

National Aeronautics and
Space Administration
Lyndon B. Johnson Space Center
White Sands Test Facility
P.O. Box 20
Las Cruces, NM 88004-0020



March 14, 2023

Reply to Attn of: RE-23-048

Mr. Rick Shean, Bureau Chief
New Mexico Environment Department
Hazardous Waste Bureau
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505

Subject: Abandonment Report for NASA Well BLM-28

On December 16, 2011, NMED directed NASA to replace or convert eight existing Westbay monitoring wells, including well BLM-28, to wells with purgeable sampling systems. NASA submitted the *Well Reconfiguration Report for BLM-28 and Notice of Intent to Plug and Abandon* to the NMED on May 4, 2020. On November 19, 2020, NMED responded with a requirement to provide a work plan for abandonment. NASA submitted *Well Abandonment Work Plan for Well BLM-28* [work plan] on April 29, 2021. NMED approved the work plan without modification on January 10, 2022. NASA submitted the *Well Plugging Plan of Operations [Plugging Plan]* for well BLM-28 to the New Mexico Office of the State Engineer (NMOSE) on May 25, 2022. The NMOSE approved the plugging plan on June 10, 2022.

NASA well BLM-28 was originally drilled in 1994. The well was completed with nominal 5-inch carbon steel surface casing to a depth of 309 feet and a 4.5-inch open borehole from 309 feet to 560 feet below ground surface. The well was fitted with a Westbay sampling system, which was removed in 2014, as NMED directed. A low-flow sampling system with a pass-through inflatable packer was installed in 2019. Although the dedicated system worked properly during the function test following installation, it failed to produce groundwater during scheduled sampling in July 2019. NASA performed troubleshooting and determined the dedicated sampling system had become lodged in the borehole. During attempts to remove the sampling system, the support cable and tubing separated from the packer. Only the steel support cable, dedicated bladder pump, and tubing were removed from the borehole. The inflatable packer and pump intake remain lodged in the borehole at approximately 500 feet. Subsequent downhole video log showed pronounced caving of the borehole walls between 400 and 415 feet below ground surface. NASA concluded that debris from the borehole walls had covered and trapped the inflatable packer, and the borehole was too unstable to attempt reinstallation of downhole sampling equipment.

In accordance with the NMED-approved work plan, the debris sitting on top of the packer was removed via mud rotary, then the remaining sampling equipment was pushed to the bottom of the borehole. The hole was then grouted entirely from the top of the compressed sampling equipment to 6 inches below ground surface. Surface features were removed, and a concrete cap was emplaced on top of the cut well casing. NASA has completed plugging and abandonment operations for well BLM-28 in accordance with the NMOSE approved plugging plans and NMED-approved work plan. NASA has developed the Abandonment Report for NASA well BLM-28. This reporting format includes a paper copy of the report as Enclosure 1, and a CD-ROM with the report in PDF as Enclosure 2.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

If you have any questions or comments concerning this submittal, please contact Antonette Doherty of my staff at 575-202-5406.

**TIMOTHY
DAVIS**

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TIMOTHY DAVIS
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Timothy J. Davis
Chief, Environmental Office

2 Enclosures

cc:

Mr. Gabriel Acevedo
Hazardous Waste Bureau
New Mexico Environment Department
2905 Rodeo Park Drive East, Building 1
Santa Fe, NM 87505



Abandonment Report for Well BLM-28

March 2023

NM8800019434

NASA Johnson Space Center White Sands Test Facility

Abandonment Report for Well BLM-28

March 2023

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

**TIMOTHY
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Timothy J. Davis
Chief, NASA Environmental Office

See Electronic Signature
Date

National Aeronautics and Space Administration

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List of Acronyms

bgs	below ground surface
BLM	Bureau of Land Management
CME	Central Mine Equipment Company
ft	Feet/Foot
NASA	National Aeronautics and Space Administration
NMAC	New Mexico Administrative Code
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
PPE	Personal protective equipment
RCRA	Resource and Recovery Act
TCLP	Toxicity Characteristic Leaching Procedure
TSDf	Treatment Storage and Disposal Facility
WSTF	White Sands Test Facility
YJD	Yellow Jacket Drilling Services, LLC

1.0 Introduction

This Well Abandonment Report summarizes activities associated with the plugging and abandonment of National Aeronautics and Space Administration (NASA) well BLM-28. The well is located at the NASA White Sands Test Facility (WSTF). The plugging and abandonment of BLM-28 was part of a larger abandonment effort completed between January 4 and January 30, 2023. Yellow Jacket Drilling Services, LLC (YJD) was contracted to perform the abandonment activities. YJD is a licensed driller in the State of New Mexico (WD-1458) that is qualified to perform well abandonment in the state.

2.0 Facility Location and Description

WSTF is located approximately 16 miles northeast of Las Cruces in southern New Mexico ([Figure 2.1](#)). WSTF's primary activities in support of the United States space program are:

1. Development, qualification, refurbishment, and testing of spacecraft propulsion systems, subsystems, and ground support equipment.
2. Investigation of flight hardware anomalies.
3. Testing of materials and components.
4. Performance of hazard and failure analyses.

Following the completion of construction of WSTF in 1964, many wastes were historically managed in hazardous waste management units, including surface impoundments, within the WSTF industrial area. These hazardous waste management units contributed to groundwater contamination. As a result of the groundwater contamination, NASA operates a network of groundwater monitoring wells throughout the site.

3.0 Well BLM-28 Summary

NASA well BLM-28 was drilled in 1994 and is registered with the New Mexico Office of the State Engineer (NMOSE) as LRG-17990 ([Figure 3.1](#)). The well was completed with nominal 5-inch carbon steel surface casing to a depth of 309 feet (ft) below ground surface (bgs) and a 4.5-inch open borehole from 309 ft to 560 ft bgs. The borehole sloughed to 539 ft bgs ([Figure 3.2](#)). Andesite bedrock is at 300 ft bgs in this location. The well was fitted with a Westbay^{®1} sampling system, which was removed in 2014 as directed by the New Mexico Environment Department (NMED) in 2011. On December 16, 2011, NMED directed NASA to replace or convert eight existing Westbay monitoring wells, including well BLM-28, to wells with purgeable sampling systems (NMED, 2011).

In 2019, BLM-28 was reconfigured with a dedicated low-flow sampling system with a pass-through inflatable packer. Function tests performed after installation successfully produced groundwater sufficient for sampling. Approximately one month later, the sampling system failed to produce groundwater during scheduled sampling. NASA performed troubleshooting and determined the dedicated sampling system had become lodged in the borehole. During attempts to remove the sampling system, the support cable and tubing separated from the packer. Only the steel support cable, dedicated bladder pump, and tubing were removed from the borehole. The inflatable packer and pump intake remained lodged in the borehole at approximately 500 ft bgs. A subsequent downhole video log of the open portion of the borehole showed pronounced caving of the borehole walls between 400 and 415 ft bgs. Based on the borehole condition, NASA concluded that debris from the borehole walls had covered and trapped the inflatable

¹ Westbay is a registered trademark of Nova Metrix Ground Monitoring (Canada) Ltd.

packer, and the borehole was too unstable to attempt reinstallation of downhole sampling equipment. NASA submitted a Notice of Intent to Plug and Abandon to the NMED (NASA, 2020b).

On November 19, 2020, NMED responded with a requirement to provide a work plan for abandonment (NMED, 2020). NASA submitted the *Well Plugging Plan of Operations for NASA Well BLM-28* to the New Mexico Office of the State Engineer (NMOSE) on May 4, 2020 ([Appendix A](#)). The NMOSE approved the Plugging Plan on May 13, 2020 (NMOSE, 2020). NASA submitted the *Well Abandonment Work Plan for Well BLM-28* on April 29, 2021 (NASA, 2021), and NMED approved the plan on January 10, 2022 (NMED, 2022).

4.0 Pre-Plugging Activities

4.1 Site Preparation

Prior to the subcontract drilling company's arrival at WSTF, NASA performed well site maintenance at BLM-28 to provide a safe work environment. Concrete filled steel bollards that were placed on each corner of the well pad were removed and staged at the edge of the cleared well pad. The square concrete well pad surrounding well BLM-28 was demolished, removed, and staged at the edge of the cleared well pad near the bollards.

4.2 Downhole Debris Removal Process

NASA and the subcontract drilling company completed debris removal activities in accordance with the NMED-approved work plan (NASA, 2021). Debris removal activities were completed using a Boart Longyear^{®2} BK-81 heavy duty drill rig and a Central Mine Equipment Company (CME)^{®3} 95 auger rig. Equipment used included a 1,500-gallon water tank, 10-ft and 5-ft sections of 3-inch steel drill pipe, air compressor, mud pump, and mud tank. A Bobcat^{®4} S300 skid steer was used to maneuver equipment.

Debris removal operations began by positioning the BK-81 over the well casing, raising the mast, and lowering the drill string to approximately 460 ft bgs. The drill string was secured while the mud tank was positioned around the well casing stick-up. The gap between the casing stick-up and the mud tank were sealed with more than 18 inches of ENVIROPLUG^{®5} medium bentonite chips. The bentonite chips were then hydrated at the surface using non-chlorinated water to form a seal and prevent any leaking from the mud tank. Caution was taken to avoid any bentonite chips from falling into the well. Bentonite mud was then mixed in the mud tank using Halliburton^{®6} Quick-Gel bentonite and non-chlorinated water. The bentonite mud was used to stabilize the borehole walls and circulate the borehole debris from on top of the inflatable packer out of the borehole.

YJD began circulating at a depth of approximately 460 ft bgs. Additional joints were added roughly every five minutes. At approximately 470 ft bgs, the return water turned red, indicated suspended fine sediments. At approximately 485 ft bgs, the driller felt increased resistance and began drilling. This ensured as much debris removal as possible. Each 5-ft interval was drilled and circulated for approximately 15 minutes before another joint was added. At approximately 500 ft bgs, the driller stopped drilling and began slowly pushing. The driller indicated slight resistance at roughly 501 ft bgs. Increased resistance was encountered at 510 ft bgs. While attempting to push the packer at 510 ft bgs, one

² Boart Longyear is a registered trademark of Longyear TM, Inc.

³ CME is a registered trademark of Central Mine Equipment Company.

⁴ Bobcat is a registered trademark of Clark Equipment Company.

⁵ ENVIROPLUG is a registered trademark of WYO-BEN, Inc.

⁶ Halliburton is a registered trademark of Halliburton Energy Services, Inc.

of the power rams on the hydraulic assembly snapped. The drill pipe was removed from the hole and the rig was towered down. A replacement rig was mobilized to the site. The borehole was left untouched for an estimated 36 hours while the replacement drill rig was mobilized, inspected, and set up at the well. While set up was occurring, the borehole depth was tagged at 496 ft bgs, which indicated the borehole sloughed approximately 15 ft. The drill rod was tripped back in, to a depth of roughly 490 ft bgs. Circulation was attempted but failed, indicating the drill bit had clogged while tripping in. The following day, the drill string was tripped out then tripped back in with a clean bit to 490 ft bgs. Attempts to circulate failed again and drill pipe was tripped back out for assessment. It was determined that the drill pipe was likely scraping against the borehole wall while being lowered, resulting in borehole debris getting pushed into the drill bit. When the field crew returned two days later following a required day off, the borehole was tagged at 501 ft bgs, suggesting the borehole had not collapsed any further and the sloughed material settled approximately 7 ft. The drill rod was tripped back in to 440 ft bgs. To limit potential for clogging the drill bit, circulation began at 440 ft bgs and was only stopped to add joints, roughly every 10 minutes. At 515 ft bgs, the driller felt resistance from the packer and began pushing the packer while circulating. The packer was successfully pushed to 530 ft bgs, at which further attempts to push the packer deeper were not successful. NASA determined that the remaining sampling material was at the bottom of the borehole. Circulation was continued for another 15 to 20 minutes to remove any material that may have fallen on top of the packer while it was forced to the bottom of the borehole. It was determined that the best option for successful abandonment was to grout the well through the drill rods to limit any potential disturbance of the borehole walls and limit potential for further collapse.

5.0 Plugging and Abandonment

The plugging process began immediately after the sampling equipment was pushed to 530 ft bgs and the borehole was circulated. Cement grout used for plugging was hand mixed onsite using Phoenix Cement^{®7}, Portland Type II, mixed with 5% by weight Quick-Gel bentonite and approximately 4.52 gallons of water per 50-pound bag of cement. The drill rods were not removed from the well. Instead, the mud pump was disconnected from the kelly drive and a diaphragm pump was connected. Approximately 287 gallons of grout was pumped downhole, displacing drilling fluid that remained in the borehole from the circulation process. Displaced drilling fluid was captured in the mud tank and containerized in a 1,600-gallon wastewater tank for appropriate storage and handling. The drill pipe was removed from the hole and decontaminated. The next day, a 2-inch steel tremie was run downhole to complete the plugging. One more batch of cement grout was pumped downhole to fill the well to roughly 1.5 ft bgs. Approximately 574 gallons of cement grout was used. Grout in excess of the calculated casing volume likely filled in the area where the borehole wall collapsed.

After allowing the grout to cure for approximately 24 hours, the area around the well casing was excavated to more than 1-ft bgs to allow room for cutting of the well casing. Surface and well casings were then cut to approximately 6.5-inches bgs using a cutting wheel. Casing was removed from the well area and placed with the previously removed bollards for removal and recycling or reuse. A concrete cap was placed on top of the well, filling in the less than 1-ft open casing. Uneven ground around the work area was levelled, and a brass cap was placed in the center of the concrete.

YJD submitted the Well Plugging Record for well BLM-28 to the NMOSE on February 2, 2023 and is included in [Appendix B](#).

⁷ Phoenix Cement is a registered trademark of Salt River Pima-Maricopa Indian Community.

6.0 Waste Management

Waste management and disposal were conducted in accordance with the NMED-approved *Well Abandonment Work Plan for Well BLM-28* (NASA, 2021; NMED, 2022) and the WSTF Resource Conservation and Recovery Act (RCRA) Hazardous Waste Permit EPA ID No. NM8800019434 (NMED, 2009). Well BLM-28 is located outside of the extent of the known WSTF groundwater contaminant plume and does not contain WSTF contaminants of concern. Nitrate/nitrite has been observed in groundwater samples at well BLM-28, in excess of the 10 mg/L total nitrogen groundwater protection standard pursuant to 20.6.2.3103.A New Mexico Administrative Code (NMAC). The as-generated waste from the plugging and abandonment activities at BLM-28 included spent disposable personal protective equipment (PPE); sediment and borehole debris; groundwater; concrete debris; cut well casing; and empty commercial packaging from the cement and bentonite products; and fluids resulting from equipment decontamination.

Non-hazardous waste consisted of spent disposable PPE, concrete debris, and empty commercial packaging from the cement and bentonite products used during the plugging and abandonment activities. The non-hazardous waste was managed in accordance with New Mexico Solid Waste Regulations in 20.9 NMAC. Following completion of plugging and abandonment activities, non-hazardous solid waste was disposed of at the Corralitos Regional Landfill. Metal determined to be recyclable, such as cut steel well casing, was decontaminated, and will be recycled under the scrap metal exemption described at 20.4.1.200 NMAC and 40 Code of Federal Regulations (CFR) 261.4(a)(13).

Inflatable packer material was believed to be observed within the as-generated environmental media that was produced from the BLM-28 borehole, presenting the potential for the waste to contain chromium. Accordingly, the groundwater, decontamination fluids, and the sediment and borehole debris were initially characterized as a hazardous solid waste. Hazardous wastes were accumulated in appropriately sized, Department of Transportation-compliant containers. The containers were managed in accordance with the requirements of 20.4.1.300 NMAC and 40 CFR 262.17.

Grab samples were collected from both the aqueous- and solid-phases of hazardous waste for further waste characterization. The samples will be analyzed for total volatile organic compounds (VOCs) using the current revision of SW-846 Method 8260 and RCRA VOCs by incorporation of EPA Method 1311, toxicity characteristic leaching procedure (TCLP). TCLP metals analyses will be performed using the current revisions of EPA Method 6010 and 7740, incorporating EPA Method 1311. If sample results are favorable, NASA will submit a no longer contained-in determination request to NMED to downgrade the as-generated media to a non-hazardous solid waste. The downgraded non-hazardous solid-phase waste will then be disposed at a RCRA Subtitle D landfill. If results indicate the waste exhibits characteristics of a hazardous waste, the waste will be manifested off-site and transported for treatment and disposal at a permitted RCRA Treatment Storage and Disposal Facility (TSDF) within permissible accumulation time limits.

Consistent with the NMED-approved work plan and permissible accumulation time limits, the as-generated aqueous-phase waste (groundwater and decontamination fluids) will be analyzed for ammonia (as nitrogen), nitrate (as nitrogen), nitrite (as nitrogen), nitrate/nitrite (as nitrogen), total kjeldahl nitrogen, and total nitrogen using EPA Method 300.0. The analytical data for total nitrogen, nitrate, and nitrite will be compared to the groundwater protection standards in 20.6.2 NMAC and the NMED noncancer tap water soil screening level for nitrate and nitrite. Dependent upon the total, RCRA, and nitrogenous analytical results, the aqueous-phase non-hazardous waste will be discharged to the sanitary sewer under the Significant User Wastewater Discharge Permit 96611 (CLC, 2019) or will be disposed at an appropriate off-site facility.

Hydrocarbon contaminated debris were managed as hazardous waste and were accumulated in appropriately sized Department of Transportation-compliant containers. The containers were managed in accordance with the requirements of 20.4.1.300 NMAC and 40 CFR 262.17. Within 90 days from the initial accumulation, the hydrocarbon contaminated waste will be manifested off-site and transported for treatment and disposal at a permitted RCRA TSDF.

7.0 References

Adoption of 40 CFR Part 262, Environmental Improvement Board, 20.4.1.300 NMAC (12-01-18).

Adoption of 40 CFR Part 263, Environmental Improvement Board, 20.4.1.400 NMAC (12-01-18).

City of Las Cruces (CLC). (2019, July 1). *Significant User Wastewater Discharge Permit Number 96611*. Las Cruces, NM.

Ground and Surface Water Protection, Water Quality Control Commission, 20.6.2 NMAC (1-15-1).

NASA Johnson Space Center White Sands Test Facility. (2020a, May 4). *Well Plugging Plan of Operations for NASA Well BLM-28*. Las Cruces, NM.

NASA Johnson Space Center White Sands Test Facility. (2020b, May 4). *Well Reconfiguration Report for Well BLM-28 and Notice of Intent to Plug and Abandon*. Las Cruces, NM.

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NMED Hazardous Waste Bureau. (2011, December 16). *Approval with Modifications Investigation Report for Evaluating the Representativeness of Groundwater Samples Collected from Westbay Wells*. Santa Fe, NM.

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NMED Hazardous Waste Bureau. (2022, January 10). *Approval Well Abandonment Work Plan for Well BLM-28*. Santa Fe, NM.

NM Office of the State Engineer. (2020, May 13). *Plugging Plan Approval for LRG-17990*. Las Cruces, NM.

Solid Waste, New Mexico Environmental Improvement Board, 20.9 NMAC (08-02-07).

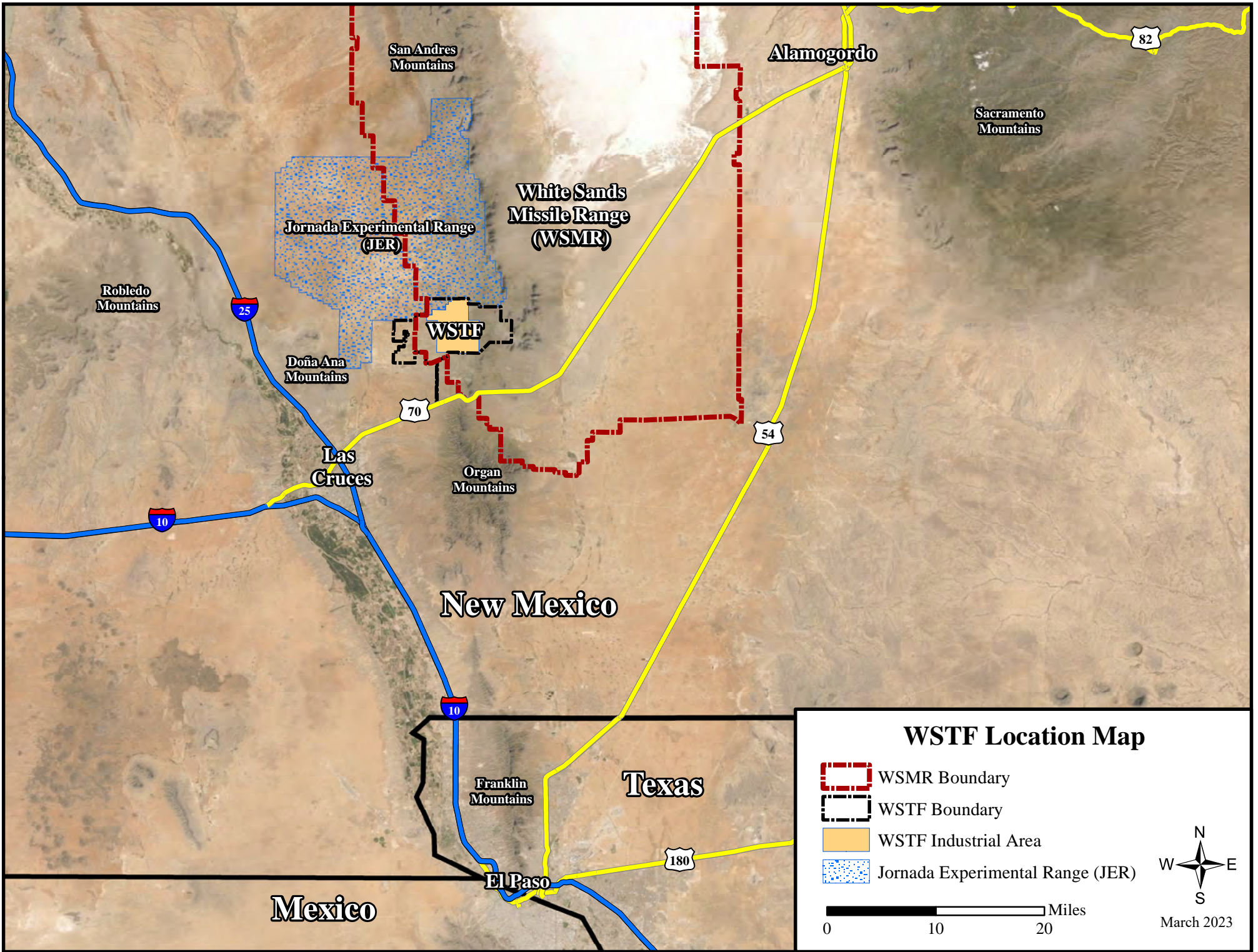
Standards for Ground Water of 10,000 mg/l TDS Concentration or Less, Water Quality Control Commission, 20.6.2.3103 NMAC (12-21-18).

Figures

Figure 2.1

WSTF Location Map

(SEE NEXT PAGE)



San Andres Mountains

Alamogordo

Sacramento Mountains

White Sands Missile Range (WSMR)

Jornada Experimental Range (JER)

Robledo Mountains

Doña Ana Mountains

WSTF

Las Cruces

Organ Mountains

New Mexico

Texas

Mexico

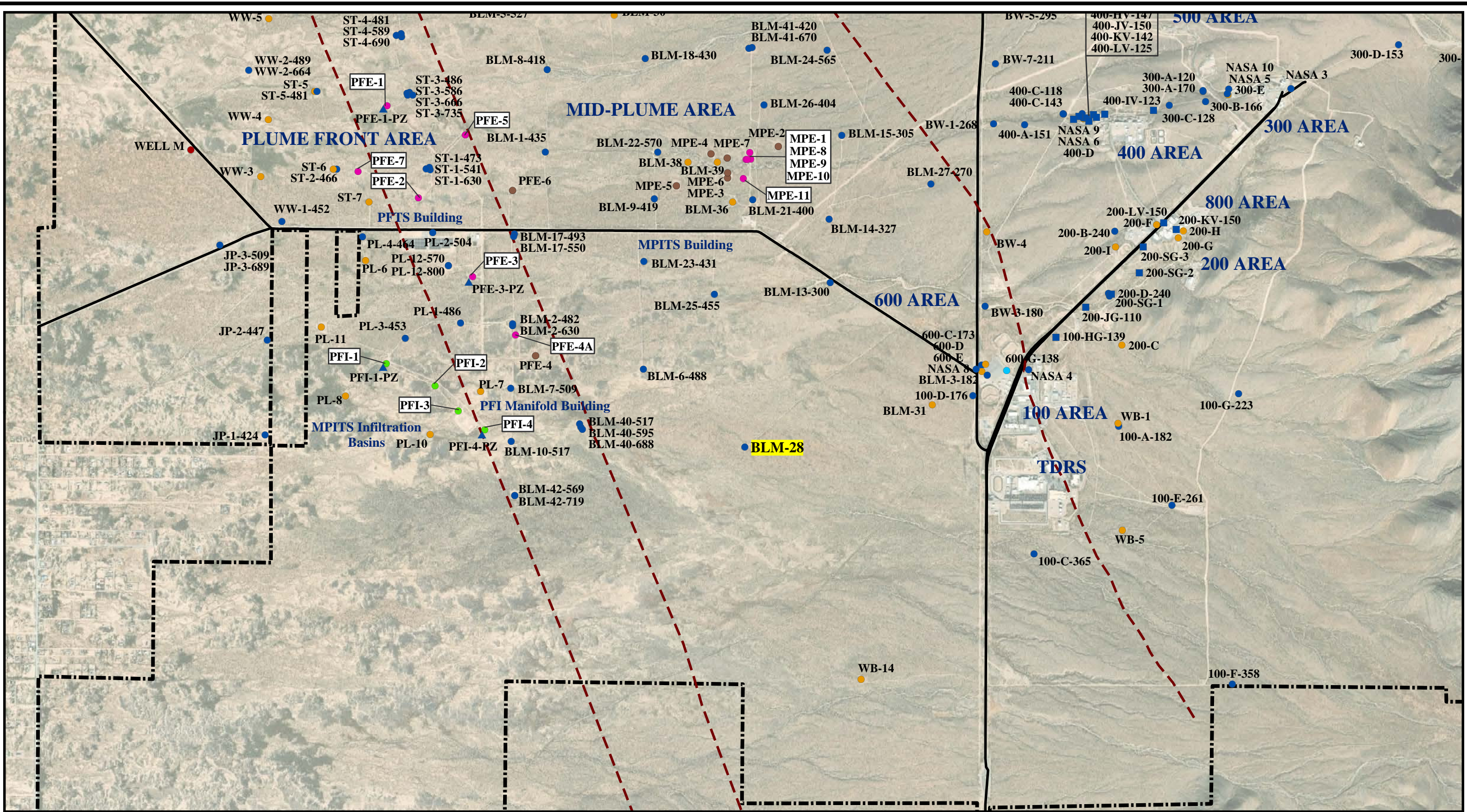
Franklin Mountains

El Paso

Figure 3.1

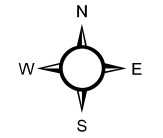
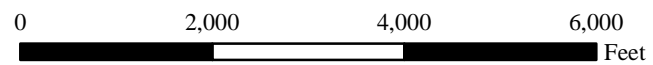
BLM-28 Well Location Map

(SEE NEXT PAGE)



Monitoring Well BLM-28 Location

- | | | | | |
|---------------------|-------------------|--------------------|--------------|-----------------|
| ● Multiport | ■ MSVGM Well | ▲ Piezometer | — Main Road | ⌚ WSTF Boundary |
| ● Conventional Well | ● Extraction Well | ● Exploration Well | - - - Faults | |
| ● Perched Well | ● Injection Well | ● Production Well | | |



March 2023

Figure 3.2

Well BLM-28 Construction Diagram

(SEE NEXT PAGE)

Location ID: **BLM-28**

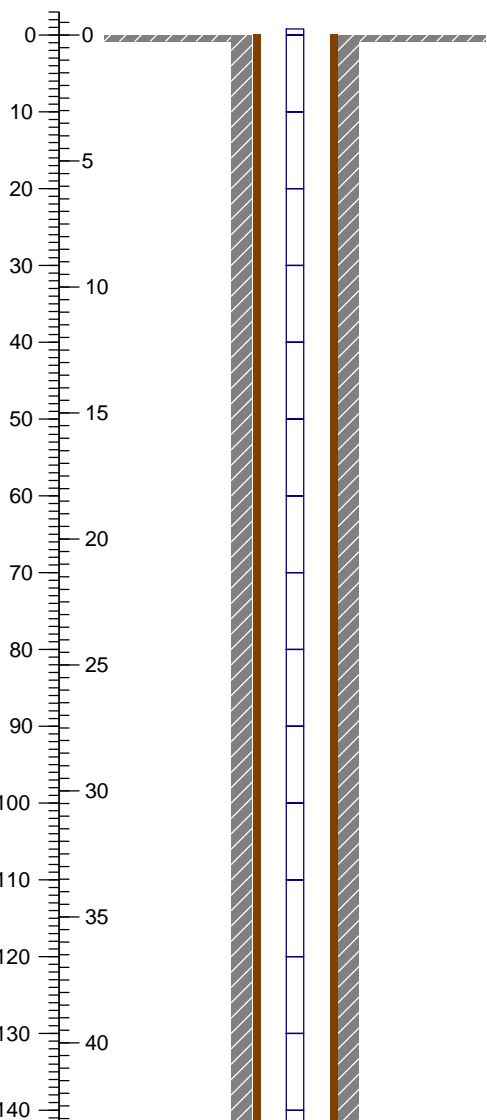
Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SW 1/4 SW 1/4 SW 1/4 Sec. 3, T21S, R3E**
 NM State Plane Coordinates (NAD 83 in meters): **166848.34N 464144.67E**
 Elevation (Brass Cap): **1414.64 m AMSL**
 Elevation (Top of Casing): **1414.87 m AMSL**
 Drilling Contractor: **Larjon Drilling Company**
 Driller: **J. Gower**
 Total Depth of Borehole (bgs): **560' (170.7 m)**
 Borehole Diameter: **8 1/2" 0-312'; 4 1/2" 312-560'**
 Depth to Bedrock (bgs): **300' (91.4 m); Andesite**
 Depth to Groundwater: **380.8' (116.07 m) TOSC (5/9/94; open borehole)**
 Total Depth Surface Casing (bgs): **309' (94.2 m)**
 Diameter and Type Surface Casing: **Nominal 5" Steel**
 Date(s) Well Installed: **5/9/94 - 5/10/94**












Date(s) Well Developed: **BH = 4/8/94 - ~5/4/94; WB = unknown**
 Field Representative(s): **G. Contaldo, D. Menzie, K. Summers**
 Total Depth Well Casing (bgs): **555' (169.2 m)**
 Type of Casing: **Westbay® MP 38 PVC**
 Diameter Well Casing: **1.5" ID; 1.9" OD**
 WB Sampling Zone(s)(bgs): **425' (130.26 m); 470' (143.97 m); and 525' (160.67 m)**
 WB Packer Zone(s)(bgs): **415-435' (127.21-133.31 m); 460-480' (140.94-146.99 m); and 515-540' (157.62-165.22 m)**
 Comments: **Depths (meters) for WB components and zones are a calculated value based on piezometric levels at MPs.**
TOSC = Top of Surface Casing
AMSL = Above Mean Sea Level

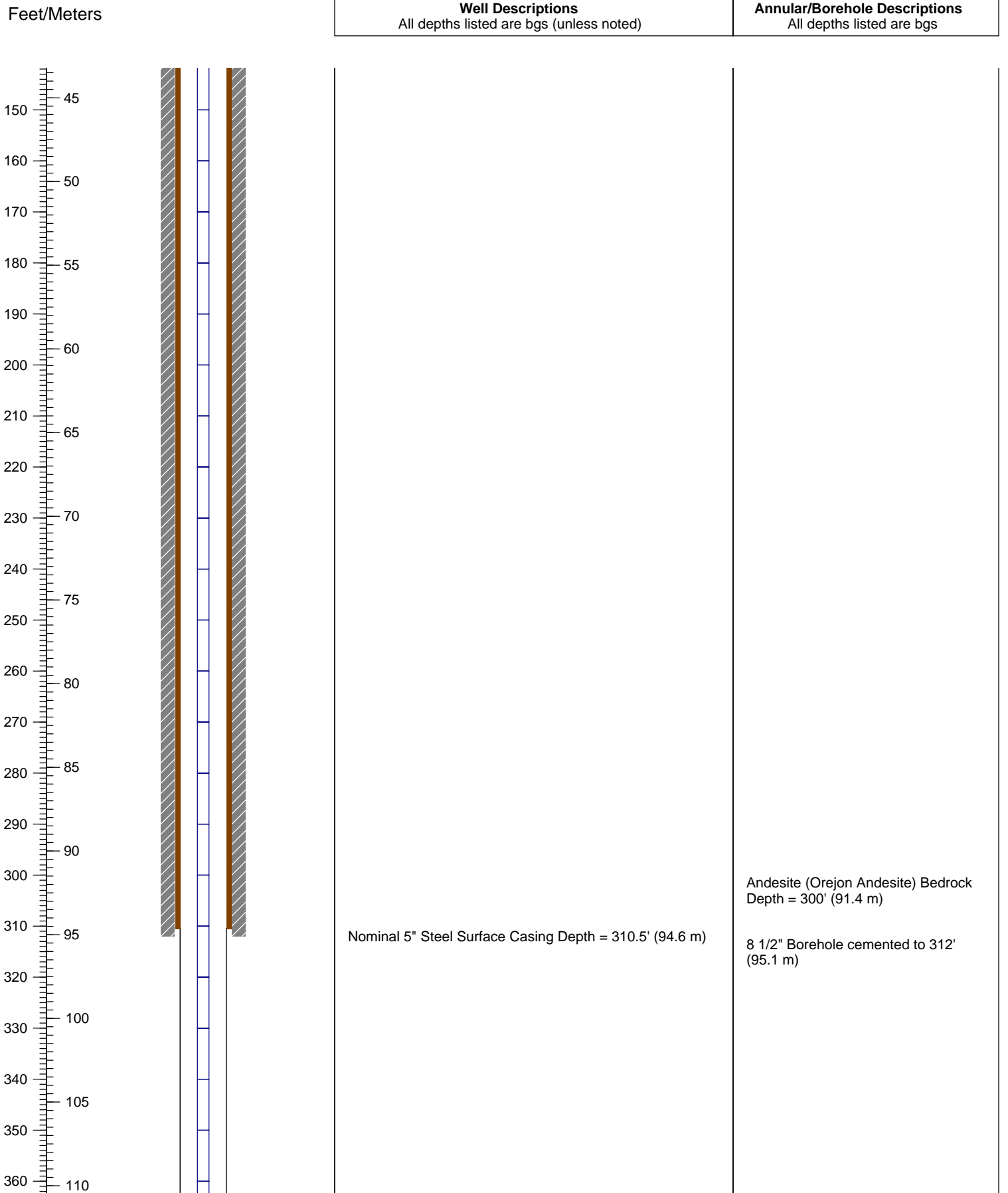
 Surface Casing Nominal 5" Carbon Steel	 1.5" ID Westbay® MP38 End Cap	 Measurement Port (MP)	 Magnetic Collar	 Cement
 1.5" ID Westbay® MP38 Casing	 Packer	 MP with Filter Sock	 Water Table	 Slough
		 Mechanical Pumping Port (PP)		

Feet/Meters	Well Descriptions All depths listed are bgs (unless noted)	Annular/Borehole Descriptions All depths listed are bgs
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Westbay® Well Stick-Up = 0.8' (0.244 m)
Surface Casing Stick-Up = ~0.13' (0.04 m)
 Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casing at ground surface

 Surface Casing	 1.5" ID Westbay® MP38 End Cap	 Measurement Port (MP)	 Magnetic Collar	 Cement
 1.5" ID Westbay® MP38 Casing	 Packer	 MP with Filter Sock	 Water Table	 Slough
		 Mechanical Pumping Port (PP)		



 Surface Casing Nominal 5" Carbon Steel  1.5" ID Westbay® MP38 Casing	Casing Explanation:  1.5" ID Westbay® MP38 End Cap  Packer	 Measurement Port (MP)  MP with Filter Sock  Mechanical Pumping Port (PP)	 Magnetic Collar  Water Table  Cement  Slough
---	--	---	--

Feet/Meters	Well Descriptions All depths listed are bgs (unless noted)	Annular/Borehole Descriptions All depths listed are bgs
	<p>Depth to Water = 380.8' (116.07 m)(Borehole; measured 5/9/94 (Top of Surface Casing) just before Westbay® well casing installation)</p> <p>MP Depth = 400' (122.70 m)</p> <p>Packer Depth = 410'-415' (125.69-127.21 m)</p> <p>Magnetic Collar Depth = 424.6' (130.14 m) Sampling MP Depth (with Filter Sock) = 425' (130.26 m)</p> <p>PP Depth = 435' (133.31 m) Packer Depth = 435'-440' (133.31-134.83 m)</p> <p>MP Depth = 450' (137.89 m) Packer Depth = 455'-460' (139.41-140.94 m)</p> <p>Magnetic Collar Depth = 469.6' (143.79 m) Sampling MP Depth (with Filter Sock) = 470' (143.97 m)</p> <p>PP Depth = 480' (146.99 m) Packer Depth = 480'-485' (146.99-148.52 m) MP Depth = 490' (150.04 m)</p> <p>Packer Depth = 510'-515' (156.10-157.62 m)</p> <p>Magnetic Collar Depth = 524.6' (160.55 m) Sampling MP Depth (with Filter Sock) = 525' (160.67 m)</p> <p>PP Depth = 535' (163.72 m) Packer Depth = 540'-545' (165.22-166.74 m) MP Depth = 545' (166.74 m)</p> <p>Westbay® MP 38 Casing TD = 555' (169.2 m) 4 1/2" Borehole TD = 560' (170.7 m)</p>	

Appendix A
New Mexico Office of the State Engineer Approved Well Plugging Plan



John R. D'Antonio, P.E.
State Engineer

Las Cruces Office- Dist 4
1680 HICKORY LOOP, SUITE J
LAS CRUCES, NM 88005

STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER

May 13, 2020

File No. LRG-17990

NASA Johnson Space Center White Sands Test Facility
Attention: **Timothy Davis**
PO Box 20
Las Cruces, NM 88004

RE: Plugging Plan Approval for LRG-17990

Greetings:

Enclosed is your copy of the Well Plugging Plan of Operations for LRG-17990, approved subject to the attached conditions. You are responsible for submitting a properly completed Plugging Record to the office within thirty (30) days after plugging is completed. The Plugging record is available at:

http://www.ose.state.nm.us/STST/Forms/WD-11%20Plugging%20Record_2009-09-08_final.pdf

Please let us know if you have any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Cheryl S. Thacker".

Cheryl S. Thacker
Water Resources Manager
WRAP, District IV

Encl (2): Well Plugging Plan of Operations and Conditions of Approval



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

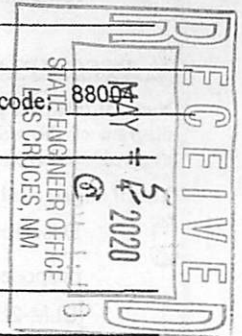
Existing Office of the State Engineer POD Number (Well Number) for well to be plugged: N/A (NASA BLM-28)

Name of well owner: NASA Johnson Space Center White Sands Test Facility (Contact: Timothy Davis)

Mailing address: P.O. Box 20 County: USA

City: Las Cruces State: New Mexico Zip code: 88004

Phone number: 575 524-5024 E-mail: timothy.j.davis@nasa.gov



III. WELL DRILLER INFORMATION:

Well Driller contracted to provide plugging services: Not contracted yet

New Mexico Well Driller License No.: _____ Expiration Date: _____

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: 32 deg, 30 min, 15.49 sec
Longitude: -106 deg, 37 min, 53.724 sec, NAD 83

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

The open borehole below the nominal 5-in. surface casing (set to 310.5 ft bgs) is collapsing and in poor condition. The 5-in. surface casing is cemented in place and renders any restoration efforts impractical due to the small diameter of the casing and borehole.

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? Yes If yes, provide additional detail, including analytical results and/or laboratory report(s): Refer to BLM-28 analytical data (Enclosure 2)

5) Static water level: 381.45 feet below land surface feet above land surface (circle one)

6) Depth of the well: 560 feet

LRG-17990

Tm: 672646

- 7) Inside diameter of innermost casing: 5 inches.
- 8) Casing material: Steel
- 9) The well was constructed with:
 an open-hole production interval, state the open interval: 310.5 - 538.75 ft (top of fill)
 a well screen or perforated pipe, state the screened interval(s): _____
- 10) What annular interval surrounding the artesian casing of this well is cement-grouted? N/A
- 11) Was the well built with surface casing? Yes If yes, is the annulus surrounding the surface casing grouted or otherwise sealed? Yes If yes, please describe:

Nominal 5-in. surface casing set to 310.5 ft in an 8.5-in diameter borehole and cemented to surface.
- 12) Has all pumping equipment and associated piping been removed from the well? No 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.

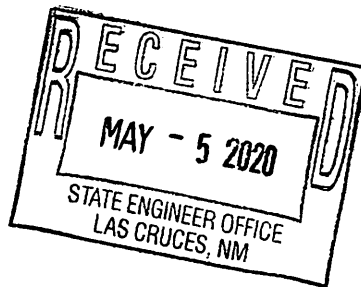
- 1) Describe the method by which cement grout shall be placed in the well, or describe requested plugging methodology proposed for the well:

BLM-28 has a packer lodged in the open borehole at 500 ft, which is covered with debris from the borehole walls. The packer will be pushed to the bottom of the borehole or drilled out. The borehole will be cleaned out to the total depth before cementing from the bottom up using a tremie pipe.
- 2) Will well head be cut-off below land surface after plugging? Yes, 6-in. below ground surface

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: 505 gallons
- 4) Type of Cement proposed: Portland Type II neat cement with 5% bentonite by weight
- 5) Proposed cement grout mix: 8.5 gallons of water per 94 pound sack of Portland cement.
- 6) Will the grout be: _____ batch-mixed and delivered to the site
 mixed on site



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

5% by weight Bentonite powder (~4.7 lbs/94 lb bag of Portland Type II cement)

8) Additional notes and calculations:

The mix of neat cement and 5% bentonite will require 8.5 gallons of water per 94 lb bag of cement; 5.2 gallons per 94 lb bag of cement and 0.7 gallons per pound of bentonite.

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

Well BLM-28 was equipped with a Westbay multiport sampling system with sampling ports at 425, 470 and 525 ft bgs. Samples were collected to monitor water quality data. BLM-28 was sampled annually until 2014 when the Westbay sampling system was removed as part of NASA's Westbay Well Conversion Work Plan. Hydrostatic heads were also monitored through the Westbay pressure ports. The attached spreadsheet provides both analytical results and hydrostatic head pressures from May 2008 through May 2014.

NASA installed a low-flow purgeable sampling system in 2019, which included a packer set at 500 ft bgs and sample intake port on a drop tube at 515 ft bgs. The pump was set above the packer. However, deterioration of the borehole walls between 400 and 415 ft bgs resulted in an accumulation of debris on top of the packer. An attempt to remove the low-flow sampling system resulted in the tubing bundle separating from the packer. The pump, 500 ft of tubing and the support cable were recovered. The packer and about 15 ft of tubing were not recovered. After evaluating the condition of the borehole using a downhole camera, NASA determined that it was not cost effective to try to restore the well.

VIII. SIGNATURE:

I, Timothy J. Davis, 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.

TIMOTHY DAVIS

Digitally signed by TIMOTHY DAVIS
Date: 2020.04.27 11:14:28 -06'00'

Signature of Applicant

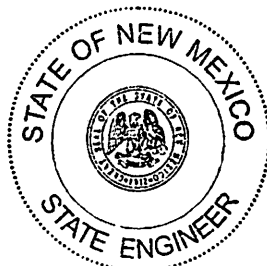
Date

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 13th day of May, 2020



John R. D Antonio, Jr., STATE ENGINEER

BY Cheryl Thacker
Cheryl Thacker
Lower Rio Grande Basin Supervisor

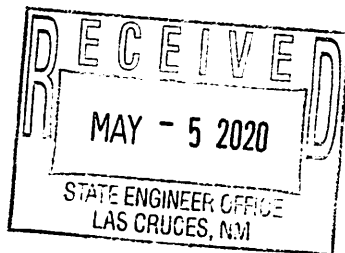
TABLE A - For plugging intervals that employ cement grout. Start with deepest interval.

	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)			Ground surface
Bottom of proposed interval of grout placement (ft bgl)			538.75 ft
Theoretical volume of grout required per interval (gallons)			505 gallons
Proposed cement grout mix gallons of water per 94-lb. sack of Portland cement			8.5 gallons of water per 94 lb bag of Portland Type II cement with 5% bentonite powder.
Mixed on-site or batch-mixed and delivered?			On site
Grout additive 1 requested			Powered bentonite
Additive 1 percent by dry weight relative to cement			5%
Grout additive 2 requested			N/A
Additive 2 percent by dry weight relative to cement			N/A



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)			N/A
Bottom of proposed sealant or grout placement (ft bgl)			N/A
Theoretical volume of sealant required per interval (gallons)			N/A
Proposed abandonment sealant (manufacturer and trade name)			N/A



Attachment
Conditions of Approval

Well Plugging Plan of Operations
Well Number LRG-17990

File No.: LRG-17990

- 1) Well LRG-17990 shall be plugged using the methods and materials identified in the State Engineer approved Well Plugging Plan of Operations filed on May 5, 2020.
- 2) In addition, well LRG-17990 shall be plugged completely using the following method per Rules and Regulations Governing Well Driller Licensing, Construction, Repair and Plugging of Wells; Subsection C of 19.27.4.30 NMAC:

All pumping appurtenance shall be removed from the well prior to plugging. To plug a well, the entire well shall be filled from the bottom upwards to ground surface using a tremie pipe. The bottom of the tremie shall remain submerged in the sealant throughout the entire sealing process; other placement methods may be acceptable and approved by the State Engineer

The well shall be plugged with an Office of the State Engineer approved sealant for use in the plugging of non-artesian wells.

The well driller shall cut the casing off at least four (4) feet below ground surface and fill the open hole with at least two (2) vertical feet of approved sealant.

Wells that do not encounter a water bearing stratum shall at a minimum be plugged by filling the well with drill cuttings or clean native fill to within 10 feet of land surface and by plugging the remaining 10 feet of the well to ground surface with a plug of the office of the state engineer approved sealant.

The driller must fill or cover any open annulus with sealant. Once the sealant has cured, the well driller or well owner may cover the seal with soil.


A plugging report for said well shall be filed with the Office of the State Engineer in the District IV office in Las Cruces within thirty (30) days of completion of the plugging.

- 2) A licensed well driller shall keep a record of the plugging work as it progresses and file a complete Plugging Record (Office of the State Engineer Form No.: WR-20) with the State Engineer no later than thirty (30) days after completion of plugging.
- 3) New Mexico Office of the State Engineer (NMOSE) witnessing of the plugging will not be required unless artesian conditions are encountered, but shall be facilitated if a NMOSE observer is onsite. NMOSE witnessing may be requested during normal

work hours by calling the District IV NMOSE office at 575-524-6161 at least 48 hours in advance. NMOSE inspection will occur dependant of personnel availability.

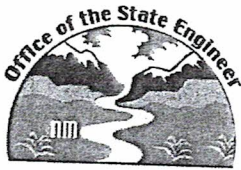
- 4) Should another regulatory agency sharing jurisdiction of the project authorize or by regulation require more stringent requirements than stated herein, the more stringent procedure shall be followed. This in part includes provisions regarding preauthorization to proceed, type of methods and materials used, inspection, or prohibition of free discharge of any fluid or other material to or from the well that is related to the plugging process.

Date: May 13, 2020



Cheryl S. Thacker
Water Resources Manager
WRAP District IV

Appendix B
New Mexico Office of the State Engineer Well Plugging Record



PLUGGING RECORD



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

I. GENERAL / WELL OWNERSHIP:

State Engineer Well Number: BLM-28
 Well owner: NASA JOHNSON SPACE CENTER WHITE SANDS FACILITY Phone No.: (575)-524-5624
 Mailing address: P.O. BOX 20
 City: LAS CRUCES State: NM Zip code: 88004

II. WELL PLUGGING INFORMATION:

- 1) Name of well drilling company that plugged well: YELLOW JACKET DRILLING SERVICES, LLC
- 2) New Mexico Well Driller License No.: WD-1458 Expiration Date: 10/31/24
- 3) Well plugging activities were supervised by the following well driller(s)/rig supervisor(s):
SEAN CARRIGAN
- 4) Date well plugging began: 1-21-23 Date well plugging concluded: 1-29-23
- 5) GPS Well Location: Latitude: 32 deg, 30 min, 15.49 sec
Longitude: -106 deg, 37 min, 53.724 sec, WGS 84
- 6) Depth of well confirmed at initiation of plugging as: _____ ft below ground level (bgl),
by the following manner: TREMIE PIPE
- 7) Static water level measured at initiation of plugging: 381 ft bgl
- 8) Date well plugging plan of operations was approved by the State Engineer: 5-5-20
- 9) Were all plugging activities consistent with an approved plugging plan? YES If not, please describe differences between the approved plugging plan and the well as it was plugged (attach additional pages as needed):

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

For each interval plugged, describe within the following columns:

Depth (ft bgl)	Plugging Material Used (include any additives used)	Volume of Material Placed (gallons)	Theoretical Volume of Borehole/ Casing (gallons)	Placement Method (tremie pipe, other)	Comments (“casing perforated first”, “open annular space also plugged”, etc.)
	<p>CEMENT GROUT 5% BETONITE</p>	<p>574 GAL.</p>	<p>505 GAL.</p>	<p>TREMIE PIPE</p>	<p>ABANDON</p>

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

III. SIGNATURE:

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

Signature of Well Driller

1/31/13

Date