that will employ approved non-cement based sealant(s). Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of sealant placement (ft bgl) | | | NA |
| Bottom of proposed sealant of grout placement (ft bgl) | | | NA |
| Theoretical volume of sealant required per interval (gallons) | | | NA |
| Proposed abandonment sealant (manufacturer and trade name) | | | NA |

# Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

## Section and Subsection

### DM-4 (39-01133) [SWMU 39-001(a)]

#### Guidelines for Plugging and Abandoning Monitoring Wells and Angled Geophysical Boreholes

Abandonment will be accomplished by filling the entire volume of the borehole or well with grout composed of 2% bentonite Type I Portland cement slurry, 1.88 lb of dry powdered bentonite, and a maximum of 6.5 gal. of approved water per 94-lb sack of dry cement. The approximate grout weight will be 12.0 to 15.0 lb per gal. All grout materials will be combined in an aboveground rigid container or mixer and mechanically blended on-site to produce a thick, lump-free mixture throughout the mixing vessel.

Overdrilling will be used to remove subsurface components. In the event that well construction materials remain in the borehole after all reasonable efforts have been made at removal, the casing and/or screen sections will be cut and the borehole will be grouted for the remaining length, as feasible. Each borehole will be sealed by grouting from the bottom of the borehole or well to the ground surface. All grouting will be accomplished by placing a tremie pipe to the bottom of the borehole (i.e., to the maximum depth drilled) and pumping grout through this pipe until undiluted grout is present at the ground surface or at the base of the surrounding concrete cover.

After 24 hr, the abandoned site will be checked for grout settlement. At that time, any settlement depression will be filled with grout. Additional grout will be added using a tremie pipe inserted to the top of the firm grout unless the depth of the unfilled portion of the well or borehole is approximately 2 ft below ground surface (bgs) and this portion is dry. The ungrouted portions of the boreholes or wells will be filled to the ground surface with concrete or neat cement. This process will be repeated until firm neat cement or concrete remains at the ground surface.

In the event that thief zones (i.e., high-porosity or permeability zone or fracture zones) are encountered that prevent grouting to the ground surface, a bentonite plug or other industry-standard borehole sealant material (e.g., Flowseal) may be employed to bridge the thief zone and prevent loss of grout to the surrounding formation.

The New Mexico Office of the State Engineer (NMOSE) requires prehydrating the bentonite. Bentonite must be prehydrated before mixing with the cement. Mix bentonite first, and then mix the wet bentonite into the wet cement. A range of 6.5 to 7.3 lb/gal. is acceptable.

Before plugging and abandonment (P&A) operations, the water levels will be measured and documented. Any water in a well or borehole will be purged. Purge water from all boreholes/wells will be containerized and sampled for waste characterization purposes (LANL 2011). One week after purging, the water levels in each well and borehole will be checked to determine whether water levels have

recovered. If any of the wells or boreholes have recharged, the New Mexico Environment Department and NMOSE will be notified (LANL 2011).

For each abandoned monitoring well, an abandonment record will be prepared to include the following information:

- project and monitoring well designation;
- location of monitoring well (northing and easting, New Mexico State Plane 1983);
- depth of well before grouting (ft bgs);
- casing or items left in the borehole by depth, description, composition, and size (if applicable);
- copy of the original borehole log, if available;
- copy of the construction diagram for the abandoned well, if available;
- reason for abandonment;
- description and total quantity of grout used initially;
- description and daily quantities of grout used to compensate for settlement;
- dates of grouting; and
- water level before grouting and date measured (if applicable).

**Section IV: Well information (2)**: Reason(s) for plugging well(s)

39-01133 (DM-4): DM-4 was one of five vertical monitoring wells/continuously cored boreholes drilled in 1994 to varying depths to investigate potential migrations from Solid Waste Management Unit (SWMU) 39-001(a) (Landfill) and SWMU 39-001(b) (Disposal Pits). DM-4 was a downgradient well to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways (ICF Kaiser 1994). No formation water has been observed in DM-4, indicating that no perched-alluvial groundwater is present in these areas (LANL 2010). Additionally, the landfill and disposal pit were excavated in 2009–2010; therefore, the potential source for any contaminant migration has been removed.

The well is not being used and is a potential conduit for subsurface contamination (LANL 2011).

**Section V: Description of Planned Well Plugging (1):** Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well.

1. Rig up 6.25-in. inside-diameter (I.D.) hollow-stem augers (outside diameter [OD] 10.5 in.) to overdrill the 4-in.-I.D. stainless steel well.
2. Overdrill to 23 ft bgs true vertical depth (TVD).
3. After the well has been overdrilled, remove well casing and screen. Place well segments and pieces on plastic sheeting at the surface.
4. Calculate the estimated amount of 2% bentonite Type I Portland cement to fill the open hole, using 10.5-in.-O.D. borehole and 21 ft bgs TVD.

5. Install tremie pipe into the open borehole to ~3 ft from the bottom to pressure grout to the ground surface, while removing the augers to ensure that the open borehole is grouted. After the grout has cured a minimum of 24 hr, measure top of cement from ground surface.
6. Backfill the remaining hole (~2 ft) with concrete or neat cement to ensure a secure surface seal.
7. A neat-cement mound with a marker will be installed over the well at ground surface. The marker will be surveyed with Global Positioning System (GPS) with an accuracy of ±0.5 ft.
8. Dress well-surface location to contour of the local area.

If well casing and screen cannot be removed, or if the casing is cut in two by the augers, or field conditions will not allow removal of the well casing, contact NMOSE for guidance to proceed with P&A operations (Christopher Thornburg [NMOSE]: 505-629-8978).

**Section VI: Plugging and Sealing Materials (8):** Additional notes and calculations

- 10.5-in. borehole: 21 ft × 0.6013 $ft^3$/ft = 12.63 $ft^3$
    - 1.36 $ft^3$/sack: Total sacks 9.28
- 10.5-in. borehole: 2 ft × 0.6013 $ft^3$/ft = 1.2 $ft^3$ (lean cement)
    - 1.18 $ft^3$/sack: Total sacks: 1.02 = 1 sack
- Total $ft^3$: 13.83 = 14
- Total sacks: 10.3 = 11 sacks

Assumption: 3-ft filter pack above the screen. No information available.

**Section VII: Additional Information**

DM-4 was used to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways from the landfill at SWMU 39-001(a) and the disposal pits at SWMU 39-001(b). No water has been observed, indicating that no perched groundwater is present in the area, or that the observations are of limited aerial extent.

**References:**

ICF Kaiser, May 1994. "Drilling Plan Operable Unit 1132, Revision B," Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia. (ICF Kaiser 1994)

LANL (Los Alamos National Laboratory), January 2010. "Investigation Report for North Ancho Canyon Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-10-0125, Los Alamos, New Mexico. (LANL 2010)

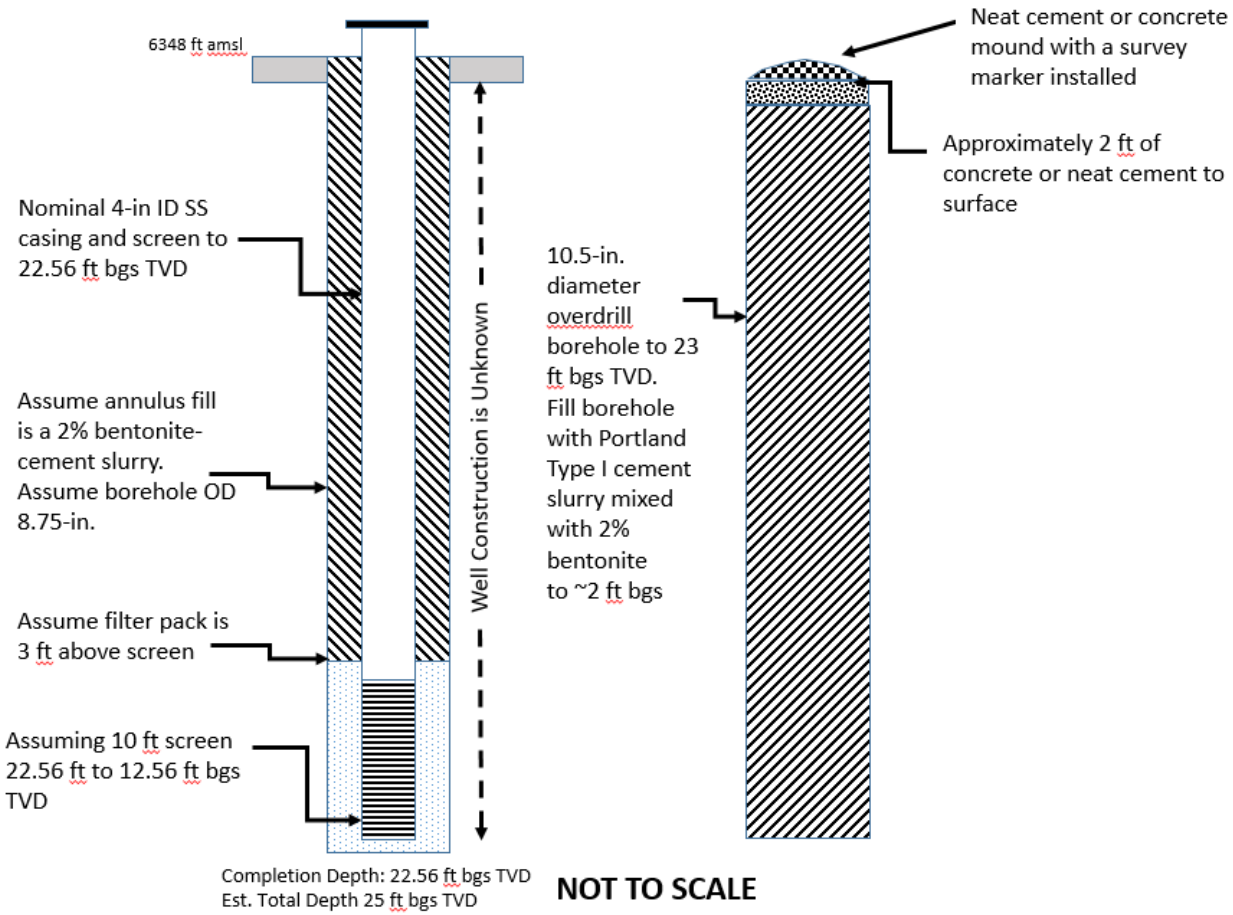
LANL (Los Alamos National Laboratory), March 2011. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1," Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011)

Morrison Knudsen Corporation, May 30, 1995. "Monitor Well Inspection at TA-39," letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho. (Morrison Knudsen Corporation 1995)

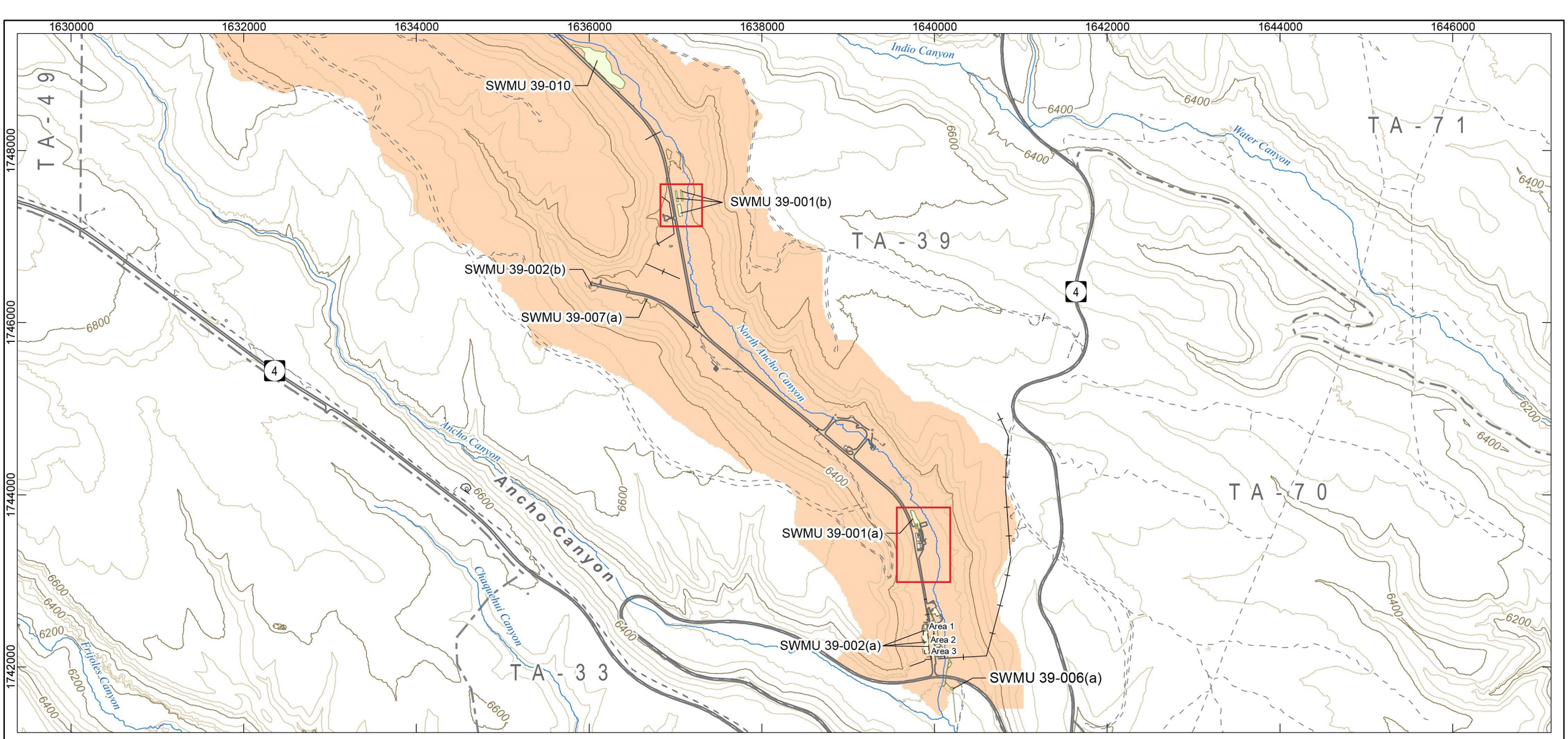
# DM-4 (39-01133)

Well Construction

Plug and Abandonment Approach




**NOT TO SCALE**




North Ancho Canyon Aggregate Area
SWMU or AOC
Structure
Former structure
Drainage channel

TA boundary
Fence
Unpaved road
Paved road

Index contour, 200-ft interval
Terrain contour, 50-ft interval
P&A Locations

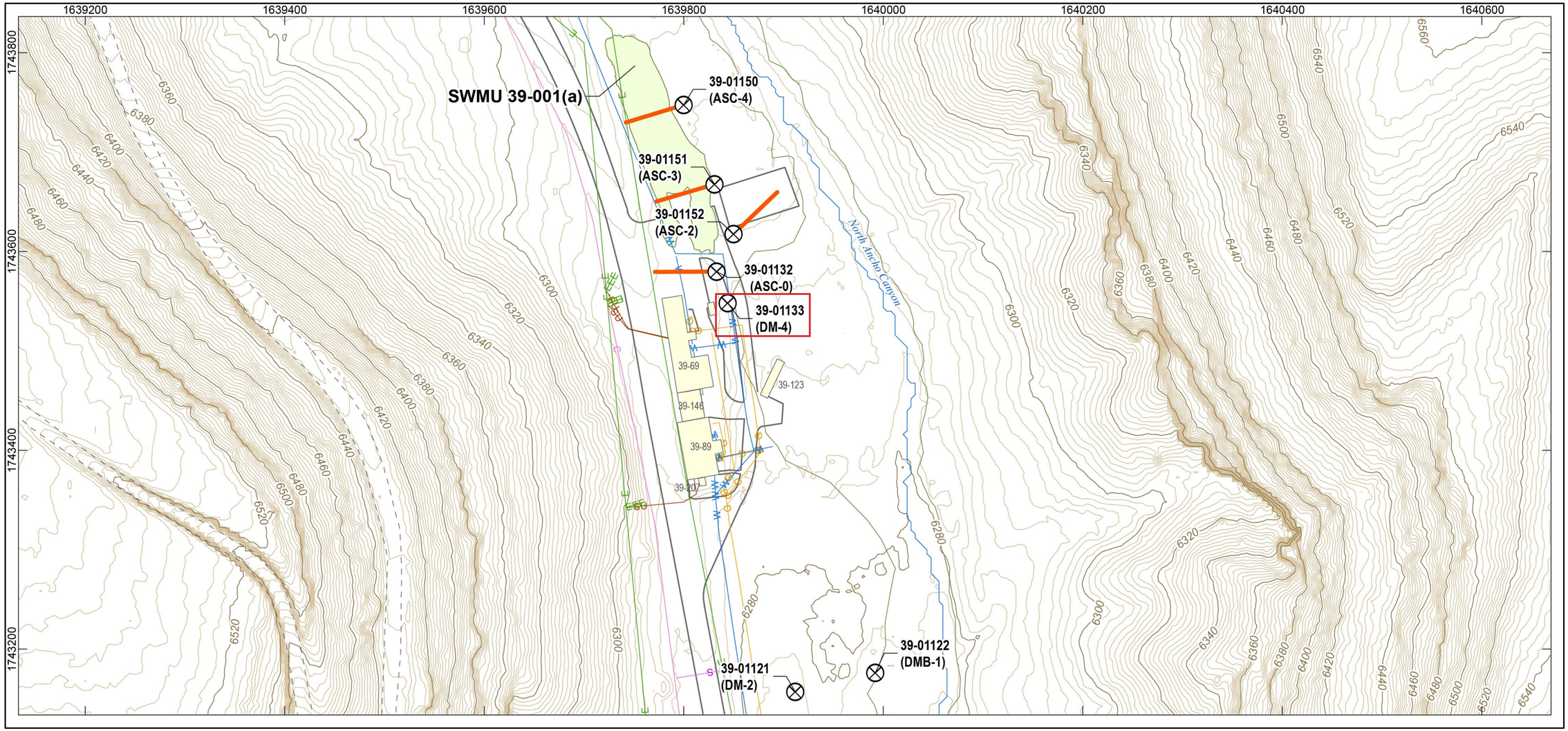
**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 0.125 0.25 0.5
Miles

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-49_north_ancho_phase_II_sites
1/13/2022 DFRANK

**Locations of plug and abandoning of monitoring wells and angled geophysical boreholes at TA-39**




Borehole, vertical or angled
Angled borehole drilling vector
Structure
SWMU or AOC
Drainage channel
Water line
Gas line
Electric line
Sewer line
Communication line
Secondary utility
Unpaved road
Paved road
Index contour, 20-ft interval
Terrain contour, 2-ft interval

**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 25 50 100
FEET

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-43_39-001(a)_angled_borehole
4/15/2022 DFRANK

**Location of SWMU 39-001(a) wells and boreholes**

## Well and Borehole Installation and Construction Details for SWMU 39-001(a)

| Unit No. | Well/ Borehole | Location ID | Casing Diameter (in.) | Casing Type | Orientation | Year Drilled | Drilling Method | Water Present | Top of Water (MD ft bgs)[a] | Top of Water (TVD ft bgs)[b] | Well/Borehole Total Depth (MD ft bgs) | Well/Borehole Total Depth (TVD ft bgs) | Status | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-001(a) | DMB-1[c] | 39-01122 | 4 | Stainless Steel | Vertical | 1994 | HSA[d] | NW[e] | n/a[f] | n/a | 117 | 117 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-2[h] | 39-01121 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 30.2 | 30.2 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-4[i] | 39-01133 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 22.56 | 22.56 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-0[j] | 39-01132 | 2 | PVC[k] | 45 degrees | 1994 | HSA | Yes | 78.85 | 41.42 | 81.05 | 42.58 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-1[l] | 39-01153 | 2 | PVC | 45 degrees | 1994 | HSA | —[m] | — | — | — | — | Abandoned when casing broke during installation. | Borehole completion documentation not found. |
| | ASC-2[n] | 39-01152 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 80.41 | 42.24 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-3[o] | 39-01151 | 2 | PVC | 45 degrees | 1994 | HSA | — | — | — | — | — | PVC casing cut by heavy equipment during 2009 excavation[p] | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-4[q] | 39-01150 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 75.41 | 39.61 | 81.4 | 42.76 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |

Notes: Total depth (TD) and field measurements were taken March 21, 2022. Well TD is field-measured feet below ground surface (ft bgs).

[a] MD = Measured depth.

[b] TVD = True vertical depth.

[c] Los Alamos National Laboratory, June 27, 1994–July 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DMB-1,” Los Alamos, New Mexico.

[d] HSA = Hollow-stem auger.

[e] NW = No water detected.

[f] n/a = Not applicable (no water detected).

[g] ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia.

[h] Los Alamos National Laboratory, July 12, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-2,” Los Alamos, New Mexico.

[i] Los Alamos National Laboratory, July 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-4,” Los Alamos, New Mexico.

[j] Los Alamos National Laboratory, June 23, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-0,” Los Alamos, New Mexico.

[k] PVC = Polyvinyl chloride.

[l] Los Alamos National Laboratory, June 15, 1994–June 21, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-1 (abandoned),” Los Alamos, New Mexico.

[m] — = Damaged and abandoned geophysical monitoring borehole.

[n] Los Alamos National Laboratory, June 13, 1994–June 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-2,” Los Alamos, New Mexico.

[o] Los Alamos National Laboratory, June 7, 1994–June 8, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-3,” Los Alamos, New Mexico.

[p] Los Alamos National Laboratory, October 20, 2009. “Subcontract Technical Representative Daily Activity Report for North Ancho Canyon Implementation,” Subcontract Number 66170, Los Alamos, New Mexico.

[q] Los Alamos National Laboratory, June 1, 1994–June 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-4,” Los Alamos, New Mexico.

# ENCLOSURE 4

# Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well DM-6 at Technical Area 39 North Ancho Canyon Aggregate Area

# WELL PLUGGING PLAN OF OPERATIONS

NOTE: A Well Plugging Plan of Operations shall be filed with and accepted by the Office of the State Engineer prior to plugging. This form may be used to plug a single well, or if you are plugging multiple monitoring wells on the same site using the same plugging methodology.

Alert! Your well may be eligible to participate in the Aquifer Mapping Program (AMP)-NM Bureau of Geology geoinfo.nmt.edu/resources/water/cgmn/ if within an area of interest and meets the minimum construction requirements, such as there is still water in your well, and the well construction reflected in a well record and log is not compromised, contact AMP at 575-835-5038 or -6951, or by email nmbg-waterlevels@nmt.edu, prior to completing this prior form. Showing proof to the OSE that your well was accepted in this program, may delay the plugging of your well until a later date.

**I. FILING FEE:** There is no filing fee for this form.

**II. GENERAL / WELL OWNERSHIP:** ☐ Check here if proposing one plan for multiple monitoring wells on the same site and attaching WD-08m

Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: DM-6

Name of well owner: Department of Energy

Mailing address: Joseph Chandler, 1200 Trinity Drive, Suite 150 County: Los Alamos

City: Los Alamos State: NM Zip code: 87544

Phone number: 505.257.7393 E-mail: joseph.chandler@em-la.doe.gov

**III. WELL DRILLER INFORMATION:**

Well Driller contracted to provide plugging services: Richard Leblanc, Yellow Jacket DRLG. Serv. LLC

New Mexico Well Driller License No.: WD-1458 Expiration Date: Oct 31, 2024

**IV. WELL INFORMATION:** ☐ Check here if this plan describes method for plugging multiple monitoring wells on the same site and attach supplemental form WD-08m and skip to #2 in this section.

Note: A copy of the existing Well Record for the well(s) to be plugged should be attached to this plan.

1) GPS Well Location: Latitude: 35 deg, 48 min, 7.56259 sec
Longitude: -106 deg, 15 min, 40.37597 sec, NAD 83

2) Reason(s) for plugging well(s):

See Well Plugging Plan of Operations-Epxanded Text for Sections IV, V, VI and VII.

3) Was well used for any type of monitoring program? Yes If yes, please use section VII of this form to detail what hydrogeologic parameters were monitored. If the well was used to monitor contaminated or poor quality water, authorization from the New Mexico Environment Department may be required prior to plugging.

4) Does the well tap brackish, saline, or otherwise poor quality water? NA If yes, provide additional detail, including analytical results and/or laboratory report(s): NA

5) Static water level: none detected feet below land surface / feet above land surface (circle one)

6) Depth of the well: 58.44 feet

7) Inside diameter of innermost casing: 4 inches.

8) Casing material: Stainless Steel

9) The well was constructed with:

☐ an open-hole production interval, state the open interval:

☑ a well screen or perforated pipe, state the screened interval(s): Unknown. No well construction records of the well can be discovered.

10) What annular interval surrounding the artesian casing of this well is cement-grouted? NA

11) Was the well built with surface casing? No If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? If yes, please describe:

Visual inspection of the surface indicated no surface casing. No well construction information available.

12) Has all pumping equipment and associated piping been removed from the well? Yes If not, describe remaining equipment and intentions to remove prior to plugging in Section VII of this form.

## V. DESCRIPTION OF PLANNED WELL PLUGGING:

☐ **If plugging method differs between multiple wells on same site, a separate form must be completed for each method.**

**Note: If this plan proposes to plug an artesian well in a way other than with cement grout, placed bottom to top with a tremie pipe, a detailed diagram of the well showing proposed final plugged configuration shall be attached, as well as any additional technical information, such as geophysical logs, that are necessary to adequately describe the proposal. Attach a copy of any signed OSE variance to this plugging plan.**

**Also, if this planned plugging plan requires a variance to 19.27.4 NMAC, attach a detailed variance request signed by the applicant.**

1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well:

See Well Plugging Plan of Operation-Expanded Text for Sections IV, V, VI and VII.

2) Will well head be cut-off below land surface after plugging? There is no well head. The protective casing and pad will be removed.

## VI. PLUGGING AND SEALING MATERIALS:

**Note: The plugging of a well that taps poor quality water may require the use of a specialty cement or specialty sealant. Attach a copy of the batch mix recipe from the cement company and/or product description for specialty cement mixes or any sealant that deviates from the list of OSE approved sealants.**

1) For plugging intervals that employ cement grout, complete and attach Table A.

2) For plugging intervals that will employ approved non-cement based sealant(s), complete and attach Table B.

3) Theoretical volume of grout required to plug the well to land surface: 16 cu. ft

4) Type of Cement proposed: 2% bentonite cement grout

5) Proposed cement grout mix: 6.5 gallons of water per 94 pound sack of Portland cement.

6) Will the grout be: batch-mixed and delivered to the site

X mixed on site

7) Grout additives requested, and percent by dry weight relative to cement:

2% bentonite to sack of 94 lb. cement; 6.5 gal/sk for 2% bentonite
1.88 lbs/94 lb sack
1.36 cu. ft/sack
110 lbs/cu.ft
14.7 lbs/gal

8) Additional notes and calculations:

See Well Plugging Plan of Operations-Expanded Text for Section IV, V, VI and VII.

**VII. ADDITIONAL INFORMATION:** List additional information below, or on separate sheet(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

**VIII. SIGNATURE:**

I, Joseph Chandler, say that I have carefully read the foregoing Well Plugging Plan of Operations and any attachments, which are a part hereof; that I am familiar with the rules and regulations of the State Engineer pertaining to the plugging of wells and will comply with them, and that each and all of the statements in the Well Plugging Plan of Operations and attachments are true to the ~~best~~ of my ~~knowledge and belief~~.

Signature of Applicant — Date: 12-14-2022

**IX. ACTION OF THE STATE ENGINEER:**

This Well Plugging Plan of Operations is:

_____ Approved subject to the attached conditions.
_____ Not approved for the reasons provided on the attached letter.

Witness my hand and official seal this_____day of _____,_____

_____., New Mexico State Engineer

By:_____

**TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of grout placement (ft bgl) | | | 0 to 2 ft bgs<br>20 ft to 2 ft bgs |
| Bottom of proposed interval of grout placement (ft bgl) | | | 58.44 ft to 20 ft bgl |
| Theoretical volume of grout required per interval (gallons) | | | ▪ 10.5-in borehole 21 ft × 0.6013 ft3/ft = 12.63 ft3<br>○ 1.36 ft3/sack Total sacks 9.28 = 60.32 gal<br>▪ 10.5-in borehole 2 ft × 0.6013 ft3/ft = 1.2 ft3 (lean cement)<br>○ 1.18 ft3/sack Total sacks 1.02 = 1 sack = 5.2 gal |
| Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement | | | 6.5 gal/sk for 2% bentonite<br>5.2 gal/sk for lean |
| Mixed on-site or batch-mixed and delivered? | | | on site |
| Grout additive 1 requested | | | bentonite |
| Additive 1 percent by dry weight relative to cement | | | 2% bentonite, 1.88 lbs/94 lbs sack cement |
| Grout additive 2 requested | | | NA |
| Additive 2 percent by dry weight relative to cement | | | NA |

**TABLE B - For plugging intervals that will employ approved non-cement based sealant(s). Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of sealant placement (ft bgl) | | | NA |
| Bottom of proposed sealant of grout placement (ft bgl) | | | NA |
| Theoretical volume of sealant required per interval (gallons) | | | NA |
| Proposed abandonment sealant (manufacturer and trade name) | | | NA |

# Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

## Section and Subsection

### DM-6 (39-01135) [SWMU 39-001(b)]

### Guidelines for Plugging and Abandoning Monitoring Wells and Angled Geophysical Boreholes

Abandonment will be accomplished by filling the entire volume of the borehole or well with grout composed of 2% bentonite Type I Portland cement slurry, 1.88 lb of dry powdered bentonite, and a maximum of 6.5 gal. of approved water per 94-lb sack of dry cement. The approximate grout weight will be 12.0 to 15.0 lb per gal. All grout materials will be combined in an aboveground rigid container or mixer and mechanically blended on-site to produce a thick, lump-free mixture throughout the mixing vessel.

Overdrilling will be used to remove subsurface components. In the event that well construction materials remain in the borehole after all reasonable efforts have been made at removal, the casing and/or screen sections will be cut and the borehole will be grouted for the remaining length, as feasible. Each borehole will be sealed by grouting from the bottom of the borehole or well to the ground surface. All grouting will be accomplished by placing a tremie pipe to the bottom of the borehole (i.e., to the maximum depth drilled) and pumping grout through this pipe until undiluted grout is present at the ground surface or at the base of the surrounding concrete cover.

After 24 hr, the abandoned site will be checked for grout settlement. At that time, any settlement depression will be filled with grout. Additional grout will be added using a tremie pipe inserted to the top of the firm grout, unless the depth of the unfilled portion of the well or borehole is approximately 2 ft below ground surface (bgs) and this portion is dry. The ungrouted portions of the boreholes or wells will be filled to the ground surface with concrete or neat cement. This process will be repeated until firm neat cement or concrete remains at the ground surface.

In the event that thief zones (i.e., high-porosity or permeability zone or fracture zones) are encountered that prevent grouting to the ground surface, a bentonite plug or other industry-standard borehole sealant material (e.g., Flowseal) may be employed to bridge the thief zone and prevent loss of grout to the surrounding formation.

The New Mexico Office of the State Engineer (NMOSE) requires prehydrating the bentonite. Bentonite must be prehydrated before mixing with the cement. Mix bentonite first, and then mix the wet bentonite into the wet cement. A range of 6.5 to 7.3 lb/gal. is acceptable.

Before plugging and abandonment (P&A) operations, the water levels will be measured and documented. Any water in a well or borehole will be purged. Purge water from all boreholes/wells will be containerized and sampled for waste characterization purposes (LANL 2011). One week after purging, the water levels in each well and borehole will be checked to determine whether water levels have

recovered. If any of the wells or boreholes have recharged, the New Mexico Environment Department and NMOSE will be notified (LANL 2011).

For each abandoned monitoring well, an abandonment record will be prepared to include the following information:

- project and monitoring well designation;
- location of monitoring well (northing and easting, New Mexico State Plane 1983);
- depth of well before grouting (ft bgs);
- casing or items left in the borehole by depth, description, composition, and size (if applicable);
- copy of the original borehole log, if available;
- copy of the construction diagram for the abandoned well, if available;
- reason for abandonment;
- description and total quantity of grout used initially;
- description and daily quantities of grout used to compensate for settlement;
- dates of grouting; and
- water level before grouting and date measured (if applicable).

**Section IV: Well information (2)**: Reason(s) for plugging well(s)

39-01135 (DM-6): DM-6 was one of five vertical monitoring wells/continuously cored boreholes drilled in 1994 to varying depths to investigate potential migrations from Solid Waste Management Unit (SWMU) 39-001(a) (Landfill) and SWMU 39-001(b) (Disposal Pits). DM-6 was a downgradient well to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways (ICF Kaiser 1994). No formation water has been observed in DM-6, indicating that no perched-alluvial groundwater is present in these areas (LANL 2010). Additionally, the landfill and disposal pit were excavated in 2009–2010; therefore, the potential source for any contaminant migration has been removed.

The well is not being used and is a potential conduit for subsurface contamination (LANL 2011).

**Section V: Description of Planned Well Plugging (1):** Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well.

1. Rig up tremie pipe and install to approximate top of screen interval depth. Screened interval is 48.44 to 58.44 ft bgs. The filter pack is 20 ft above the screen. Bentonite seal 25 to 27.5 bgs. No backfill material from 25 to 0 ft bgs. Screen is 10 ft. Tremie pipe depth ~55 ft bgs.
2. Calculate amount of grout needed to fill the screen interval and casing to 20 ft bgs within 4-in. casing.
3. Pump calculated amount of 2% bentonite Type I Portland cement.
4. Allow grout to cure for minimum of 24 hr.

5. Measure top of cement. Note depth for depth bgs.
6. Rig up 6.25-in. inside diameter (I.D.) hollow-stem augers (outside diameter [O.D.] 10.5 in.) to overdrill the 4-in.-I.D. stainless steel well.
7. Overdrill to 20 ft bgs true vertical depth (TVD).
8. After the well has been overdrilled, remove well casing. Place well segments and pieces on plastic sheeting at the surface.
9. Calculate the estimated amount of 2% bentonite Type I Portland cement to fill the open hole, using 10.5-in.-O.D. borehole and 18 ft bgs TVD.
10. Install tremie pipe into the open borehole to ~3 ft from the bottom to pressure grout to the ground surface while removing the augers to ensure that the open borehole is grouted. After the grout has cured a minimum of 24 hr, measure top of cement from ground surface.
11. Backfill the remaining hole (~2 ft) with concrete or neat cement to ensure a secure surface seal.
12. A neat-cement mound with a marker will be installed over the well at ground surface. The marker will be surveyed with Global Positioning System (GPS) with an accuracy of ±0.5 ft.
13. Dress well-surface location to contour of the local area.

If well casing and screen cannot be removed, or if the casing is cut in two by the augers, or field conditions will not allow removal of the well casing, contact NMOSE for guidance to proceed with P&A operations (Christopher Thornburg [NMOSE]: 505-629-8978).

**Section VI: Plugging and Sealing Materials (8):** Additional notes and calculations

- 38.44 ft × 0.0873 $ft^3$/ft = 3.36 $ft^3$
    - 1.36 $ft^3$/sack: Total sacks 2.47
- 10.5-in.-O.D. borehole: 18 ft bgs × 0.6013 $ft^3$/ft = 10.82 $ft^3$
    - 1.36 $ft^3$/sack: Total sacks = 7.96
- 10.5-in.-O.D. borehole: 2 ft × 0.6013 $ft^3$/ft = 1.2 $ft^3$ (lean cement)
    - 1.18 $ft^3$/sack: Total sacks 1.02 = 1 sack
- Total $ft^3$: 15.38 = 16
- Total sacks: 11.45 = 12 sacks

**Section VII: Additional Information**

DM-6 was used to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways from the landfill at SWMU 39-001(a) and the disposal pits at SWMU 39-001(b). No water has been observed, indicating that no perched groundwater is present in the area, or that the observations are of limited aerial extent.

**References**

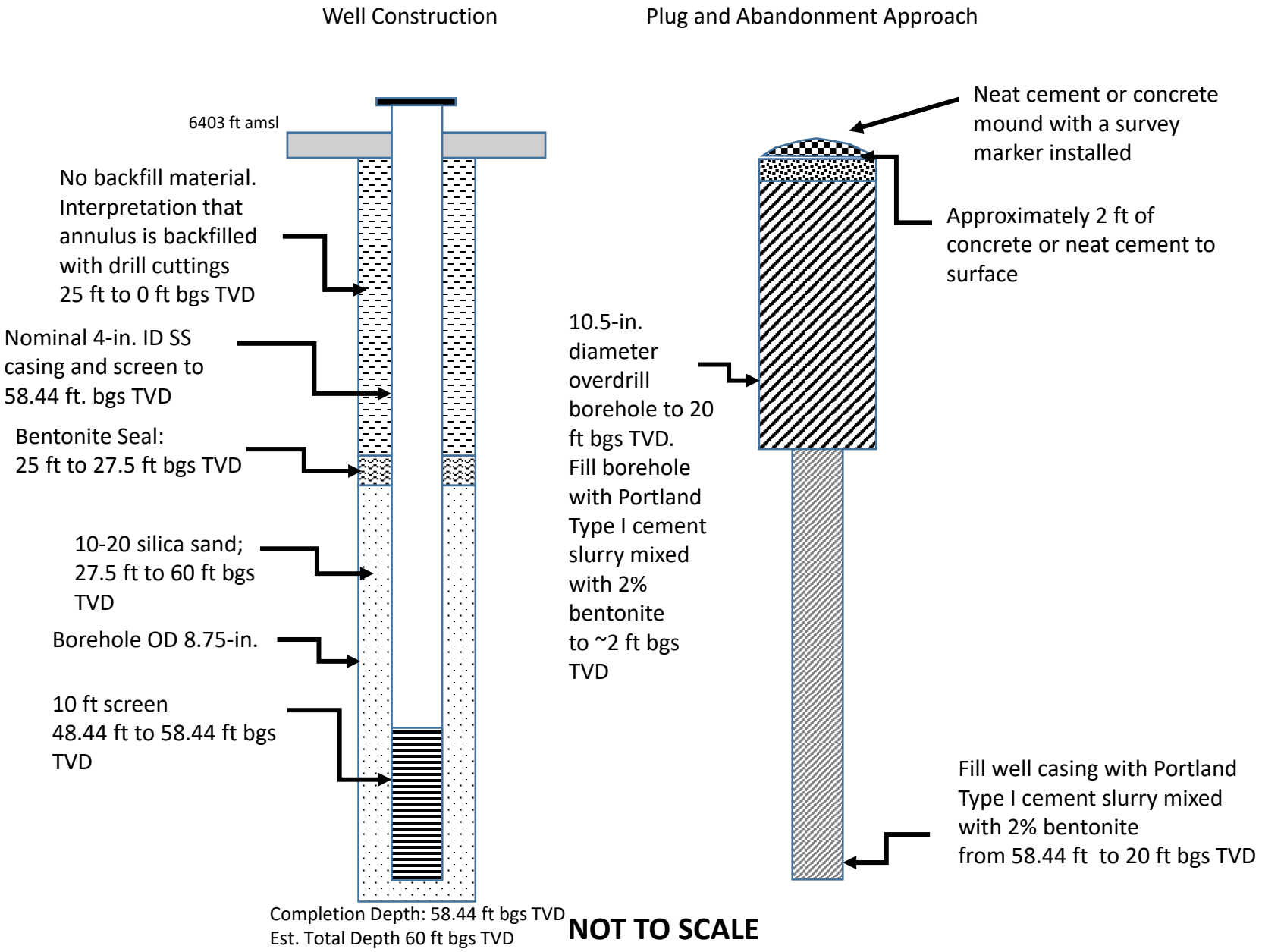
ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia. (ICF Kaiser 1994)

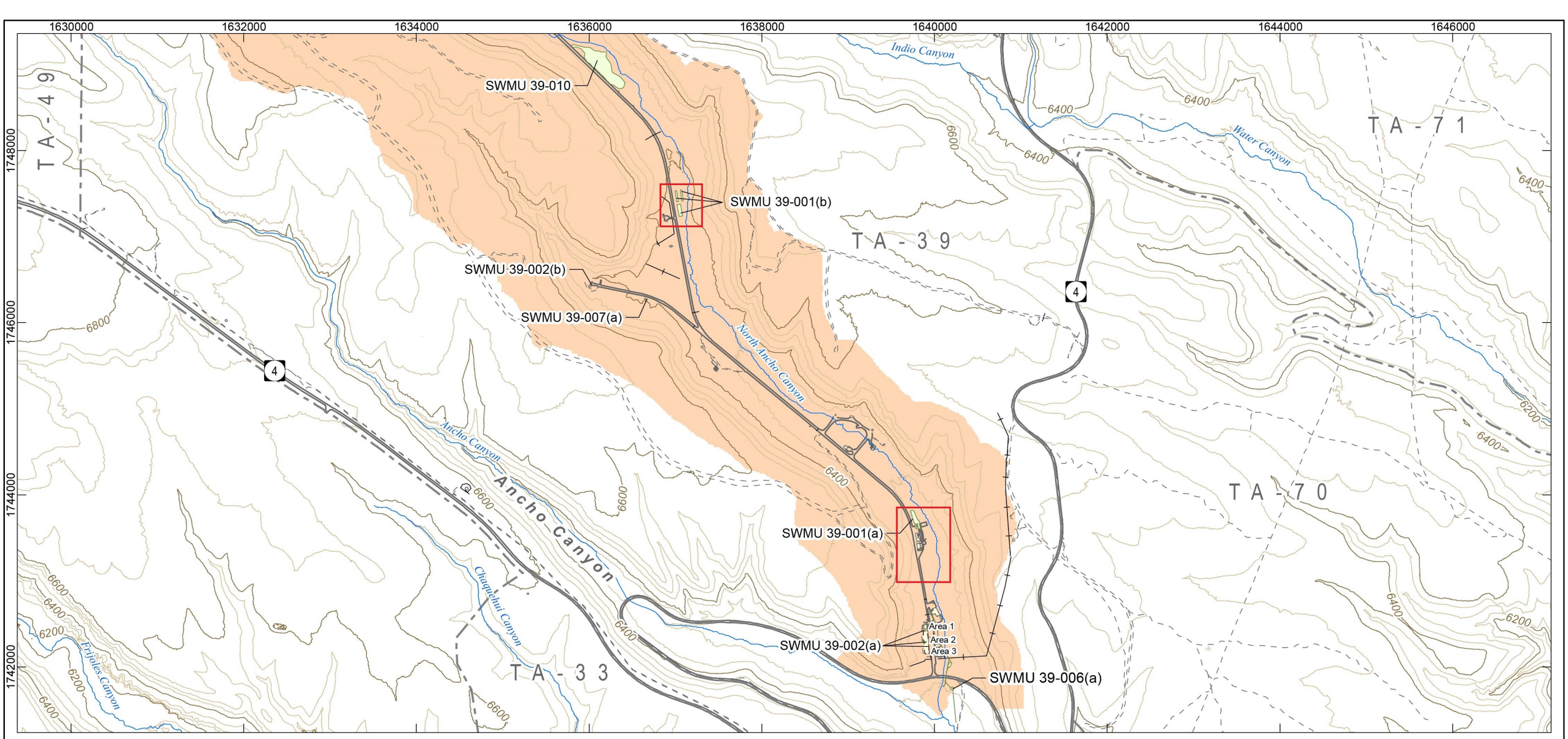
LANL (Los Alamos National Laboratory), January 2010. “Investigation Report for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-10-0125, Los Alamos, New Mexico. (LANL 2010)

LANL (Los Alamos National Laboratory), March 2011. “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011)

Morrison Knudsen Corporation, May 30, 1995. “Monitor Well Inspection at TA-39,” letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho. (Morrison Knudsen Corporation 1995)

# DM-6 (39-01135)


Well Construction
Plug and Abandonment Approach
6403 ft amsl
No backfill material. Interpretation that annulus is backfilled with drill cuttings 25 ft to 0 ft bgs TVD
Nominal 4-in. ID SS casing and screen to 58.44 ft. bgs TVD
Bentonite Seal: 25 ft to 27.5 ft bgs TVD
10-20 silica sand; 27.5 ft to 60 ft bgs TVD
Borehole OD 8.75-in.
10 ft screen 48.44 ft to 58.44 ft bgs TVD
Completion Depth: 58.44 ft bgs TVD
Est. Total Depth 60 ft bgs TVD
Neat cement or concrete mound with a survey marker installed
Approximately 2 ft of concrete or neat cement to surface
10.5-in. diameter overdrill borehole to 20 ft bgs TVD. Fill borehole with Portland Type I cement slurry mixed with 2% bentonite to ~2 ft bgs TVD
Fill well casing with Portland Type I cement slurry mixed with 2% bentonite from 58.44 ft to 20 ft bgs TVD
NOT TO SCALE




North Ancho Canyon Aggregate Area
SWMU or AOC
Structure
Former structure
Drainage channel

TA boundary
Fence
Unpaved road
Paved road

Index contour, 200-ft interval
Terrain contour, 50-ft interval
P&A Locations

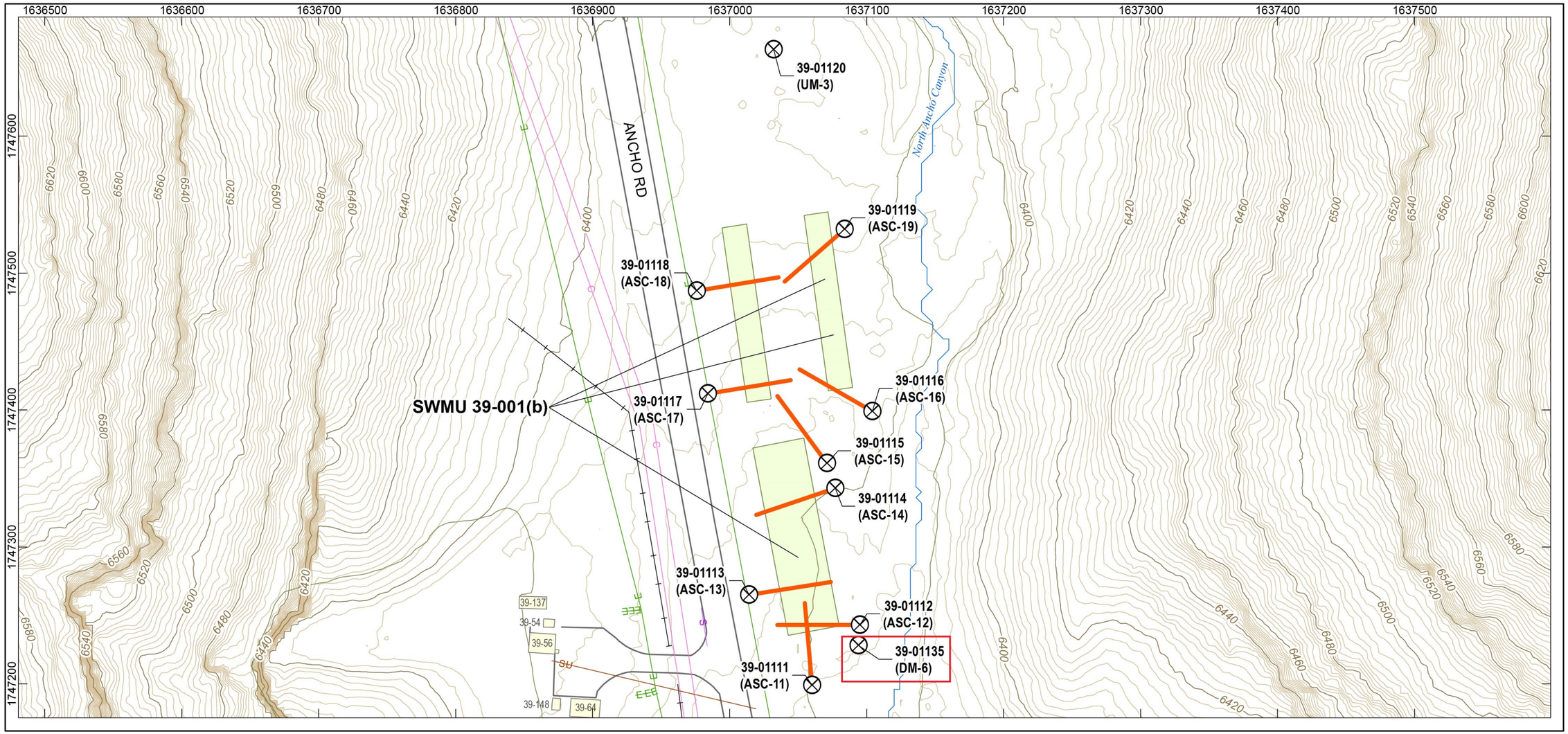
**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 0.125 0.25 0.5
Miles

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-49_north_ancho_phase_II_sites
1/13/2022 DFRANK

**Locations of plug and abandoning of monitoring wells and angled geophysical boreholes at TA-39**




**Location of SWMU 39-001(b) wells and boreholes**

**Well and Borehole Installation and Construction Details for SWMU 39-001(b)**

| Unit No. | Well/ Borehole | Location ID | Casing Diameter (in.) | Casing Type | Orientation | Year Drilled | Drilling Method | Water Present | Top of Water (MD ft bgs)[a] | Top of Water (TVD ft bgs)[b] | Well/Borehole Total Depth (MD ft bgs) | Well/Borehole Total Depth (TVD ft bgs) | Status | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-001(b) | DM-6[c] | 39-01135 | 4 | Stainless Steel | Vertical | 1994 | HSA[d] | NW[e] | n/a | n/a[f] | 58.44 | 58.44 | Existing | HSA 8.75-in. borehole diameter: 0–27 ft bgs – no backfill material; 25–27.5 ft bgs – bentonite seal; 27.5–57.5 bgs – 10-20 silica sand, 10-ft screen length. Depth discrepancy in field check with well construction information in the "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1"[g] and "Monitor Well Inspection at TA-39.[c] |
| | UM-3[c] | 39-01120 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 54.69 | 54.69 | Existing | HSA 8.75-in. borehole diameter: 0–25.19 ft bgs – 3% cement backfill; 25.19–27.69 ft bgs – bentonite seal; 37.69–56.5 bgs – 10-20 silica sand, 15-ft screen length. 2-ft sump. Bottom of well at 54.69 ft bgs. Depth discrepancy in field check with well construction information in the "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1"[g] and "Monitor Well Inspection at TA-39.[c] |
| | ASC-11[h] | 39-01111 | 2 | PVC[i] | 45 degrees | 1994 | HSA | Yes | 78.59 | 41.28 | 80.61 | 42.35 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-12[h] | 39-01112 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 77.79 | 40.86 | 81.4 | 42.76 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-13[h] | 39-01113 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 77.36 | 40.64 | 80.4 | 42.24 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-14[h] | 39-01114 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 80.89 | 42.49 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-15[h] | 39-01115 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 41.7 | 21.9 | 81.81 | 42.98 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-16[h] | 39-01116 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 79.09 | 41.54 | 79.37 | 41.69 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-17[h] | 39-01117 | 2 | PVC | 45 degrees | 1994 | HSA | NT[k] | NT | NT | 81.03 | 42.57 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] Unable to get measurements because newly installed transformer and fence prevented measurement equipment from being used. |
| | ASC-18[h] | 39-01118 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 81.22 | 42.67 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-19[h] | 39-01119 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 79.11 | 41.56 | 80.52 | 42.3 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |

Notes: Total depth (TD) and field measurements were taken March 21, 2022. Well TD is field-measured feet below ground surface.

[a] MD = Measured depth.

[b] TVD = True vertical depth.

[c] Morrison Knudsen Corporation, May 30, 1995. "Monitor Well Inspection at TA-39," letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho.

[d] HSA = Hollow-stem auger.

[e] NW = No water detected.

[f] n/a = Not applicable (no water detected).

[g] Los Alamos National Laboratory, March 2011. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area Revision 1," Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico.

[h] Los Alamos National Laboratory, February 2010. "Information Concerning the Angled Boreholes Associated with Past Environmental Investigations at Technical Area 39," Los Alamos National Laboratory document LA-UR-10-0579, Los Alamos, New Mexico.

[i] PVC = Polyvinyl chloride.

[j] ICF Kaiser, May 1994. "Drilling Plan Operable Unit 1132, Revision B," Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia.

[k] NT = Depth and water level not taken. Newly installed transformer and fence did not provide enough room for the measurement equipment to be used.

# ENCLOSURE 5

# Well Plugging Plan of Operations Form for the Plugging and Abandonment of Monitoring Well UM-3 at Technical Area 39 North Ancho Canyon Aggregate Area

# WELL PLUGGING PLAN OF OPERATIONS

NOTE: A Well Plugging Plan of Operations shall be filed with and accepted by the Office of the State Engineer prior to plugging. This form may be used to plug a single well, or if you are plugging multiple monitoring wells on the same site using the same plugging methodology.

Alert! Your well may be eligible to participate in the Aquifer Mapping Program (AMP)-NM Bureau of Geology geoinfo.nmt.edu/resources/water/cgmn/ if within an area of interest and meets the minimum construction requirements, such as there is still water in your well, and the well construction reflected in a well record and log is not compromised, contact AMP at 575-835-5038 or -6951, or by email nmbg-waterlevels@nmt.edu, prior to completing this prior form. Showing proof to the OSE that your well was accepted in this program, may delay the plugging of your well until a later date.

**I. FILING FEE:** There is no filing fee for this form.

**II. GENERAL / WELL OWNERSHIP:** ☐ Check here if proposing one plan for multiple monitoring wells on the same site and attaching WD-08m

Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: UM-3

Name of well owner: Department of Energy

Mailing address: Joseph Chandler 1200 Trinity Drive, Suite 150 County: Los Alamos

City: Los Alamos State: NM Zip code: 87544

Phone number: 505.257.7393 E-mail: joseph.chandler@em-la.doe.gov

**III. WELL DRILLER INFORMATION:**

Well Driller contracted to provide plugging services: Richard Leblanc, Yellow Jacket DRLG. Serv. LLC

New Mexico Well Driller License No.: WD-1458 Expiration Date: Oct 31, 2024

**IV. WELL INFORMATION:** ☐ Check here if this plan describes method for plugging multiple monitoring wells on the same site and attach supplemental form WD-08m and skip to #2 in this section.

Note: A copy of the existing Well Record for the well(s) to be plugged should be attached to this plan.

1) GPS Well Location: Latitude: 35 deg, 48 min, 11.86484 sec
Longitude: -106 deg, 15 min, 41.12932 sec, NAD 83

2) Reason(s) for plugging well(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

3) Was well used for any type of monitoring program? Yes If yes, please use section VII of this form to detail what hydrogeologic parameters were monitored. If the well was used to monitor contaminated or poor quality water, authorization from the New Mexico Environment Department may be required prior to plugging.

4) Does the well tap brackish, saline, or otherwise poor quality water? NA If yes, provide additional detail, including analytical results and/or laboratory report(s): NA

5) Static water level: none detected feet below land surface / feet above land surface (circle one)

6) Depth of the well: 54.69 feet

7) Inside diameter of innermost casing: 4 inches.

8) Casing material: Stainless Steel

9) The well was constructed with:

☐ an open-hole production interval, state the open interval:

☑ a well screen or perforated pipe, state the screened interval(s): 39.69-54.69 bgs

10) What annular interval surrounding the artesian casing of this well is cement-grouted? NA

11) Was the well built with surface casing? No If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? If yes, please describe:

Visual inspection of the surface indicated no surface casing. Well construction information reported no surface casing.

12) Has all pumping equipment and associated piping been removed from the well? Yes If not, describe remaining equipment and intentions to remove prior to plugging in Section VII of this form.

## V. DESCRIPTION OF PLANNED WELL PLUGGING:

☐ **If plugging method differs between multiple wells on same site, a separate form must be completed for each method.**

**Note: If this plan proposes to plug an artesian well in a way other than with cement grout, placed bottom to top with a tremie pipe, a detailed diagram of the well showing proposed final plugged configuration shall be attached, as well as any additional technical information, such as geophysical logs, that are necessary to adequately describe the proposal. Attach a copy of any signed OSE variance to this plugging plan.**

**Also, if this planned plugging plan requires a variance to 19.27.4 NMAC, attach a detailed variance request signed by the applicant.**

1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

2) Will well head be cut-off below land surface after plugging? There is no well head. The protective casing and pad will be removed.

## VI. PLUGGING AND SEALING MATERIALS:

**Note: The plugging of a well that taps poor quality water may require the use of a specialty cement or specialty sealant. Attach a copy of the batch mix recipe from the cement company and/or product description for specialty cement mixes or any sealant that deviates from the list of OSE approved sealants.**

1) For plugging intervals that employ cement grout, complete and attach Table A.

2) For plugging intervals that will employ approved non-cement based sealant(s), complete and attach Table B.

3) Theoretical volume of grout required to plug the well to land surface: 16 cu. ft.

4) Type of Cement proposed: 2% bentonite cement grout

5) Proposed cement grout mix: 6.5 gallons of water per 94 pound sack of Portland cement.

6) Will the grout be: batch-mixed and delivered to the site

X mixed on site

7) Grout additives requested, and percent by dry weight relative to cement:

2% bentonite to sack of 94 lb. cement
1.88 lbs/94 lb sack
1.36 cu. ft./sack
110 lbs/cu.ft
14.7 lbs/gal
6.5 gal/sk 2%bentonite

8) Additional notes and calculations:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VII. ADDITIONAL INFORMATION:** List additional information below, or on separate sheet(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VIII. SIGNATURE:**

I, Joseph Chandler, say that I have carefully read the foregoing Well Plugging Plan of Operations and any attachments, which are a part hereof; that I am familiar with the rules and regulations of the State Engineer pertaining to the plugging of wells and will comply with them, and that each and all of the statements in the Well Plugging Plan of Operations and attachments are true to the ~~best of~~ my knowledge ~~and~~ belief.

Signature of Applicant

12-14-2022
Date

**IX. ACTION OF THE STATE ENGINEER:**

This Well Plugging Plan of Operations is:

_____ Approved subject to the attached conditions.
_____ Not approved for the reasons provided on the attached letter.

Witness my hand and official seal this_____day of _____,_____

_____., New Mexico State Engineer

By:_____

**TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of grout placement (ft bgl) | | | 0 to 2 ft bgl<br>20 ft to 2 ft bgl |
| Bottom of proposed interval of grout placement (ft bgl) | | | 54.69 ft to 20 ft bgl |
| Theoretical volume of grout required per interval (gallons) | | | • 34.7 ft × 0.0873 ft3/ft = 3.03 ft3 (20 ft to 54.69 ft bgs)<br>÷ 1.36 ft3/sack Total sacks 2.23 = 14.5 gal<br>• 10.5-in borehole 18 ft bgs × 0.6013 ft3/ft = 10.82 ft3<br>÷ 1.36 ft3/sack Total sacks 7.96 = 53.74 gal<br>• 10.5-in borehole 2 ft × 0.5454 ft3/ft = 1.2 ft3<br>÷ 1.18 ft3/sack Total sacks 1.02 = 1 sack ×5.2 gal |
| Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement | | | 6.5 gal/sk with 2% bentonite<br>5.2 gal/sk for lean |
| Mixed on-site or batch-mixed and delivered? | | | on site |
| Grout additive 1 requested | | | bentonite |
| Additive 1 percent by dry weight relative to cement | | | 2% bentonite, 1.88 lbs/94 lbs sack cement |
| Grout additive 2 requested | | | NA |
| Additive 2 percent by dry weight relative to cement | | | NA |

**TABLE B - For plugging intervals that will employ approved non-cement based sealant(s). Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of sealant placement (ft bgl) | | | NA |
| Bottom of proposed sealant of grout placement (ft bgl) | | | NA |
| Theoretical volume of sealant required per interval (gallons) | | | NA |
| Proposed abandonment sealant (manufacturer and trade name) | | | NA |

# Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

## Section and Subsection

### UM-3 (39-01120) [SWMU 39-001(b)]

#### Guidelines for Plugging and Abandoning Monitoring Wells and Angled Geophysical Boreholes

Abandonment will be accomplished by filling the entire volume of the borehole or well with grout composed of 2% bentonite Type I Portland cement slurry, 1.88 lb of dry powdered bentonite, and a maximum of 6.5 gal. of approved water per 94-lb sack of dry cement. The approximate grout weight will be 12.0 to 15.0 lb per gal. All grout materials will be combined in an aboveground rigid container or mixer and mechanically blended on-site to produce a thick, lump-free mixture throughout the mixing vessel.

Overdrilling will be used to remove subsurface components. In the event that well construction materials remain in the borehole after all reasonable efforts have been made at removal, the casing and/or screen sections will be cut and the borehole will be grouted for the remaining length, as feasible. Each borehole will be sealed by grouting from the bottom of the borehole or well to the ground surface. All grouting will be accomplished by placing a tremie pipe to the bottom of the borehole (i.e., to the maximum depth drilled) and pumping grout through this pipe until undiluted grout is present at the ground surface or at the base of the surrounding concrete cover.

After 24 hr, the abandoned site will be checked for grout settlement. At that time, any settlement depression will be filled with grout. Additional grout will be added using a tremie pipe inserted to the top of the firm grout unless the depth of the unfilled portion of the well or borehole is approximately 2 ft below ground surface (bgs) and this portion is dry. The ungrouted portions of the boreholes or wells will be filled to the ground surface with concrete or neat cement. This process will be repeated until firm neat cement or concrete remains at the ground surface.

In the event that thief zones (i.e., high-porosity or permeability zone or fracture zones) are encountered that prevent grouting to the ground surface, a bentonite plug or other industry-standard borehole sealant material (e.g., Flowseal) may be employed to bridge the thief zone and prevent loss of grout to the surrounding formation.

The New Mexico Office of the State Engineer (NMOSE) requires prehydrating the bentonite. Bentonite must be prehydrated before mixing with the cement. Mix bentonite first, and then mix the wet bentonite into the wet cement. A range of 6.5 to 7.3 lb/gal. is acceptable.

Before plugging and abandonment (P&A) operations, the water levels will be measured and documented. Any water in a well or borehole will be purged. Purge water from all boreholes/wells will be containerized and sampled for waste characterization purposes (LANL 2011). One week after purging, the water levels in each well and borehole will be checked to determine whether water levels have

recovered. If any of the wells or boreholes have recharged, the New Mexico Environment Department and NMOSE will be notified (LANL 2011).

For each abandoned monitoring well, an abandonment record will be prepared to include the following information:

- project and monitoring well designation;
- location of monitoring well (northing and easting, New Mexico State Plane 1983);
- depth of well before grouting (ft bgs);
- casing or items left in the borehole by depth, description, composition, and size (if applicable);
- copy of the original borehole log, if available;
- copy of the construction diagram for the abandoned well, if available;
- reason for abandonment;
- description and total quantity of grout used initially;
- description and daily quantities of grout used to compensate for settlement;
- dates of grouting; and
- water level before grouting and date measured (if applicable).

**Section IV: Well information (2)**: Reason(s) for plugging well(s)

39-01120 (UM-3): UM-3 was one of five vertical monitoring wells/continuously cored boreholes drilled in 1994 to varying depths to investigate potential migrations from Solid Waste Management Unit (SWMU) 39-001(a) (Landfill) and SWMU 39-001(b) (Disposal Pits). UM-3 was the only upgradient well to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways (ICF Kaiser 1994). No formation water has been observed in UM-3, indicating that no perched-alluvial groundwater is present in these areas (LANL 2010). Additionally, the landfill and disposal pit were excavated in 2009–2010; therefore, the potential source for any contaminant migration has been removed.

The well is not being used and is a potential conduit for subsurface contamination (LANL 2011).

**Section V: Description of Planned Well Plugging (1):** Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well

1. Rig up tremie pipe and install to approximate top of screen interval depth. Screened interval is 29.5 to 56.5 ft bgs. Bentonite seal 29.5 to 27 bgs. A 3% bentonite cement backfill from 27 to 0 ft bgs. Screen is 15 ft. Install the tremie pipe to ~40 ft bgs.
2. Calculate amount of grout needed to fill the screen interval and casing to 20 ft bgs within 4-in. casing
3. Grouting to 5 ft bgs to assist in the removal of the casing from the borehole. It will provide enough open casing to place lifting bells or cabling to remove the casing and to help reduce the total weight of the casing and cement.

4. Pump calculated amount of 2% bentonite Type I Portland cement.
5. Allow grout to cure for minimum of 24 hr.
6. Measure top of cement. Note depth for depth bgs.
7. Rig up 6.25-in.-inside diameter (ID) hollow-stem augers (outside diameter [O.D.] 10.5 in.) to overdrill the 4-in.-I.D. stainless steel well.
8. Overdrill to 20 ft bgs true vertical depth (TVD).
9. After the well has been overdrilled, remove well casing. Place well segments and pieces on plastic sheeting at the surface.
10. Calculate the estimated amount of 2% bentonite Type I Portland cement to fill the open hole, using 10.5-in.-O.D. borehole and 18 ft bgs TVD.
11. Install tremie pipe into the open borehole to ~3 ft from the bottom to pressure-grout to the ground surface while removing the augers to ensure that the open borehole is grouted. After the grout has cured a minimum of 24 hr, measure top of cement from ground surface.
12. Backfill the remaining hole (~2 ft) with concrete or neat cement to ensure a secure surface seal.
13. A neat-cement mound with a marker will be installed over the well at ground surface. The marker will be surveyed with Global Positioning System (GPS) with an accuracy of ±0.5 ft.
14. Dress well-surface location to contour of the local area.

If well casing and screen cannot be removed, or if the casing is cut in two by the augers, or field conditions will not allow removal of the well casing, contact NMOSE for guidance to proceed with P&A operations (Christopher Thornburg [NMOSE]: 505-629-8978).

**Section VI: Plugging and Sealing Materials (8):** Additional notes and calculations

- 34.7 ft × 0.0873 $ft^3$/ft = 3.03 $ft^3$ (20 ft to 54.69 ft bgs)
    - 1.36 $ft^3$/sack: Total sacks = 2.23
- 10.5-in. borehole: 18 ft bgs × 0.6013 $ft^3$/ft = 10.82 $ft^3$
    - 1.36 $ft^3$/sack: Total sacks 7.96
- 10.5-in. borehole: 2 ft × 0.5454 $ft^3$/ft = 1.2 $ft^3$
    - 1.18 $ft^3$/sack: Total sacks 1.02 = 1 sack
- Total $ft^3$: 15.05 = 16
- Total sacks: 11.21 = 12 sacks

Information: Depth discrepancy in field check with well construction information in the Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1 (LANL 2011).

**Section VII: Additional Information**

UM-3 was used to investigate the presence of perched alluvial aquifers and/or potential contaminant migration pathways from the landfill at SWMU 39-001(a) and the disposal pits at SWMU 39-001(b). No

water has been observed, indicating that no perched groundwater is present in the area, or that the observations are of limited aerial extent.

**References:**

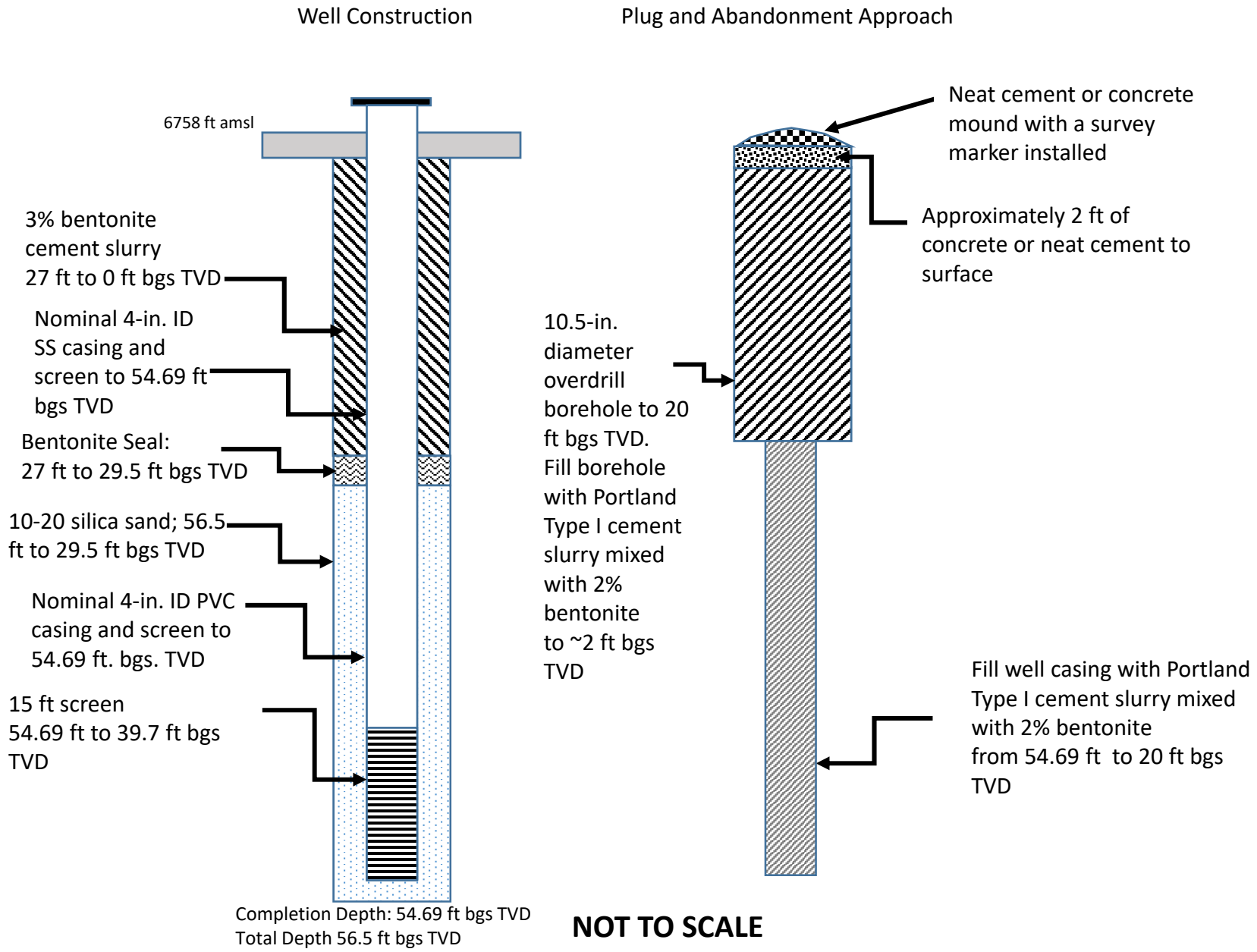
ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia. (ICF Kaiser 1994)

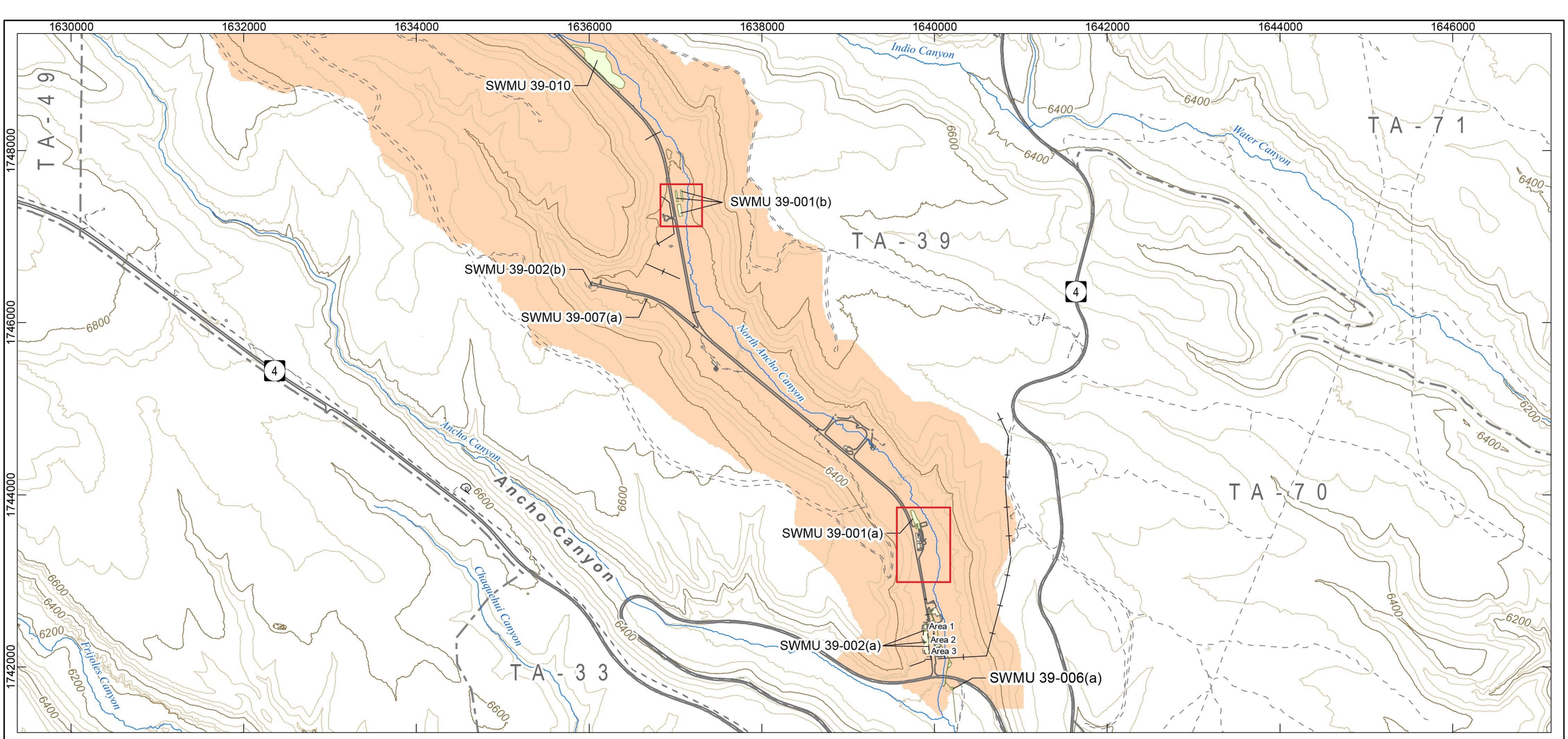
LANL (Los Alamos National Laboratory), January 2010. “Investigation Report for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-10-0125, Los Alamos, New Mexico. (LANL 2010)

LANL (Los Alamos National Laboratory), March 2011. “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011)

Morrison Knudsen Corporation, May 30, 1995. “Monitor Well Inspection at TA-39,” letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho. (Morrison Knudsen Corporation 1995)

# UM-3 (39-01120)


Well Construction
Plug and Abandonment Approach
6758 ft amsl
3% bentonite cement slurry 27 ft to 0 ft bgs TVD
Nominal 4-in. ID SS casing and screen to 54.69 ft bgs TVD
Bentonite Seal: 27 ft to 29.5 ft bgs TVD
10-20 silica sand; 56.5 ft to 29.5 ft bgs TVD
Nominal 4-in. ID PVC casing and screen to 54.69 ft. bgs. TVD
15 ft screen 54.69 ft to 39.7 ft bgs TVD
Completion Depth: 54.69 ft bgs TVD
Total Depth 56.5 ft bgs TVD
Neat cement or concrete mound with a survey marker installed
Approximately 2 ft of concrete or neat cement to surface
10.5-in. diameter overdrill borehole to 20 ft bgs TVD. Fill borehole with Portland Type I cement slurry mixed with 2% bentonite to ~2 ft bgs TVD
Fill well casing with Portland Type I cement slurry mixed with 2% bentonite from 54.69 ft to 20 ft bgs TVD
NOT TO SCALE




North Ancho Canyon Aggregate Area
SWMU or AOC
Structure
Former structure
Drainage channel

TA boundary
Fence
Unpaved road
Paved road

Index contour, 200-ft interval
Terrain contour, 50-ft interval
P&A Locations

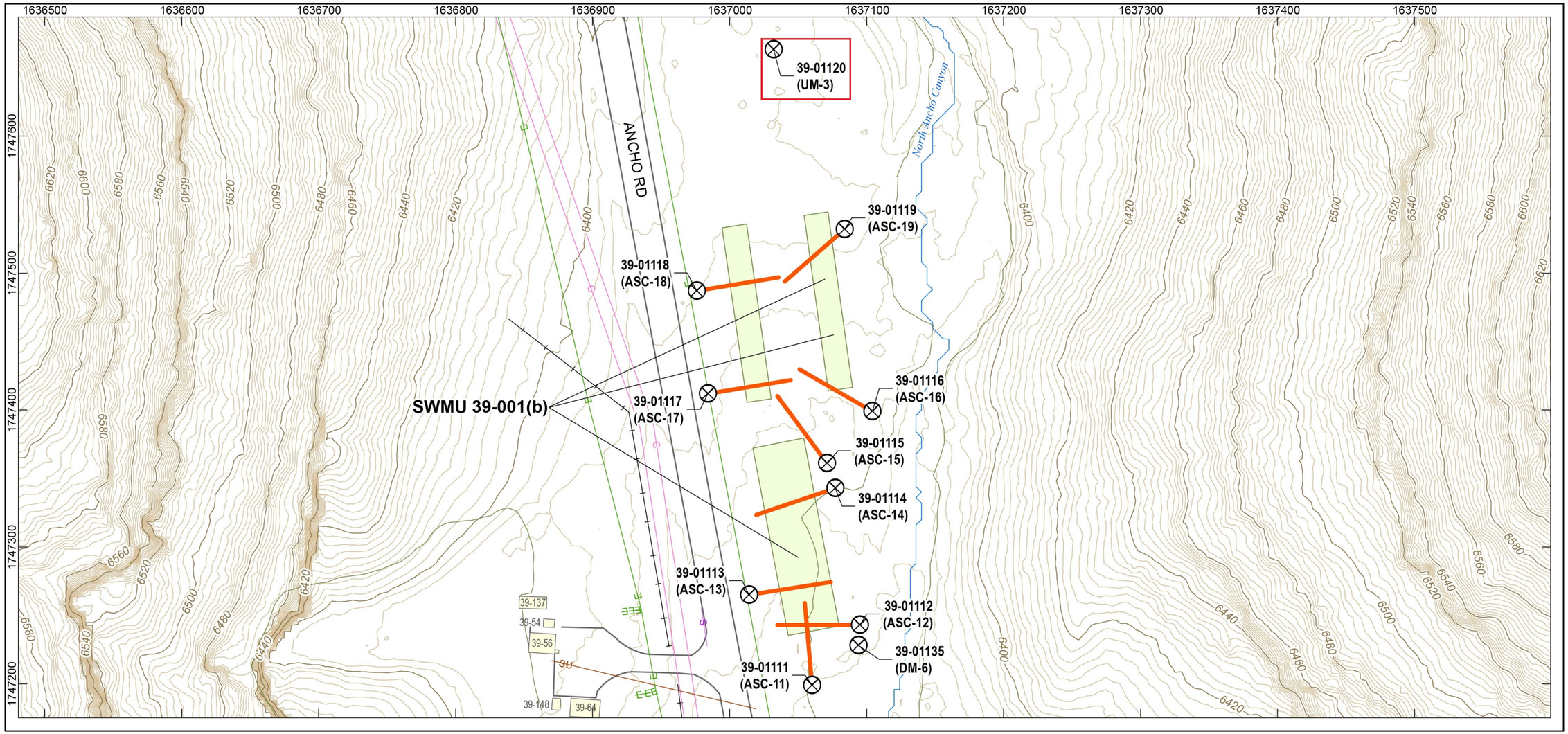
**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 0.125 0.25 0.5
Miles

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-49_north_ancho_phase_II_sites
1/13/2022 DFRANK

**Locations of plug and abandoning of monitoring wells and angled geophysical boreholes at TA-39**




**Location of SWMU 39-001(b) wells and boreholes**

**Well and Borehole Installation and Construction Details for SWMU 39-001(b)**

| Unit No. | Well/ Borehole | Location ID | Casing Diameter (in.) | Casing Type | Orientation | Year Drilled | Drilling Method | Water Present | Top of Water (MD ft bgs)[a] | Top of Water (TVD ft bgs)[b] | Well/Borehole Total Depth (MD ft bgs) | Well/Borehole Total Depth (TVD ft bgs) | Status | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-001(b) | DM-6[c] | 39-01135 | 4 | Stainless Steel | Vertical | 1994 | HSA[d] | NW[e] | n/a | n/a[f] | 58.44 | 58.44 | Existing | HSA 8.75-in. borehole diameter: 0–27 ft bgs – no backfill material; 25–27.5 ft bgs – bentonite seal; 27.5–57.5 bgs – 10-20 silica sand, 10-ft screen length. Depth discrepancy in field check with well construction information in the "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1"[g] and "Monitor Well Inspection at TA-39.[c] |
| | UM-3[c] | 39-01120 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 54.69 | 54.69 | Existing | HSA 8.75-in. borehole diameter: 0–25.19 ft bgs – 3% cement backfill; 25.19–27.69 ft bgs – bentonite seal; 37.69–56.5 bgs – 10-20 silica sand, 15-ft screen length. 2-ft sump. Bottom of well at 54.69 ft bgs. Depth discrepancy in field check with well construction information in the "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1"[g] and "Monitor Well Inspection at TA-39.[c] |
| | ASC-11[h] | 39-01111 | 2 | PVC[i] | 45 degrees | 1994 | HSA | Yes | 78.59 | 41.28 | 80.61 | 42.35 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-12[h] | 39-01112 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 77.79 | 40.86 | 81.4 | 42.76 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-13[h] | 39-01113 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 77.36 | 40.64 | 80.4 | 42.24 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-14[h] | 39-01114 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 80.89 | 42.49 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-15[h] | 39-01115 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 41.7 | 21.9 | 81.81 | 42.98 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-16[h] | 39-01116 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 79.09 | 41.54 | 79.37 | 41.69 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-17[h] | 39-01117 | 2 | PVC | 45 degrees | 1994 | HSA | NT[k] | NT | NT | 81.03 | 42.57 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] Unable to get measurements because newly installed transformer and fence prevented measurement equipment from being used. |
| | ASC-18[h] | 39-01118 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 81.22 | 42.67 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-19[h] | 39-01119 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 79.11 | 41.56 | 80.52 | 42.3 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |

Notes: Total depth (TD) and field measurements were taken March 21, 2022. Well TD is field-measured feet below ground surface.

[a] MD = Measured depth.

[b] TVD = True vertical depth.

[c] Morrison Knudsen Corporation, May 30, 1995. "Monitor Well Inspection at TA-39," letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho.

[d] HSA = Hollow-stem auger.

[e] NW = No water detected.

[f] n/a = Not applicable (no water detected).

[g] Los Alamos National Laboratory, March 2011. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area Revision 1," Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico.

[h] Los Alamos National Laboratory, February 2010. "Information Concerning the Angled Boreholes Associated with Past Environmental Investigations at Technical Area 39," Los Alamos National Laboratory document LA-UR-10-0579, Los Alamos, New Mexico.

[i] PVC = Polyvinyl chloride.

[j] ICF Kaiser, May 1994. "Drilling Plan Operable Unit 1132, Revision B," Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia.

[k] NT = Depth and water level not taken. Newly installed transformer and fence did not provide enough room for the measurement equipment to be used.

# ENCLOSURE 6

# Well Plugging Plan of Operations Form for the Plugging and Abandonment of 13 Angled Geophysical Boreholes ASC-0, ASC-2, ASC-3, ASC-4, ASC-11, ASC-12, ASC-13, ASC-14, ASC-15, ASC-16, ASC-17, ASC-18, and ASC-19 at Technical Area 39 North Ancho Canyon Aggregate Area

# WELL PLUGGING PLAN OF OPERATIONS

NOTE: A Well Plugging Plan of Operations shall be filed with and accepted by the Office of the State Engineer prior to plugging. This form may be used to plug a single well, or if you are plugging multiple monitoring wells on the same site using the same plugging methodology.

Alert! Your well may be eligible to participate in the Aquifer Mapping Program (AMP)-NM Bureau of Geology geoinfo.nmt.edu/resources/water/cgnm/ if within an area of interest and meets the minimum construction requirements, such as there is still water in your well, and the well construction reflected in a well record and log is not compromised, contact AMP at 575-835-5038 or -6951, or by email nmbg-waterlevels@nmt.edu, prior to completing this prior form. Showing proof to the OSE that your well was accepted in this program, may delay the plugging of your well until a later date.

**I. FILING FEE:** There is no filing fee for this form.

**II. GENERAL / WELL OWNERSHIP:** [X] Check here if proposing one plan for multiple monitoring wells on the same site and attaching WD-08m

Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: See Attachment for Angled Boreholes Supplemental Form WD-08m

Name of well owner: Department of Energy

Mailing address: Joseph Chandler, 1200 Trinity Drive, Suite 150 County: Los Alamos

City: Los Alamos State: NM Zip code: 87544

Phone number: 281.961.3141 E-mail: joseph.chandler@em-la.doe.gov

**III. WELL DRILLER INFORMATION:**

Well Driller contracted to provide plugging services: Richard Leblanc, Yellow Jacket DRLG. Serv. LLC

New Mexico Well Driller License No.: WD-1458 Expiration Date: October 31, 2024

**IV. WELL INFORMATION:** [✓] Check here if this plan describes method for plugging multiple monitoring wells on the same site and attach supplemental form WD-08m and skip to #2 in this section.

Note: A copy of the existing Well Record for the well(s) to be plugged should be attached to this plan.

1) GPS Well Location: Latitude: _____ deg, _____ min, _____ sec
Longitude: _____ deg, _____ min, _____ sec, NAD 83

2) Reason(s) for plugging well(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

3) Was well used for any type of monitoring program? Yes If yes, please use section VII of this form to detail what hydrogeologic parameters were monitored. If the well was used to monitor contaminated or poor quality water, authorization from the New Mexico Environment Department may be required prior to plugging.

4) Does the well tap brackish, saline, or otherwise poor quality water? NA If yes, provide additional detail, including analytical results and/or laboratory report(s): NA

5) Static water level: See tables feet below land surface / feet above land surface (circle one)

6) Depth of the well: ~80 feet

7) Inside diameter of innermost casing: 2 inches.

8) Casing material: PVC

9) The well was constructed with:

☐ an open-hole production interval, state the open interval: NA. All geophysical boreholes are cased 2-in PV

☐ a well screen or perforated pipe, state the screened interval(s): Unknown. No construction records can be discovered. 1994 plan did not specify any screen

10) What annular interval surrounding the artesian casing of this well is cement-grouted? NA

11) Was the well built with surface casing? No If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? _____ If yes, please describe:

Visual inspection of the surface indicated no surface casing. No construction information available.

12) Has all pumping equipment and associated piping been removed from the well? Yes If not, describe remaining equipment and intentions to remove prior to plugging in Section VII of this form

## V. DESCRIPTION OF PLANNED WELL PLUGGING:

☐ **If plugging method differs between multiple wells on same site, a separate form must be completed for each method.**

**Note: If this plan proposes to plug an artesian well in a way other than with cement grout, placed bottom to top with a tremie pipe, a detailed diagram of the well showing proposed final plugged configuration shall be attached, as well as any additional technical information, such as geophysical logs, that are necessary to adequately describe the proposal. Attach a copy of any signed OSE variance to this plugging plan.**

**Also, if this planned plugging plan requires a variance to 19.27.4 NMAC, attach a detailed variance request signed by the applicant.**

1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

2) Will well head be cut-off below land surface after plugging? There is no well head. The protective casing and pad will be removed.

## VI. PLUGGING AND SEALING MATERIALS:

**Note: The plugging of a well that taps poor quality water may require the use of a specialty cement or specialty sealant Attach a copy of the batch mix recipe from the cement company and/or product description for specialty cement mixes or any sealant that deviates from the list of OSE approved sealants.**

1) For plugging intervals that employ cement grout, complete and attach Table A.

2) For plugging intervals that will employ approved non cement based sealant(s), complete and attach Table B.

3) Theoretical volume of grout required to plug the well to land surface: See Attachment Supplemental Form WD

4) Type of Cement proposed: 2% bentonite cement grout

5) Proposed cement grout mix: 6.5 gallons of water per 94 pound sack of Portland cement.

6) Will the grout be: _____ batch-mixed and delivered to the site

X mixed on site

7) Grout additives requested, and percent by dry weight relative to cement:

2% bentonite to sack of 94 lb. cement
1.88 lbs/94 lb sack
1.36 cu. ft./sack
110 lbs/cu.ft
14.7 lbs/gal
6.5 gal/sk for 2% bentonite cement

8) Additional notes and calculations:

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VII. ADDITIONAL INFORMATION:** List additional information below, or on separate sheet(s):

See Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII.

**VIII. SIGNATURE:**

I, Joseph Chandler, say that I have carefully read the foregoing Well Plugging Plan of Operations and any attachments, which are a part hereof; that I am familiar with the rules and regulations of the State Engineer pertaining to the plugging of wells and will comply with them, and that each and all of the statements in the Well Plugging Plan of Operations and attachments are true to ~~the best~~ of my ~~knowledge and belief~~.

Signature of Applicant

12-14-2022
Date

**IX. ACTION OF THE STATE ENGINEER:**

This Well Plugging Plan of Operations is:

_____ Approved subject to the attached conditions.
_____ Not approved for the reasons provided on the attached letter.

Witness my hand and official seal this _____ day of _____, _____

_____., New Mexico State Engineer

By: _____

**TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of grout placement (ft bgl) | | | 0 ft to 2 ft bgs<br>20 ft to 2 ft bgs |
| Bottom of proposed interval of grout placement (ft bgl) | | | ~ 80 ft Measured depth (MD) to 20 ft bgs |
| Theoretical volume of grout required per interval (gallons) | | | 80 ft × 0.0218 ft³/ft = 1.74 ft³ (80 ft to 20 ft bgs)<br>1.36 ft³/sack; Total sacks = 0.86 = 1<br>20 ft MD to 2 ft MD of 7.25-in - diameter borehole = 18 ft × 0.9276 ft³/ft = 5.9 ft³<br>1.36 ft³/sack; Total sacks = 4.34<br>7.25-in borehole: 2 ft × 0.9276 ft³/ft = 0.86 ft³ (heat cement)<br>1.18 ft³/sack; Total sacks = 0.55 = 1 sack<br>Total ft³: 7.67 = 27<br>•Total sacks: = 7 sacks |
| Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement | | | 6.5 gal/sk for 2% bentonite<br>5.2 gal/sk for lean |
| Mixed on-site or batch-mixed and delivered? | | | on site |
| Grout additive 1 requested | | | bentonite |
| Additive 1 percent by dry weight relative to cement | | | 2% bentonite, 1.88 lbs/94 lbs sack cement |
| Grout additive 2 requested | | | NA |
| Additive 2 percent by dry weight relative to cement | | | NA |

**TABLE B - For plugging intervals that will employ approved non-cement based sealant(s). Start with deepest interval.**

| | Interval 1 – deepest | Interval 2 | Interval 3 – most shallow |
|---|---|---|---|
| | | | Note: if the well is non-artesian and breaches only one aquifer, use only this column. |
| Top of proposed interval of sealant placement (ft bgl) | | | NA |
| Bottom of proposed sealant of grout placement (ft bgl) | | | NA |
| Theoretical volume of sealant required per interval (gallons) | | | NA |
| Proposed abandonment sealant (manufacturer and trade name) | | | NA |

# NEW MEXICO OFFICE OF THE STATE ENGINEER

***ATTACHMENT to WD-08 Plan of Plugging***
***MULTIPLE MONITORING WELL DESCRIPTIONS***

This Attachment is to be completed if more than one (1) monitoring well is to be plugged using the same method.

**Location (Required):**

| ☐ NM State Plane (NAD83) (Feet) ☐ NM West Zone ☐ NM Central Zone ☐ NM East Zone | ☐ UTM (NAD83) (Meters) ☐ Zone 13N ☐ Zone 12N | ■ Lat/Long (WGS84) (1/10th of second) | OTHER (allowable only for move-from descriptions - see application form for format) ☐ PLSS (quarters, section, township, range) ☐ Hydrographic Survey, Map & Tract ☐ Lot, Block & Subdivision ☐ Grant |
|---|---|---|---|

| OSE POD Number: | Other Well ID: | X or Longitude (ddmmss): | Y or Latitude (ddmmss): | Other Location Info (PLSS): | Casing ID- (inches): | Depth to Water- (ft bgs): MD | Total well Depth- (ft bgs): MD | Grout Volume: | Surface Casing (Y or N): |
|---|---|---|---|---|---|---|---|---|---|
| ASC-0 | 39-01132 | - 106° 15' 7.1213" | 35° 47' 31.48422" | - | 2 | 78.85 | 81.05 | 8 cu. ft. | N |
| ASC-2 | 39-01152 | - 106° 15' 6.91494" | 35° 47' 31.86006" | - | 2 | Dry | 80.41 | 8 cu. ft. | N |
| ASC-3 | 39-01151 | - 106° 15' 7.1456" | 35° 47' 32.35458" | - | 2 | NA | Borehole damaged during | 1 cu. ft. | N |
| ASC-4 | 39-01150 | - 106° 15' 7.52194" | 35° 47' 33.1458" | - | 2 | 75.41 | 81.4 | 8 cu. ft. | N |
| ASC-11 | 39-0111 | - 106° 15' 40.78872" | 35° 48' 7.27573" | - | 2 | 78.59 | 80.61 | 8 cu. ft. | N |
| ASC-12 | 39-01112 | - 106° 15' 40.36385" | 35° 48' 7.71095" | - | 2 | 77.79 | 81.4 | 8 cu. ft. | N |
| ASC-13 | 39-01113 | - 106° 15' 41.34744" | 35° 48' 7.92844" | - | 2 | 77.36 | 80.4 | 8 cu. ft. | N |
| ASC-14 | 39-01114 | - 106° 15' 40.58253" | 35° 48' 8.69996" | - | 2 | Dry | 80.49 | 8 cu.ft. | N |
| ASC-15 | 39-01115 | - 106° 15' 40.6554" | 35° 48' 8.87798" | - | 2 | 41.7 | 81.81 | 8 cu.ft. | N |
| ASC-16 | 39-01116 | - 106° 15' 40.2548" | 35° 48' 9.25386" | - | 2 | 79.09 | 79.37 | 8 cu. ft. | N |
| ASC-17 | 39-01117 | - 106° 15' 41.71173" | 35° 48' 9.38229" | - | 2 | Dry | 80.61 | 8 cu. ft. | N |
| ASC-18 | 39-01118 | - 106° 15' 41.80897" | 35° 48' 10.12406" | - | 2 | Dry | 81.22 | 8 cu. ft. | N |

FOR OSE INTERNAL USE  Multiple Montioring POD Descriptions, Form wr-08m (Rev 7/31/19)

| File Number: | Trn Number: |
|---|---|
| Trans Description (optional): | |

# NEW MEXICO OFFICE OF THE STATE ENGINEER

***ATTACHMENT to WD-08 Plan of Plugging***
***MULTIPLE MONITORING WELL DESCRIPTIONS***

This Attachment is to be completed if more than one (1) monitoring well is to be plugged using the same method.

**Location (Required):**

| ☐ NM State Plane (NAD83) (Feet) ☐ NM West Zone ☐ NM Central Zone ☐ NM East Zone | ☐ UTM (NAD83) (Meters) ☐ Zone 13N ☐ Zone 12N | ■ Lat/Long (WGS84) (1/10th of second) | OTHER (allowable only for move-from descriptions - see application form for format) ☐ PLSS (quarters, section, township, range) ☐ Hydrographic Survey, Map & Tract ☐ Lot, Block & Subdivision ☐ Grant |
|---|---|---|---|

| OSE POD Number: | Other Well ID: | X or Longitude (ddmmss): | Y or Latitude (ddmmss): | Other Location Info (PLSS): | Casing ID- (inches): | Depth to Water- (ft bgs): MD | Total well Depth- (ft bgs)MD | Grout Volume: | Surface Casing (Y or N): |
|---|---|---|---|---|---|---|---|---|---|
| ASC-19 | 39-01119 | - 106° 15' 40.49781" | 35° 48' 10.56926" | - | 2 | 79.11 | 80.52 | 8 cu. ft. | N |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

FOR OSE INTERNAL USE **Multiple Montioring POD Descriptions**, Form wr-08m (Rev 7/31/19)

| File Number: | Trn Number: |
|---|---|
| Trans Description (optional): | |

# Well Plugging Plan of Operations-Expanded Text for Sections IV, V, VI and VII

## Section and Subsection

### Angled Geophysical Boreholes

- **(ASC-0; 39-01132) [SWMU 39-001(a)]**
- **(ASC-2; 39-01152) [SWMU 39-001(a)]**
- **(ASC-3; 39-01151) [SWMU 39-001(a)]**
- **(ASC-4; 39-01150) [SWMU 39-001(a)]**
- **(ASC-11; 39-01111) [SWMU 39-001(b)]**
- **(ASC-12; 39-01112) [SWMU 39-001(b)]**
- **(ASC-13; 39-01113) [SWMU 39-001(b)]**
- **(ASC-14; 39-01114) [SWMU 39-001(b)]**
- **(ASC-15; 39-01115) [SWMU 39-001(b)]**
- **(ASC-16; 39-01116) [SWMU 39-001(b)]**
- **(ASC-17; 39-01117) [SWMU 39-001(b)]**
- **(ASC-18; 39-01118) [SWMU 39-001(b)]**
- **(ASC-19; 39-01119) [SWMU 39-001(b)]**

### Guidelines for Plugging and Abandoning Monitoring Wells and Angled Geophysical Boreholes

Abandonment will be accomplished by filling the entire volume of the borehole or well with grout composed of 2% bentonite Type I Portland cement slurry, 1.88 lb of dry powdered bentonite, and a maximum of 6.5 gal. of approved water per 94-lb sack of dry cement. The approximate grout weight will be 12.0 to 15.0 lb per gal. All grout materials will be combined in an aboveground rigid container or mixer and mechanically blended on-site to produce a thick, lump-free mixture throughout the mixing vessel.

Overdrilling will be used to remove subsurface components. In the event that well construction materials remain in the borehole after all reasonable efforts have been made at removal, the casing and/or screen sections will be cut and the borehole will be grouted for the remaining length, as feasible. Each borehole will be sealed by grouting from the bottom of the borehole or well to the ground surface. All grouting will be accomplished by placing a tremie pipe to the bottom of the borehole (i.e., to the maximum depth drilled) and pumping grout through this pipe until undiluted grout is present at the ground surface or at the base of the surrounding concrete cover.

After 24 hr, the abandoned site will be checked for grout settlement. At that time, any settlement depression will be filled with grout. Additional grout will be added using a tremie pipe inserted to the

top of the firm grout unless the depth of the unfilled portion of the well or borehole is approximately 2 ft below ground surface (bgs) and this portion is dry. The ungrouted portions of the boreholes or wells will be filled to the ground surface with concrete or neat cement. This process will be repeated until firm neat cement or concrete remains at the ground surface.

In the event that thief zones (i.e., high-porosity or permeability zone or fracture zones) are encountered that prevent grouting to the ground surface, a bentonite plug or other industry-standard borehole sealant material (e.g., Flowseal) may be employed to bridge the thief zone and prevent loss of grout to the surrounding formation.

The New Mexico Office of the State Engineer (NMOSE) requires prehydrating the bentonite. Bentonite must be prehydrated before mixing with the cement. Mix bentonite first, and then mix the wet bentonite into the wet cement. A range of 6.5 to 7.3 lb/gal. is acceptable.

Before plugging and abandonment (P&A) operations, the water levels will be measured and documented. Any water in a well or borehole will be purged. Purge water from all boreholes/wells will be containerized and sampled for waste characterization purposes (LANL 2011). One week after purging, the water levels in each well and borehole will be checked to determine whether water levels have recovered. If any of the wells or boreholes have recharged, the New Mexico Environment Department and NMOSE will be notified (LANL 2011).

For each abandoned angled geophysical borehole, an abandonment record will be prepared to include the following information:

- project and monitoring well designation;
- location of monitoring well (northing and easting, New Mexico State Plane 1983);
- depth of well before grouting (feet bgs);
- casing or items left in the borehole by depth, description, composition, and size (if applicable);
- copy of the original borehole log if available;
- copy of the construction diagram for the abandoned well if available;
- reason for abandonment;
- description and total quantity of grout used initially;
- description and daily quantities of grout used to compensate for settlement;
- dates of grouting; and
- water level before grouting and date measured (as applicable).

**Section IV: Well information (2)**: Reason(s) for plugging well(s)

No formation water has been observed in any monitoring well in the vicinity of these boreholes, indicating that no perched-alluvial groundwater is present in these areas (LANL 2010). Additionally, the landfill and disposal pit were excavated in 2009–2010; therefore, the potential source for any contaminant migration has been removed.

The angled geophysical boreholes were not installed with screens or filter pack and were not intended to be monitoring wells. They are not being used and are a potential conduit for subsurface contamination (LANL 2011).

**Section V: Description of Planned Well Plugging (1):** Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well.

The same method will be used for each of the angled geophysical boreholes.

1. Rig up tremie pipe and install to approximately 2 ft from bottom of borehole. Tremie pipe depth should be ~78 ft bgs.
2. Calculate amount of grout needed to fill the borehole to 20 ft bgs within 2-in. casing.
3. Pump calculated amount of 2% bentonite Type I Portland cement.
4. Grout to 20 ft bgs.
5. Allow grout to cure for minimum of 24 hr.
6. Measure top of cement. Note depth for depth bgs.
7. Rig up 3.75-in.-inside diameter (I.D.), 7.75-in.-outside diameter (O.D.) hollow-stem augers to overdrill the 2-in.-I.D. polyvinyl chloride (PVC) angled geophysical boreholes.
8. Overdrill to 20 bgs.
9. Calculate the amount of 2% bentonite Type I Portland cement to fill the open hole. Calculate grout estimate using 7.75-in.-O.D. borehole and 20-ft measured depth.
10. Install tremie pipe into the open borehole to ~3 ft from bottom to pressure-grout from the bottom of the borehole to the ground surface, while removing the augers to ensure that the open borehole is grouted. After the grout has cured a minimum of 24 hr, tag top of cement from ground surface.
11. Backfill the remaining hole (~2 ft) with concrete or neat cement to ensure a secure surface seal. Dress surface location to contour of the local area.

**Section VI: Plugging and Sealing Materials (8):** Additional notes and calculations

For the purposes of estimating cement volumes, the assumption for the angled geophysical boreholes measured depth (MD) is 80 ft bgs. The actual MD will be reported, and grout calculations will be made at each angled geophysical borehole.

- 60 ft × 0.0218 $ft^3$/ft = 1.31 $ft^3$ (80 ft to 20 ft bgs)
    - 1.36 $ft^3$/sack: Total sacks = 0.96 = 1
- 20 ft MD to 2 ft MD of 7.75-in.-diameter borehole = 18 ft × 0.3276 $ft^3$/ft = 5.9 $ft^3$
    - 1.36 $ft^3$/sack: Total sacks = 4.34
- 7.75-in borehole: 2 ft × 0.3276 $ft^3$/ft = 0.66 $ft^3$ (lean cement)
    - 1.18 $ft^3$/sack: Total sacks = 0.55 = 1
- Total $ft^3$: 7.87 = 8
- Total sacks: = 7

Information: Geophysical boreholes are 2 in. and have no screens. Borehole construction documents are unknown.

**Section VII: Additional Information**

All depths are MD ft bgs.

Fourteen (14) 45-degree angled geophysical monitoring boreholes were continuously cored in 1994 to approximately 80 ft to collect soil samples around the solid waste management units (SWMUs) for the 1997 RCRA (Resource Conservation and Recovery Act) Facility Investigation (RFI) report and to monitor water/liquid moisture from SWMU 39-001(a) (Landfill) and SWMU 39-001(b) (Disposal Pits). Each bore was cased with 2-in. PVC. No information can be found that details the construction of any of the angled geophysical boreholes. All indications are that the angled geophysical boreholes were installed only with PVC casing and no screens, since they are not designated monitoring wells. The 1994 drilling plan (ICF Kaiser 1994) states only that the 45-degree-angle boreholes were to be completed with 2-in. PVC casing cemented in place to facilitate geophysical logging. No information is available to determine if the annulus was backfilled with cement or cuttings.

Six angled boreholes (ASC-0, ASC-1, ASC-2, ASC-3, ASC-4 and ASC-5) were drilled at the SWMU 39-001(a) landfill. ASC-1 was abandoned when casing broke during installation. ASC-3 was damaged by heavy equipment during the 2009 excavation of the landfill. This angled geophysical borehole has been abandoned to ground surface and a bentonite plug was placed over the protruding PVC (LANL 2010). The borehole is planned to be overdrilled to 2 ft bgs for proper surface completion and the surface will be dressed to the contour of the area.

Nine angled boreholes (ASC-11, ASC-12, ASC-13, ASC-14, ASC-15, ASC-16, ASC-17, ASC-18 and ASC-19) were drilled at the SWMU 39-001(b) disposal pits.

Water detected in the boreholes may be the result of the PVC casing becoming damaged during the 2009 excavations at SWMU 39-001(a) and SWMU 39-001(b). It is known that the PVC casing at ASC-3 was damaged during excavation operations at SWMU 39-001(a) in 2009 (LANL 2009).

**References:**

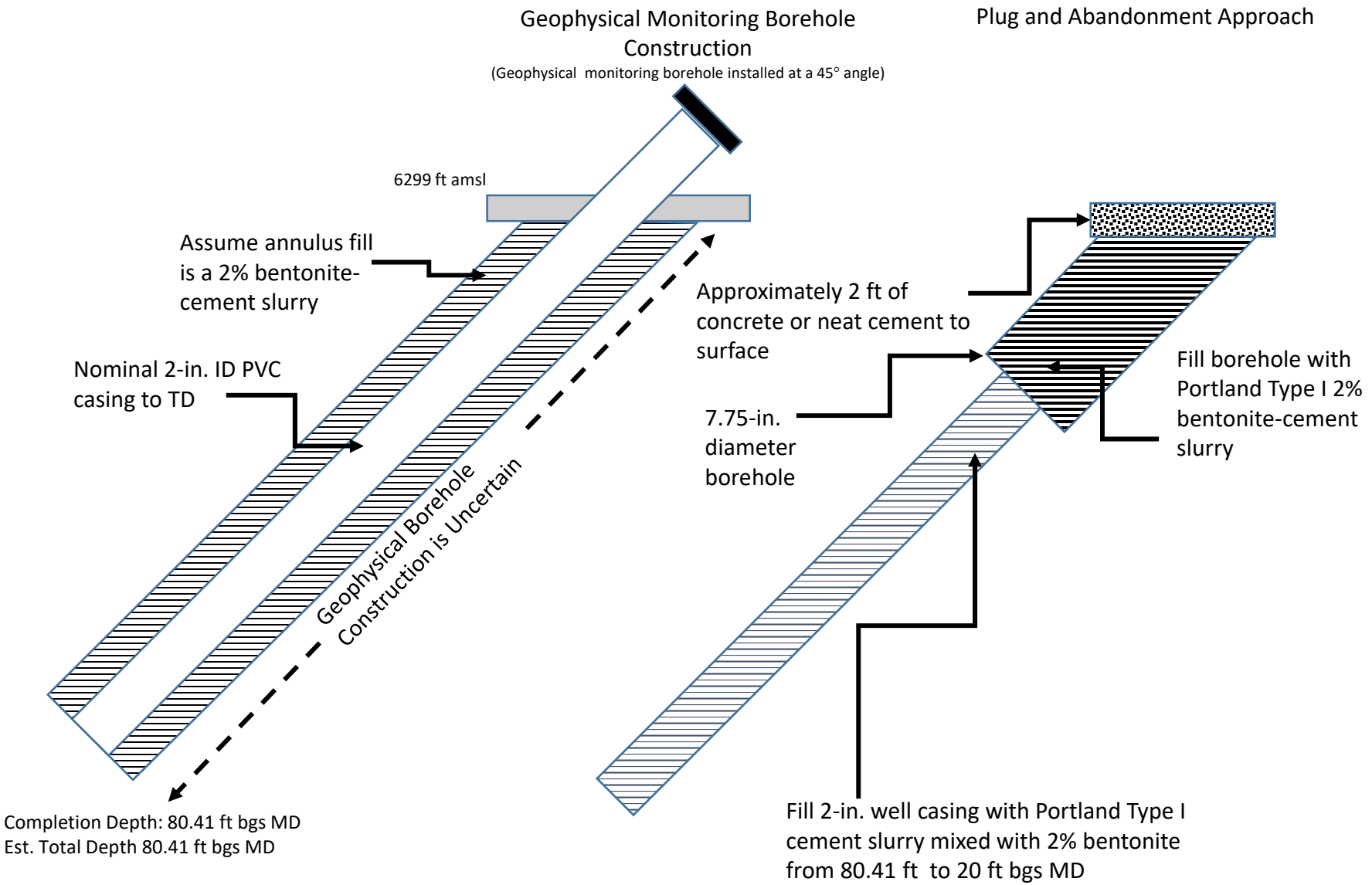
ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia. (ICF Kaiser 1994)

LANL (Los Alamos National Laboratory), October 20, 2009. “Subcontract Technical Representative Daily Activity Report for North Ancho Canyon Implementation,” Subcontract Number 66170, Los Alamos, New Mexico.

LANL (Los Alamos National Laboratory), January 2010. “Investigation Report for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-10-0125, Los Alamos, New Mexico. (LANL 2010)

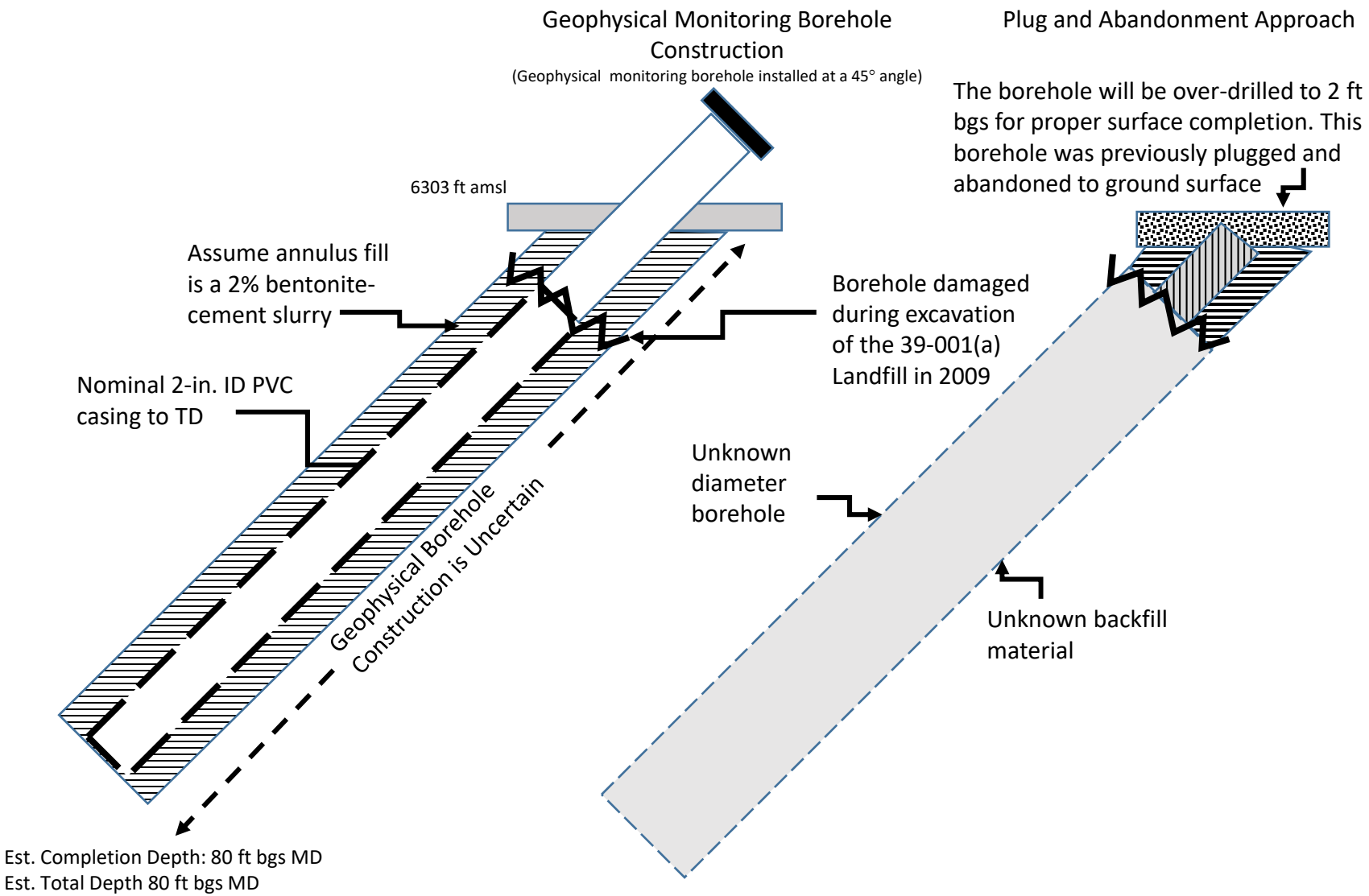
LANL (Los Alamos National Laboratory), March 2011. “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011)

# ASC-2 (39-01152)



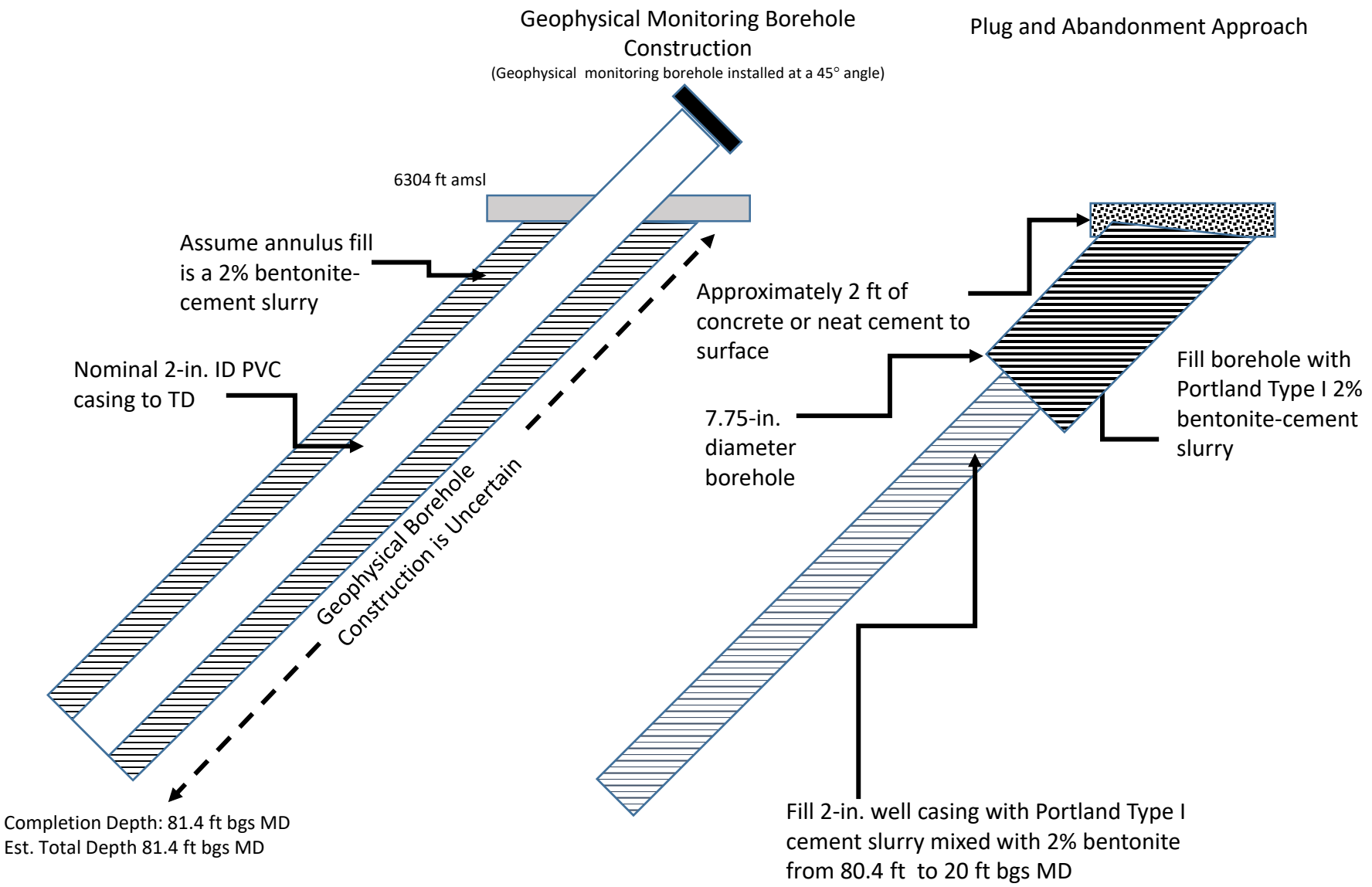

**NOT TO SCALE**

# ASC-3 (39-01151)



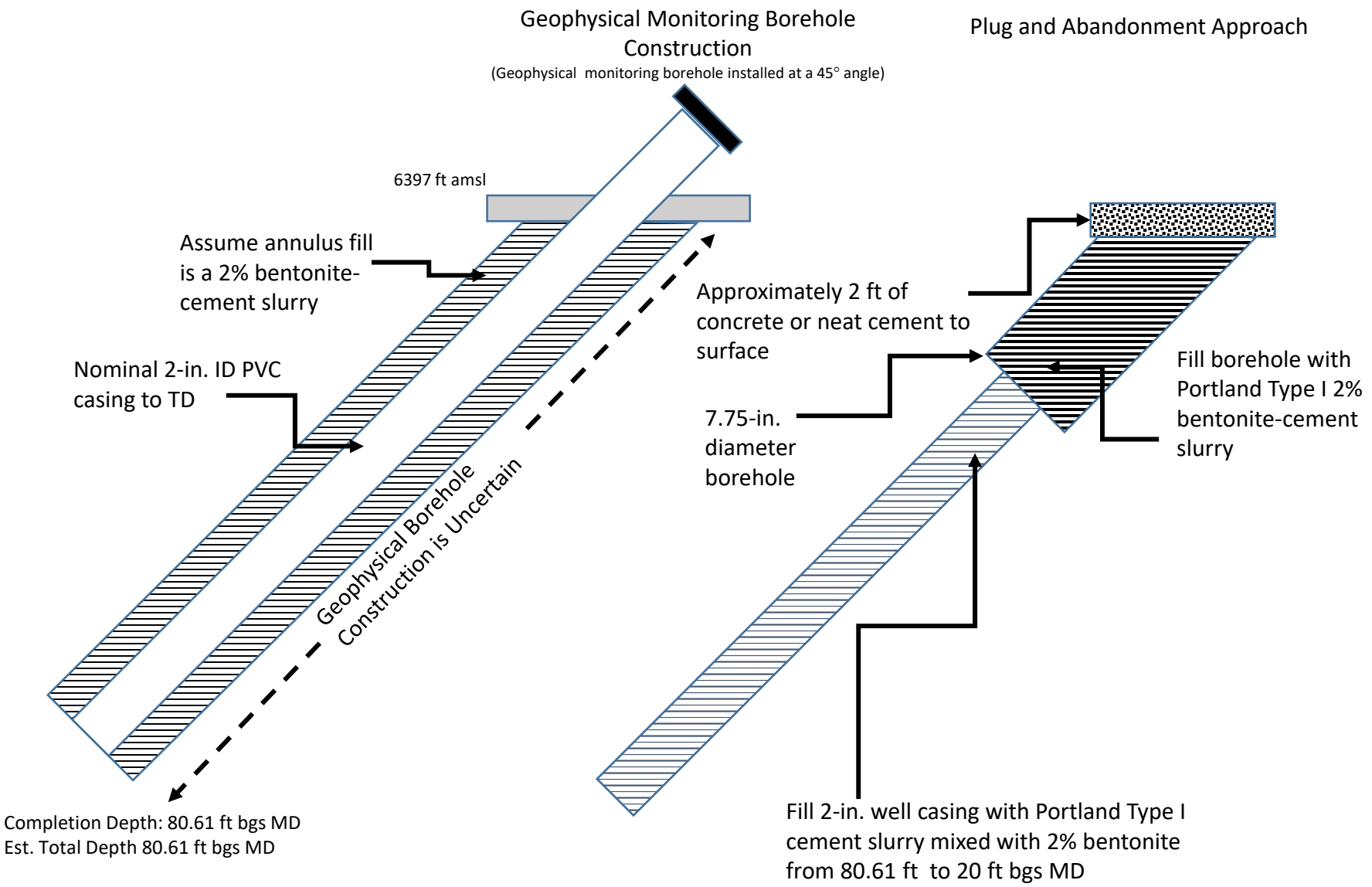

**NOT TO SCALE**

# ASC-4 (39-01150)



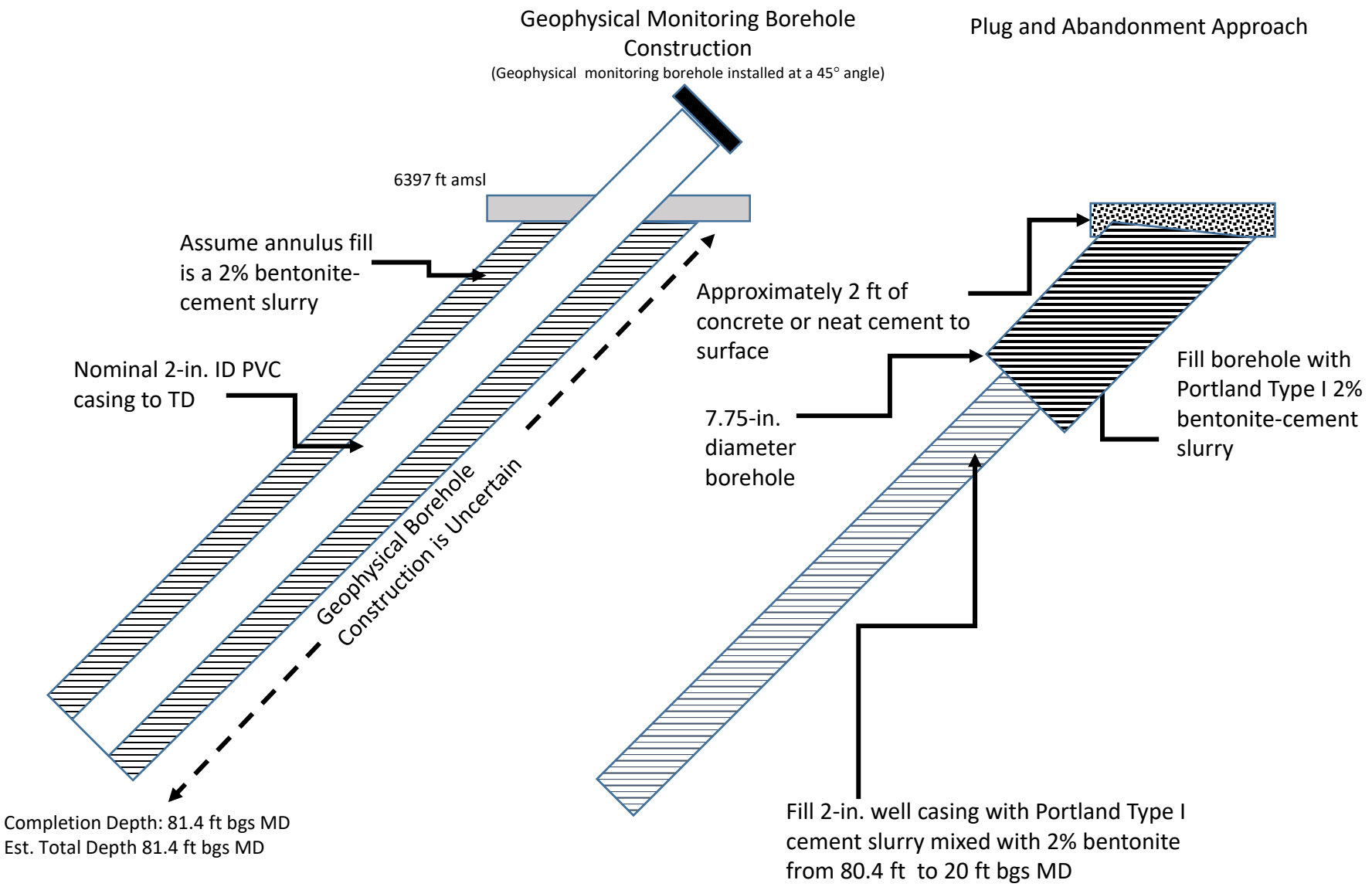

**NOT TO SCALE**

# ASC-11 (39-01111)



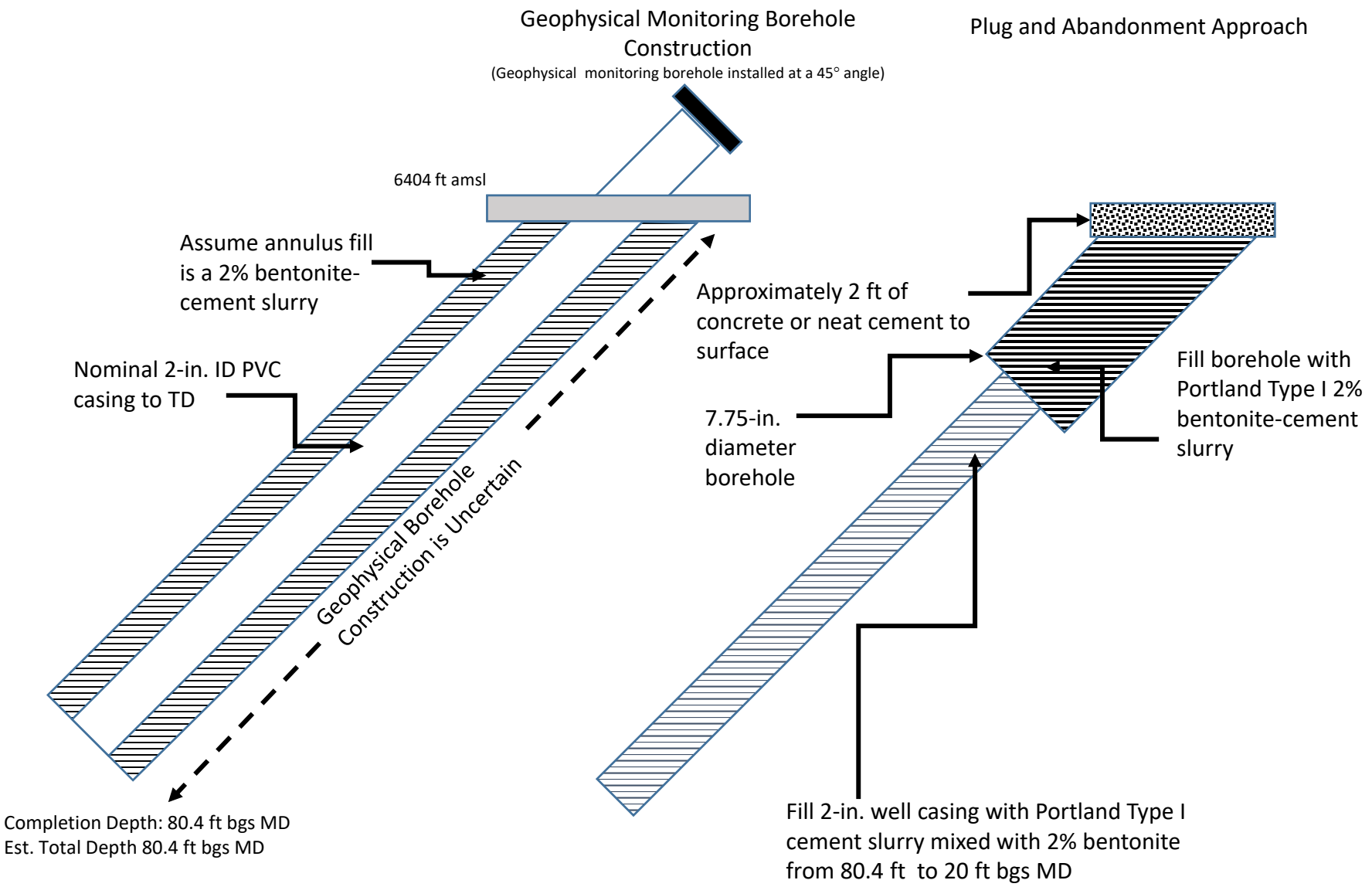

**NOT TO SCALE**

# ASC-12 (39-01112)



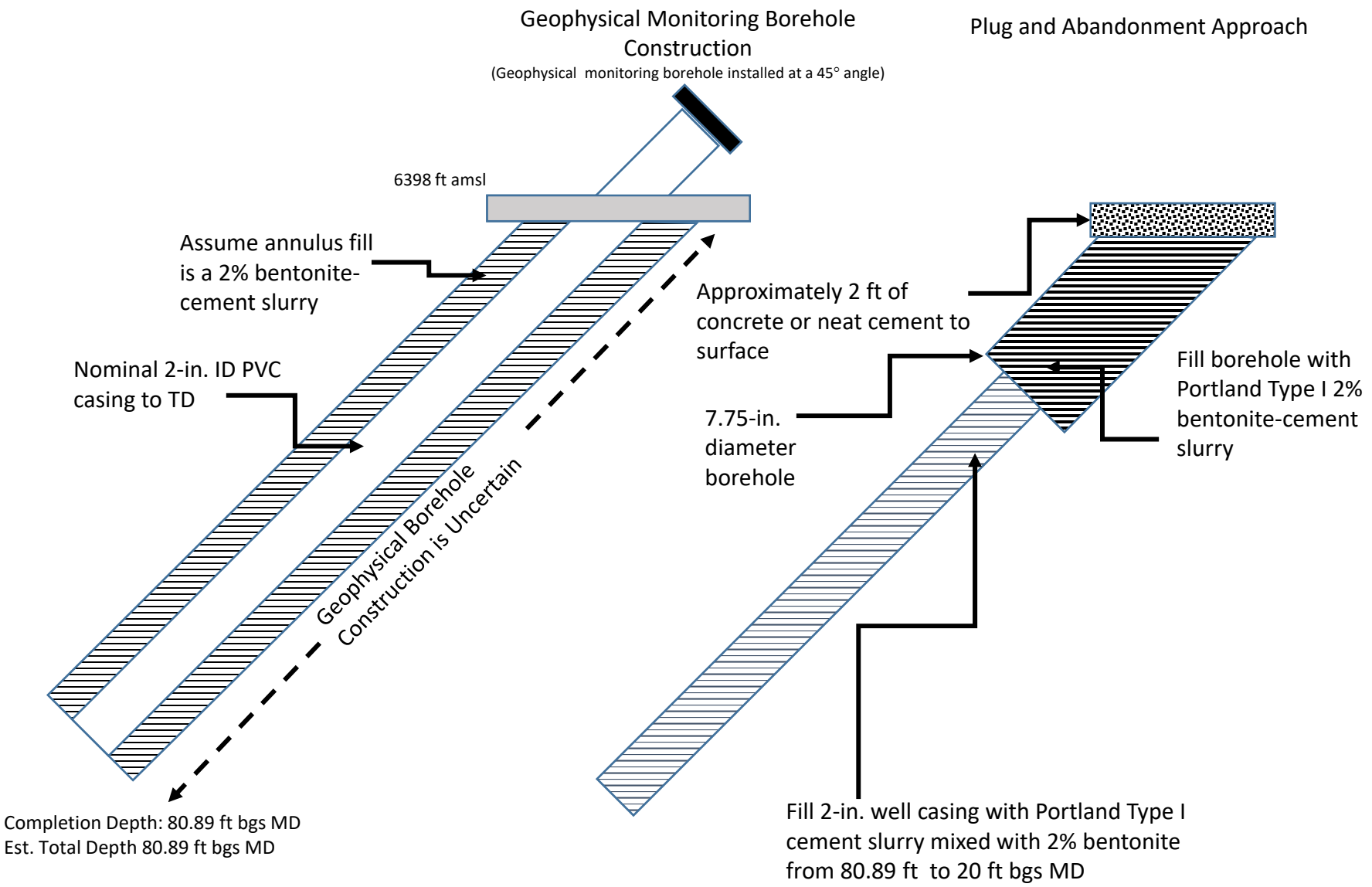

**NOT TO SCALE**

# ASC-13 (39-01113)



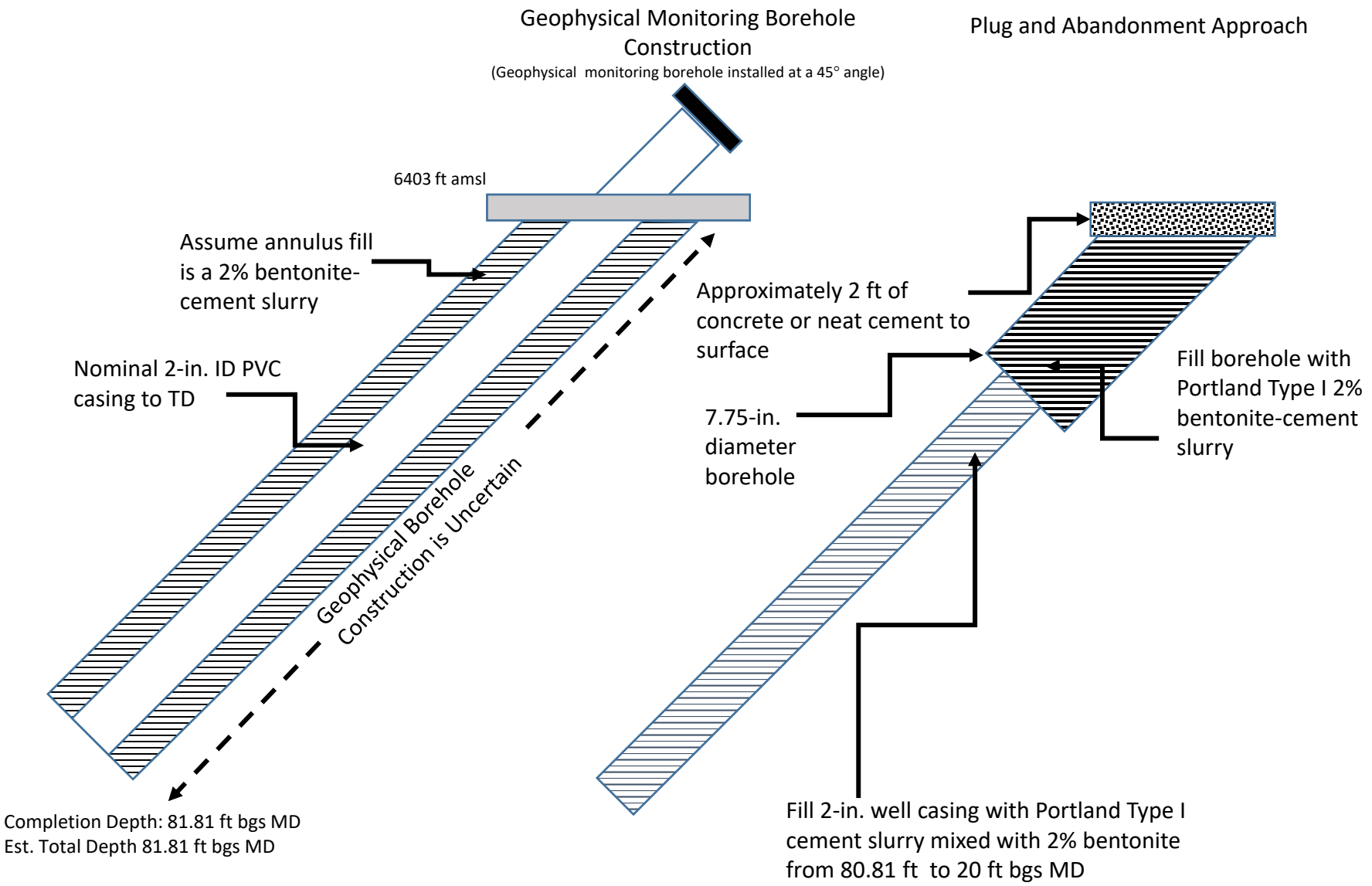

**NOT TO SCALE**

# ASC-14 (39-01114)



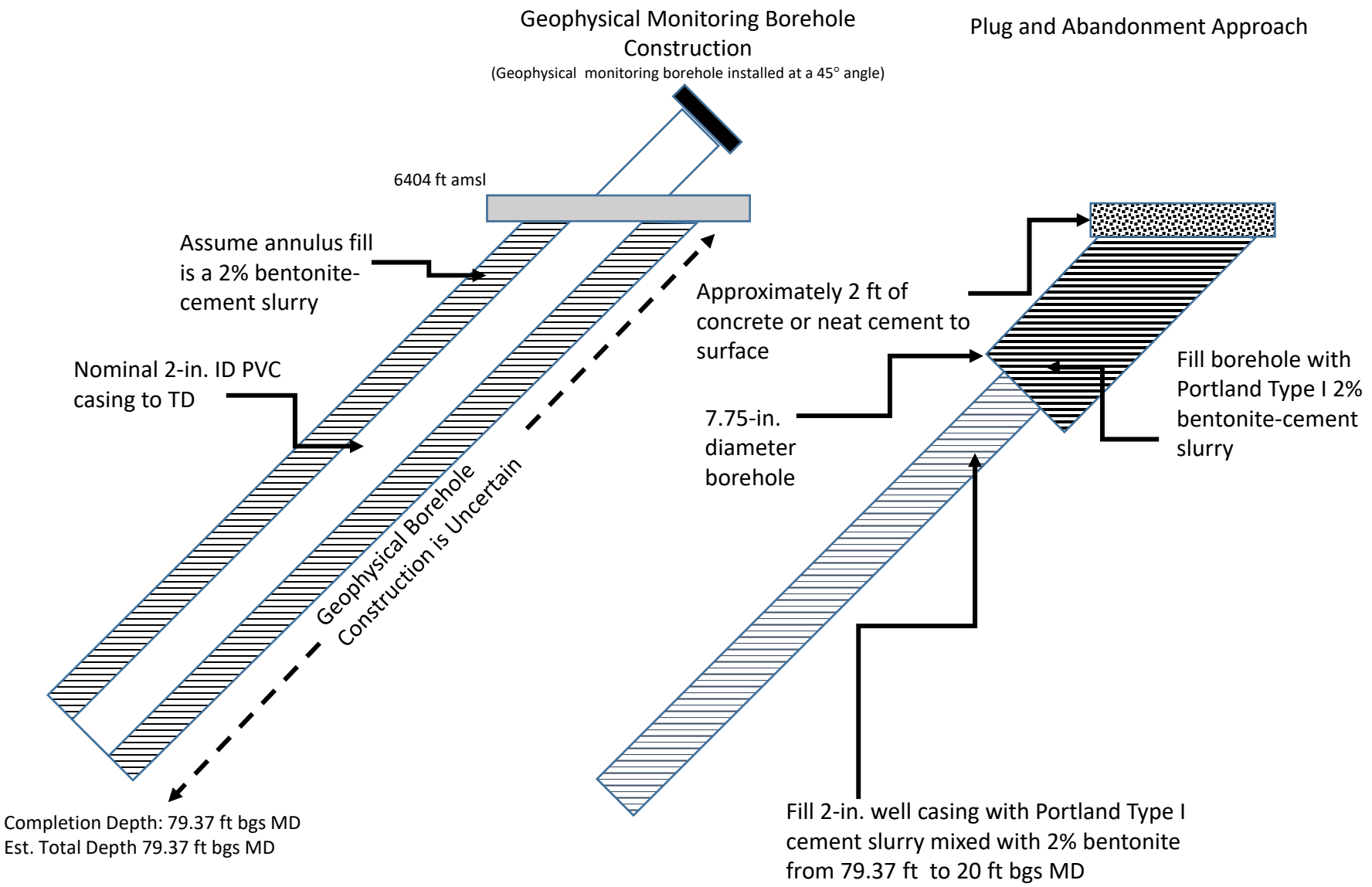

**NOT TO SCALE**

# ASC-15 (39-01115)



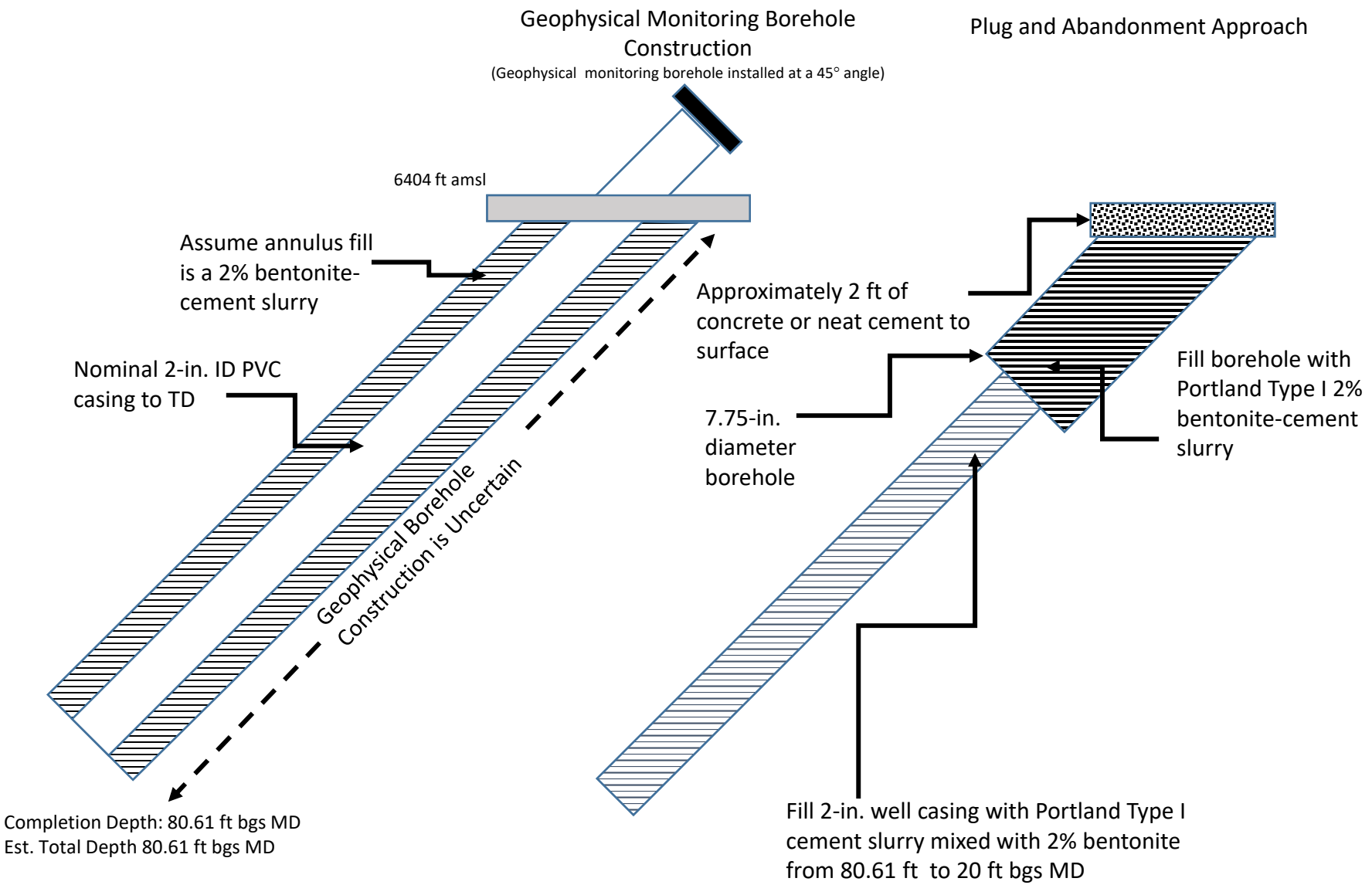

**NOT TO SCALE**

# ASC-16 (39-01116)



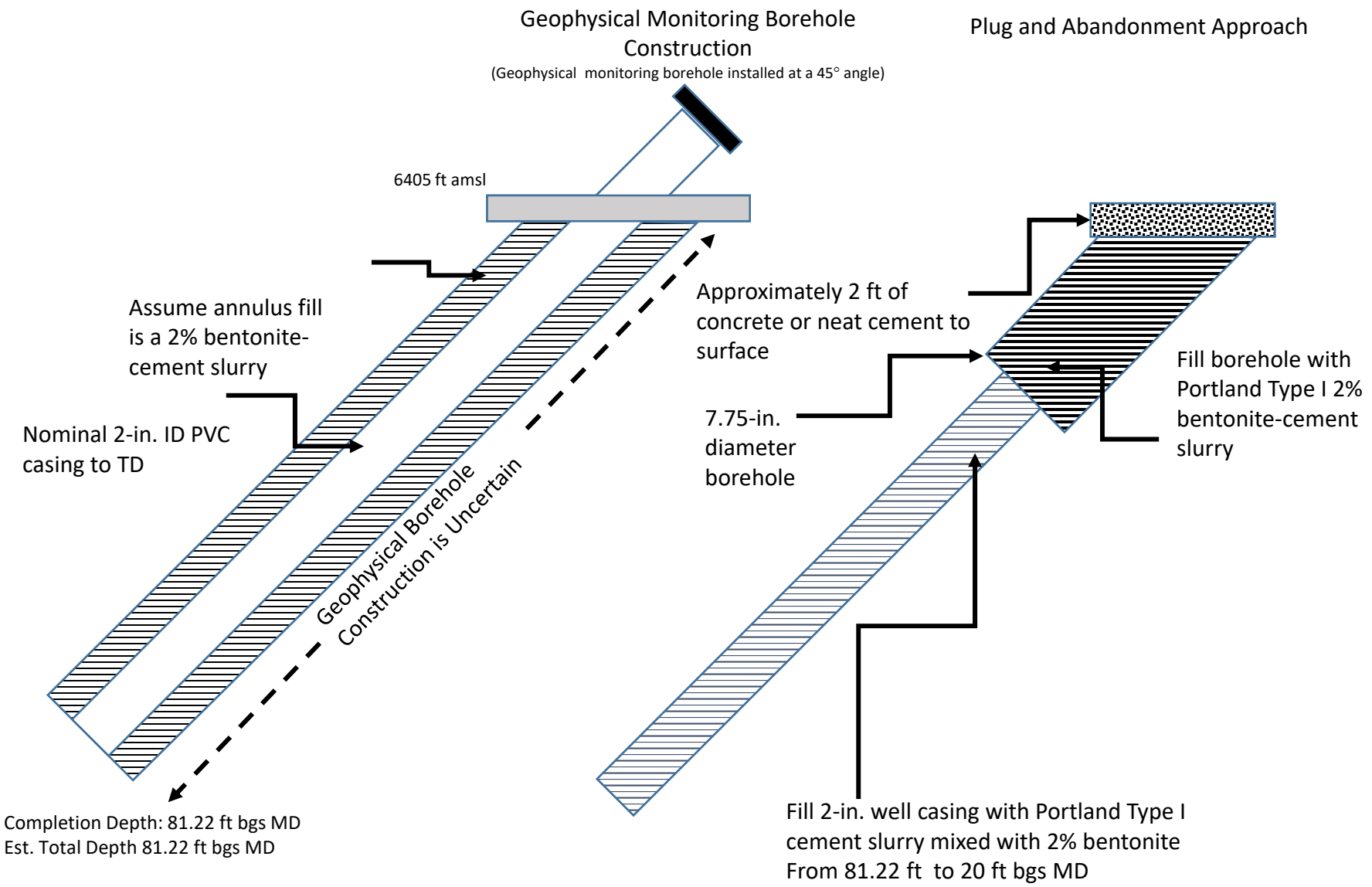

**NOT TO SCALE**

# ASC-17 (39-01117)



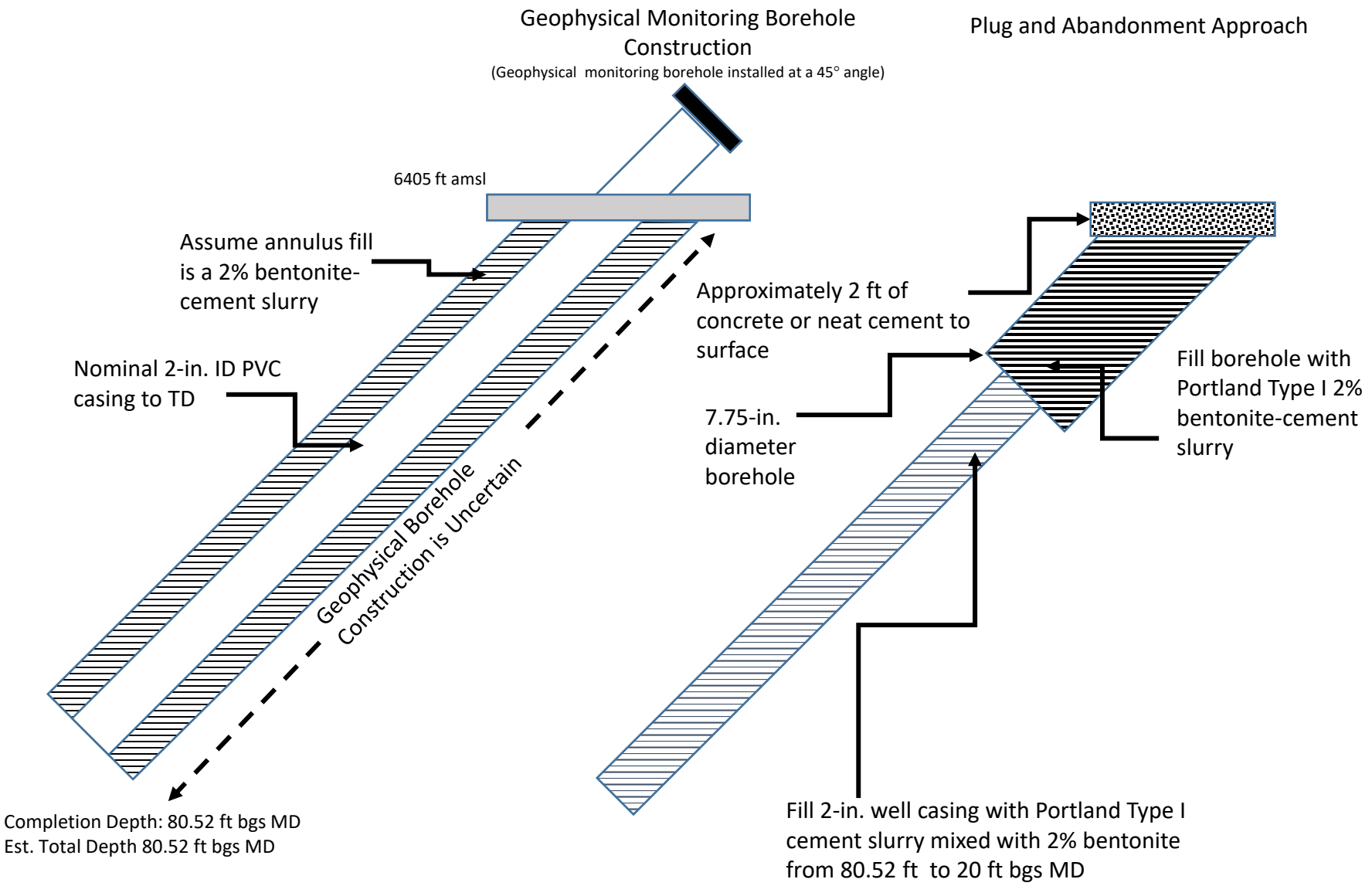

**NOT TO SCALE**

# ASC-18 (39-01118)

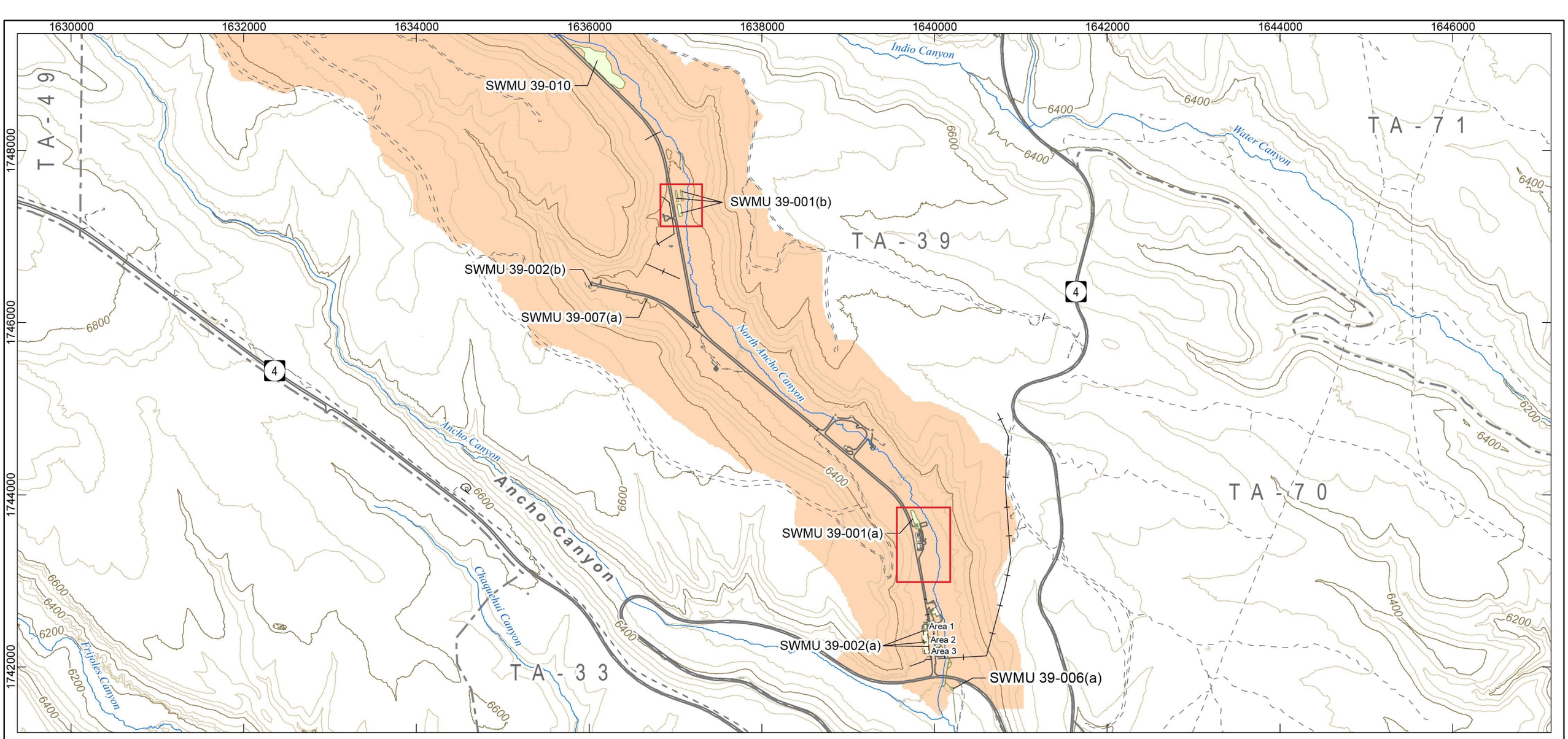



**NOT TO SCALE**

# ASC-19 (39-01119)




**NOT TO SCALE**




North Ancho Canyon Aggregate Area
SWMU or AOC
Structure
Former structure
Drainage channel

TA boundary
Fence
Unpaved road
Paved road

Index contour, 200-ft interval
Terrain contour, 50-ft interval
P&A Locations

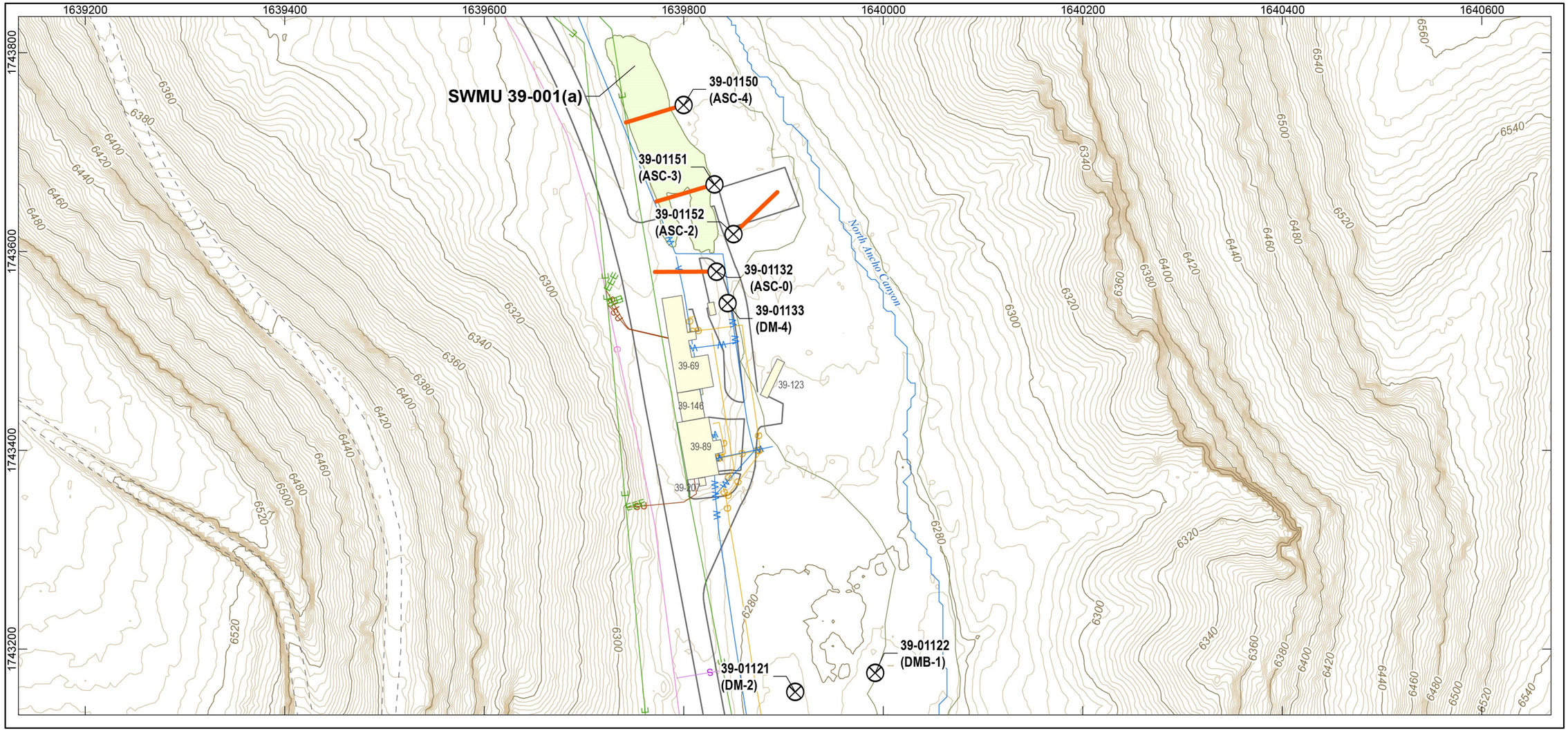
**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 0.125 0.25 0.5
Miles

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-49_north_ancho_phase_II_sites
1/13/2022 DFRANK

**Locations of plug and abandoning of monitoring wells and angled geophysical boreholes at TA-39**




Borehole, vertical or angled
Angled borehole drilling vector
Structure
SWMU or AOC
Drainage channel
Water line
Gas line
Electric line
Sewer line
Communication line
Secondary utility
Unpaved road
Paved road
Index contour, 20-ft interval
Terrain contour, 2-ft interval

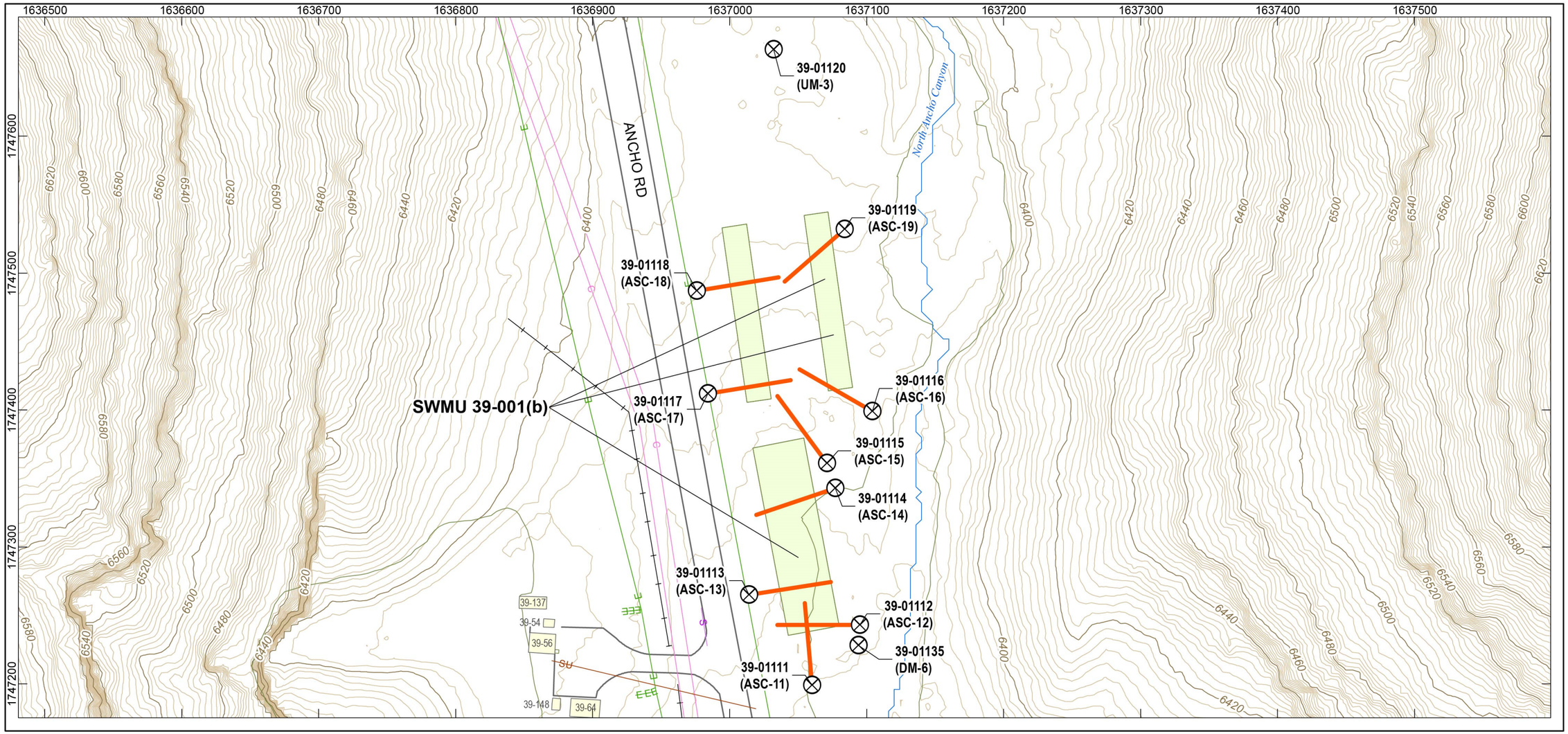
**DISCLAIMER:** This map was created for work processes associated with the LLCC. All other uses for this map should be confirmed with N3B staff.

0 25 50 100
FEET

State Plane Coordinate System
New Mexico Central Zone, US Survey Feet
North American Datum 1983
National Geodetic Vertical Datum 1929

N3B/T2S
MAP: map_21-0024-43_39-001(a)_angled_borehole
4/15/2022 DFRANK

**Location of SWMU 39-001(a) wells and boreholes**




**Location of SWMU 39-001(b) wells and boreholes**

## Well and Borehole Installation and Construction Details for SWMU 39-001(a)

| Unit No. | Well/ Borehole | Location ID | Casing Diameter (in.) | Casing Type | Orientation | Year Drilled | Drilling Method | Water Present | Top of Water (MD ft bgs)[a] | Top of Water (TVD ft bgs)[b] | Well/Borehole Total Depth (MD ft bgs) | Well/Borehole Total Depth (TVD ft bgs) | Status | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-001(a) | DMB-1[c] | 39-01122 | 4 | Stainless Steel | Vertical | 1994 | HSA[d] | NW[e] | n/a[f] | n/a | 117 | 117 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-2[h] | 39-01121 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 30.2 | 30.2 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | DM-4[i] | 39-01133 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 22.56 | 22.56 | Existing | Well completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-0[j] | 39-01132 | 2 | PVC[k] | 45 degrees | 1994 | HSA | Yes | 78.85 | 41.42 | 81.05 | 42.58 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-1[l] | 39-01153 | 2 | PVC | 45 degrees | 1994 | HSA | —[m] | — | — | — | — | Abandoned when casing broke during installation. | Borehole completion documentation not found. |
| | ASC-2[n] | 39-01152 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 80.41 | 42.24 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-3[o] | 39-01151 | 2 | PVC | 45 degrees | 1994 | HSA | — | — | — | — | — | PVC casing cut by heavy equipment during 2009 excavation[p] | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |
| | ASC-4[q] | 39-01150 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 75.41 | 39.61 | 81.4 | 42.76 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[g] |

Notes: Total depth (TD) and field measurements were taken March 21, 2022. Well TD is field-measured feet below ground surface (ft bgs).

[a] MD = Measured depth.

[b] TVD = True vertical depth.

[c] Los Alamos National Laboratory, June 27, 1994–July 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DMB-1,” Los Alamos, New Mexico.

[d] HSA = Hollow-stem auger.

[e] NW = No water detected.

[f] n/a = Not applicable (no water detected).

[g] ICF Kaiser, May 1994. “Drilling Plan Operable Unit 1132, Revision B,” Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia.

[h] Los Alamos National Laboratory, July 12, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-2,” Los Alamos, New Mexico.

[i] Los Alamos National Laboratory, July 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole DM-4,” Los Alamos, New Mexico.

[j] Los Alamos National Laboratory, June 23, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-0,” Los Alamos, New Mexico.

[k] PVC = Polyvinyl chloride.

[l] Los Alamos National Laboratory, June 15, 1994–June 21, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-1 (abandoned),” Los Alamos, New Mexico.

[m] — = Damaged and abandoned geophysical monitoring borehole.

[n] Los Alamos National Laboratory, June 13, 1994–June 15, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-2,” Los Alamos, New Mexico.

[o] Los Alamos National Laboratory, June 7, 1994–June 8, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-3,” Los Alamos, New Mexico.

[p] Los Alamos National Laboratory, October 20, 2009. “Subcontract Technical Representative Daily Activity Report for North Ancho Canyon Implementation,” Subcontract Number 66170, Los Alamos, New Mexico.

[q] Los Alamos National Laboratory, June 1, 1994–June 6, 1994. “Los Alamos National Laboratory Environmental Restoration Program Sample Management Facility Core Sample Log for Borehole ASC-4,” Los Alamos, New Mexico.

**Well and Borehole Installation and Construction Details for SWMU 39-001(b)**

| Unit No. | Well/ Borehole | Location ID | Casing Diameter (in.) | Casing Type | Orientation | Year Drilled | Drilling Method | Water Present | Top of Water (MD ft bgs)[a] | Top of Water (TVD ft bgs)[b] | Well/Borehole Total Depth (MD ft bgs) | Well/Borehole Total Depth (TVD ft bgs) | Status | Construction |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 39-001(b) | DM-6[c] | 39-01135 | 4 | Stainless Steel | Vertical | 1994 | HSA[d] | NW[e] | n/a | n/a[f] | 58.44 | 58.44 | Existing | HSA 8.75-in. borehole diameter: 0–27 ft bgs – no backfill material; 25–27.5 ft bgs – bentonite seal; 27.5–57.5 bgs – 10-20 silica sand, 10-ft screen length. Depth discrepancy in field check with well construction information in the "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1"[g] and "Monitor Well Inspection at TA-39.[c] |
| | UM-3[c] | 39-01120 | 4 | Stainless Steel | Vertical | 1994 | HSA | NW | n/a | n/a | 54.69 | 54.69 | Existing | HSA 8.75-in. borehole diameter: 0–25.19 ft bgs – 3% cement backfill; 25.19–27.69 ft bgs – bentonite seal; 37.69–56.5 bgs – 10-20 silica sand, 15-ft screen length. 2-ft sump. Bottom of well at 54.69 ft bgs. Depth discrepancy in field check with well construction information in the "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1"[g] and "Monitor Well Inspection at TA-39.[c] |
| | ASC-11[h] | 39-01111 | 2 | PVC[i] | 45 degrees | 1994 | HSA | Yes | 78.59 | 41.28 | 80.61 | 42.35 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-12[h] | 39-01112 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 77.79 | 40.86 | 81.4 | 42.76 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-13[h] | 39-01113 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 77.36 | 40.64 | 80.4 | 42.24 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-14[h] | 39-01114 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 80.89 | 42.49 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-15[h] | 39-01115 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 41.7 | 21.9 | 81.81 | 42.98 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-16[h] | 39-01116 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 79.09 | 41.54 | 79.37 | 41.69 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-17[h] | 39-01117 | 2 | PVC | 45 degrees | 1994 | HSA | NT[k] | NT | NT | 81.03 | 42.57 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] Unable to get measurements because newly installed transformer and fence prevented measurement equipment from being used. |
| | ASC-18[h] | 39-01118 | 2 | PVC | 45 degrees | 1994 | HSA | NW | n/a | n/a | 81.22 | 42.67 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |
| | ASC-19[h] | 39-01119 | 2 | PVC | 45 degrees | 1994 | HSA | Yes | 79.11 | 41.56 | 80.52 | 42.3 | Existing | Borehole completion documentation not found. Assume annulus is backfilled with cement.[j] |

Notes: Total depth (TD) and field measurements were taken March 21, 2022. Well TD is field-measured feet below ground surface.

[a] MD = Measured depth.

[b] TVD = True vertical depth.

[c] Morrison Knudsen Corporation, May 30, 1995. "Monitor Well Inspection at TA-39," letter to Brad Wilcox (LANL) from Lucas Trujillo (Morrison Knudsen Corporation), Boise, Idaho.

[d] HSA = Hollow-stem auger.

[e] NW = No water detected.

[f] n/a = Not applicable (no water detected).

[g] Los Alamos National Laboratory, March 2011. "Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area Revision 1," Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico.

[h] Los Alamos National Laboratory, February 2010. "Information Concerning the Angled Boreholes Associated with Past Environmental Investigations at Technical Area 39," Los Alamos National Laboratory document LA-UR-10-0579, Los Alamos, New Mexico.

[i] PVC = Polyvinyl chloride.

[j] ICF Kaiser, May 1994. "Drilling Plan Operable Unit 1132, Revision B," Document prepared for Los Alamos National Laboratory by ICF Kaiser, Fairfax, Virginia.

[k] NT = Depth and water level not taken. Newly installed transformer and fence did not provide enough room for the measurement equipment to be used.

# ENCLOSURE 7

# Response to the New Mexico Office of the State Engineer Comments for Well Plugging Plan of Operations for Monitoring Wells and Boreholes at Technical Area 39 North Ancho Canyon Aggregate Area (August 2022)

**Response to the New Mexico Office of the State Engineer Comments for**
**Well Plugging Plan of Operations for Monitoring Wells and Boreholes at Technical Area 39**
**North Ancho Canyon Aggregate Area (August 2022)**
**Dated September 14, 2022**

## INTRODUCTION

To facilitate review of this response, the New Mexico Office of the State Engineer (NMOSE's) comments are included verbatim (in italics). The U.S. Department of Energy (DOE) Environmental Management Los Alamos Field Office responses follow each NMOSE comment.

## SPECIFIC COMMENTS

### NMOSE Comment

***1.*** *Multiple options/possibilities were requested as part of the plan, OSE requires that a single method be proposed, alterations to an approved plan or any deviation from NM Statute will require a request for variance from the Applicant to the OSE.*

### DOE Response

1. The Well Plugging Plan of Operations expanded text for Sections IV, V, VI, and VII within Enclosures 1, 2, 3, 4, and 5 were revised to present a single plugging and abandonment method.

### NMOSE Comment

***2.*** *The enclosed document, entitled Contamination/Low Quality Water Present, will need to be submitted for each well/borehole.*

### DOE Response

2. Water is not present in any of the wells/boreholes. If water is detected in any of the wells during the plugging and abandonment activities, the Contamination/Low Quality Water Present form will be submitted for each well/borehole within which water is detected.

### NMOSE Comment

***3.*** *The OSE is aware that an accelerated correction action has also been approved for the area these wells are located, therefore we would like it to be submitted as part of the resubmission document, to ensure the proper analysis of contamination and possible issues that could be encountered while plugging the wells/boreholes.*

### DOE Response

3. The New Mexico Environment Department– (NMED-) approved 2018 "Accelerated Corrective Action Report for North Ancho Canyon Aggregate Area" is included with the resubmission documents (LANL 2018, NMED 2018).

**NMOSE Comment**

***4.*** *A letter or workplan approval is needed from the New Mexico Environment Department (NMED), acknowledging that these wells are no longer needed for monitoring.*

**DOE Response**

4. NMED approved the 2011 “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1” (LANL 2011, NMED 2011), which proposed the plugging and abandonment of each of the wells included in the “Well Plugging Plan of Operations for Monitoring Wells and Boreholes at Technical Area 39, North Ancho Canyon Aggregate Area.”

**NMED Comment**

***5.*** *A 0-20 foot overdrill will need to be incorporated into the Well Plugging Plan of Operations for wells that are deeper than 20-ft bgs because of the lack of well information available. The lower portion of the well below 20-feet bgs shall be completely filled with sealant prior to advancing the overdrill operations. The upper 20-feet will require overdrilling and the casing removed prior to applying the cement sealant. Hollow stem augers used in the process of overdrilling shall only be removed during the sealant placement process so that sealant is displaced in the borehole during auger removal.*

**DOE Response**

5. The 0–20 ft overdrill has been incorporated into the Well Plugging Plan of Operations for all wells that are deeper than 20 ft below ground surface (bgs). The overdrill details are included in the revised Well Plugging Plan of Operations expanded text for Sections IV, V, VI, and VII within Enclosures 1, 2, 3, 4, and 5 and in the included borehole schematics.

**NMOSE Comment**

***6.*** *The water to cement ratio when incorporating hydrated bentonite into the cement mix should increase by 0.67 gallons per 1% of hydrated bentonite per 90# sack of cement. A 2% cement bentonite should contain no less than ~7.4 gallons/sack. Please amend the applications to reflect proper water quantities.*

**DOE Response**

6. During the October 12, 2022, meeting between NMOSE, EM-LA, and N3B, NMOSE stated that the reference to the 90-lb sack of cement was a typographical error. NMOSE guidelines require 6.5 gal. of water per 94 lb of cement for a 2% bentonite mix. The standard weight for a sack of cement is 94 lb. During the October 12, 2022, meeting NMOSE stated that 6.5 to 7.3 gal. is acceptable. The revised Well Plugging Plan of Operations expanded text for Sections IV, V, VI, and VII within Enclosures 1, 2, 3, 4, and 5 states the proper water quantities.

## REFERENCES

LANL (Los Alamos National Laboratory), March 2011. “Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1,” Los Alamos National Laboratory document LA-UR-11-1817, Los Alamos, New Mexico. (LANL 2011)

LANL (Los Alamos National Laboratory), January 2018. “Accelerated Corrective Action Report for North Ancho Canyon Aggregate Area,” Los Alamos National Laboratory document LA-UR-17-31388, Los Alamos, New Mexico. (LANL 2018)

NMED (New Mexico Environment Department), May 2011. “Approval with Modifications, Phase II Investigation Work Plan North Ancho Canyon Aggregate Area, Revision 1,” New Mexico Environment Department letter to G. Rael (NA-LA) and M. Graham (LANL) from J.E. Kieling, (NMED-HWB), Santa Fe, New Mexico. (NMED 2011)

NMED (New Mexico Environment Department), March 2018. "Approval, Accelerated Corrective Action Report for North Ancho Canyon Aggregate Area,” New Mexico Environment Department letter to D. Hintz (EM-LA) and B. Robinson (LANL) from J. Kieling, (NMED-HWB), Santa Fe, New Mexico (NMED 2018)

# ENCLOSURE 8

## Supplemental Documents
## (on CD included with this document)

1. Accelerated Corrective Action Report for North Ancho Canyon Aggregate Area (LA-UR-17-31388)
2. Approval, Accelerated Corrective Action Report for North Ancho Canyon Aggregate Area (ESHID-602930)
3. Phase II Investigation Work Plan for North Ancho Canyon Aggregate Area, Revision 1 (LA-UR-11-1817)
4. Approval with Modifications, Phase II Investigation Work Plan North Ancho Canyon Aggregate Area, Revision 1 (EP2011-5255)
5. Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1 (EM2019-0430)
6. Approval, Work Plans for the Plugging and Abandonment of Wells and Boreholes for Fiscal Year 2019, Revision 1 (December 2019) (EMID-701881)