National Aeronautics and
Space Administration

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

August 30, 2024

Reply to Attn of: RE-24-120

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

Subject: Response to Disapproval of the NASA WSTF Westbay Well Reconfiguration Work Plan for Wells PL-7, PL-8, PL-10, ST-5, and WW-3

NASA submitted the *Well Reconfiguration Work Plan for Westbay Wells PL-7, PL-8, PL-10, ST-5, and WW-3* on April 29, 2021. On February 6, 2024, NMED disapproved the work plan and directed NASA to address one comment. The one comment has been addressed and the work plan revised.

Enclosed is the revised work plan for the reconfiguration or replacement of Plume Front wells equipped with the Westbay sampling systems to purgeable sampling systems at WSTF. NASA proposes to reconfigure or replace the Westbay systems in monitoring wells PL-7, PL-8, PL-10, ST-5, and WW-3 with nested or clustered wells utilizing conventional bladder pumps.

This submittal includes a printed response table that cross-references NMED's comments as Enclosure 1, a bound, paper copy of the revised report is included as Enclosure 2, and a DVD with electronic copies of the final report, redline-strikeout report, and response table are comprised as Enclosure 3.

The FY24 Agency Environmental budget has been substantially cut; it is likely the FY25 budget will also be less than planned. As a result, NASA is unable to meet the schedules originally proposed for installing the wells listed herein. The earliest timeframe NASA will be able to resume monitoring well installation or reconfiguration is FY26. If NASA concludes that nested wells are appropriate for reconfiguring any or all Westbay wells herein, NASA proposes a phased approach in which one nested well is constructed and evaluated to determine the success of the well design. Although the current target date is expected to be 2026, NASA will evaluate every possible option, as they may become available, to obtain the resources needed to address these commitments in a timely manner. NASA will keep NMED apprised of developments that could affect the ongoing groundwater monitoring program at WSTF. NASA proposes this as a discussion topic for future NASA/NMED partnering meetings.

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

Digitally signed by Timothy Davis
Date: 2024.08.30 11:52:43 -06'00'

Timothy J. Davis
Chief, Environmental Office

3 Enclosures

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

Well Reconfiguration Work Plan for Westbay Wells PL-7, PL-8, PL-10, ST-5, and WW-3

Purpose	On March 29, 2016, the New Mexico Environmental Department (NMED) approved the National Aeronautics and Space Administration (NASA) *White Sands Test Facility (WSTF) Periodic Monitoring Report Fourth Quarter 2015.* In the approval letter, NMED expressed concerns for periodic detections of N-nitrosodimethylamine (NDMA) at various sampling intervals in sentinel wells WW-3, PL-6, PL-7, PL-8, PL-10, and BLM-30 during 2015. NMED directed NASA to submit a work plan for the conversion of Westbay®[1] multiport sampling systems in wells WW-3, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, and BLM-30 to purgeable sampling systems no later than March 31, 2017. On March 30, 2017, NASA submitted a report titled *Detections of NDMA and TCE in WSTF Groundwater Monitoring Wells BLM-30, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, WW-3* (NASA, 2017a), which recommended additional evaluation of chemical analytical data before converting the Westbay sampling systems in these wells to purgeable systems. NMED approved the report with modifications (NMED, 2017) that included a requirement to complete the data representativeness evaluation and direction to replace monitoring wells PL-5 and PL-6 because of inadequate seals between monitoring zones in these wells. The NMED-approved data representativeness evaluation has been ongoing since 2017 and has required several requests for extensions of time for submittal of the required work plan for reconfiguration of Westbay wells. The latest, approved by NMED on January 25, 2021, extended the due date for submittal of the reconfiguration work plan to April 30, 2021. This work plan is submitted in accordance with the NMED directive. This work plan does not include wells BLM-30 and PL-5. The proposed reconfiguration or plugging and abandonment (P&A) of these wells had been previously addressed in separate work plans: • *Well Reconfiguration Work Plan for Well BLM-30* (NASA, 2017c, Enclosure 1) • *Work Plan for Abandonment of NASA WSTF Well PL-5 and Replacement with Monitoring Well PL-12* (NASA, 2017b). NASA will address the replacement of well PL-6 under separate cover.
Basis for Well Conversion	Irregular detections of NDMA at wells PL-6, PL-7, PL-8, PL-10, ST-5, and WW-3 prompted NASA to investigate the Westbay systems' ability to provide representative groundwater samples (NASA, 2017a). Detections of NDMA have occurred sporadically and inconsistently over time (NASA, 2017a). The results from the investigation confirmed the presence of anomalous NDMA and that samples from Westbay wells may not be representative of groundwater conditions (NASA, 2017a). NASA believes

[1] Westbay® is a registered trademark of Westbay® Instruments, a division of Nova Metrix, LLC.

	reconfiguring wells PL-7, PL-8, PL-10, ST-5, and WW-3 to use purgeable sampling systems will allow for the collection of analytical groundwater samples that are more representative of aquifer conditions. Therefore, NASA proposes to reconfigure or replace the current Westbay systems in these wells with purgeable systems to improve the quality of samples collected for chemical analysis. In lieu of any current alternative to the Westbay and FLUTe sampling systems, nested wells using PFAS-free bladder pumps for multi-zone wells or clustered wells will be the most viable long-term solution for the collection of representative groundwater sampling data at PL-7, PL-8, PL-10, ST-5, and WW-3, and potentially at other multi-zone groundwater monitoring wells in the Plume Front area. Samples collected from a purgeable system are expected to provide data that will better characterize the Plume Front area of the WSTF groundwater contaminant plume (Figure 1).
Well Background	**Wells PL-7, PL-8, and PL-10** Westbay multiport monitoring wells PL-7, PL-8, and PL-10 were installed to monitor the Plume Front and the effectiveness of the groundwater remediation system west of the WSTF groundwater contaminant plume (Figure 1). The well PL-7 borehole was drilled in 1992 within the saturated Quaternary to Tertiary Santa Fe Group Alluvium to a total depth of 804 feet (ft) below ground surface (bgs) and completed using nominal 4-inch diameter Schedule 10 stainless steel casing with three screened zones to a total depth of 655.4 ft bgs. The screen intervals are located at 475.0 to 485.0; 555.0 to 565.0; and 625.0 to 635.0 ft bgs. A 1.5-inch MP-38 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 480, 560, and 630 ft bgs. The current PL-7 well configuration is illustrated in Figure 2. Hydraulic conditions are classified as unconfined throughout all three monitoring zones. The initial depth to water when drilled was 451.46 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 486.56 ft bgs (4/26/2024). The well PL-8 borehole was drilled in 1999 to a total depth of 1,020 ft bgs and completed using nominal 4-inch diameter Schedule 10 stainless-steel casing with four screened zones to a total depth of 1,000 ft bgs. The screen intervals are located at 448.2 to 458.2; 598.5 to 608.6; 774.0 to 784.0; and 959.5 to 969.6 ft bgs. A 1.5-inch MP-38 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 455, 605, 780, and 965 ft bgs. The current PL-8 well configuration is illustrated in Figure 3. Hydraulic conditions are unconfined throughout all four monitoring zones within the Santa Fe Group alluvium. The initial depth to water when drilled was 404.46 ft bgs and the most recent depth to water in the shallow Westbay

sampling port calculated from pressure differentials is 455.75 ft bgs (4/26/2024).

Well PL-10 was drilled to replace well PL-9 in 2002. The multiport monitoring well is located downgradient of the Plume Front injection wells and was placed to monitor the injection of treated groundwater. The PL-10 borehole was drilled to a total depth of 1,025 ft bgs in the Santa Fe Group Alluvium and was completed using nominal 5-inch diameter Schedule 10 stainless-steel casing with four screened zones to a total depth of 999.95 ft bgs. The screen intervals are located at 479.3 to 489.3; 589.3 to 599.3; 809.3 to 819.3; and 959.3 to 969.5 ft bgs. A 2.25-inch MP-55 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 484, 592, 813, and 962 ft bgs. The current PL-10 well configuration is illustrated in Figure 4. Conditions are unconfined throughout all four monitoring zones within the Santa Fe Group alluvium. The initial depth to water when drilled was 439.69 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 468.39 ft bgs (4/26/2024).

Well ST-5

Well ST-5 was drilled to determine vertical groundwater gradients in the Jornada Aquifer downgradient of the Western Boundary Fault Zone and the ST-3 well cluster. The well is located west of the Western Boundary Fault Zone in an area of sub-parallel half-graben step faults where Tertiary volcanic bedrock is offset to a depth of over 2,000 ft into the southern Jornada del Muerto Basin (Figure 1). The borehole was drilled to a total depth of 1,210 ft bgs. Well ST-5 was completed with nominal 4-inch diameter Schedule 10 stainless-steel casing with five screened zones to a total depth of 1,200.4 ft bgs. The screen intervals are located at 480.1 to 490; 650 to 660.1; 810 to 820; 979.9 to 989.9; and 1,170.1 to 1,180.1 ft bgs. A 1.5-inch MP-38 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 485, 650, 815, 985, and 1,175 ft bgs. The current ST-5 well configuration is illustrated in Figure 5. Hydraulic conditions are classified as unconfined within the saturated Quaternary to Tertiary Santa Fe Group alluvium throughout all five monitoring zones. The initial depth to water when drilled was 389.84 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 428.72 ft bgs (4/26/2024).

Well WW-3

Well WW-3 was drilled to provide a groundwater monitoring point between well ST-6 and the NASA water supply wells. The well is located west of the Western Boundary Fault Zone (Figure 1). The borehole was drilled to a total depth of 1,025 ft bgs. Well WW-3 was completed with nominal 5-inch diameter, Schedule 80 PVC casing with four screened zones to a total depth

	of 1,014.1 ft bgs. The screened intervals are located at 463.75 to 473.75; 564.66 to 574.65; 705.95 to 715.95; and 973.44 to 983.44 ft bgs. A 2.25-inch MP-55 Westbay multiport groundwater sampling system was installed within the conventional PVC casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 469, 569, 710, and 977 ft bgs. The current WW-3 well configuration is illustrated in Figure 6. Hydraulic conditions are classified as unconfined within the saturated Quaternary to Tertiary Santa Fe Group alluvium throughout all four monitoring zones. The initial depth to water when drilled was approximately 386 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 413.13 ft bgs (4/26/2024).
Westbay System Removal	Westbay systems in wells PL-7, PL-8, PL-10, ST-5, and WW-3 are installed inside conventional casing with multiple screened intervals. The Westbay casing will be removed, and the conventional casing and upper screens will be evaluated for any existing problems. If NASA determines the casing and screens are suitable for reuse, the lower screens will be grouted and dedicated bladder pumps will be installed in the upper screens. If the upper screens and/or casing are unsuitable for reuse, the wells will be plugged and abandoned. WSTF Environmental Department personnel will supervise Westbay Instruments personnel and a qualified subcontractor drilling company during Westbay sampling system removal. Westbay Instruments personnel will provide the specialized tools needed to perforate the packers within each system. Following perforation of the packers, the subcontractor drilling company will use a pulling unit to remove the Westbay casing and sample system components from the conventional well casings. The removal process, the plugging and abandonment activities, as well as the drilling activities will be supervised and documented by WSTF Environmental Department contractor personnel. WSTF Environmental Department contractor personnel will also be responsible for directing and documenting waste management activities, which are discussed further in the Investigation-Derived Waste and Waste Characterization section of this work plan.
Well Plugging and Abandonment	If necessary, groundwater monitoring wells PL-7, PL-8, PL-10, ST-5, and WW-3 or portions thereof will be abandoned in accordance with 19.27.4 New Mexico Administrative Code (NMAC). Each borehole will be cemented from bottom up using a tremie pipe to the desired elevation or to the surface.
Well Replacement and Monitoring Zones	If a new well is required, the well will be drilled near the original location of the abandoned monitoring well. It will be completed as either a nested or clustered well with a purgeable groundwater sampling system. The goal of the replacement well is to continue to monitor the current zones in each of the wells. Sampling zones will be located comparably to the current active monitoring zones to ensure consistency and reliability of groundwater data within the Plume Front area. Some sampling zones may not be replicated. This will be dependent upon the lithology and water-bearing zones identified during the drilling of any new well(s). Reconfigured or new wells will be

	named sequentially using the current convention (i.e., 600C-006-GW through 600C-010-GW) in the order of installation. Following the installation, each monitoring well will be developed to remove any residual sediment or soil from the well. Water quality parameters will be taken periodically until the turbidity is below 5 nephelometric turbidity units.
Purgeable Sampling System and Installation	Nested or clustered groundwater monitoring wells equipped with conventional bladder pump systems appear to be the most viable long-term solution for the collection of representative groundwater sampling data at PL-7, PL-8, PL-10, ST-5, WW-3 locations, and potentially at other multi-zone groundwater monitoring wells in the Plume Front area. Figure 7 illustrates a generalized nested well design for reconfiguration or replacement of wells PL-7, PL-8, PL-10, ST-5, and WW-3.
Groundwater Sampling	Prior to collecting groundwater samples, the system will be purged until the required amount of water is removed. Exact purging volumes for each well zone are calculated based upon minimal water level drawdown to equalization and water quality stabilization. Groundwater quality parameter measurements will be recorded periodically during purging to establish parameter stabilization for three (3) consecutive readings once the minimum purge volume has been reached. Once both conditions have been met sample collection may begin. Groundwater samples will be collected in accordance with the WSTF Groundwater Monitoring Plan (GMP: NASA, 2023). Initial sampling will be performed within 5 days of development. Each monitoring well/zone will be sampled quarterly for at least one year for volatile organic compounds, nitrosamines, metals, semi-volatile organic compounds, and inorganic compounds. Results from these sampling events will be reported in the WSTF Periodic Monitoring Reports, which are submitted quarterly to NMED. After one year, sampling at wells replacing PL-7, PL-8, PL-10, ST-5, and WW-3 will be conducted in accordance with the schedule identified for these wells in the GMP, which is updated annually and approved by NMED.
Investigation-Derived Waste and Waste Characterization	Information related to the characterization, management, and disposition of waste generated during this project is provided in this section. Waste characterization is conducted in accordance with Section 4.3.10 (Collection and Management of Investigation Derived Waste) of the WSTF RCRA Permit (NMED, 2023). All waste will be properly managed and disposed of in accordance with NASA procedures and state and federal regulations. Anticipated waste streams that may be generated during this project include: • **Westbay system components.** Wells PL-7, PL-8, PL-10, ST-5, and WW-3 are located outside the defined extent of the WSTF groundwater plume. Components of the Westbay sampling system and groundwater removed from these wells are not considered contaminated. The components also do not contain materials that, when discarded as a solid waste, would exhibit characteristics of hazardous waste. This waste is characterized as non-hazardous solid waste.

	• **Groundwater.** Groundwater produced from the aquifer outside of the WSTF groundwater contaminant plume does not exhibit characteristics of hazardous waste and does not contain listed hazardous waste. Activities that produce groundwater may include development activities, purging, and groundwater sampling. Waste groundwater is characterized as non-hazardous solid waste. • **Decontamination fluids.** Decontamination fluids such as water and soap solutions used to wash and decontaminate equipment during this project are non-hazardous solid waste. The decontamination fluids will not exhibit the characteristics of hazardous waste nor be characterized as listed hazardous waste. • **Contact waste.** Contact waste, or debris, such as used disposable sampling equipment, personal protective equipment, plastic sheeting, and other debris generated during at locations outside of the WSTF groundwater contaminant plume are non-hazardous solid waste. • **Petroleum Contaminated Debris.** Debris such as rags and wipes that may be contaminated with petroleum products during routine pulling unit maintenance. This debris is characterized as hazardous waste with the D018 hazardous waste code. The Environmental Protection Agency (EPA) has established through the "contained-in policy" that groundwater, and other environmental media, is not solid waste but is subject to regulation as if it were hazardous waste when it contains listed waste (EPA, 1996). Available historical analytical data from wells PL-7, PL-8, PL-10, ST-5, and WW-3 indicate that these wells are located outside of the WSTF contaminant plume and do not contain WSTF contaminants of concern (trichloroethylene, tetrachloroethylene, 1,1,2-trichloro-1,2,2-trifluoroethane, trichlorofluoromethane). Therefore, F001 and F002 hazardous waste codes do not apply to groundwater actively managed from these wells. As a result of this determination, groundwater and materials that contact groundwater at these locations are not subject to regulation as listed hazardous waste. Groundwater at these locations also do not exhibit toxicity characteristics and have non-detectable or low parts per trillion range NDMA concentrations. Groundwater and decontamination fluids generated during development, purging, and sampling activities will be containerized in mobile trailers or other appropriate containers as non-hazardous solid waste. The collected fluids will be sampled for volatile organic compounds and NDMA prior to proper disposal, which may occur through the WSTF Mid-plume Interception and Treatment System, WSTF sanitary sewer, or other appropriate method. Because groundwater is not contaminated at the project wells, contact waste is characterized as non-hazardous waste. Westbay sampling system components removed from the wells and associated contact debris will be collected at the end of each working shift and transferred to an appropriate non-hazardous solid waste container. The non-hazardous contact waste will be disposed in accordance with the State-approved Solid Waste Management Program (RCRA Subtitle D). Debris that may have contacted

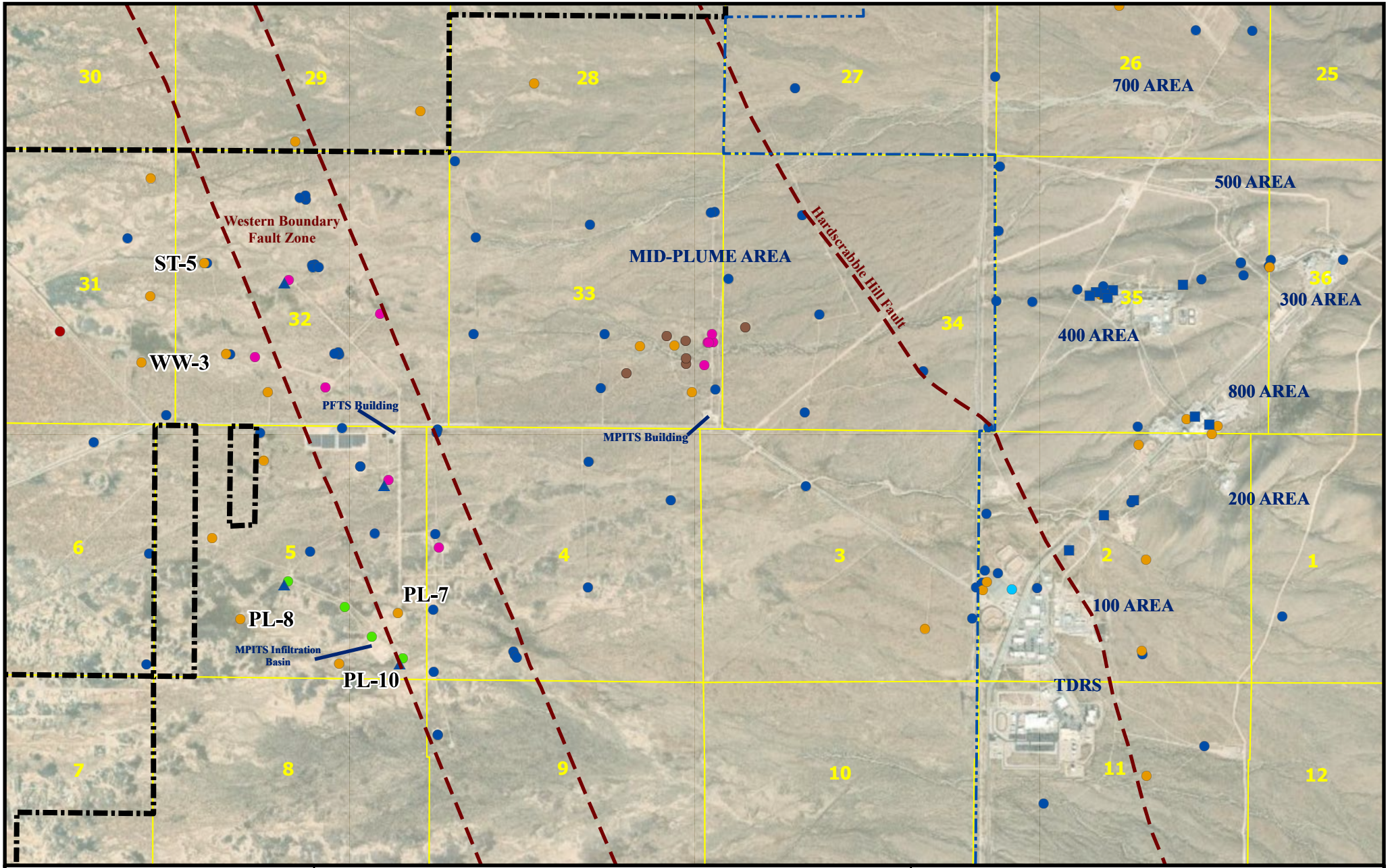
	petroleum-based oils or fuels will be managed as hazardous waste in accordance with 20.4.1 NMAC and 40 CFR 262.17 at a less than 90-day central accumulation area. If generated, petroleum contaminated debris will be properly disposed of at a RCRA permitted treatment, storage, and disposal facility.
Schedule	The FY24 Agency Environmental budget has been substantially cut and it is likely the FY25 budget will also be less than planned. As a result, the earliest timeframe WSTF will be able to resume monitor well installation is FY26. NASA and its contractors have never constructed a nested well at WSTF. If NASA concludes that nested wells are appropriate for reconfiguring any or all Westbay wells herein, NASA proposes a phased approach in which one nested well is constructed and evaluated to determine the success of the well design. Although the current target date is expected to be 2026, NASA will evaluate every possible option, as they may become available, to obtain the resources needed to address the reconfigurations in a timely manner. NASA will keep NMED apprised of developments that could affect the ongoing groundwater monitoring program at WSTF.
References	EPA. "Requirements for Management of Hazardous Contaminated Media (HWIR-Media)." *Federal Register* 61, No. 83 (April 29, 1996): 18780.https://www.govinfo.gov/content/pkg/FR-1996-04-29/pdf/96-10096.pdf NASA Johnson Space Center White Sands Test Facility. (1999, January 20). *Plume Front Stabilization Work Plan*. Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2017a, March 30). *Detections of NDMA and TCE in WSTF Groundwater Monitoring Wells BLM-30, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, and WW-3.* Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2017b, December 27). *Work Plan for Abandonment of NASA WSTF Well PL-5 and Replacement with Monitoring Well PL-12.* Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2017c, December 28). *Well Reconfiguration Work Plan for Well BLM-30*. Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2023, April 27). *NASA WSTF Groundwater Monitoring Plan Update for 2023*. Las Cruces, NM. NMED Hazardous Waste Bureau. (2016, March 29). *Approval NASA WSTF Periodic Monitoring Report Fourth Quarter 2015*. Santa Fe, NM. NMED Hazardous Waste Bureau. (2017, October 4). *Approval with Modifications Detections of NDMA (N-Nitrosodimethylamine) and TCE*

	(Trichloroethylene) In WSTF Groundwater Monitoring Wells BLM-30, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, and WW-3. Santa Fe, NM. NMED Hazardous Waste Bureau. (2021, January 25). *Approval Request for Fourth Extension of Time for Well Reconfiguration Work Plan*. Santa Fe, NM. NMED Hazardous Waste Bureau. (2023, March 28). *RCRA Permit EPA ID # NM8800019434*. Santa Fe, NM. Well Driller Licensing; Construction, Repair and Plugging of Wells, Office of the State Engineer, 19.27.4 NMAC (6-30-17).

Figures

Figure 1 Well Location Map

(SEE NEXT PAGE)



N
W E
S

August 2024

Feet
0 5001,000 2,000 3,000

Prepared by:srees

- Conventional Well
- Exploration Well
- Extraction Well
- Injection Well
- Multiport Well
- Perched Well
- Piezometer
- Production Well
- MSVGM Well
- WSTF Boundary
- WSTF Industrial Area
- PLSS - Sections
- Fault

Well Location Map
Westbay Well Reconfiguration

NASA Johnson Space Center
White Sands Test Facility Las Cruces,
New Mexico

Coordinate System:
NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet

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Figure 2 PL-7 Westbay Well Completion Diagram

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WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **PL-7** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 NE 1/4 SE 1/4 Sec. 5, T21S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **167231.65N 462332.97E**
Elevation (Brass Cap): **1378.56 m AMSL**
Elevation (Top of Casing): **1378.95 m AMSL**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Total Depth of Borehole (bgs): **804' (245.1 m)**
Borehole Diameter: **9 7/8" 0-804'; reamed 16 1/2" 0-80'; reamed 13" 80-675'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **451.57' (137.64 m) TOC (12/15/92)**
Total Depth Surface Casing (bgs): **80' (24.4 m)**
Diameter and Type Surface Casing: **13.5" ID, 14" OD Steel**
Date(s) Well Installed: **CW = 11/19/92-11/24/92; WB = 12/15/92-12/17/92**
Date(s) Well Developed: **CW = 11/24/92-12/10/92; WB = Not Recorded**

Field Representative(s): **See list in Annular/Borehole Descriptions below**
Total Depth Well Casing(s) (bgs): **CW = 655.4' (199.8 m); WB = 650' (198.1 m)**
Type of Casing(s): **CW = Stainless Steel; WB = MP 38 PVC**
Diameter Well Casing(s): **CW = 4" ID/4.5" OD; WB = 1.5" ID/1.9" OD**
Casing Schedule: **CW = 5 (0-395.0') and 10 (395.0'-TD)**
CW Screened Zone(s) (bgs): **475.0-485.0' (144.8-147.8 m); 555.0-565.0' (169.2-172.2 m); and 625.0-635.0' (190.5-193.5 m)**
WB Sampling Zone(s) (bgs): **480' (146.95 m); 560' (171.20 m); and 630' (192.43 m)**
WB Packer Zone(s) (bgs): **470-490' (143.91-149.99 m); 550-570' (168.15-174.24 m); and 620-650' (TD) (189.38-198.1 m)**
Comments: **CW = Conventional Well WB = Westbay® Well TD = Total Depth**

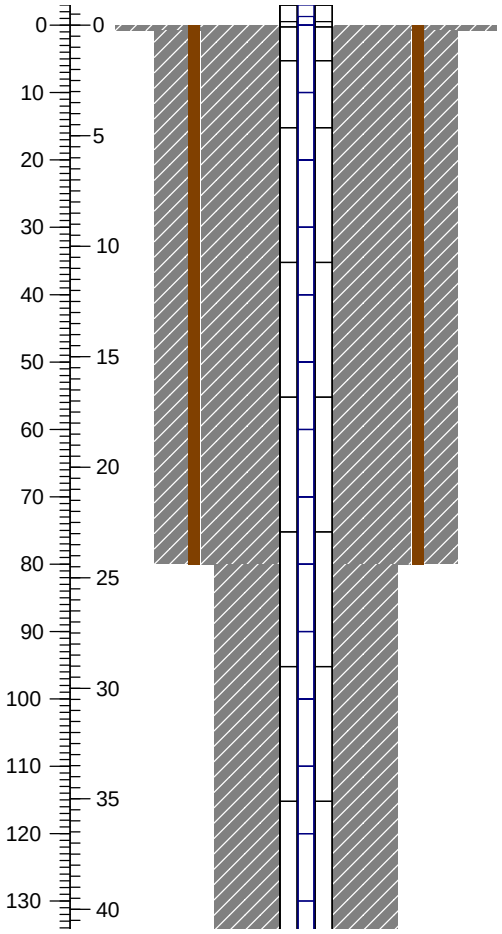
Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Centralizers not listed**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Packer
- Mechanical Pumping Port (PP)
- Magnetic Collar

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.29' (0.394 m)
Conventional Well Stick-Up = ~0.53' (~0.2 m)

Surface Casing Stick-Up = ~0. Original stick-up measured at installation was 2.4' (0.7 m). Casing was cut to gound surface after installation 10/16/92. (Exact Stick-Up Not Measured or Surveyed).

Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

The upper 10 couplings (0-100') are reinforced with stainless steel hose clamps

14" OD Steel Surface Casing Depth = 80' (24.4 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Cement Grout (Cement with 5% Bentonite) = 0'

Field Representatives: Mary Canavan; Greg Contaldo; Pam Egan; Jack Kirby; and Dave Menzie

16 1/2" Borehole Cemented to 80' (24.4 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Centralizers not listed

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing

1.5" ID Westbay® MP 38 End Cap

Measurement Port (MP)

MP with Filter Sock

Mechanical Pumping Port (PP)

Magnetic Collar

Packer

Annular Materials Explanation:

Cement

Bentonite (Grout Well DF)

Bentonite Seal

8/20 Sand/ Bentonite Mix

Slough

1/8 Gravel

4/8 Sand

6/9 Sand

8/12 Sand

8/20 Sand

10/20 Sand

16/40 Sand

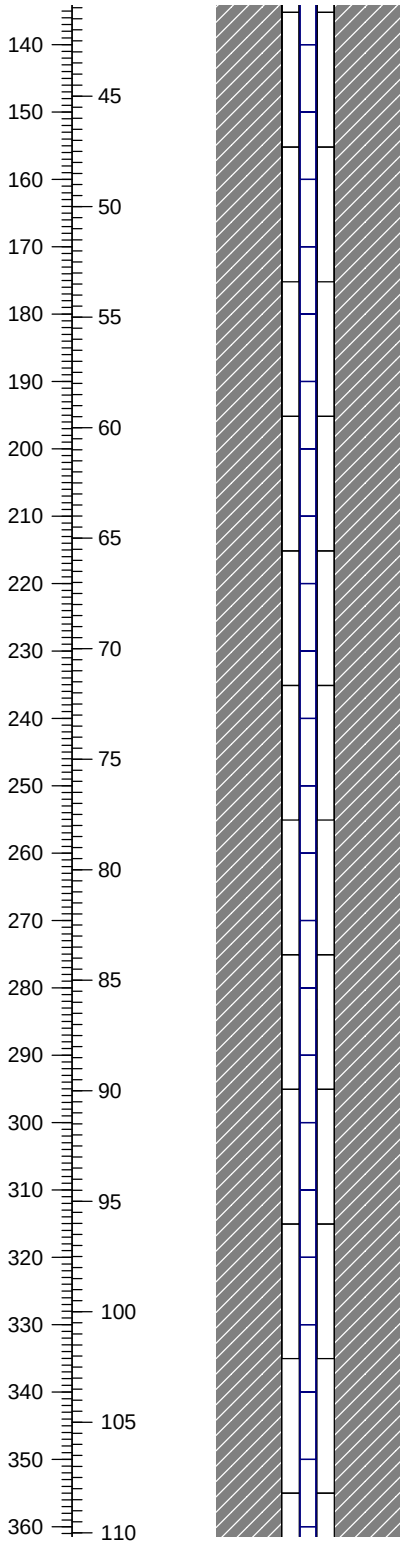
20/40 Sand

30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
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- Water Table
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- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

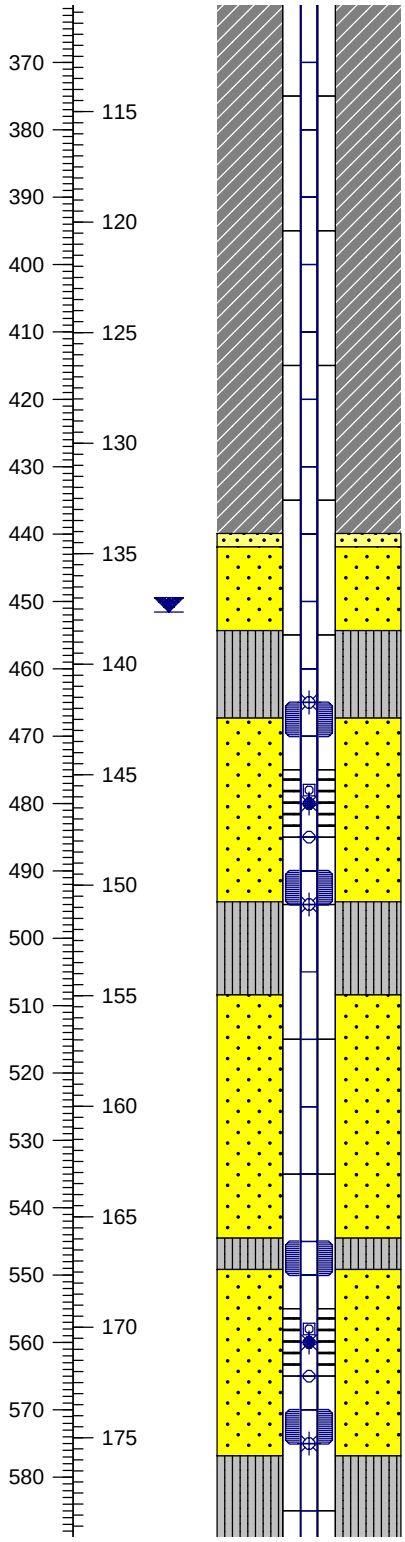
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



All stainless steel casing above 395.0' (120.4 m) is schedule 5. All casing below is schedule 10.

Top of 16/40 Sand = 439.9' (134.1 m)

Top of 8/20 Sand = 441.9' (134.7 m)

Water Table = 451.57' (137.64 m; measured 12/15/92 just before Westbay® well casing installation; TOC)

MP Depth = 465' (142.39 m)

Top of Bentonite Seal = 454.3' (138.5 m)

Packer Depth = 465'-470' (142.39-143.91 m)

Top of 8/20 Sand = 467.3' (142.4 m)

Top of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 475.0' (144.8 m)

Magnetic Collar Depth = 479.6' (146.83 m)

Sampling MP Depth (with Filter Sock) = 480' (146.95 m)

PP Depth = 485' (148.47 m)

Bottom of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 485.0' (147.8 m)

Top of Bentonite Seal = 494.6' (150.8 m)

Packer Depth = 490'-495' (149.99-151.51 m)

MP Depth = 495' (151.51 m)

Top of 8/20 Sand = 508.4' (155.0 m)

Packer Depth = 545'-550' (166.63-168.15 m)

Top of Bentonite Seal = 544.5' (166.0 m)

Top of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 555.0' (169.2 m)

Top of 8/20 Sand = 549.2' (167.4 m)

Magnetic Collar Depth = 559.6' (171.08 m)

Sampling MP Depth (with Filter Sock) = 560' (171.20 m)

PP Depth = 565' (172.72 m)

Bottom of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 565.0' (172.2 m)

Top of Bentonite Seal = 576.8' (175.8 m)

Packer Depth = 570'-575' (174.24-175.76 m)

MP Depth = 575' (175.76 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Centralizers not listed

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

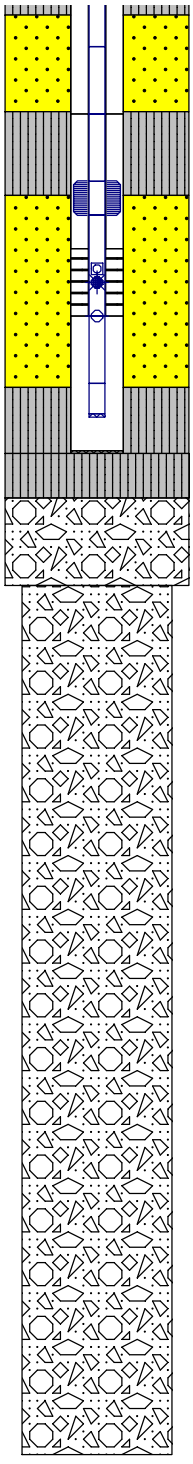
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810

180 185 190 195 200 205 210 215 220 225 230 235 240 245



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 615'-620' (187.86-189.38 m)

Top of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 625.0' (190.5 m)

Magnetic Collar Depth = 629.6' (192.31 m)

Sampling MP Depth (with Filter Sock) = 630' (192.43 m)

Bottom of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 635.0' (193.5 m)

PP Depth = 635' (193.95 m)

Westbay® MP 38 Casing TD = 650' (198.1 m)

Conventional 4" Stainless Steel Well TD = 655.4' (199.8 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of 8/20 Sand = 590.3' (179.9 m)

Top of Bentonite Seal = 604.7' (184.3 m)

Top of 8/20 Sand = 617.1' (188.1 m)

Top of Bentonite Seal = 645.6' (196.8 m)

Top of Slough = 662' (201.8 m)

13" Borehole TD = 675' (205.7 m)

9 7/8" Borehole TD = 804' (245.1 m)

Figure 3 PL-8 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

JSC - White Sands Test Facility, Las Cruces, New Mexico, USA

Location ID: **PL-8** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **NW 1/4 SE 1/4 SW 1/4 Sec. 5, T21S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **167197.62N 461407.25E**
Elevation (Brass Cap): **1363.00 m AMSL**
Elevation (Top of Casing): **1363.20 m AMSL**
Drilling Contractor: **Stewart Brothers Drilling Company**
Driller: **J. Aguilar**
Total Depth of Borehole (bgs): **1,020' (310.9 m)**
Borehole Diameter: **12 1/4" 0-1,020'; reamed 17 1/2" 0-122'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **404.51' (123.29 m) TOC (9/21/99)**
Total Depth Surface Casing (bgs): **122' (37.2 m)**
Diameter and Type Surface Casing: **13.5" ID, 14" OD Steel**
Date(s) Well Installed: **CW = 4/8/99-4/12/99; WB = 9/21/99-9/29/99**
Date(s) Well Developed: **CW = 6/3/99 - 9/8/99; WB = Not Recorded**

Field Representative(s): **M. Canavan, G. Giles, M. McClure, (see comments)**
Total Depth Well Casing(s) (bgs): **CW = 1,000' (304.8 m); WB = 990' (301.8 m)**
Type of Casing(s): **CW = 304 Stainless Steel; WB = MP 38 PVC**
Diameter Well Casing(s): **CW = 4" ID/4.5" OD; WB = 1.5" ID/1.9" OD**
Casing Schedule: **10 (CW) (CW = Conventional Well WB = Westbay®)**
CW Screened Zone(s) (bgs): **448.2-458.2' (136.6-139.7 m); 598.5-608.6' (182.4-185.5 m); 774.0-784.0' (235.9-239.0 m); and 959.5-969.6' (292.5-295.5 m)**
WB Sampling Zone(s) (bgs): **455' (138.68 m); 605' (184.4 m); 780' (237.74 m); and 965' (294.13 m)**
WB Packer Zone(s) (bgs): **445-465' (136.46-142.58 m); 595-615' (181.36-187.45 m); 770-790' (234.70-240.79 m); and 955-975' (291.08-297.18 m)**
Comments: **Field Reps, cont'd.: L. Hunnicutt-Mack, M. Rivera, J. Pearson**

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID 304 Stainless Steel**
- Conventional Screen — **4" ID 304 Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID 304 Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Packer
- Mechanical Pumping Port (PP)
- Magnetic Collar

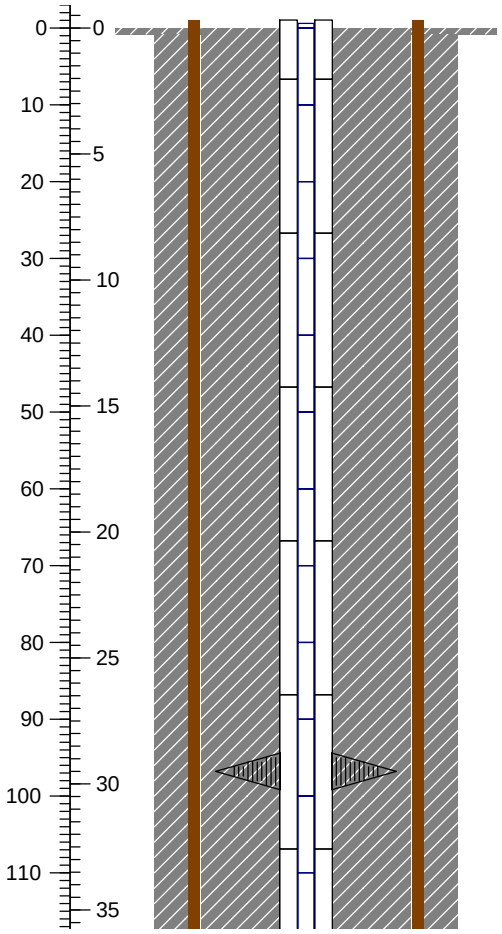
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Westbay® Well Stick-Up = ~0.65' (0.197 m)
Conventional Well Stick-Up = ~1.04' (~0.3 m). Original stick-up measured at installation was 3.38'. Casing cut to present level 8/99.

Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)
Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

Three steel centralizers welded to casing at ~96.8' (~29.5 m)

Top of Cement Grout (Portland II Cement with 5% Bentonite) = 0'

Surface Casing
14" OD Steel
Conventional Casing
4" ID 304 Stainless Steel
Conventional Screen
4" ID 304 Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID 304 Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

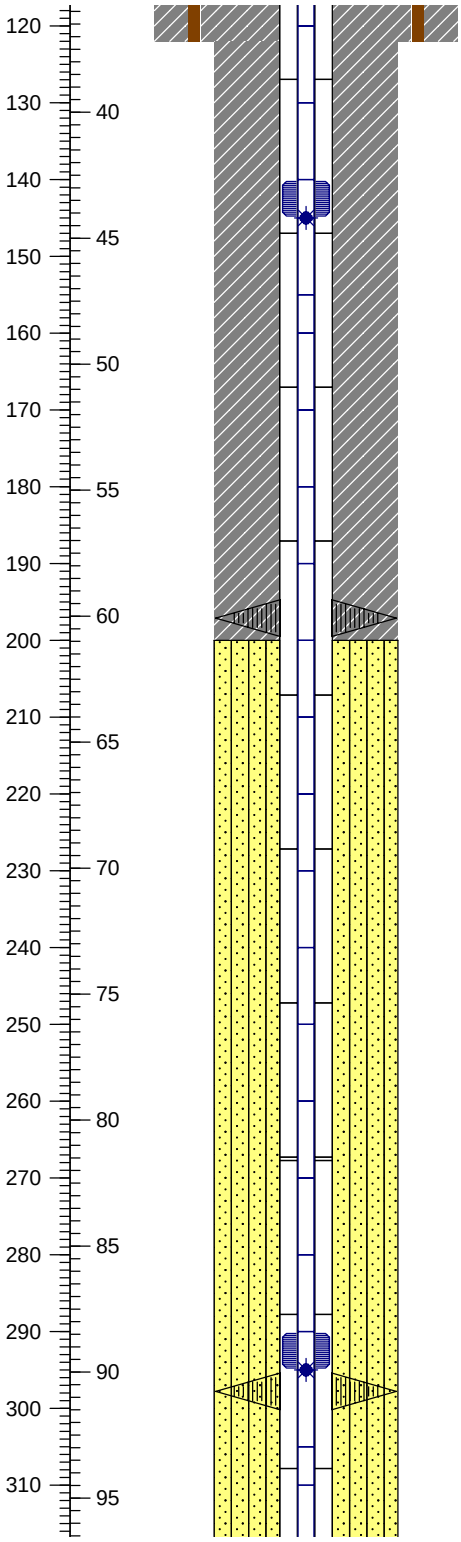
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



14" OD Steel Surface Casing Depth = 122' (37.2 m)

17 1/2" Borehole Cemented to 122' (37.2 m)

Stabilizing Packer Depth = 140'-145' (42.67-44.19 m)

MP Depth (with Filter Sock) = 145' (44.19 m)

Three steel centralizers welded to casing at ~197.1' (~60.1 m)

Top of 10/20 Sand/Bentonite Mix = 200' (61.0 m)(Exact Depth of Sand/Bentonite Mix Not Recorded)

Crossover Adapter from Schedule 40 Threads to Schedule 80 Threads on the 4" ID Schedule 10, 304 Stainless Steel Conventional Casing = 267.3' (81.5 m)

Stabilizing Packer Depth = 290'-295' (88.39-89.91 m)

MP Depth (with Filter Sock) = 295' (89.91 m)

Three steel centralizers welded to casing at ~297.8' (~90.8 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID 304 Stainless Steel
Conventional Screen
4" ID 304 Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID 304 Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

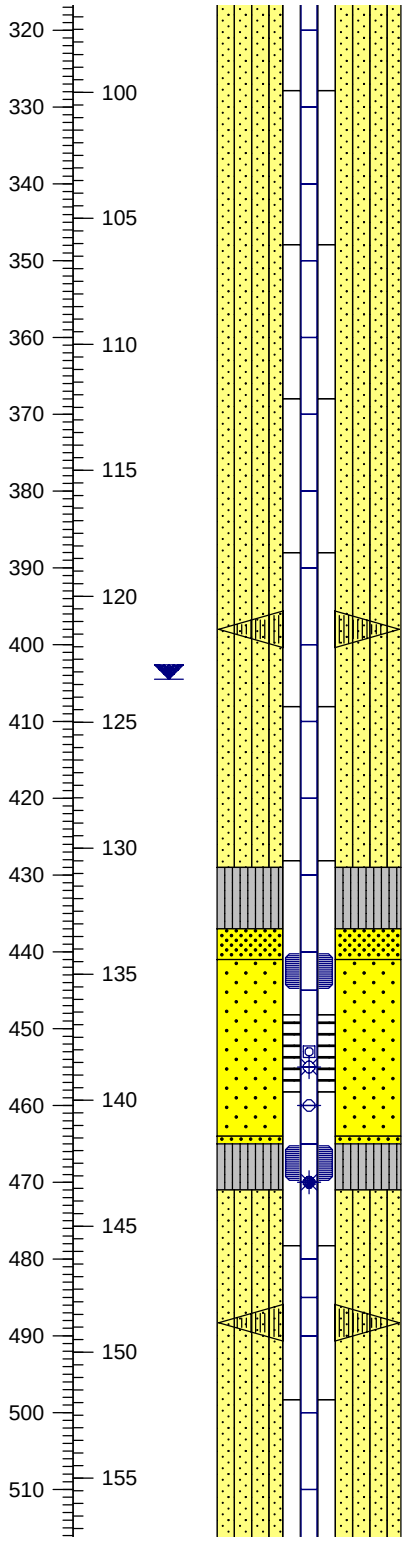
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Three steel centralizers welded to casing at ~398.0' (~121.3 m)

Water Table = 404.51' (123.29 m; measured 9/21/99 just before Westbay® well casing installation; TOC)

Packer Depth = 440'-445' (134.94-136.46 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 448.2' (136.6 m; Rated at 400'-600' Depth)

Magnetic Collar Depth = ~454' (~139.21 m)(Exact Location Not Recorded)

Sampling MP Depth = 455' (139.51 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 458.2' (139.7 m; Rated at 400'-600' Depth)

PP Depth = 460' (141.03 m)

Packer Depth = 465'-470' (142.58-144.10 m)

MP Depth (with Filter Sock) = 470' (144.10 m)

Three steel centralizers welded to casing at ~488.3' (~148.8 m)

Top of Upper Bentonite Seal = 429' (130.8 m)

Top of Upper 30/70 Sand = 437' (133.2 m)

Top of 10/20 Sand = 441' (134.4 m)

Top of Lower 30/70 Sand = 464' (141.4 m)

Top of Lower Bentonite Seal = 465' (141.7 m)

Top of 10/20 Sand/Bentonite Mix = 471' (143.6 m)

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID 304 Stainless Steel**
- Conventional Screen — **4" ID 304 Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID 304 Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

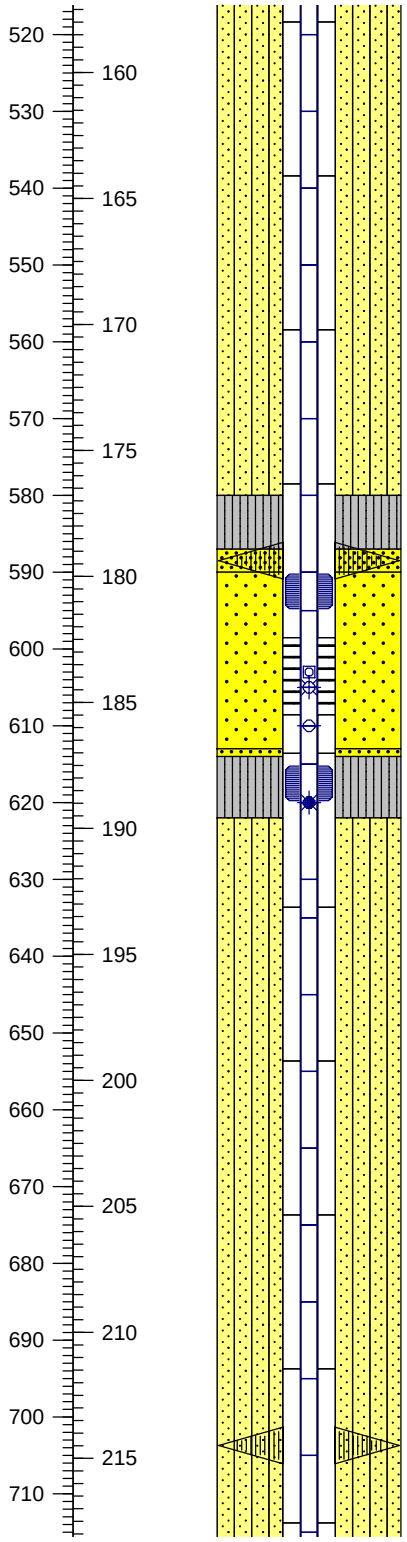
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Three steel centralizers welded to casing at ~588.5' (~179.4 m)

Packer Depth = 590'-595' (180.90-182.42 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 598.5' (182.4 m; Rated at 600'-1,000' Depth)

Magnetic Collar Depth = ~604' (~185.17 m)(Exact Location Not Recorded)

Sampling MP Depth = 605' (185.47 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 608.6' (185.5 m; Rated at 600'-1,000' Depth)

PP Depth = 610' (186.99 m)

Packer Depth = 615'-620' (188.54-190.06 m)

MP Depth (with Filter Sock) = 620' (190.06 m)

Three steel centralizers welded to casing at ~703.7' (~214.5 m)

Top of Upper Bentonite Seal = 580' (176.8 m)

Top of Upper 30/70 Sand = 587' (178.9 m)

Top of 10/20 Sand = 590' (179.8 m)

Top of Lower 30/70 Sand = 613' (186.8 m)

Top of Lower Bentonite Seal = 614' (187.1 m)

Top of 10/20 Sand/Bentonite Mix = 622' (189.6 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID 304 Stainless Steel
Conventional Screen
4" ID 304 Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID 304 Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

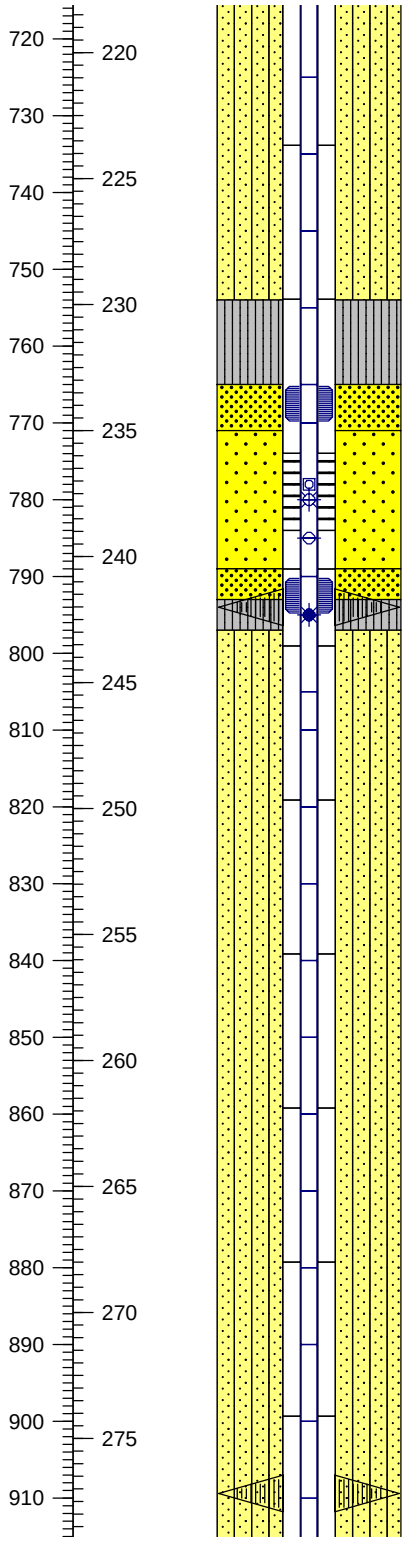
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Packer Depth = 765'-770' (234.45-235.97 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 774.0' (235.9 m; Rated at 600'-1,000' Depth)

Magnetic Collar Depth = ~779' (~238.72 m)(Exact Location Not Recorded)

Sampling MP Depth = 780' (239.02 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 784.0' (239.0 m; Rated at 600'-1,000' Depth)

PP Depth = 785' (240.54 m)

Packer Depth = 790'-795' (242.09-243.61 m)

Three steel centralizers welded to casing at ~794.0' (~242.0 m)

MP Depth (with Filter Sock) = 795' (243.61 m)

Three steel centralizers welded to casing at ~909.4' (~277.2 m)

Top of Upper Bentonite Seal = 754' (229.8 m)

Top of Upper 30/70 Sand = 765' (233.2 m)

Top of 10/20 Sand = 771' (235.0 m)

Top of Lower 30/70 Sand = 789' (240.5 m)

Top of Lower Bentonite Seal = 793' (241.7 m)

Top of 10/20 Sand/Bentonite Mix = 797' (242.9 m)

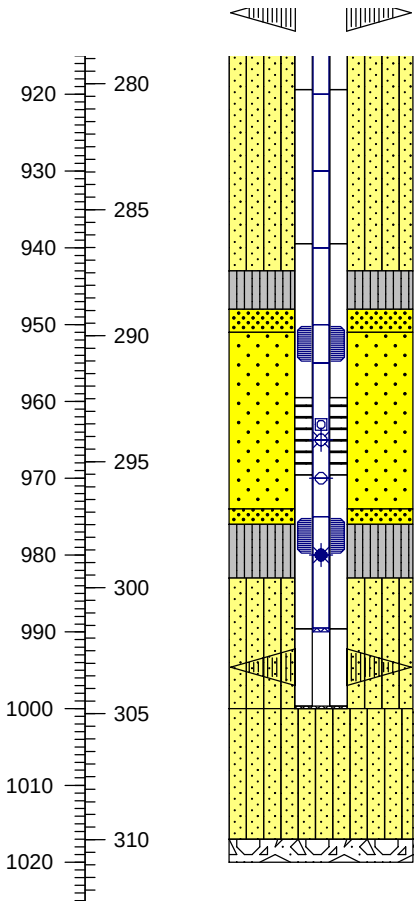
Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID 304 Stainless Steel**
- Conventional Screen — **4" ID 304 Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID 304 Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 950'-955' (290.97-292.49 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 959.5' (292.5 m; Rated at 600'-1,000' Depth)

Magnetic Collar Depth = ~964' (~295.24 m)(Exact Location Not Recorded)

Sampling MP Depth = 965' (295.54 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 969.6' (295.5 m; Rated at 600'-1,000' Depth)

PP Depth = 970' (297.06 m)

Packer Depth = 975'-980' (298.61-300.13 m)

MP Depth (with Filter Sock) = 980' (300.13 m)

Westbay® MP 38 Casing TD = 990' (301.8 m)

Three steel centralizers welded to casing at ~994.6' (~303.2 m)

Conventional 4" 304 Stainless Steel Well TD = 1,000' (304.8 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 943' (287.4 m)

Top of Upper 30/70 Sand = 948' (289.0 m)

Top of 10/20 Sand = 951' (289.9 m)

Top of Lower 30/70 Sand = 974' (296.9 m)

Top of Lower Bentonite Seal = 976' (297.5 m)

Top of 10/20 Sand/Bentonite Mix = 983' (299.6 m)

Top of Slough = 1,017' (310.0 m)

12 1/4" Borehole TD = 1,020' (310.9 m)

Figure 4 PL-10 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **PL-10** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SW 1/4 SE 1/4 Sec 5, T21S, R3E**
NM State Plane Coordinates (NAD 83 in meters) **166935.47N 461987.44E**
Elevation (Brass Cap): **1373.22 m AMSL**
Elevation (Top of Casing): **1373.65 m AMSL**
Drilling Contractor: **Stewart Brothers Drilling Company**
Driller: **G. Cardenas**
Total Depth of Borehole (bgs): **1,025' (312.4 m)**
Borehole Diameter: **12 1/4" 0-120' (reamed 17 1/2"); 12 1/4" 120'-1,025'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **439.82' (134.06 m) TOC (9/10/02)**
Total Depth Surface Casing (bgs): **112' (34.1 m)**
Diameter and Type Surface Casing: **13 1/2" ID; 14" OD Steel**
Date(s) Well Installed: **CW = 7/28/02 - 8/9/02; WB = 9/10/02 - 9/13/02**
Date(s) Well Developed: **CW = 8/10/02 - 9/9/02; WB = Not Recorded**

Field Representative(s): **M. Canavan, L. Hunnicutt-Mack, (see comments)**
Total Depth Well Casing(s) (bgs): **CW = 999.95'; WB = 990.65'**
Type of Casing(s): **CW = Stainless Steel; WB = PVC**
Diameter Well Casing(s): **CW = 5.30" ID/5.56" OD; WB = 2.25" ID; 2.9" OD**
Casing Schedule: **10 (CW) (CW = Conventional Well WB = Westbay® Well)**
CW Screened Zone(s) (bgs): **479.30-489.30' (146.09-149.14 m); 589.30-599.30' (179.62-182.67 m); 809.30-819.30 (246.67 m-249.72 m); 959.30-969.50' (292.39-295.50 m)**
WB Sampling Zone(s) (bgs): **483.57' (147.39 m); 591.78' (180.37 m); 813.19' (247.86 m); and 962.41' (293.34 m)**
WB Packer Zone(s) (bgs): **473.28-493.36' (144.33-150.69 m); 581.49-606.49' (177.56-185.21 m); 802.90-822.98' (245.04-251.21 m); and 952.12-975.48' (290.53-297.55 m)**
Comments: **Field Reps. cont'd: J. Pearson, M. Stepro, R. Weaver**

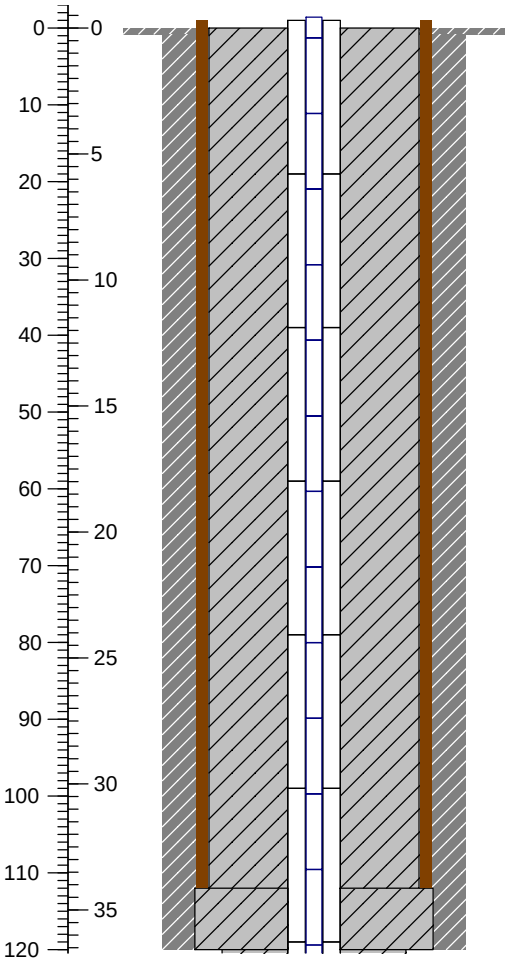
Casing Explanation:

- Surface Casing **14" OD Steel**
- Conventional Casing **5.30" ID SCH 10 Stainless Steel**
- Conventional Screen **5.30" ID SCH 10 Stainless Steel 0.020"-slot**
- Conventional End Cap **5.30" ID SCH 10 Stainless Steel**
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.41' (0.429 m)
Conventional Well Stick-Up = ~1' (~0.3 m) at installation. (Exact Stick-Up Not Measured or Surveyed)

Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)

Westbay® well casing is a combination of 300 and 600 Series casing. All pumping ports are 300 Series. All other casing is 600 Series.

Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

14" OD Steel Surface Casing Depth = 112' (34.1 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Bentonite Grout (Grout Well DF) = 0'

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **5.30" ID SCH 10 Stainless Steel**
- Conventional Screen — **5.30" ID SCH 10 Stainless Steel 0.020"-slot**
- Conventional End Cap — **5.30" ID SCH 10 Stainless Steel**
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

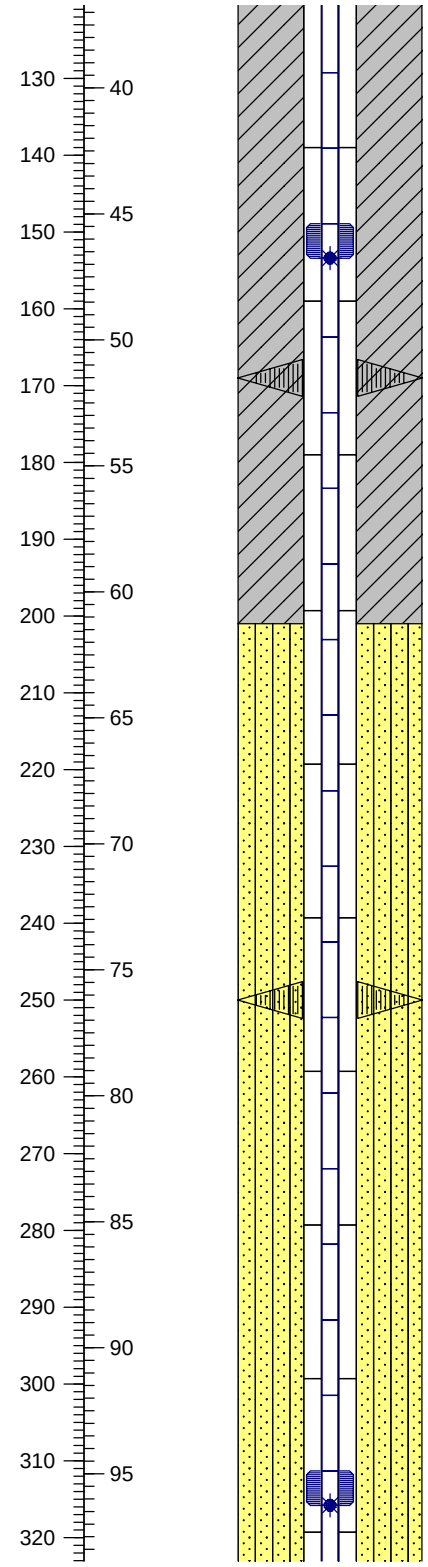
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Surface Casing Cemented to 120' (36.6 m)

Stabilizing Packer Depth = 148.93-153.40' (45.39-46.76 m)

MP Depth (with Filter Sock) = 153.40' (46.76 m)

Stainless steel bolted cage centralizer attached to casing at ~169.0' (~51.51 m)

Top of 10/20 Sand/Bentonite Mix = 201' (61.3 m)

Centralizer listed on well design, but not indicated on casing tally. Unknown if this centralizer is present.

Stabilizing Packer Depth = 311.33-315.80' (94.89-96.26 m)

MP Depth (with Filter Sock) = 315.80' (96.26 m)

Casing Explanation:

- Surface Casing
  14" OD Steel
  Conventional Casing
  5.30" ID SCH 10 Stainless Steel
- Conventional Screen
  5.30" ID SCH 10 Stainless Steel
  0.020"-slot
- Conventional End Cap
  5.30" ID SCH 10 Stainless Steel
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

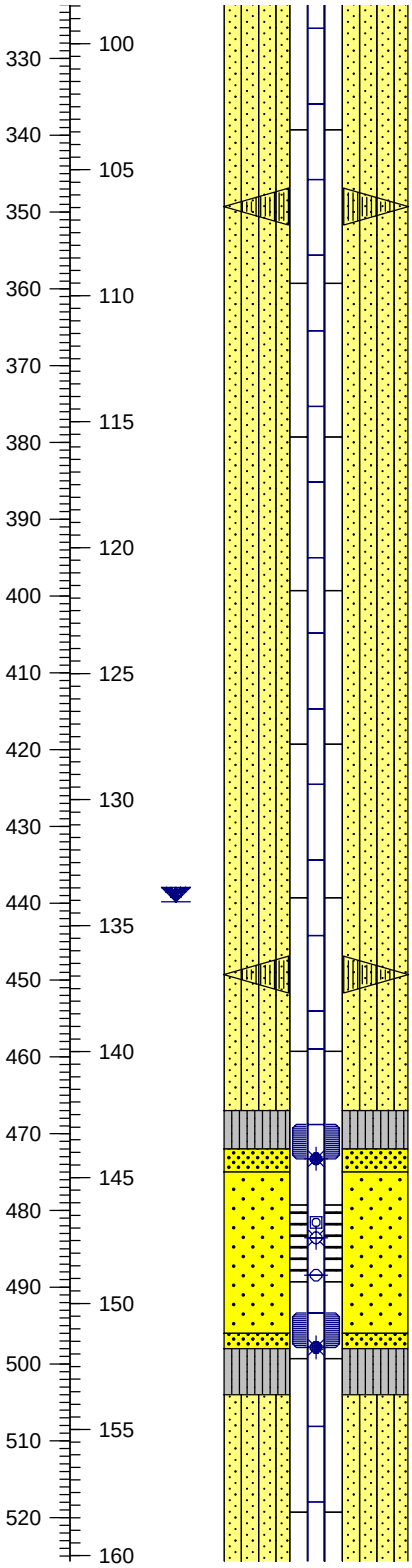
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Stainless steel bolted cage centralizer attached to casing at ~349.3' (~106.47 m)

Water Table = ~439.82' (134.06 m; measured 9/10/01 during Westbay® well casing installation; TOC)

Stainless steel bolted cage centralizer attached to casing at ~449.3' (~136.95 m)

Packer Depth = 468.81-473.28' (142.97-144.33 m)

MP Depth (with Filter Sock) = 473.28' (144.33 m)

Top of Conventional Screen = 479.30' (146.09 m)

Magnetic Collar Depth = ~481.57' (~147.07 m)(Exact Location Not Recorded)

Sampling MP Depth = 483.57' (147.68 m)

300 to 600 Series Westbay® well casing adapter below the pumping port

Bottom of Conventional Screen = 489.30' (149.14 m)

PP Depth = 488.45' (149.17 m)

Packer Depth = 493.36-497.83' (150.69-152.05 m)

MP Depth (with Filter Sock) = 497.83' (152.05 m)

Water Table = 439.82' (134.06 m; measured 9/10/02 just before Westbay casing installation)

Top of Upper Bentonite Seal = 467' (142.3 m)

Top of Upper 30/70 Sand = 472' (143.9 m)

Top of 10/20 Sand = 475' (144.8 m)

Top of Lower 30/70 Sand = 496' (151.2 m)

Top of Lower Bentonite Seal = 498' (151.8 m)

Top of 10/20 Sand/Bentonite Mix = 504' (153.6 m)

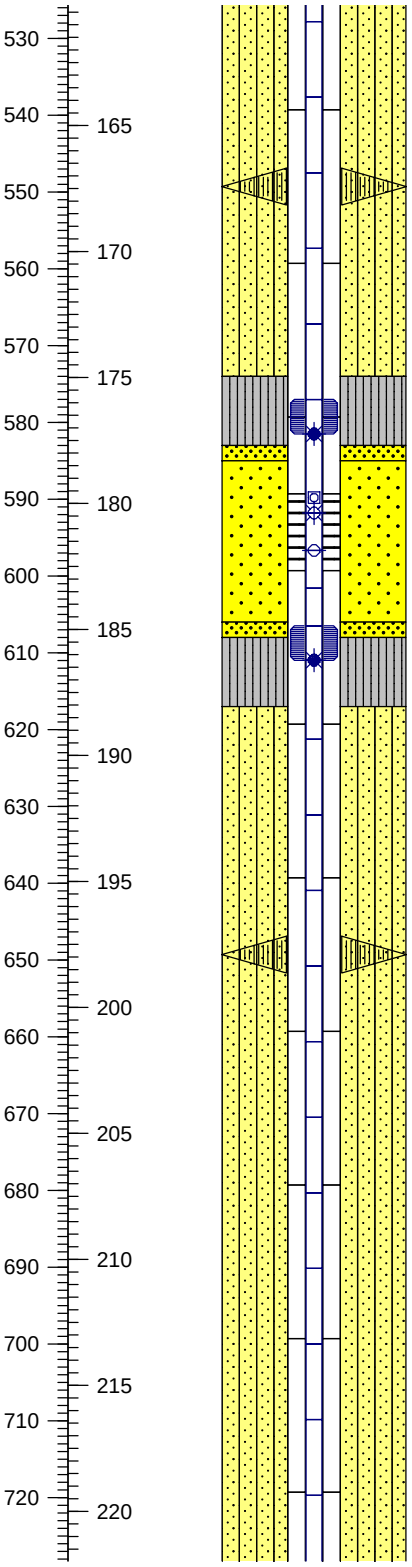
Casing Explanation:

- Surface Casing
  14" OD Steel
- Conventional Casing
  5.30" ID SCH 10 Stainless Steel
- Conventional Screen
  5.30" ID SCH 10 Stainless Steel
  0.020"-slot
- Conventional End Cap
  5.30" ID SCH 10 Stainless Steel
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Stainless steel bolted cage centralizer attached to casing at ~549.3' (~167.43 m)

Packer Depth = 577.02-581.49' (175.88-177.56 m)

MP Depth (with Filter Sock) = 581.49' (177.56 m)

Top of Conventional Screen = 589.30' (179.62 m)

Magnetic Collar Depth = ~589.78' (~180.09 m)(Exact Location Not Recorded)

Sampling MP Depth = 591.78' (180.70 m)

300 to 600 Series Westbay® well casing adapter below the pumping port

Bottom of Conventional Screen = 599.30' (182.67 m)

PP Depth = 596.66' (182.19 m)

Packer Depth = 606.49-610.96' (185.21-186.57 m)

MP Depth (with Filter Sock) = 610.96' (186.57 m)

Stainless steel bolted cage centralizer attached to casing at ~649.3' (~197.91 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 574' (175.0 m)

Top of Upper 30/70 Sand = ~583' (~177.7 m)(Exact location not measured)

Top of 10/20 Sand = 585' (178.3 m)

Top of Lower 30/70 Sand = ~606' (~184.7 m)(Exact location not measured)

Top of Lower Bentonite Seal = 608' (185.3 m)

Top of 10/20 Sand/Bentonite Mix = 617' (188.1 m)

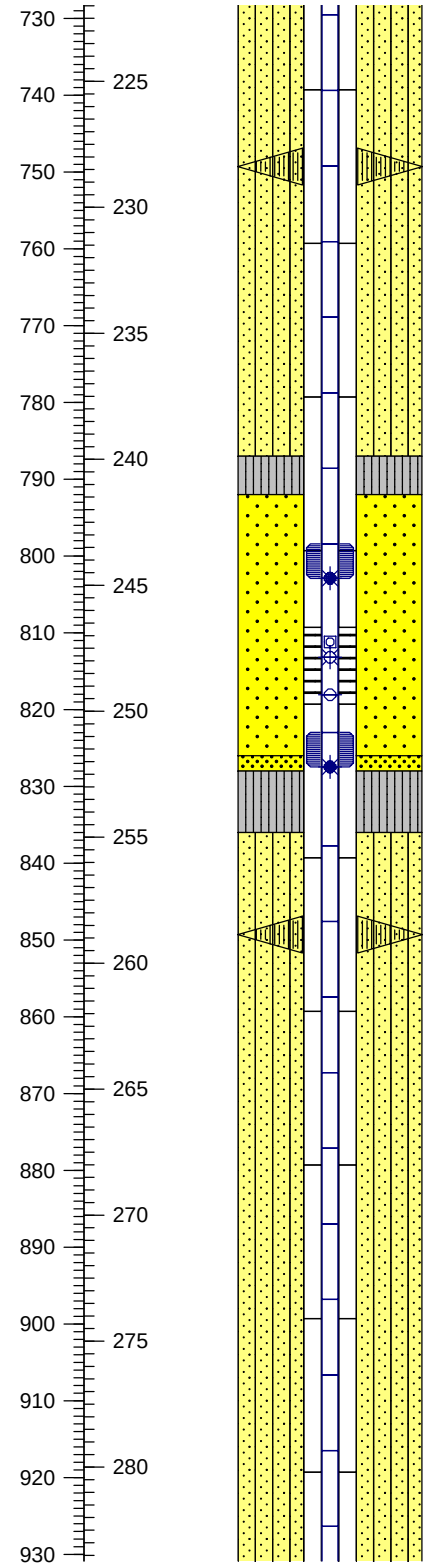
Casing Explanation:

- Surface Casing
  14" OD Steel
- Conventional Casing
  5.30" ID SCH 10 Stainless Steel
- Conventional Screen
  5.30" ID SCH 10 Stainless Steel
  0.020"-slot
- Conventional End Cap
  5.30" ID SCH 10 Stainless Steel
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Stainless steel bolted cage centralizer attached to casing at ~749.3' (~228.39 m)

Packer Depth = 798.43-802.90' (243.68-245.04 m)

MP Depth (with Filter Sock) = 802.90' (245.04 m)

Top of Conventional Screen = 809.30' (246.67 m)

Magnetic Collar Depth = ~811.19' (~247.63 m)(Exact Location Not Recorded)

Sampling MP Depth = 813.19' (248.24 m)

300 to 600 Series Westbay® well casing adapter below the pumping port

Bottom of Conventional Screen = 819.30' (249.72 m)

PP Depth = 818.06' (249.73 m)

Packer Depth = 822.98-827.45' (251.21-252.57 m)

MP Depth (with Filter Sock) = 827.45' (252.57 m)

Stainless steel bolted cage centralizer attached to casing at ~849.3' (~258.87 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 787' (239.9 m)

Top of 10/20 Sand = 792' (241.4 m)

Top of Lower 30/70 Sand = 826' (251.8 m)

Top of Lower Bentonite Seal = ~828' (~252.4 m)(Exact location not measured)

Top of 10/20 Sand/Bentonite Mix = 836' (254.8 m)

Surface Casing
14" OD Steel
Conventional Casing
5.30" ID SCH 10 Stainless Steel
Conventional Screen
5.30" ID SCH 10 Stainless Steel
0.020"-slot
Conventional End Cap
5.30" ID SCH 10 Stainless Steel
Bolted Steel Centralizers

Water Table

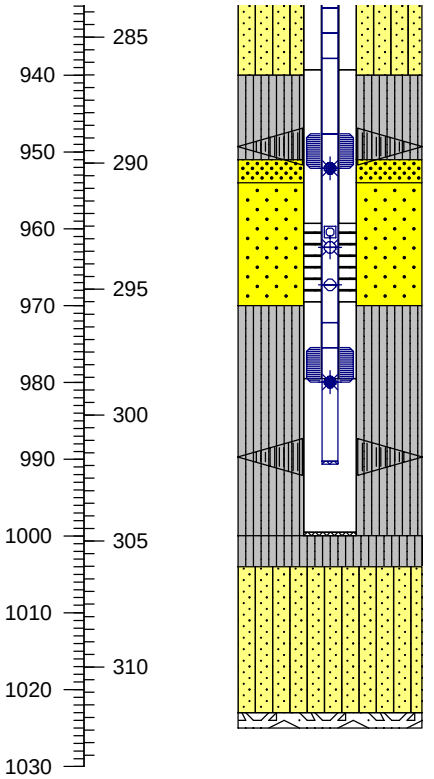
Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 947.65-952.12' (289.17-290.53 m)

MP Depth (with Filter Sock) = 952.12' (290.53 m)
Top of Conventional Screen = 959.30' (292.39 m)
Magnetic Collar Depth = ~960.41' (~292.97 m)(Exact Location Not Recorded)
Sampling MP Depth = 962.41' (293.58 m)
300 to 600 Series Westbay® well casing adapter below the pumping port
Bottom of Conventional Screen = 969.50' (295.50 m)
PP Depth = 967.29' (295.07 m)
Packer Depth = 975.48-979.95' (297.55-298.91 m)
MP Depth (with Filter Sock) = 979.95' (298.91 m)
Westbay® MP 55 Casing TD = 990.65' (301.95 m)

Stainless steel bolted cage centralizer attached to casing at ~989.7' (~301.66 m)

Conventional 5.30" ID 304L Stainless Steel Well TD = 999.95' (304.78 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 940' (286.5 m)

Top of Upper 30/70 Sand = ~951' (~289.9 m)(Exact location not measured)

Top of 10/20 Sand = ~954' (~290.8 m)(Exact location not measured)

Top of Lower Bentonite Seal = 970' (295.7 m)

Top of 10/20 Sand/Bentonite Mix = 1,004' (306.0 m)

Top of Slough = 1,023' (311.8 m) from Geophysics

12 1/4" Borehole Total Depth = 1,025' (312.4 m)

Figure 5 ST-5 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **ST-5**

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

Township and Range: **SW 1/4 SW 1/4 NW 1/4 Sec. 32, T20S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **169288.64N 461195.83E**
Elevation (Brass Cap): **1359.65 m AMSL**
Elevation (Top of Casing): **1360.13 m**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower, J. Clanton, D. Sanchez**
Total Depth of Borehole (bgs): **1,210' (368.81 m)**
Borehole Diameter: **12 1/4" 0-1,210'; reamed 16 1/2" 0-80'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **389.97' (118.86 m) TOC (6/24/93)**
Total Depth Surface Casing (bgs): **80' (24.4 m)**
Diameter and Type Surface Casing: **14" OD Steel**
Date(s) Well Installed: **CW = 4/22/93 - 4/27/93; WB = 6/24/93 - 6/29/93**
Date(s) Well Developed: **CW = 4/28/93 - 6/23/93; WB = Not Recorded**

Field Representative(s): **Canavan, Contaldo, Egan, Menzie, Summers**
Total Depth Well Casing(s) (bgs): **CW: 1,200.4' (365.88 m) WB: 1,195' (364.24 m)**
Type of Casing(s): **CW = Stainless Steel; WB = MP 38 PVC**
Diameter Well Casing(s): **CW = 4" ID/4.5" OD; WB = 1.5" ID, 1.9" OD**
Casing Schedule: **10 (CW) (CW = Conventional Well WB = Westbay® Well)**
CW Screened Zone(s) (bgs): **480.1-490' (146.3-149.4 m); 650-660.1' (198.1-201.2 m); 810-820' (246.9-249.9 m); 979.9-989.9' (298.7-301.7 m); 1,170.1-1,180.1' (356.6-359.7 m)**
WB Sampling Port(s) (bgs): **485' (148.56 m); 655' (200.35 m); 815' (249.07 m); 985' (300.76 m); 1,175' (358.45 m)**
WB Packer Zone(s) (bgs): **475-495' (145.52-151.62 m); 645-665' (197.30-203.43 m); 805-825' (246.02-252.10 m); 975-995'**
Comments: **WB depths (m) calculated from piez. depths at MP's.**

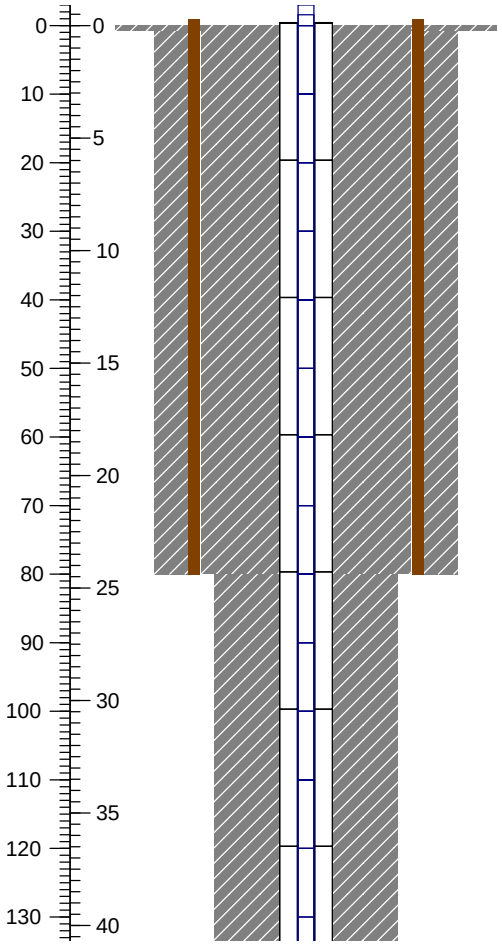
Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.6' (0.483 m)
Conventional Well Stick-Up = ~0.48' (~0.15 m). Original stick-up measured at installation was 2.38'. Casing cut to present level following installation.
Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)
Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

14" OD Steel Surface Casing Depth = 80' (24.38 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Cement Grout (Neat Cement with 5% Bentonite) = 0'

16 1/2" Borehole Cemented to 80' (24.4 m)

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

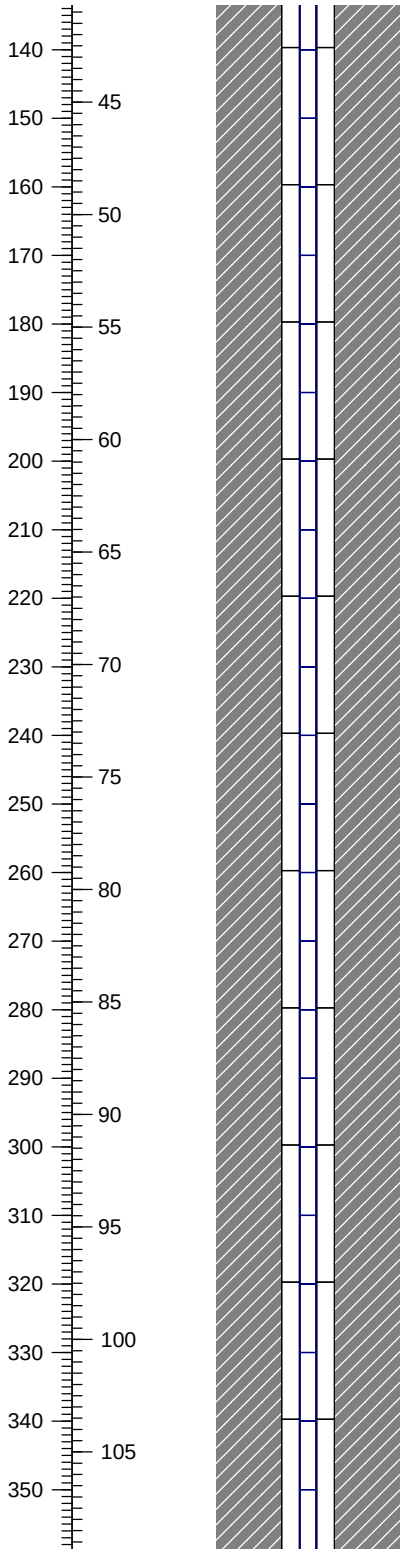
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

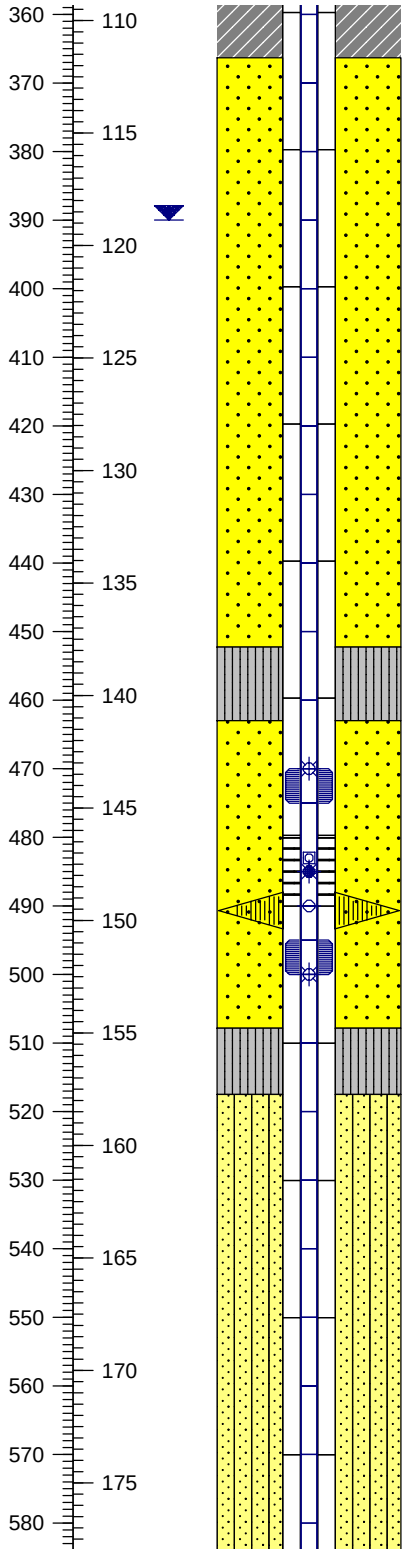
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Water Table = 389.97' (118.86 m) TOC measured 6/24/93 prior to Westbay® well casing installation.

MP Depth = 470' (144.00 m)
Packer Depth = 470'-475' (144.00-145.52 m)
Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 480.1' (146.3 m)
Crossover thread adapter on the 4" ID Schedule 10 Stainless Steel Conventional Casing = 479.7' (146.2 m)(for extra strength screens)

Magnetic Collar Depth = 484.6' (148.44 m)(0.4' above sampling MP)
Sampling MP Depth (with Filter Sock) = 485' (148.56 m)
PP Depth = 490' (150.08 m)
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 490.0' (149.4 m)
Three steel centralizers welded to casing at ~490.4' (~149.5 m) (0.4' below screen)
Packer Depth = 495'-500' (151.62-153.14 m)
MP Depth = 500' (153.14 m)

Top of 8/20 Sand = 366.3' (111.6 m)

Top of Upper Bentonite Seal = 452.3' (137.9 m)

Top of 8/20 Sand = 463' (141.1 m)

Top of Lower Bentonite Seal = 507.8' (154.8 m)

Top of 8/20 Sand/Bentonite Drilling Mud Mix = 517.5' (157.7 m)

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions All depths listed are bgs (unless noted)	Annular/Borehole Descriptions All depths listed are bgs
	Top of Upper Bentonite Seal = 620.2' (189.0 m)
	Top of 8/20 Sand = 631.8' (192.6 m)
Packer Depth = 640'-645' (195.78-197.30 m)	
Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 650.0' (198.1 m)	
Magnetic Collar Depth = 654.6' (200.23 m)(0.4' above sampling MP)	
Sampling MP Depth (with Filter Sock) = 655' (200.35 m)	
PP Depth = 660' (201.87 m)	
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 660.1' (201.2 m)	
Three steel centralizers welded to casing at ~660.5' (~201.3 m) (0.4' below screen)	
Packer Depth = 665'-670' (203.43-204.95 m)	Top of Lower Bentonite Seal = 674' (205.4 m)
MP Depth = 670' (204.95 m)	
	Top of 8/20 Sand/Bentonite Drilling Mud Mix = 688.5' (209.9 m)
	Top of Upper Bentonite Seal = 771.8' (235.2 m)
Packer Depth = 800'-805' (244.50-246.02 m)	Top of 8/20 Sand = 792.4' (241.5 m)
Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 810.0' (246.9 m)	

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

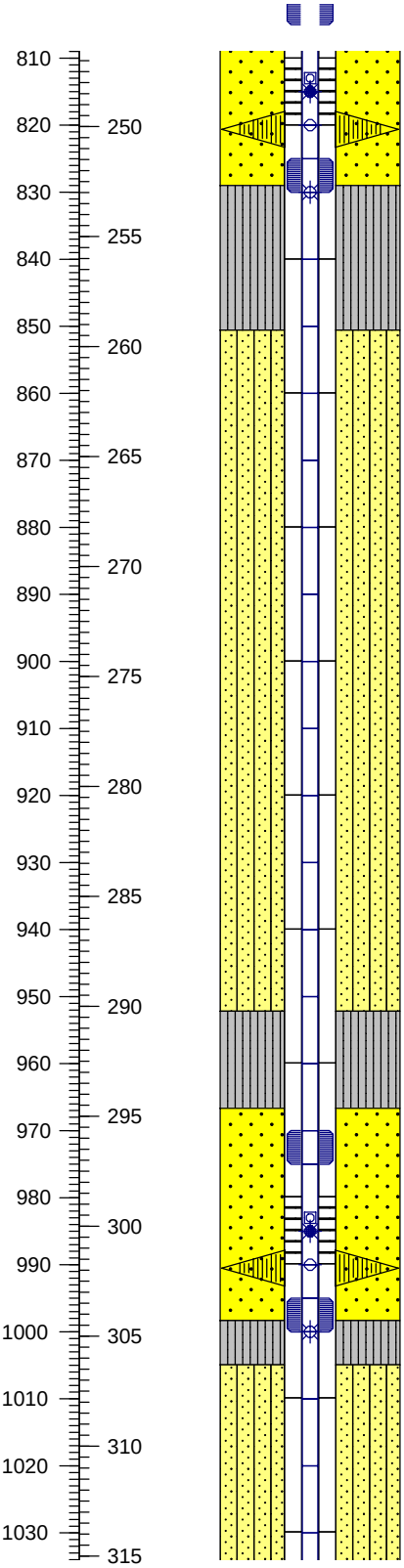
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Magnetic Collar Depth = 814.6' (248.95 m)(0.4' above sampling MP)
Sampling MP Depth (with Filter Sock) = 815' (249.07 m)
PP Depth = 820' (250.59 m)
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 820.0' (249.9 m)
Three steel centralizers welded to casing at ~820.4' (~250.0 m) (0.4' below screen)
Packer Depth = 825'-830' (252.10-253.62 m)
MP Depth = 830' (253.62 m)

Top of Lower Bentonite Seal = 829' (252.7 m)

Top of 8/20 Sand/Bentonite Drilling Mud Mix = 850.6' (259.3 m)

Top of Upper Bentonite Seal = 952.2' (290.2 m)

Packer Depth = 970'-975' (296.19-297.71 m)

Top of 8/20 Sand = 966.7' (294.7 m)

Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 979.9' (298.7 m)
Magnetic Collar Depth = 984.6' (300.64 m)(0.4' above sampling MP)
Sampling MP Depth (with Filter Sock) = 985' (300.76 m)
PP Depth = 990' (302.28 m)
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 989.9' (301.7 m)
Three steel centralizers welded to casing at ~990.3' (~301.8 m) (0.4' below screen)
Packer Depth = 995'-1,000' (303.78-305.30 m)
MP Depth = 1,000' (305.30 m)

Top of Lower Bentonite Seal = 998.3' (304.3 m)
Top of 8/20 Sand/Bentonite Drilling Mud Mix = 1,104.9' (306.3 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

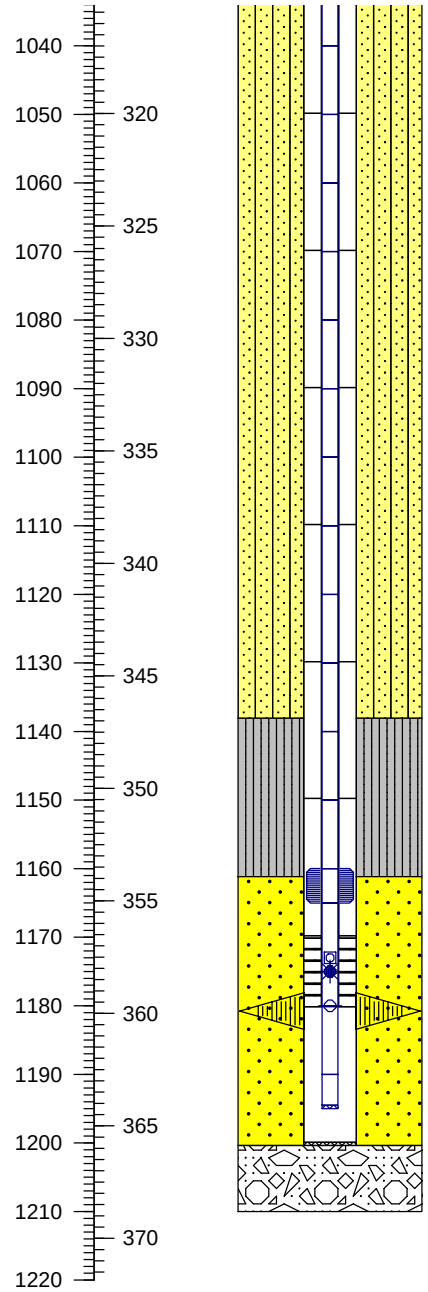
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Packer Depth = 1,160'-1,165' (353.88-355.40 m)

Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 1,170.1' (356.6 m)

Magnetic Collar Depth = 1,174.6' (358.33 m)(0.4' above sampling MP)

Sampling MP Depth (with Filter Sock) = 1,175' (358.45 m)

PP Depth = 1,180' (359.97 m)

Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 1,180.1' (359.7 m)

Three steel centralizers welded to casing at ~1,180.5' (~359.8 m) (0.4' below screen)

Westbay® MP 38 Casing TD = 1,195' (364.2 m)

Conventional 4" ID Stainless Steel Well TD = 1,200.4' (365.88 m)

Top of Upper Bentonite Seal = 1,138.1' (346.9 m)

Top of 8/20 Sand = 1,161.2' (353.9 m)

Top of Slough = 1,200' (365.8 m) 4/22/93 (just prior to conventional casing installation)

12 1/4" Borehole TD = 1,210' (368.81 m)

Figure 6 WW-3 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **WW-3** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **NE 1/4 SE 1/4 SE 1/4 Sec. 31, T20S, R3E**
NM State Plane Coordinates (NAD 83 in meters) **168705.18N 460826.37E**
Elevation (Brass Cap): **1354.97 m AMSL**
Elevation (Top of Casing): **1355.55 m AMSL**
Drilling Contractor: **Stewart Brothers Drilling Company**
Driller: **D. Gaddy**
Total Depth of Borehole (bgs): **1,025' (312.42 m)**
Borehole Diameter: **17 1/2" (0 - 115'); 12 1/4" (115 - 1,025')**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **~386' (~117.65 m) (4/29/01)**
Total Depth Surface Casing (bgs): **112' (34.14 m)**
Diameter and Type Surface Casing: **13 1/2" ID; 14" OD Carbon Steel**
Date(s) Well Installed: **CW = 3/1/01-3/8/01; WB = 4/27/01-4/29/01**
Date(s) Well Developed: **CW = 4/2/01 - 4/26/01; WB = Not Recorded**

Field Representative(s): **M. Canavan, G. Giles, J. Pearson, (see comments)**
Total Depth Well Casing(s) (bgs): **CW=1,014.08'; WB=1,002.78'**
Type of Casing(s): **PVC Conventional Well (CW) and Westbay® Well (WB)**
Diameter Well Casing(s): **4.75" ID / 5.5" OD (CW); 2.25" ID/ 2.9" OD (WB)**
Casing Schedule: **CW = 80 WB = MP55**
CW Screened Zone(s) (bgs): **463.8-473.8' (141.37-144.40 m); 564.7-574.7' (172.12-175.15 m); 706.0-716.0' (215.17-218.22 m); and 973.4-983.4' (296.70-299.75 m)**
WB Sampling Zone(s) (bgs): **468.78' (142.88 m); 568.84' (173.38 m); 709.91' (216.38 m); 977.28' (297.87 m)**
WB Packer Zone(s) (bgs): **458.93-478.62' (139.88-145.88 m); 560.64-578.68' (170.88-176.68 m); 704.99-719.75' (214.88-219.38 m); 964.16-987.12' (293.88-300.87 m)**
Comments: **Field Reps. cont'd: L. Hunnicutt-Mack, M. Stepro, R. Weaver**

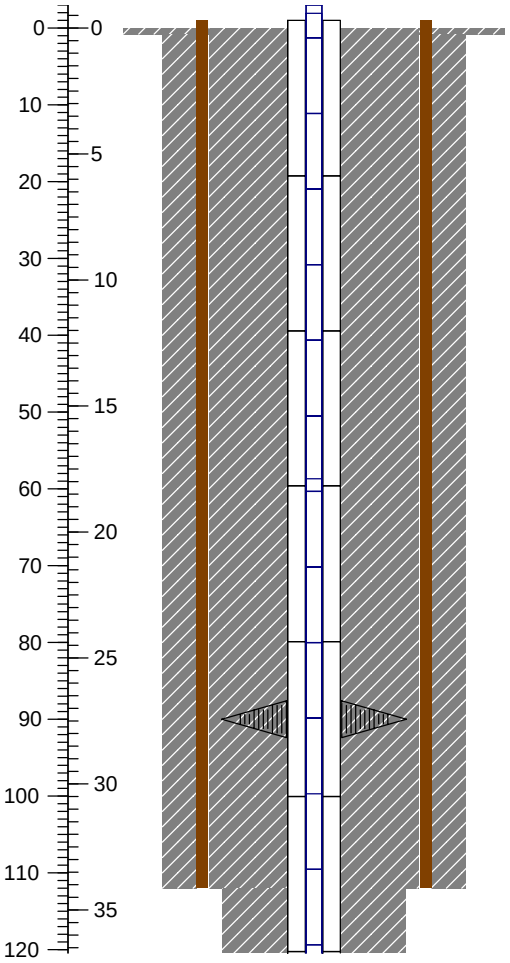
Casing Explanation:

- Surface Casing **14" OD Steel**
- Conventional Casing **4.75" ID Schedule 80 PVC**
- Conventional Screen **4.75" ID Schedule 80 PVC 0.020"-slot**
- Conventional End Cap **4.75" ID Schedule 80 PVC**
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.92' (0.584 m)
Conventional Well Stick-Up = ~1.0' (~0.3 m)(Exact Stick-Up Not Surveyed)

Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)

Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

Stainless steel bolted cage centralizer attached to casing at ~90.0' (~27.4 m)

14" OD Steel Surface Casing Depth = 112' (34.14 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Cement Grout (Portland II Cement with 5% Bentonite) = 0'

Comments continued: bgs = below ground surface; TOC = Top of Casing; Casing Depths = CW = 1,014.1' (309.09 m); WB = 1,002.78' (305.65 m); Depths (meters) for WB components and zones are based on field notes.

Geologic Formation = Santa Fe Group Alluvium 0 - 600' (0 - 182.88 m)

17 1/2" Borehole Cemented to 115' (35.05 m)

Surface Casing
14" OD Steel
Conventional Casing
4.75" ID Schedule 80 PVC
Conventional Screen
4.75" ID Schedule 80 PVC
0.020"-slot
Conventional End Cap
4.75" ID Schedule 80 PVC
Bolted Steel Centralizers

Water Table

Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

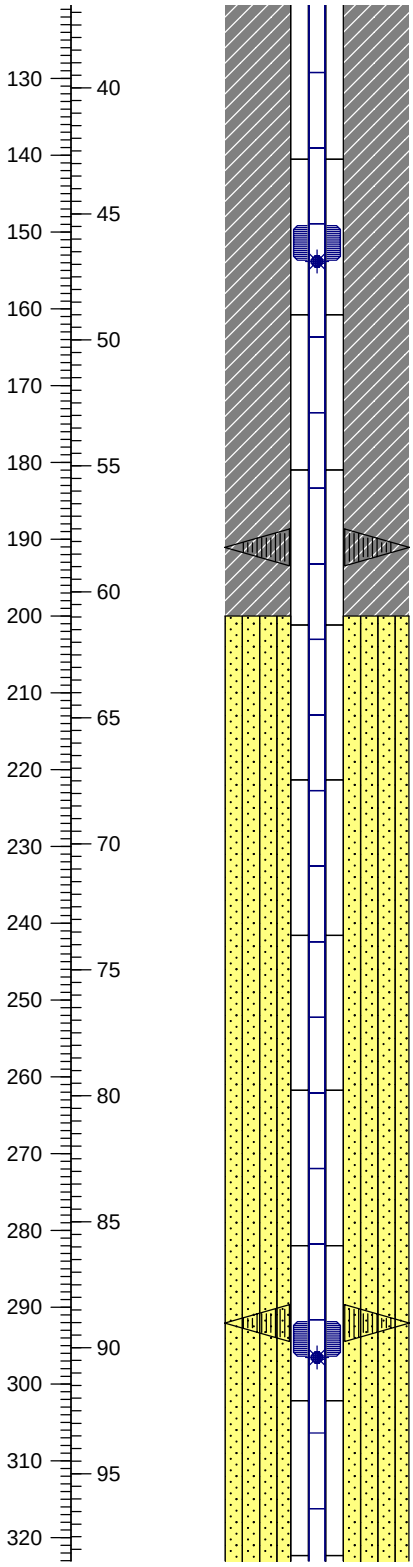
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Stabilizing Packer Depth = 148.91-153.83' (45.39-46.89 m)

MP Depth (with Filter Sock) = 153.83' (46.89 m)

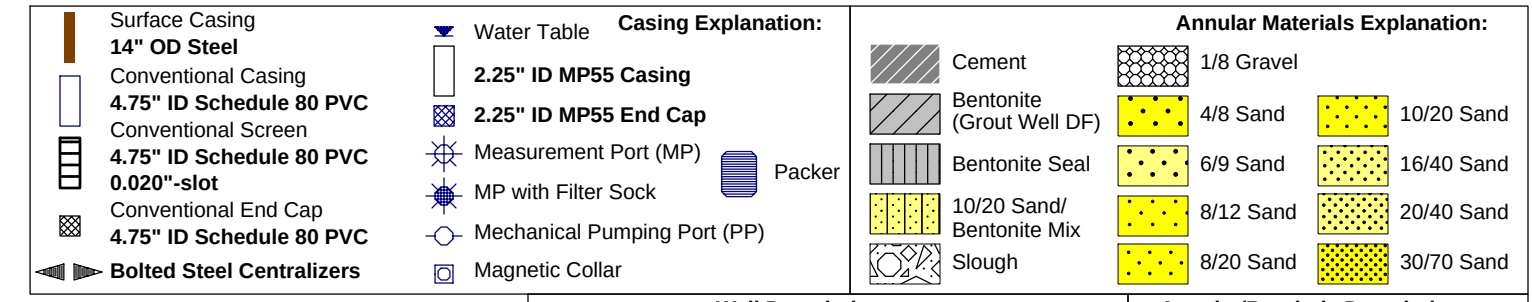
Stainless steel bolted cage centralizer attached to casing at ~191.1' (~58.2 m)

Top of 10/20 Sand/Bentonite Mix = 200' (60.96 m)

Stainless steel bolted cage centralizer attached to casing at ~292.1' (~89.0 m)

Stabilizing Packer Depth = 291.62-296.54' (88.89-90.39 m)

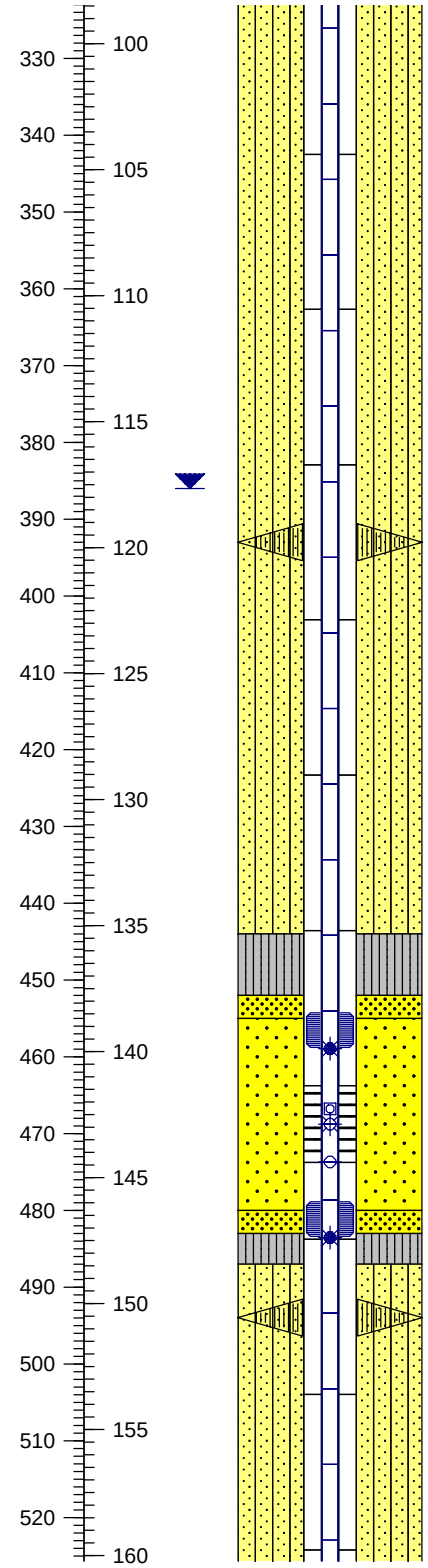
MP Depth (with Filter Sock) = 296.54' (90.39 m)



Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Water Table = ~386' (117.7 m; measured 4/29/01 during Westbay® well casing installation; TOC)

Stainless steel bolted cage centralizer attached to casing at ~393.0' (~119.8 m)

Packer Depth = 454.01 - 458.93' (138.38 - 139.88 m)

MP Depth (with Filter Sock) = 458.93' (139.38 m)

Magnetic Collar Depth = ~466.78' (~142.27 m)(Exact Location Not Recorded)

Top of Conventional Screen = 463.8' (141.37 m)

Sampling MP Depth = 468.78' (142.27 m)

PP Depth = 473.70' (144.38 m)

Bottom of Conventional Screen = 473.8' (144.41 m)

Packer Depth = 478.62 - 483.54' (145.88 -147.38 m)

MP Depth (with Filter Sock) = 483.54' (147.38 m)

Stainless steel bolted cage centralizer attached to casing at ~494.0' (~150.6 m)

Top of Upper Bentonite Seal = 444' (135.33 m)

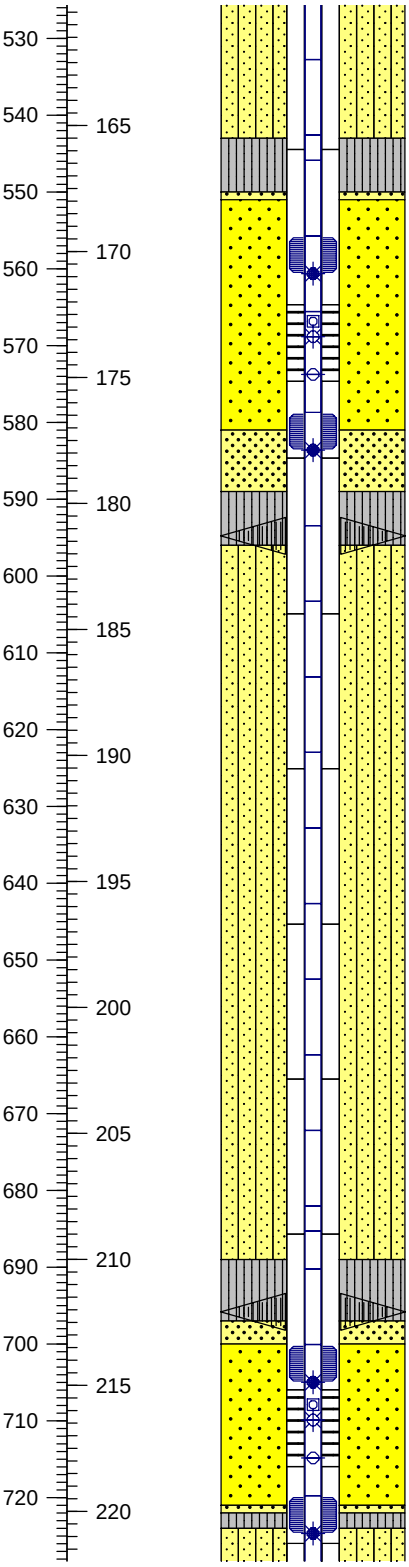
Top of Upper 30/70 Sand = 452' (137.77 m)

Top of 10/20 Sand = 455' (138.68 m)

Top of Lower 30/70 Sand = 480' (146.30 m)

Top of Lower Bentonite Seal = 483' (147.22 m)

Top of 10/20 Sand/Bentonite Mix = 487' (148.44 m)



Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs

530 / 165
540 / 170
550 / 175
560 / 180
570 / 185
580 / 190
590 / 195
600 / 200
610 / 205
620 / 210
630 / 215
640 / 220
650
660
670
680
690
700
710
720

Packer Depth = 555.71 - 560.64' (169.38 - 170.88 m)

MP Depth (with Filter Sock) = 560.64' (170.88 m)

Magnetic Collar Depth = ~566.84' (~172.77 m)(Exact Location Not Recorded)

Top of Conventional Screen = 564.7' (172.12 m)

Sampling MP Depth = 568.84' (173.38 m)

PP Depth = 573.76' (174.88 m)

Bottom of Conventional Screen = 574.7' (175.17 m)

Packer Depth = 578.68 - 583.60' (176.38 - 177.88 m)

MP Depth (with Filter Sock) = 583.60' (177.88 m)

Stainless steel bolted cage centralizer attached to casing at ~594.8' (~181.3 m)

Stainless steel bolted cage centralizer attached to casing at ~695.8' (~212.1 m)

Packer Depth = 700.06 - 704.99' (213.38 - 214.88 m)

MP Depth (with Filter Sock) = 704.99' (214.88 m)

Magnetic Collar Depth = ~707.91' (~215.77 m)(Exact Location Not Recorded)

Top of Conventional Screen = 706.0' (215.19 m)

Sampling MP Depth = 709.91' (216.38 m)

PP Depth = 714.83' (217.88 m)

Bottom of Conventional Screen = 716.0' (218.24 m)

Packer Depth = 719.75 - 724.67' (219.38 - 220.88 m)

Top of Upper Bentonite Seal = 543' (165.51 m)

Top of Upper 20/40 Sand = 550' (167.64 m)

Top of 10/20 Sand = 551' (167.94 m)

Top of Lower 20/40 Sand = 581' (177.09 m)

Top of Lower Bentonite Seal = 589' (179.53 m)

Top of 10/20 Sand/Bentonite Mix = 596' (181.66 m)

Geologic Formation = Volcanic-Rich Santa Fe Group Alluvium 600 - 1,025' (182.88 - 312.42 m)

Top of Upper Bentonite Seal = 689' (210.01 m)

Top of Upper 20/40 Sand = 697' (212.45 m)

Top of 10/20 Sand = 700' (213.36 m)

Top of Lower 20/40 Sand = 721' (219.76 m)

Top of Lower Bentonite Seal = 722' (220.07 m)

Surface Casing
14" OD Steel
Conventional Casing
4.75" ID Schedule 80 PVC
Conventional Screen
4.75" ID Schedule 80 PVC
0.020"-slot
Conventional End Cap
4.75" ID Schedule 80 PVC
Bolted Steel Centralizers

Water Table

Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

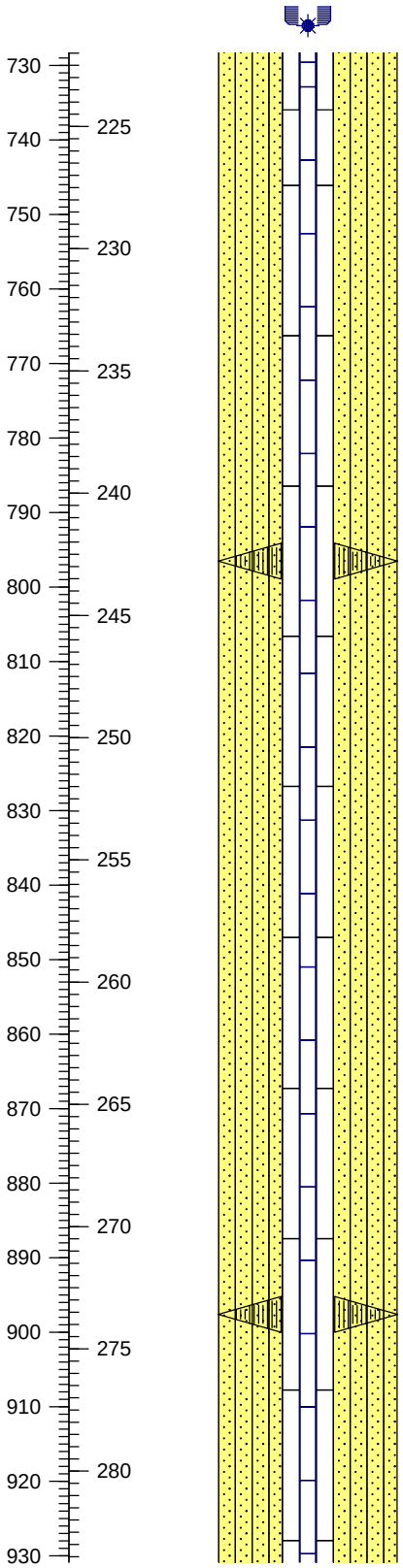
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



MP Depth (with Filter Sock) = 724.67' (220.88 m)

Stainless steel bolted cage centralizer attached to casing at ~796.5' (~242.8 m)

Stainless steel bolted cage centralizer attached to casing at ~897.6' (~273.6 m)

Top of 10/20 Sand/Bentonite Mix = 724' (220.68 m)

Surface Casing
14" OD Steel
Conventional Casing
4.75" ID Schedule 80 PVC
Conventional Screen
4.75" ID Schedule 80 PVC
0.020"-slot
Conventional End Cap
4.75" ID Schedule 80 PVC
Bolted Steel Centralizers

Water Table

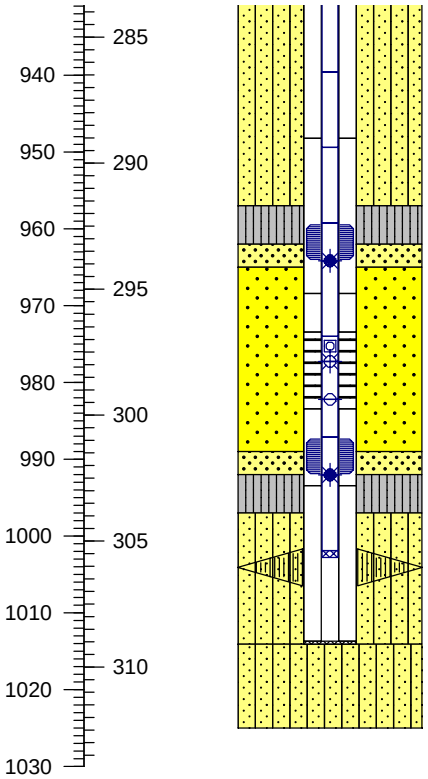
Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 959.24 - 964.16' (292.38 - 293.88 m)

MP Depth (with Filter Sock) = 964.16' (293.88 m)

Magnetic Collar Depth = ~975.28' (~297.27 m)(Exact Location Not Recorded)

Top of Conventional Screen = 973.4' (296.69 m)

Sampling MP Depth = 977.28' (297.87 m)

PP Depth = 982.20' (299.37 m)

Bottom of Conventional Screen = 983.4' (299.74 m)

Packer Depth = 987.12 - 992.04' (300.87 - 302.37 m)

MP Depth (with Filter Sock) = 992.04' (302.37 m)

Westbay® MP 55 Casing TD = 1,002.78' (305.65 m)

Stainless steel bolted cage centralizer attached to casing at ~1,004.08' (~306.0 m)

Conventional 4" 304 Stainless Steel Well TD = 1,014.1' (309.09 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = ~957' (~291.7 m)(Exact Location Not Measured)

Top of Upper 20/40 Sand = ~962' (~293.2 m)(Exact Location Not Measured)

Top of 10/20 Sand = 965' (294.13 m)

Top of Lower 20/40 Sand = ~989' (~301.4 m)(Exact Location Not Measured)

Top of Lower Bentonite Seal = ~992' (~302.4 m)(Exact Location Not Measured)

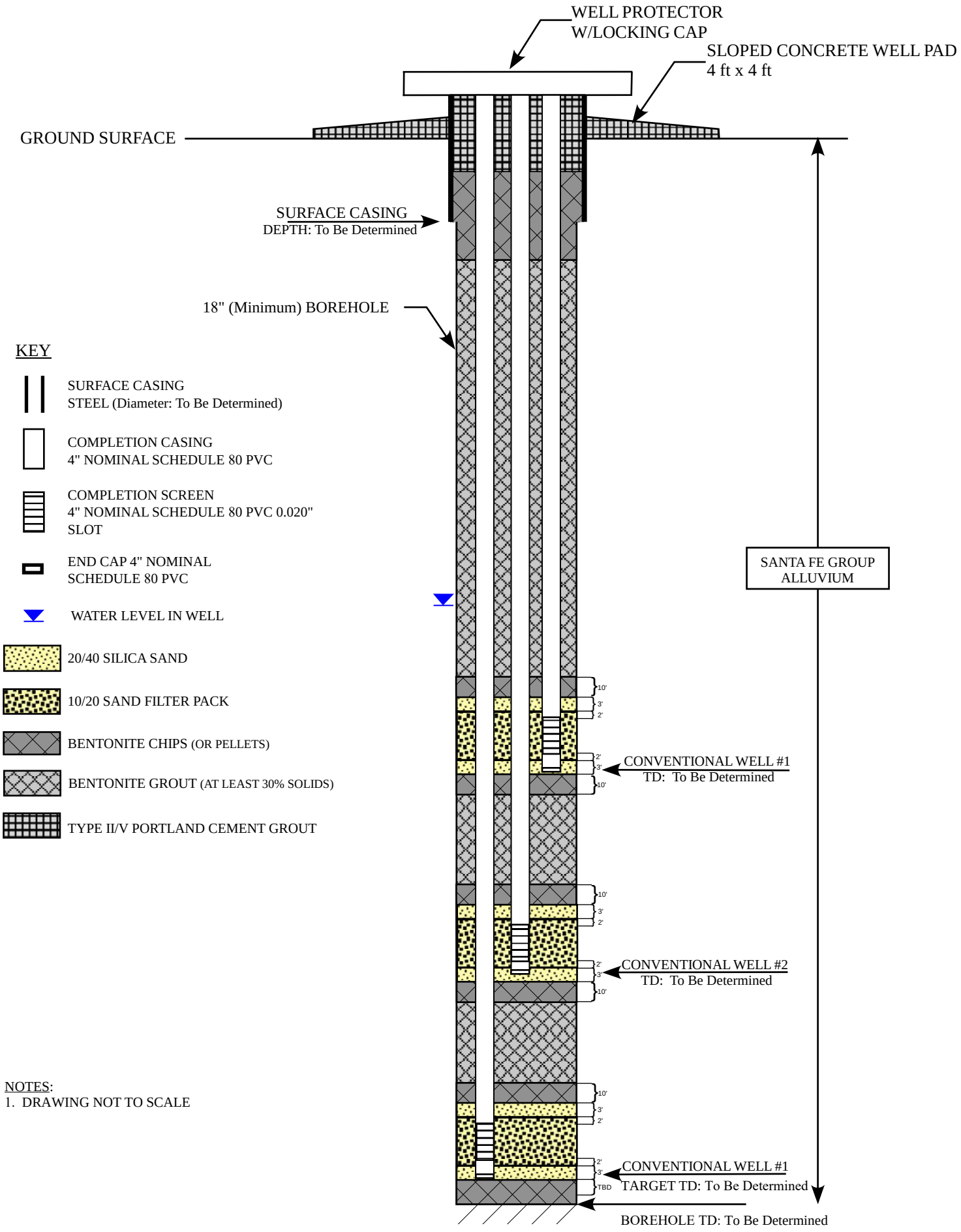
Top of 10/20 Sand/Bentonite Mix = 997' (303.89 m)

Slough not measured

12 1/4" Borehole TD = 1,025' (312.42 m)

Figure 7 Conventional Nested Well Design

(SEE NEXT PAGE)



NOTES:
1. DRAWING NOT TO SCALE

WELL DIAGRAM: CONVENTIONAL NESTED WELL EXAMPLE

Comments for Disapproval of the Reconfiguration Work Plans for Monitoring Wells PL-7, PL-8, PL-10, ST-5, and WW-3

NMED Comment Number	NMED Comments	NASA Revisions/Responses/Discussion
1. Basis for Well Conversion, Page 1	**Permittee Statement:** "NASA believes reconfiguring wells PL-7, PL-8, PL-10, ST-5, and WW-3 to use purgeable sampling systems will allow for the collection of analytical groundwater samples that are more representative of aquifer conditions. Therefore, NASA proposes to replace the Westbay systems in these wells with purgeable, multiport Water Flexible Liner Underground Technologies (FLUTe)®2 systems to improve the quality of samples collected for chemical analysis. Samples collected from the Water FLUTe system are expected to provide data that will better characterize the Plume Front area of the WSTF groundwater contaminant plume (Figure 1)." **NMED Comment:** Due to the apparent propensity for FLUTe system liner materials to leach residual concentrations of N-nitrosodimethylamine (NDMA) (WSTF primary contaminant of concern) and 1,4-dioxane (WSTF analyte of interest) as reported in the November 2021 *Abbreviated Investigation Work Plan for Groundwater Data Representativeness Phase 2: Water FLUTe Well Evaluation* (Work Plan) and further evidenced by data and information provided in the April 2023 *Groundwater Data Representativeness Phase 2: Water FLUTe Well Evaluation Abbreviated Investigation Report*, that could affect interpretation of groundwater data collected at groundwater monitoring wells equipped with FLUTe sampling systems, additional use of the groundwater sampling system at PL-7, PL-8, PL-10, ST-5, and WW-3 does not appear appropriate at this time. In lieu of any current alternative to Westbay and FLUTe sampling systems, nested groundwater monitoring wells equipped with bladder pumps may be the most viable long-term solution for the collection of representative groundwater sampling data at PL-7, PL-8, PL-10, ST-5, and WW-3, and potentially at other multi-zone groundwater monitoring	Concur. Based upon NMED's comment, the multiport Water FLUTe sampling system does not appear to be an appropriate replacement for the Westbay systems at this time. The Work Plan has been revised to propose the reconfiguration of wells PL-7, PL-8, PL-10, ST-5, and WW-3 to nested groundwater monitoring wells with sampling zones at least comparable to the current multi-zone monitoring wells to ensure consistency and reliability of groundwater data collection at these locations. NASA reserves the right to propose the use of another viable groundwater sampling system in the future that will allow for adequate purging and unbiased groundwater data collection from existing multi-zone groundwater monitoring wells.

NMED Comment Number	NMED Comments	NASA Revisions/Responses/Discussion
	wells in the Plume Front area. The Work Plan must be revised to propose reconfiguration of PL-7, PL-8, PL-10, ST-5, and WW-3 to nested groundwater monitoring wells with sampling zones at least comparable to the current multi-zone monitoring wells to ensure consistency and reliability of groundwater data collection within the Plume Front area at these locations. Nested groundwater monitoring wells may be completed as dual-sampling zone wells equipped with packers and bladder pump systems or as single sampling zone wells. Well reconfiguration may be proposed in phases to ensure continuity of groundwater data collection at the Plume Front area and well performance evaluation. Alternatively, the Permittee may propose the use of another viable groundwater sampling system that will allow for adequate purging and unbiased groundwater data collection from existing multi-zone groundwater monitoring wells. Revise the Work Plan accordingly.	

Well Reconfiguration Work Plan for Westbay Wells PL-7, PL-8, PL-10, ST-5, and WW-3

Purpose	On March 29, 2016, the New Mexico Environmental Department (NMED) approved the National Aeronautics and Space Administration (NASA) *White Sands Test Facility (WSTF) Periodic Monitoring Report Fourth Quarter 2015.* In the approval letter, NMED expressed concerns for periodic detections of N-nitrosodimethylamine (NDMA) at various sampling intervals in sentinel wells WW-3, PL-6, PL-7, PL-8, PL-10, and BLM-30 during 2015. NMED directed NASA to submit a work plan for the conversion of Westbay®[1] multiport sampling systems in wells WW-3, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, and BLM-30 to purgeable sampling systems no later than March 31, 2017. On March 30, 2017, NASA submitted a report titled *Detections of NDMA and TCE in WSTF Groundwater Monitoring Wells BLM-30, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, WW-3* (NASA, 2017a), which recommended additional evaluation of chemical analytical data before converting the Westbay sampling systems in these wells to purgeable systems. NMED approved the report with modifications (NMED, 2017) that included a requirement to complete the data representativeness evaluation and direction to replace monitoring wells PL-5 and PL-6 because of inadequate seals between monitoring zones in these wells. The NMED-approved data representativeness evaluation has been ongoing since 2017 and has required several requests for extensions of time for submittal of the required work plan for reconfiguration of Westbay wells. The latest, approved by NMED on January 25, 2021, extended the due date for submittal of the reconfiguration work plan to April 30, 2021. This work plan is submitted in accordance with the NMED directive. This work plan does not include wells BLM-30 and PL-5. The proposed reconfiguration or plugging and abandonment (P&A) of these wells had been previously addressed in separate work plans: • *Well Reconfiguration Work Plan for Well BLM-30* (NASA, 2017c, Enclosure 1) • *Work Plan for Abandonment of NASA WSTF Well PL-5 and Replacement with Monitoring Well PL-12* (NASA, 2017b). NASA will address the replacement of well PL-6 under separate cover.
Basis for Well Conversion	Irregular detections of NDMA at wells PL-6, PL-7, PL-8, PL-10, ST-5, and WW-3 prompted NASA to investigate the Westbay systems' ability to provide representative groundwater samples (NASA, 2017a). Detections of NDMA have occurred sporadically and inconsistently over time (NASA, 2017a). The results from the investigation confirmed the presence of anomalous NDMA and that samples from Westbay wells may not be representative of groundwater conditions (NASA, 2017a). NASA believes

[1] Westbay® is a registered trademark of Westbay® Instruments, a division of Nova Metrix, LLC.

	reconfiguring wells PL-7, PL-8, PL-10, ST-5, and WW-3 to use purgeable sampling systems will allow for the collection of analytical groundwater samples that are more representative of aquifer conditions. Therefore, NASA proposes to reconfigure or replace the current Westbay systems in these wells with purgeable systems to improve the quality of samples collected for chemical analysis. In lieu of any current alternative to the Westbay and FLUTe sampling systems, nested wells using PFAS-free bladder pumps for multi-zone wells or clustered wells will~~may~~ be the most viable long-term solution for the collection of representative groundwater sampling data at PL-7, PL-8, PL-10, ST-5, and WW-3, and potentially at other multi-zone groundwater monitoring wells in the Plume Front area. Samples collected from a purgeable system are expected to provide data that will better characterize the Plume Front area of the WSTF groundwater contaminant plume (Figure 1).
Well Background	**Wells PL-7, PL-8, and PL-10** Westbay multiport monitoring wells PL-7, PL-8, and PL-10 were installed to monitor the Plume Front and the effectiveness of the groundwater remediation system west of the WSTF groundwater contaminant plume (Figure 1). The well PL-7 borehole was drilled in 1992 within the saturated Quaternary to Tertiary Santa Fe Group Alluvium to a total depth of 804 feet (ft) below ground surface (bgs) and completed using nominal 4-inch diameter Schedule 10 stainless steel casing with three screened zones to a total depth of 655.4 ft bgs. The screen intervals are located at 475.0 to 485.0; 555.0 to 565.0; and 625.0 to 635.0 ft bgs. A 1.5-inch MP-38 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 480, 560, and 630 ft bgs. The current PL-7 well configuration is illustrated in Figure 2. Hydraulic conditions are classified as unconfined throughout all three monitoring zones. The initial depth to water when drilled was 451.46 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is ~~477~~486.56~~.09~~ ft bgs (~~1~~4/~~20~~26/~~2021~~2024). The well PL-8 borehole was drilled in 1999 to a total depth of 1,020 ft bgs and completed using nominal 4-inch diameter Schedule 10 stainless-steel casing with four screened zones to a total depth of 1,000 ft bgs. The screen intervals are located at 448.2 to 458.2; 598.5 to 608.6; 774.0 to 784.0; and 959.5 to 969.6 ft bgs. A 1.5-inch MP-38 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 455, 605, 780, and 965 ft bgs. The current PL-8 well configuration is illustrated in Figure 3. Hydraulic conditions are unconfined throughout all four monitoring zones within the Santa Fe Group alluvium. The initial depth to water when drilled was 404.46 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 455.75 ft bgs

(4/26/2024). ~~and the most recent depth to water calculated from formation pressure in the shallow Westbay sampling port is 435.52 ft bgs (1/20/2021). All monitoring zones are within the Santa Fe Group alluvium.~~

Well PL-10 was drilled to replace well PL-9 in 2002. The multiport monitoring well is located downgradient of the Plume Front injection wells and was placed to monitor the injection of treated groundwater. The PL-10 borehole was drilled to a total depth of 1,025 ft bgs in the Santa Fe Group Alluvium and was completed using nominal 5-inch diameter Schedule 10 stainless-steel casing with four screened zones to a total depth of 999.95 ft bgs. The screen intervals are located at 479.3 to 489.3; 589.3 to 599.3; 809.3 to 819.3; and 959.3 to 969.5 ft bgs. A 2.25-inch MP-55 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 484, 592, 813, and 962 ft bgs. The current PL-10 well configuration is illustrated in Figure 4. Conditions are unconfined throughout all four monitoring zones within the Santa Fe Group alluvium. The initial depth to water when drilled was 439.69 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 468.39 ft bgs (4/26/2024). ~~and the most recent calculated depth to water in the shallow Westbay sampling port is 450.34 ft bgs (01/20/2020).~~

Well ST-5

Well ST-5 was drilled to determine vertical groundwater gradients in the Jornada Aquifer downgradient of the Western Boundary Fault Zone and the ST-3 well cluster. The well is located west of the Western Boundary Fault Zone in an area of sub-parallel half-graben step faults where Tertiary volcanic bedrock is offset to a depth of over 2,000 ft into the southern Jornada del Muerto Basin (Figure 1). The borehole was drilled to a total depth of 1,210 ft bgs. Well ST-5 was completed with nominal 4-inch diameter Schedule 10 stainless-steel casing with five screened zones to a total depth of 1,200.4 ft bgs. The screen intervals are located at 480.1 to 490; 650 to 660.1; 810 to 820; 979.9 to 989.9; and 1,170.1 to 1,180.1 ft bgs. A 1.5-inch MP-38 Westbay multiport groundwater sampling system was installed within the conventional stainless-steel casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 485, 650, 815, 985, and 1,175 ft bgs. The current ST-5 well configuration is illustrated in Figure 5. Hydraulic conditions are classified as unconfined within the saturated Quaternary to Tertiary Santa Fe Group alluvium throughout all five monitoring zones. The initial depth to water when drilled was 389.84 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 428.72 ft bgs (4/26/2024).~~and the depth to water calculated from the formation pressure at the shallow Westbay sampling port is 471.89 ft bgs (01/20/2021). Monitoring zones are located in saturated Quaternary to Tertiary Santa Fe Group Alluvium.~~

	Well WW-3 Well WW-3 was drilled to provide a groundwater monitoring point between well ST-6 and the NASA water supply wells. The well is located west of the Western Boundary Fault Zone (Figure 1). The borehole was drilled to a total depth of 1,025 ft bgs. Well WW-3 was completed with nominal 5-inch diameter, Schedule 80 PVC casing with four screened zones to a total depth of 1,014.1 ft bgs. The screened intervals are located at 463.75 to 473.75; 564.66 to 574.65; 705.95 to 715.95; and 973.44 to 983.44 ft bgs. A 2.25-inch MP-55 Westbay multiport groundwater sampling system was installed within the conventional PVC casing and included packers to isolate each individual sampling zone. Westbay groundwater sampling ports are located at approximately 469, 569, 710, and 977 ft bgs. The current WW-3 well configuration is illustrated in Figure 6. Hydraulic conditions are classified as unconfined within the saturated Quaternary to Tertiary Santa Fe Group alluvium throughout all four monitoring zones. The initial depth to water when drilled was approximately 386 ft bgs and the most recent depth to water in the shallow Westbay sampling port calculated from pressure differentials is 413.13 ft bgs (4/26/2024).~~throughout all four monitoring zones and the depth to water calculated from the formation pressure at the shallow Westbay sampling port is 407.3 ft bgs (01/20/2021). All monitoring zones are in saturated Quaternary to Tertiary Santa Fe Group Alluvium~~.
Westbay System Removal	Westbay systems in wells PL-7, PL-8, PL-10, ST-5, and WW-3 are installed inside conventional casing with multiple screened intervals. The Westbay casing will be removed, and the conventional casing and upper screens will be evaluated for any existing problems. If NASA determines the casing and screens are suitable for reuse, the lower screens will be grouted and dedicated bladder pumps will be installed in the upper screens. If the upper screens and/or casing are unsuitable for reuse, the~~The~~ wells will be plugged and abandoned~~ after the Westbay components are removed~~. WSTF E~~e~~nvironmental Department personnel will supervise Westbay Instruments personnel and a qualified subcontractor drilling company during Westbay sampling system removal. Westbay Instruments personnel will provide the specialized tools needed to perforate the packers within each system. Following perforation of the packers, the subcontractor drilling company will use a pulling unit to remove the Westbay casing and sample system components from the conventional well casings. The removal process, the plugging and abandonment activities, as well as the drilling activities will be supervised and documented by WSTF Environmental Department contractor personnel. WSTF Environmental Department contractor personnel will also be responsible for directing and documenting waste management activities, which are discussed further in the Investigation-Derived Waste and Waste Characterization section of this work plan.
Well Plugging and Abandonment	If necessary, ~~G~~groundwater monitoring wells PL-7, PL-8, PL-10, ST-5, and WW-3 ~~ or portions thereof~~ will be abandoned in accordance with 19.27.4 New Mexico Administrative Code (NMAC). Each borehole will be cemented

	from ~~the~~ bottom up using a tremie pipe ~~total depth~~ to the desired elevation or to the surface.
Well Replacement and Monitoring Zones	If a ~~Each~~ new well is required, the well ~~will~~ be drilled near the original location of the abandoned monitoring well. It will be completed as either a nested or clustered well~~s~~ with a purgeable groundwater sampling system~~s~~. The goal of the replacement well is to continue to monitor the current zones in each of the wells. Sampling zones will be located comparably to the current active ~~multi-zone~~ monitoring zones ~~wells to~~ ensure consistency and reliability of groundwater data ~~collection~~ within the Plume Front area ~~at these locations~~. Some sampling zones may not be replicated. ~~The goal of the replacement wells is to continue to monitor the same zones in each of the wells.~~ This will be dependent upon the lithology and water-bearing zones identified during the drilling of ~~in~~ any ~~the~~ new well(s). Reconfigured or new wells will be named sequentially using the current convention (i.e., 600C-006-GW through 600C-010-GW) in the order of installation. Following the installation, each monitoring well will be developed to remove any residual sediment or soil from the well. Water quality parameters will be taken periodically until the turbidity is below 5 nephelometric turbidity units.
Purgeable Sampling System and Installation	~~In lieu of any current alternative to the Westbay and FLUTe sampling systems,~~ N~~n~~ested or clustered groundwater monitoring wells equipped with conventional bladder pump systems ~~may~~ appear to be the most viable long-term solution for the collection of representative groundwater sampling data at PL-7, PL-8, PL-10, ST-5, WW-3 locations, and potentially at other multi-zone groundwater monitoring wells in the Plume Front area. Figure 7 ~~through Figure 11~~ illustrate~~s~~ ~~the~~a generalized nested well design~~s~~ for reconfiguration or replacement of wells PL-7, PL-8, PL-10, ST-5, and WW-3.
Groundwater Sampling	Prior to collecting groundwater samples, the system will be purged ~~by pressurizing the drive tube with nitrogen gas. This causes the bottom check valve to close and allow water to flow up through the sample tube. Once all water is expelled from the system, the gas pressure is released, the bottom check valve opens, and the system refills from the formation through the bladder and intake port. The purging process is repeated~~ until the required amount of water is ~~purged~~removed. Exact purging volumes for each well zone are ~~determined~~calculated based upon minimal water level drawdown to equalization and water quality stabilization. Groundwater quality parameter measurements will be recorded periodically during purging to establish parameter stabilization ~~within~~ for three (3) consecutive readings once the minimum purge volume has been reached. Once both conditions have been met sample collection ~~will~~ may begin. Groundwater samples will be collected in accordance with the WSTF Groundwater Monitoring Plan (GMP: NASA, 2023). Initial sampling will be performed ~~between~~ within 5 ~~10 to 30~~ days ~~following installation of each system~~of development. Each monitoring well/zone will be sampled quarterly for at least one year for volatile organic compounds, nitrosamines, metals, semi-volatile organic compounds, and inorganic compounds. Results from

	these sampling events will be reported in the WSTF Periodic Monitoring Reports, which are submitted quarterly to NMED. After one year, sampling at wells replacing PL-7, PL-8, PL-10, ST-5, and WW-3 will be conducted in accordance with the schedule identified for these wells in the GMP, which is updated annually and approved by NMED.
Investigation-Derived Waste and Waste Characterization	Information related to the characterization, management, and disposition of waste generated during this project is provided in this section. Waste characterization is conducted in accordance with Section 4.3.10 (Collection and Management of Investigation Derived Waste) of the WSTF RCRA Permit (NMED, 2023). All waste will be properly managed and disposed of in accordance with NASA procedures and state and federal regulations. Anticipated waste streams that may be generated during this project include: • **Westbay system components.** Wells PL-7, PL-8, PL-10, ST-5, and WW-3 are located outside the defined extent of the WSTF groundwater plume. Components of the Westbay sampling system and groundwater removed from these wells are not considered contaminated. The components also do not contain materials that, when discarded as a solid waste, would exhibit characteristics of hazardous waste. This waste is characterized as non-hazardous solid waste. • **Groundwater.** Groundwater produced from the aquifer outside of the WSTF groundwater contaminant plume does not exhibit characteristics of hazardous waste and does not contain listed hazardous waste. Activities that produce groundwater may include development activities, purging, and groundwater sampling. Waste groundwater is characterized as non-hazardous solid waste. • **Decontamination fluids.** Decontamination fluids such as water and soap solutions used to wash and decontaminate equipment during this project are non-hazardous solid waste. The decontamination fluids will not exhibit the characteristics of hazardous waste nor be characterized as listed hazardous waste. • **Contact waste.** Contact waste, or debris, such as used disposable sampling equipment, personal protective equipment, plastic sheeting, and other debris generated during at locations outside of the WSTF groundwater contaminant plume are non-hazardous solid waste. • **Petroleum Contaminated Debris.** Debris such as rags and wipes that may be contaminated with petroleum products during routine pulling unit maintenance. This debris is characterized as hazardous waste with the D018 hazardous waste code. The Environmental Protection Agency (EPA) has established through the "contained-in policy" that groundwater, and other environmental media, is not solid waste but is subject to regulation as if it were hazardous waste when it contains listed waste (EPA, 1996). Available historical analytical data from wells PL-7, PL-8, PL-10, ST-5, and WW-3 indicate that these wells are

	located outside of the WSTF contaminant plume and do not contain WSTF contaminants of concern (trichloroethylene, tetrachloroethylene, 1,1,2-trichloro-1,2,2-trifluoroethane, trichlorofluoromethane). Therefore, F001 and F002 hazardous waste codes do not apply to groundwater actively managed from these wells. As a result of this determination, groundwater and materials that contact groundwater at these locations are not subject to regulation as listed hazardous waste. Groundwater at these locations also do not exhibit toxicity characteristics and have non-detectable or low parts per trillion range NDMA concentrations. Groundwater and decontamination fluids generated during development, purging, and sampling activities will be containerized in mobile trailers or other appropriate containers as non-hazardous solid waste. The collected fluids will be sampled for volatile organic compounds and NDMA prior to proper disposal, which may occur through the WSTF Mid-plume Interception and Treatment System, WSTF sanitary sewer, or other appropriate method. Because groundwater is not contaminated at the project wells, contact waste is characterized as non-hazardous waste. Westbay sampling system components removed from the wells and associated contact debris will be collected at the end of each working shift and transferred to an appropriate non-hazardous solid waste container. The non-hazardous contact waste will be disposed in accordance with the State-approved Solid Waste Management Program (RCRA Subtitle D). Debris that may have contacted petroleum-based oils or fuels will be managed as hazardous waste in accordance with 20.4.1 NMAC and 40 CFR 262.17 at a less than 90-day central accumulation area. If generated, petroleum contaminated debris will be properly disposed of at a RCRA permitted treatment, storage, and disposal facility.
Schedule	~~NASA plans to initiate well reconfiguration activities at wells PL-7, PL-8, PL-10, ST-5, and WW-5 following NMED approval of this work plan. Well reconfiguration will be conducted in two phases. First, each well must be carefully evaluated following removal of the Westbay sampling systems to ensure there is no damage or corrosion that would preclude the installation of a FLUTe liner. Second, FLUTe liners will be ordered for all wells that are in good condition. FLUTe estimated it will require approximately one and one half months to construct the liners. NASA estimates that Westbay system removal and well inspection will require approximately three to four days per well. An additional three days will be required to complete the FLUTe liner installation for each well reconfiguration. The total project duration will be approximately three and one half to four months. This estimate assumes the Westbay systems can be removed without significant problems since they are all installed in cased wells, as opposed to open boreholes.~~ ~~NASA expects project procurement, planning, and scheduling to require approximately two months from the time of NMED's approval of this work plan. NASA expects groundwater sampling of the reconfigured wells will be completed within 30 days of the final well reconfiguration. Finally, receipt and processing of groundwater chemical analytical data requires approximately two months, after which a well reconfiguration report can be prepared. Based on these anticipated durations, NASA expects to submit~~

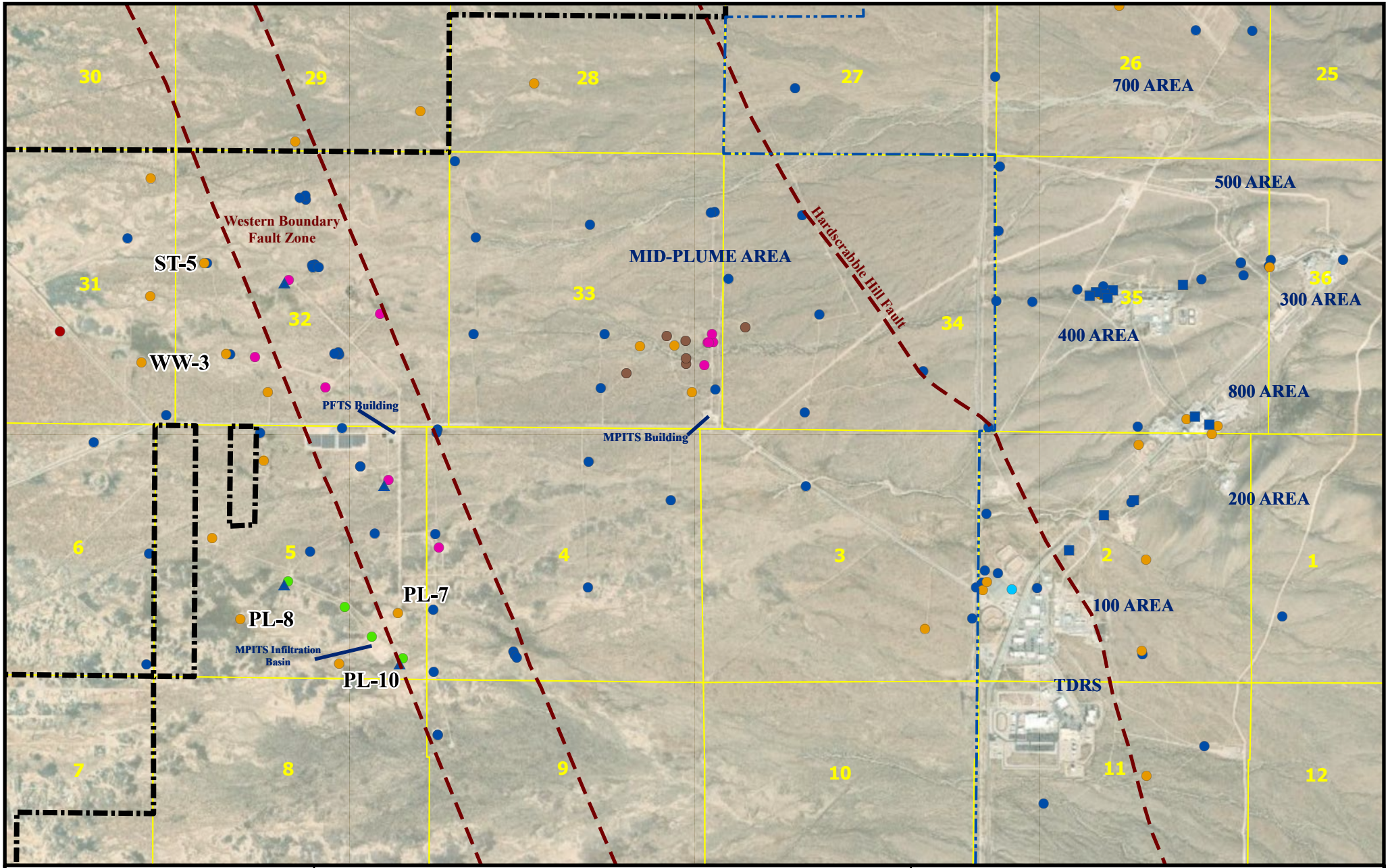
	~~the final well reconfiguration report to NMED approximately 10 months after NMED approval of this work plan.~~ The FY24 Agency Environmental budget has been substantially cut and it is likely the FY25 budget will also be less than planned. As a result, the earliest timeframe WSTF will be able to resume monitor well installation is FY26. NASA and its contractors have never constructed a nested well at WSTF. If NASA concludes that nested wells are appropriate for reconfiguring any or all Westbay wells herein, NASA proposes a phased approach in which one nested well is constructed and evaluated to determine the success of the well design. Although the current target date is expected to be 2026, NASA will evaluate every possible option, as they may become available, to obtain the resources needed to address the reconfigurations in a timely manner. NASA will keep NMED apprised of developments that could affect the ongoing groundwater monitoring program at WSTF.
References	EPA. "Requirements for Management of Hazardous Contaminated Media (HWIR-Media)." *Federal Register* 61, No. 83 (April 29, 1996): 18780.https://www.govinfo.gov/content/pkg/FR-1996-04-29/pdf/96-10096.pdf NASA Johnson Space Center White Sands Test Facility. (1999, January 20). *Plume Front Stabilization Work Plan*. Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2017a, March 30). *Detections of NDMA and TCE in WSTF Groundwater Monitoring Wells BLM-30, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, and WW-3.* Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2017b, December 27). *Work Plan for Abandonment of NASA WSTF Well PL-5 and Replacement with Monitoring Well PL-12.* Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2017c, December 28). *Well Reconfiguration Work Plan for Well BLM-30*. Las Cruces, NM. NASA Johnson Space Center White Sands Test Facility. (2023, April 27). *NASA WSTF Groundwater Monitoring Plan Update for 2023*. Las Cruces, NM. NMED Hazardous Waste Bureau. (2016, March 29). *Approval NASA WSTF Periodic Monitoring Report Fourth Quarter 2015*. Santa Fe, NM. NMED Hazardous Waste Bureau. (2017, October 4). *Approval with Modifications Detections of NDMA (N-Nitrosodimethylamine) and TCE (Trichloroethylene) In WSTF Groundwater Monitoring Wells BLM-30, PL-5, PL-6, PL-7, PL-8, PL-10, ST-5, and WW-3*. Santa Fe, NM.

	NMED Hazardous Waste Bureau. (2021, January 25). *Approval Request for Fourth Extension of Time for Well Reconfiguration Work Plan*. Santa Fe, NM. NMED Hazardous Waste Bureau. (2023, March 28). *RCRA Permit EPA ID # NM8800019434*. Santa Fe, NM. Well Driller Licensing; Construction, Repair and Plugging of Wells, Office of the State Engineer, 19.27.4 NMAC (6-30-17).

Figures

Figure 1 Well Location Map

(SEE NEXT PAGE)



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W E
S

August 2024

Feet
0 5001,000 2,000 3,000

Prepared by:srees

- Conventional Well
- Exploration Well
- Extraction Well
- Injection Well
- Multiport Well
- Perched Well
- Piezometer
- Production Well
- MSVGM Well
- WSTF Boundary
- WSTF Industrial Area
- PLSS - Sections
- Fault

Well Location Map
Westbay Well Reconfiguration

NASA Johnson Space Center
White Sands Test Facility Las Cruces,
New Mexico

Coordinate System:
NAD 1983 HARN StatePlane New Mexico Central FIPS 3002 Feet

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Figure 2 PL-7 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **PL-7** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 NE 1/4 SE 1/4 Sec. 5, T21S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **167231.65N 462332.97E**
Elevation (Brass Cap): **1378.56 m AMSL**
Elevation (Top of Casing): **1378.95 m AMSL**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower**
Total Depth of Borehole (bgs): **804' (245.1 m)**
Borehole Diameter: **9 7/8" 0-804'; reamed 16 1/2" 0-80'; reamed 13" 80-675'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **451.57' (137.64 m) TOC (12/15/92)**
Total Depth Surface Casing (bgs): **80' (24.4 m)**
Diameter and Type Surface Casing: **13.5" ID, 14" OD Steel**
Date(s) Well Installed: **CW = 11/19/92-11/24/92; WB = 12/15/92-12/17/92**
Date(s) Well Developed: **CW = 11/24/92-12/10/92; WB = Not Recorded**

Field Representative(s): **See list in Annular/Borehole Descriptions below**
Total Depth Well Casing(s) (bgs): **CW = 655.4' (199.8 m); WB = 650' (198.1 m)**
Type of Casing(s): **CW = Stainless Steel; WB = MP 38 PVC**
Diameter Well Casing(s): **CW = 4" ID/4.5" OD; WB = 1.5" ID/1.9" OD**
Casing Schedule: **CW = 5 (0-395.0') and 10 (395.0'-TD)**
CW Screened Zone(s) (bgs): **475.0-485.0' (144.8-147.8 m); 555.0-565.0' (169.2-172.2 m); and 625.0-635.0' (190.5-193.5 m)**
WB Sampling Zone(s) (bgs): **480' (146.95 m); 560' (171.20 m); and 630' (192.43 m)**
WB Packer Zone(s) (bgs): **470-490' (143.91-149.99 m); 550-570' (168.15-174.24 m); and 620-650' (TD) (189.38-198.1 m)**
Comments: **CW = Conventional Well WB = Westbay® Well TD = Total Depth**

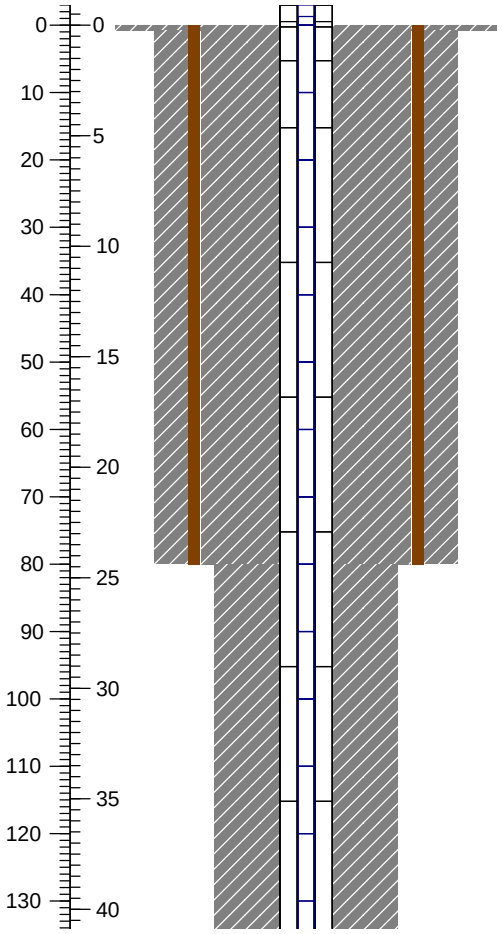
Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Centralizers not listed**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Packer
- Mechanical Pumping Port (PP)
- Magnetic Collar

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.29' (0.394 m)
Conventional Well Stick-Up = ~0.53' (~0.2 m)

Surface Casing Stick-Up = ~0. Original stick-up measured at installation was 2.4' (0.7 m). Casing was cut to gound surface after installation 10/16/92. (Exact Stick-Up Not Measured or Surveyed).

Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

The upper 10 couplings (0-100') are reinforced with stainless steel hose clamps

14" OD Steel Surface Casing Depth = 80' (24.4 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Cement Grout (Cement with 5% Bentonite) = 0'

Field Representatives: Mary Canavan; Greg Contaldo; Pam Egan; Jack Kirby; and Dave Menzie

16 1/2" Borehole Cemented to 80' (24.4 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Centralizers not listed

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing

1.5" ID Westbay® MP 38 End Cap

Measurement Port (MP)

MP with Filter Sock

Mechanical Pumping Port (PP)

Magnetic Collar

Packer

Annular Materials Explanation:

Cement

Bentonite (Grout Well DF)

Bentonite Seal

8/20 Sand/ Bentonite Mix

Slough

1/8 Gravel

4/8 Sand

6/9 Sand

8/12 Sand

8/20 Sand

10/20 Sand

16/40 Sand

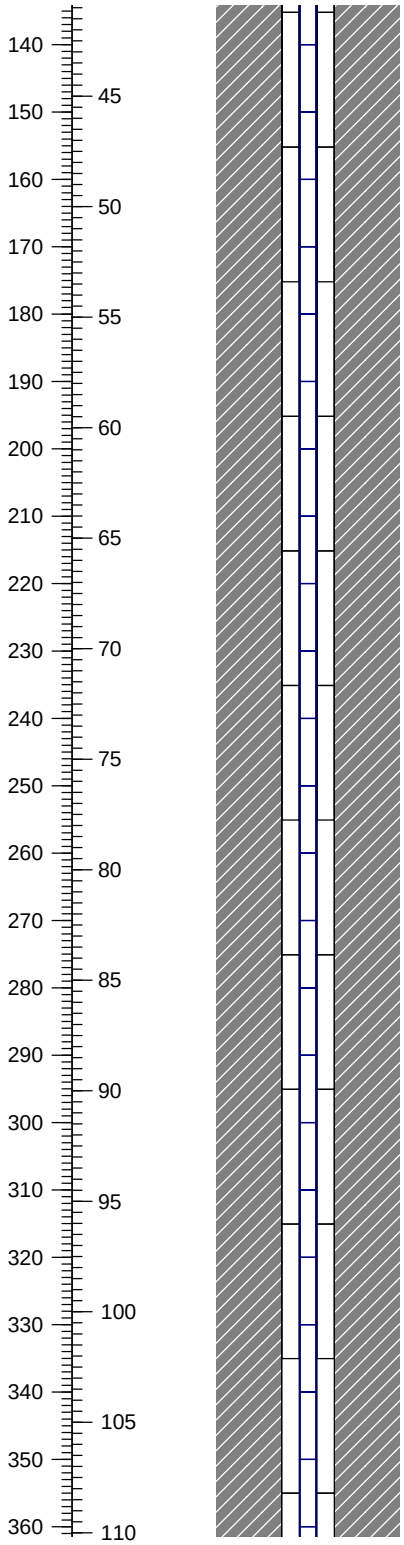
20/40 Sand

30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Centralizers not listed**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

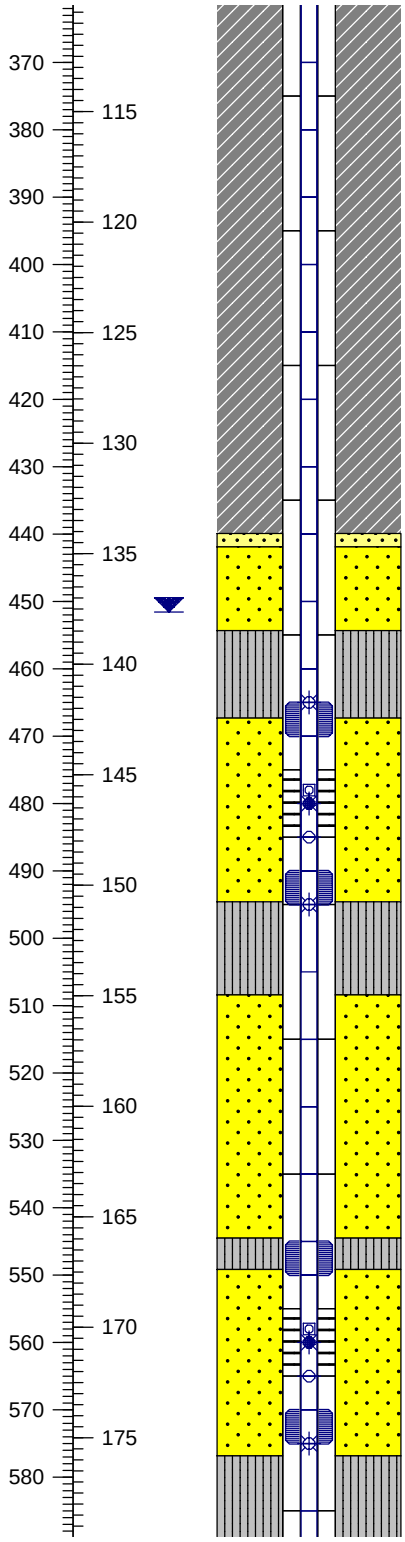
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



All stainless steel casing above 395.0' (120.4 m) is schedule 5. All casing below is schedule 10.

Top of 16/40 Sand = 439.9' (134.1 m)

Top of 8/20 Sand = 441.9' (134.7 m)

Water Table = 451.57' (137.64 m; measured 12/15/92 just before Westbay® well casing installation; TOC)

MP Depth = 465' (142.39 m)

Top of Bentonite Seal = 454.3' (138.5 m)

Packer Depth = 465'-470' (142.39-143.91 m)

Top of 8/20 Sand = 467.3' (142.4 m)

Top of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 475.0' (144.8 m)

Magnetic Collar Depth = 479.6' (146.83 m)

Sampling MP Depth (with Filter Sock) = 480' (146.95 m)

PP Depth = 485' (148.47 m)

Bottom of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 485.0' (147.8 m)

Top of Bentonite Seal = 494.6' (150.8 m)

Packer Depth = 490'-495' (149.99-151.51 m)

MP Depth = 495' (151.51 m)

Top of 8/20 Sand = 508.4' (155.0 m)

Packer Depth = 545'-550' (166.63-168.15 m)

Top of Bentonite Seal = 544.5' (166.0 m)

Top of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 555.0' (169.2 m)

Top of 8/20 Sand = 549.2' (167.4 m)

Magnetic Collar Depth = 559.6' (171.08 m)

Sampling MP Depth (with Filter Sock) = 560' (171.20 m)

PP Depth = 565' (172.72 m)

Bottom of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 565.0' (172.2 m)

Top of Bentonite Seal = 576.8' (175.8 m)

Packer Depth = 570'-575' (174.24-175.76 m)

MP Depth = 575' (175.76 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Centralizers not listed

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

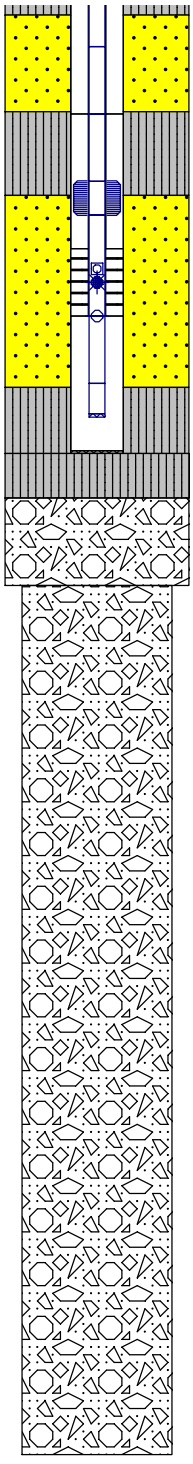
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

590 600 610 620 630 640 650 660 670 680 690 700 710 720 730 740 750 760 770 780 790 800 810

180 185 190 195 200 205 210 215 220 225 230 235 240 245



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 615'-620' (187.86-189.38 m)

Top of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 625.0' (190.5 m)

Magnetic Collar Depth = 629.6' (192.31 m)

Sampling MP Depth (with Filter Sock) = 630' (192.43 m)

Bottom of 4" ID Stainless Steel 0.020"-Slot Extra Strength Screen = 635.0' (193.5 m)

PP Depth = 635' (193.95 m)

Westbay® MP 38 Casing TD = 650' (198.1 m)

Conventional 4" Stainless Steel Well TD = 655.4' (199.8 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of 8/20 Sand = 590.3' (179.9 m)

Top of Bentonite Seal = 604.7' (184.3 m)

Top of 8/20 Sand = 617.1' (188.1 m)

Top of Bentonite Seal = 645.6' (196.8 m)

Top of Slough = 662' (201.8 m)

13" Borehole TD = 675' (205.7 m)

9 7/8" Borehole TD = 804' (245.1 m)

Figure 3 PL-8 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

JSC - White Sands Test Facility, Las Cruces, New Mexico, USA

Location ID: **PL-8** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **NW 1/4 SE 1/4 SW 1/4 Sec. 5, T21S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **167197.62N 461407.25E**
Elevation (Brass Cap): **1363.00 m AMSL**
Elevation (Top of Casing): **1363.20 m AMSL**
Drilling Contractor: **Stewart Brothers Drilling Company**
Driller: **J. Aguilar**
Total Depth of Borehole (bgs): **1,020' (310.9 m)**
Borehole Diameter: **12 1/4" 0-1,020'; reamed 17 1/2" 0-122'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **404.51' (123.29 m) TOC (9/21/99)**
Total Depth Surface Casing (bgs): **122' (37.2 m)**
Diameter and Type Surface Casing: **13.5" ID, 14" OD Steel**
Date(s) Well Installed: **CW = 4/8/99-4/12/99; WB = 9/21/99-9/29/99**
Date(s) Well Developed: **CW = 6/3/99 - 9/8/99; WB = Not Recorded**

Field Representative(s): **M. Canavan, G. Giles, M. McClure, (see comments)**
Total Depth Well Casing(s) (bgs): **CW = 1,000' (304.8 m); WB = 990' (301.8 m)**
Type of Casing(s): **CW = 304 Stainless Steel; WB = MP 38 PVC**
Diameter Well Casing(s): **CW = 4" ID/4.5" OD; WB = 1.5" ID/1.9" OD**
Casing Schedule: **10 (CW) (CW = Conventional Well WB = Westbay®)**
CW Screened Zone(s) (bgs): **448.2-458.2' (136.6-139.7 m); 598.5-608.6' (182.4-185.5 m); 774.0-784.0' (235.9-239.0 m); and 959.5-969.6' (292.5-295.5 m)**
WB Sampling Zone(s) (bgs): **455' (138.68 m); 605' (184.4 m); 780' (237.74 m); and 965' (294.13 m)**
WB Packer Zone(s) (bgs): **445-465' (136.46-142.58 m); 595-615' (181.36-187.45 m); 770-790' (234.70-240.79 m); and 955-975' (291.08-297.18 m)**
Comments: **Field Reps, cont'd.: L. Hunnicutt-Mack, M. Rivera, J. Pearson**

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID 304 Stainless Steel**
- Conventional Screen — **4" ID 304 Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID 304 Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Packer
- Mechanical Pumping Port (PP)
- Magnetic Collar

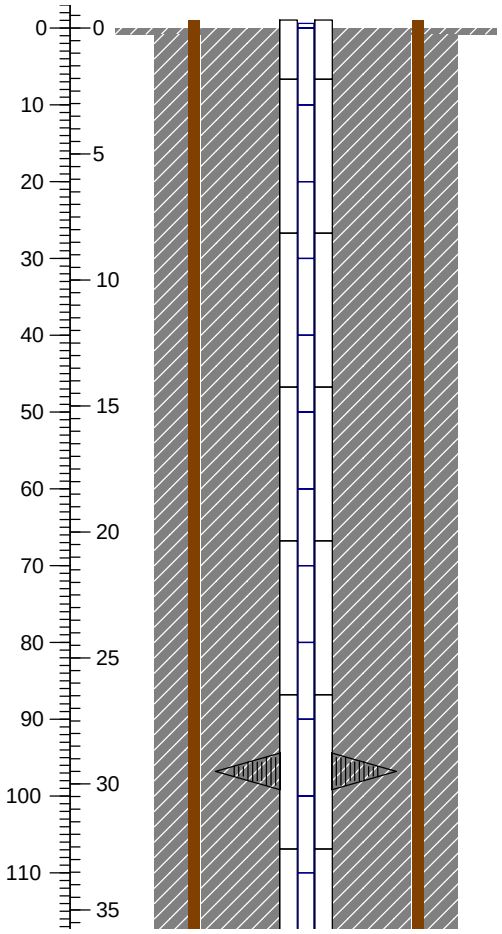
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Westbay® Well Stick-Up = ~0.65' (0.197 m)
Conventional Well Stick-Up = ~1.04' (~0.3 m). Original stick-up measured at installation was 3.38'. Casing cut to present level 8/99.

Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)
Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

Three steel centralizers welded to casing at ~96.8' (~29.5 m)

Top of Cement Grout (Portland II Cement with 5% Bentonite) = 0'

Surface Casing
14" OD Steel
Conventional Casing
4" ID 304 Stainless Steel
Conventional Screen
4" ID 304 Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID 304 Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

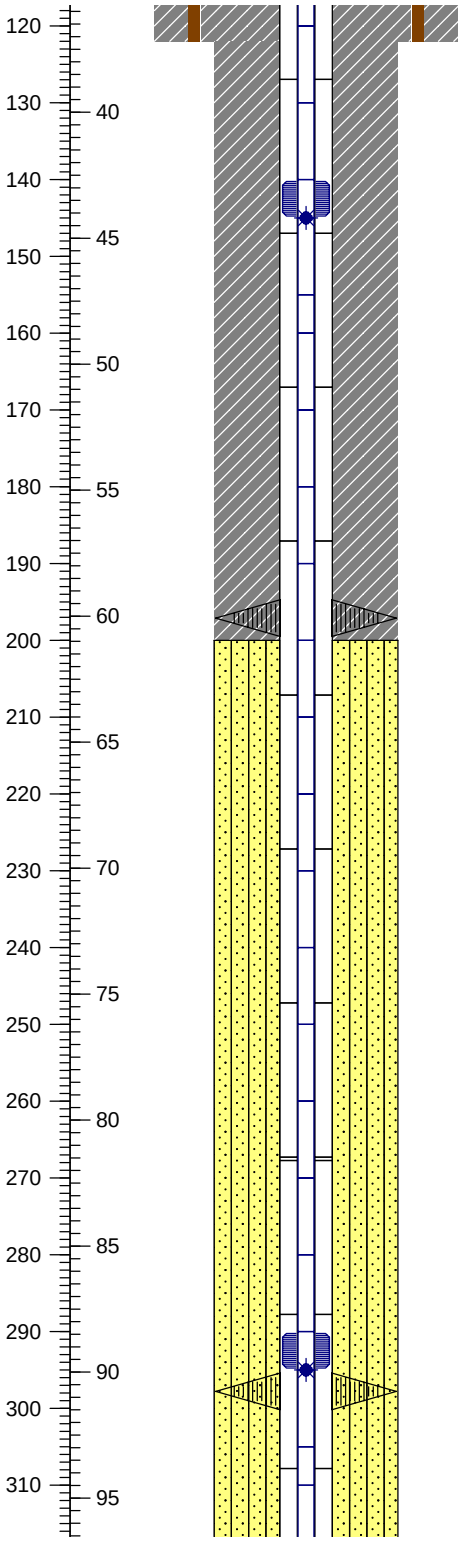
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



14" OD Steel Surface Casing Depth = 122' (37.2 m)

17 1/2" Borehole Cemented to 122' (37.2 m)

Stabilizing Packer Depth = 140'-145' (42.67-44.19 m)

MP Depth (with Filter Sock) = 145' (44.19 m)

Three steel centralizers welded to casing at ~197.1' (~60.1 m)

Top of 10/20 Sand/Bentonite Mix = 200' (61.0 m)(Exact Depth of Sand/Bentonite Mix Not Recorded)

Crossover Adapter from Schedule 40 Threads to Schedule 80 Threads on the 4" ID Schedule 10, 304 Stainless Steel Conventional Casing = 267.3' (81.5 m)

Stabilizing Packer Depth = 290'-295' (88.39-89.91 m)

MP Depth (with Filter Sock) = 295' (89.91 m)

Three steel centralizers welded to casing at ~297.8' (~90.8 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID 304 Stainless Steel
Conventional Screen
4" ID 304 Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID 304 Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

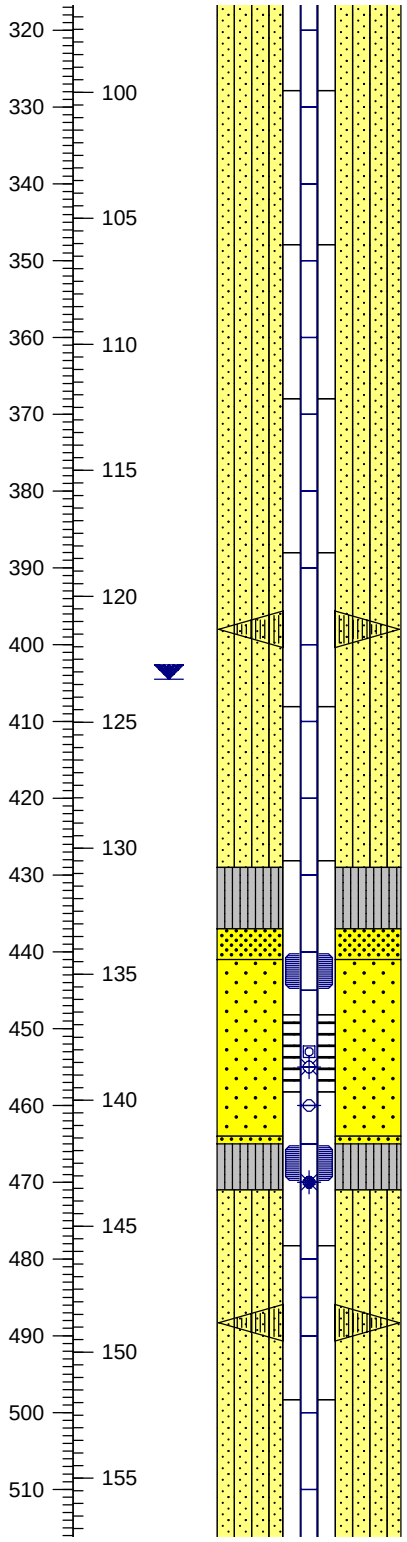
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Three steel centralizers welded to casing at ~398.0' (~121.3 m)

Water Table = 404.51' (123.29 m; measured 9/21/99 just before Westbay® well casing installation; TOC)

Packer Depth = 440'-445' (134.94-136.46 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 448.2' (136.6 m; Rated at 400'-600' Depth)

Magnetic Collar Depth = ~454' (~139.21 m)(Exact Location Not Recorded)

Sampling MP Depth = 455' (139.51 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 458.2' (139.7 m; Rated at 400'-600' Depth)

PP Depth = 460' (141.03 m)

Packer Depth = 465'-470' (142.58-144.10 m)

MP Depth (with Filter Sock) = 470' (144.10 m)

Three steel centralizers welded to casing at ~488.3' (~148.8 m)

Top of Upper Bentonite Seal = 429' (130.8 m)

Top of Upper 30/70 Sand = 437' (133.2 m)

Top of 10/20 Sand = 441' (134.4 m)

Top of Lower 30/70 Sand = 464' (141.4 m)

Top of Lower Bentonite Seal = 465' (141.7 m)

Top of 10/20 Sand/Bentonite Mix = 471' (143.6 m)

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID 304 Stainless Steel**
- Conventional Screen — **4" ID 304 Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID 304 Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

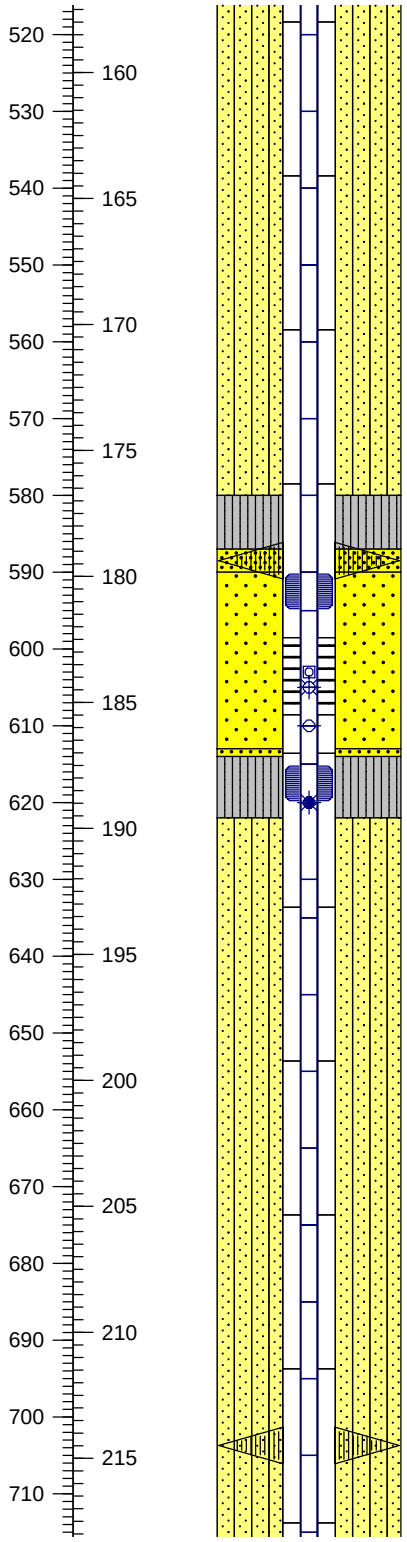
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Three steel centralizers welded to casing at ~588.5' (~179.4 m)

Packer Depth = 590'-595' (180.90-182.42 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 598.5' (182.4 m; Rated at 600'-1,000' Depth)

Magnetic Collar Depth = ~604' (~185.17 m)(Exact Location Not Recorded)

Sampling MP Depth = 605' (185.47 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 608.6' (185.5 m; Rated at 600'-1,000' Depth)

PP Depth = 610' (186.99 m)

Packer Depth = 615'-620' (188.54-190.06 m)

MP Depth (with Filter Sock) = 620' (190.06 m)

Three steel centralizers welded to casing at ~703.7' (~214.5 m)

Top of Upper Bentonite Seal = 580' (176.8 m)

Top of Upper 30/70 Sand = 587' (178.9 m)

Top of 10/20 Sand = 590' (179.8 m)

Top of Lower 30/70 Sand = 613' (186.8 m)

Top of Lower Bentonite Seal = 614' (187.1 m)

Top of 10/20 Sand/Bentonite Mix = 622' (189.6 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID 304 Stainless Steel
Conventional Screen
4" ID 304 Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID 304 Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

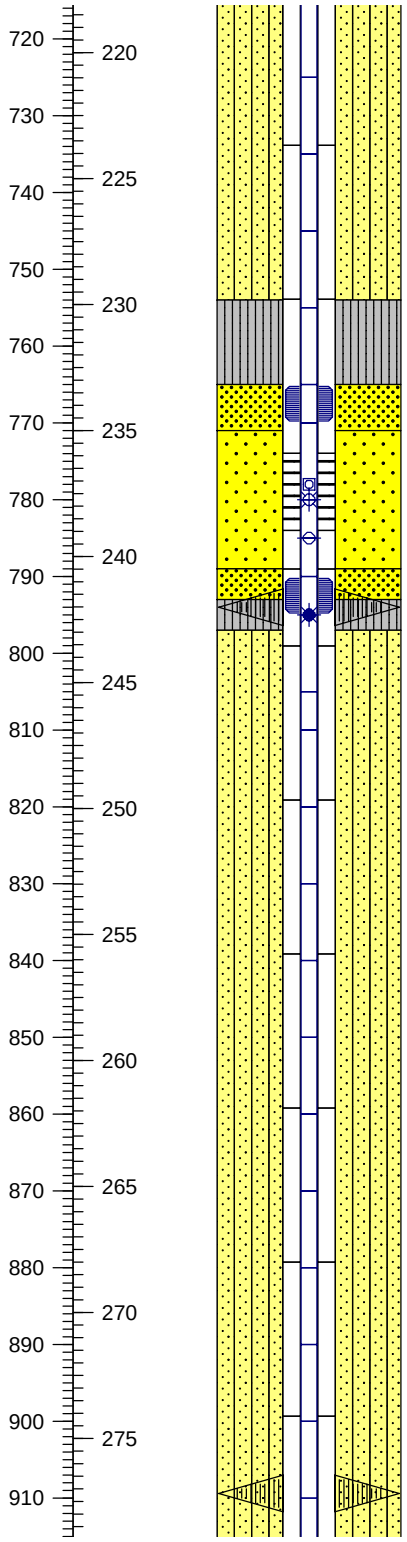
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Packer Depth = 765'-770' (234.45-235.97 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 774.0' (235.9 m; Rated at 600'-1,000' Depth)

Magnetic Collar Depth = ~779' (~238.72 m)(Exact Location Not Recorded)

Sampling MP Depth = 780' (239.02 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 784.0' (239.0 m; Rated at 600'-1,000' Depth)

PP Depth = 785' (240.54 m)

Packer Depth = 790'-795' (242.09-243.61 m)

Three steel centralizers welded to casing at ~794.0' (~242.0 m)

MP Depth (with Filter Sock) = 795' (243.61 m)

Three steel centralizers welded to casing at ~909.4' (~277.2 m)

Top of Upper Bentonite Seal = 754' (229.8 m)

Top of Upper 30/70 Sand = 765' (233.2 m)

Top of 10/20 Sand = 771' (235.0 m)

Top of Lower 30/70 Sand = 789' (240.5 m)

Top of Lower Bentonite Seal = 793' (241.7 m)

Top of 10/20 Sand/Bentonite Mix = 797' (242.9 m)

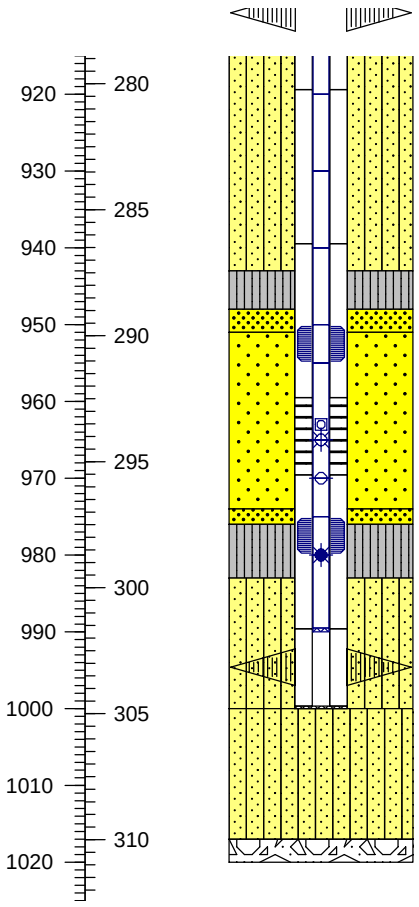
Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID 304 Stainless Steel**
- Conventional Screen — **4" ID 304 Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID 304 Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 950'-955' (290.97-292.49 m)

Top of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 959.5' (292.5 m; Rated at 600'-1,000' Depth)

Magnetic Collar Depth = ~964' (~295.24 m)(Exact Location Not Recorded)

Sampling MP Depth = 965' (295.54 m)

Bottom of 4" ID 304 Stainless Steel 0.020"-Slot Screen = 969.6' (295.5 m; Rated at 600'-1,000' Depth)

PP Depth = 970' (297.06 m)

Packer Depth = 975'-980' (298.61-300.13 m)

MP Depth (with Filter Sock) = 980' (300.13 m)

Westbay® MP 38 Casing TD = 990' (301.8 m)

Three steel centralizers welded to casing at ~994.6' (~303.2 m)

Conventional 4" 304 Stainless Steel Well TD = 1,000' (304.8 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 943' (287.4 m)

Top of Upper 30/70 Sand = 948' (289.0 m)

Top of 10/20 Sand = 951' (289.9 m)

Top of Lower 30/70 Sand = 974' (296.9 m)

Top of Lower Bentonite Seal = 976' (297.5 m)

Top of 10/20 Sand/Bentonite Mix = 983' (299.6 m)

Top of Slough = 1,017' (310.0 m)

12 1/4" Borehole TD = 1,020' (310.9 m)

Figure 4 PL-10 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **PL-10** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **SE 1/4 SW 1/4 SE 1/4 Sec 5, T21S, R3E**
NM State Plane Coordinates (NAD 83 in meters) **166935.47N 461987.44E**
Elevation (Brass Cap): **1373.22 m AMSL**
Elevation (Top of Casing): **1373.65 m AMSL**
Drilling Contractor: **Stewart Brothers Drilling Company**
Driller: **G. Cardenas**
Total Depth of Borehole (bgs): **1,025' (312.4 m)**
Borehole Diameter: **12 1/4" 0-120' (reamed 17 1/2"); 12 1/4" 120'-1,025'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **439.82' (134.06 m) TOC (9/10/02)**
Total Depth Surface Casing (bgs): **112' (34.1 m)**
Diameter and Type Surface Casing: **13 1/2" ID; 14" OD Steel**
Date(s) Well Installed: **CW = 7/28/02 - 8/9/02; WB = 9/10/02 - 9/13/02**
Date(s) Well Developed: **CW = 8/10/02 - 9/9/02; WB = Not Recorded**

Field Representative(s): **M. Canavan, L. Hunnicutt-Mack, (see comments)**
Total Depth Well Casing(s) (bgs): **CW = 999.95'; WB = 990.65'**
Type of Casing(s): **CW = Stainless Steel; WB = PVC**
Diameter Well Casing(s): **CW = 5.30" ID/5.56" OD; WB = 2.25" ID; 2.9" OD**
Casing Schedule: **10 (CW) (CW = Conventional Well WB = Westbay® Well)**
CW Screened Zone(s) (bgs): **479.30-489.30' (146.09-149.14 m); 589.30-599.30' (179.62-182.67 m); 809.30-819.30 (246.67 m-249.72 m); 959.30-969.50' (292.39-295.50 m)**
WB Sampling Zone(s) (bgs): **483.57' (147.39 m); 591.78' (180.37 m); 813.19' (247.86 m); and 962.41' (293.34 m)**
WB Packer Zone(s) (bgs): **473.28-493.36' (144.33-150.69 m); 581.49-606.49' (177.56-185.21 m); 802.90-822.98' (245.04-251.21 m); and 952.12-975.48' (290.53-297.55 m)**
Comments: **Field Reps. cont'd: J. Pearson, M. Stepro, R. Weaver**

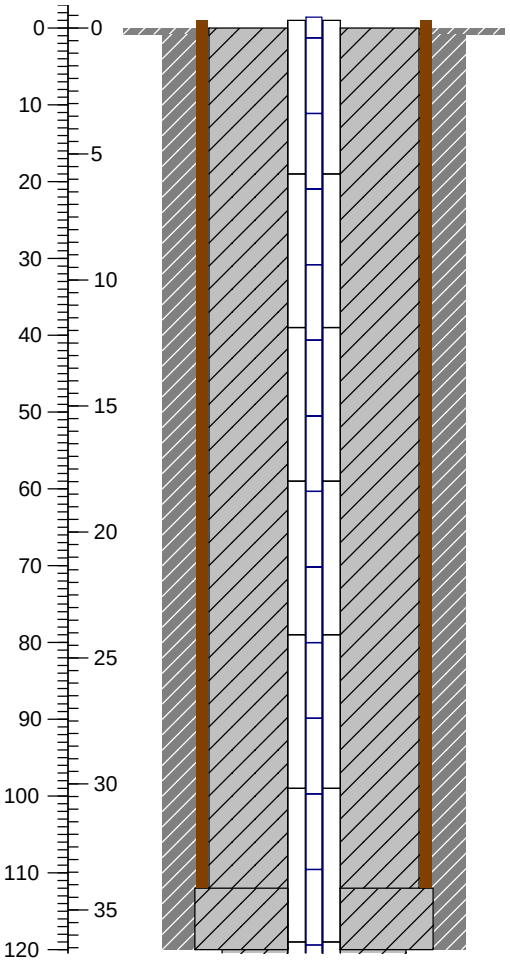
Casing Explanation:

- Surface Casing **14" OD Steel**
- Conventional Casing **5.30" ID SCH 10 Stainless Steel**
- Conventional Screen **5.30" ID SCH 10 Stainless Steel 0.020"-slot**
- Conventional End Cap **5.30" ID SCH 10 Stainless Steel**
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.41' (0.429 m)
Conventional Well Stick-Up = ~1' (~0.3 m) at installation. (Exact Stick-Up Not Measured or Surveyed)

Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)

Westbay® well casing is a combination of 300 and 600 Series casing. All pumping ports are 300 Series. All other casing is 600 Series.

Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

14" OD Steel Surface Casing Depth = 112' (34.1 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Bentonite Grout (Grout Well DF) = 0'

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **5.30" ID SCH 10 Stainless Steel**
- Conventional Screen — **5.30" ID SCH 10 Stainless Steel 0.020"-slot**
- Conventional End Cap — **5.30" ID SCH 10 Stainless Steel**
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

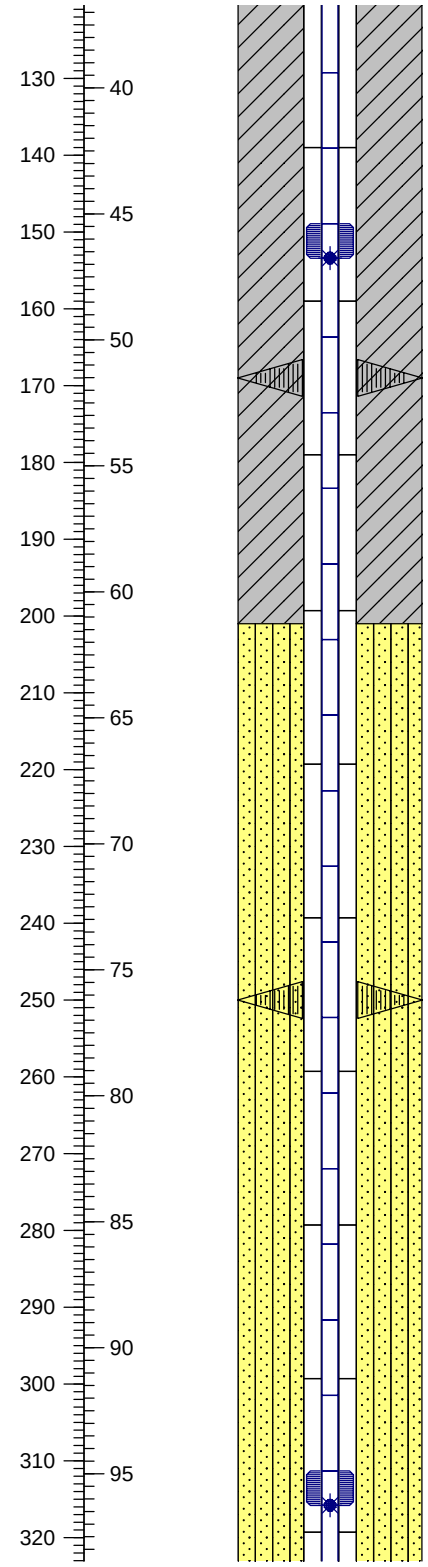
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Surface Casing Cemented to 120' (36.6 m)

Stabilizing Packer Depth = 148.93-153.40' (45.39-46.76 m)

MP Depth (with Filter Sock) = 153.40' (46.76 m)

Stainless steel bolted cage centralizer attached to casing at ~169.0' (~51.51 m)

Top of 10/20 Sand/Bentonite Mix = 201' (61.3 m)

Centralizer listed on well design, but not indicated on casing tally. Unknown if this centralizer is present.

Stabilizing Packer Depth = 311.33-315.80' (94.89-96.26 m)

MP Depth (with Filter Sock) = 315.80' (96.26 m)

Casing Explanation:

- Surface Casing
  14" OD Steel
  Conventional Casing
  5.30" ID SCH 10 Stainless Steel
- Conventional Screen
  5.30" ID SCH 10 Stainless Steel
  0.020"-slot
- Conventional End Cap
  5.30" ID SCH 10 Stainless Steel
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

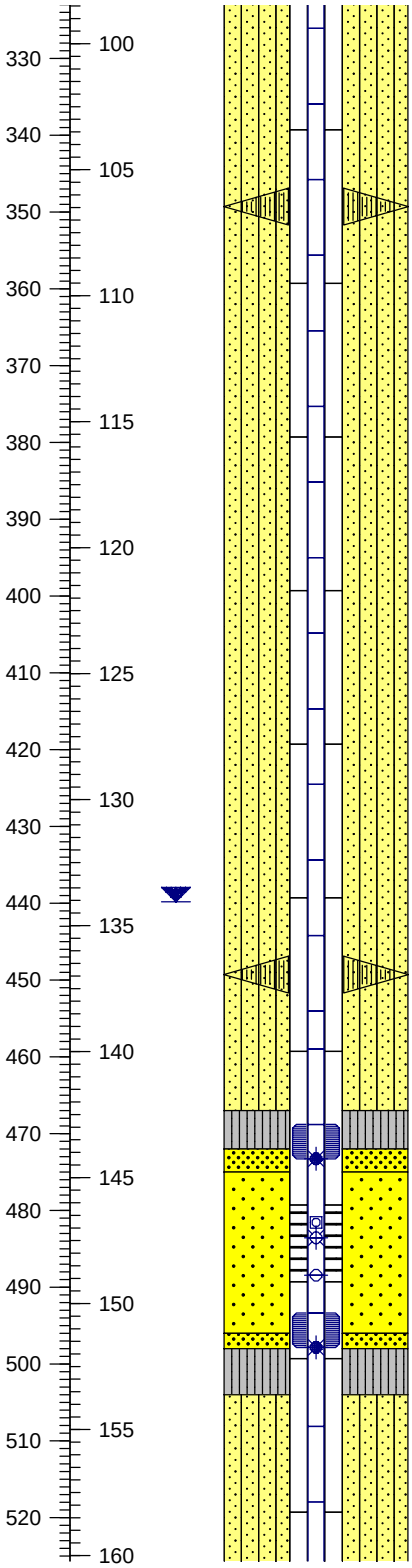
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Stainless steel bolted cage centralizer attached to casing at ~349.3' (~106.47 m)

Water Table = ~439.82' (134.06 m; measured 9/10/01 during Westbay® well casing installation; TOC)

Stainless steel bolted cage centralizer attached to casing at ~449.3' (~136.95 m)

Packer Depth = 468.81-473.28' (142.97-144.33 m)

MP Depth (with Filter Sock) = 473.28' (144.33 m)

Top of Conventional Screen = 479.30' (146.09 m)

Magnetic Collar Depth = ~481.57' (~147.07 m)(Exact Location Not Recorded)

Sampling MP Depth = 483.57' (147.68 m)

300 to 600 Series Westbay® well casing adapter below the pumping port

Bottom of Conventional Screen = 489.30' (149.14 m)

PP Depth = 488.45' (149.17 m)

Packer Depth = 493.36-497.83' (150.69-152.05 m)

MP Depth (with Filter Sock) = 497.83' (152.05 m)

Water Table = 439.82' (134.06 m; measured 9/10/02 just before Westbay casing installation)

Top of Upper Bentonite Seal = 467' (142.3 m)

Top of Upper 30/70 Sand = 472' (143.9 m)

Top of 10/20 Sand = 475' (144.8 m)

Top of Lower 30/70 Sand = 496' (151.2 m)

Top of Lower Bentonite Seal = 498' (151.8 m)

Top of 10/20 Sand/Bentonite Mix = 504' (153.6 m)

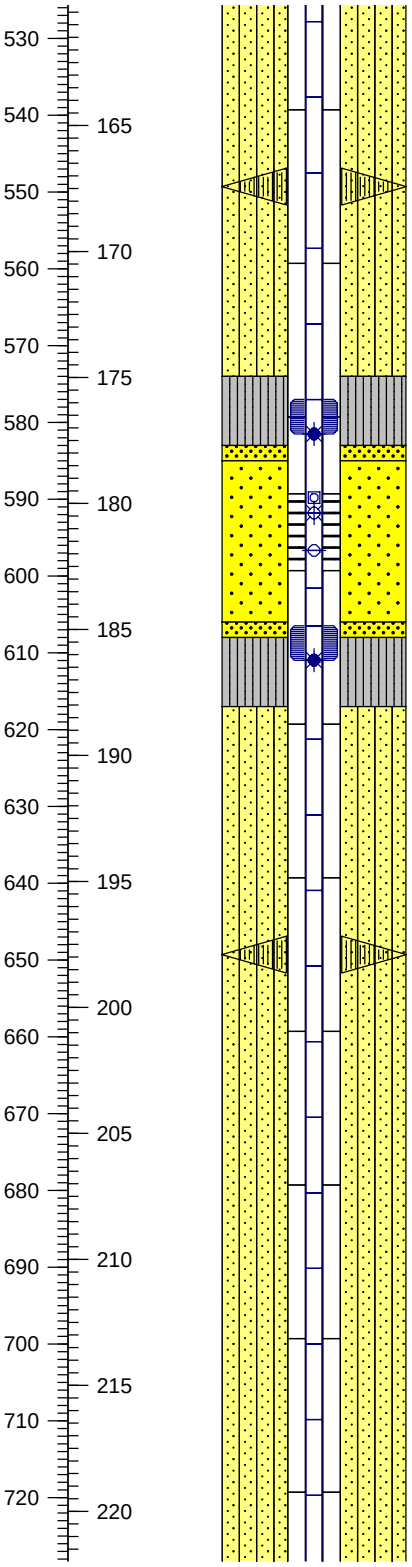
Casing Explanation:

- Surface Casing
  14" OD Steel
- Conventional Casing
  5.30" ID SCH 10 Stainless Steel
- Conventional Screen
  5.30" ID SCH 10 Stainless Steel
  0.020"-slot
- Conventional End Cap
  5.30" ID SCH 10 Stainless Steel
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Stainless steel bolted cage centralizer attached to casing at ~549.3' (~167.43 m)

Packer Depth = 577.02-581.49' (175.88-177.56 m)

MP Depth (with Filter Sock) = 581.49' (177.56 m)

Top of Conventional Screen = 589.30' (179.62 m)

Magnetic Collar Depth = ~589.78' (~180.09 m)(Exact Location Not Recorded)

Sampling MP Depth = 591.78' (180.70 m)

300 to 600 Series Westbay® well casing adapter below the pumping port

Bottom of Conventional Screen = 599.30' (182.67 m)

PP Depth = 596.66' (182.19 m)

Packer Depth = 606.49-610.96' (185.21-186.57 m)

MP Depth (with Filter Sock) = 610.96' (186.57 m)

Stainless steel bolted cage centralizer attached to casing at ~649.3' (~197.91 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 574' (175.0 m)

Top of Upper 30/70 Sand = ~583' (~177.7 m)(Exact location not measured)

Top of 10/20 Sand = 585' (178.3 m)

Top of Lower 30/70 Sand = ~606' (~184.7 m)(Exact location not measured)

Top of Lower Bentonite Seal = 608' (185.3 m)

Top of 10/20 Sand/Bentonite Mix = 617' (188.1 m)

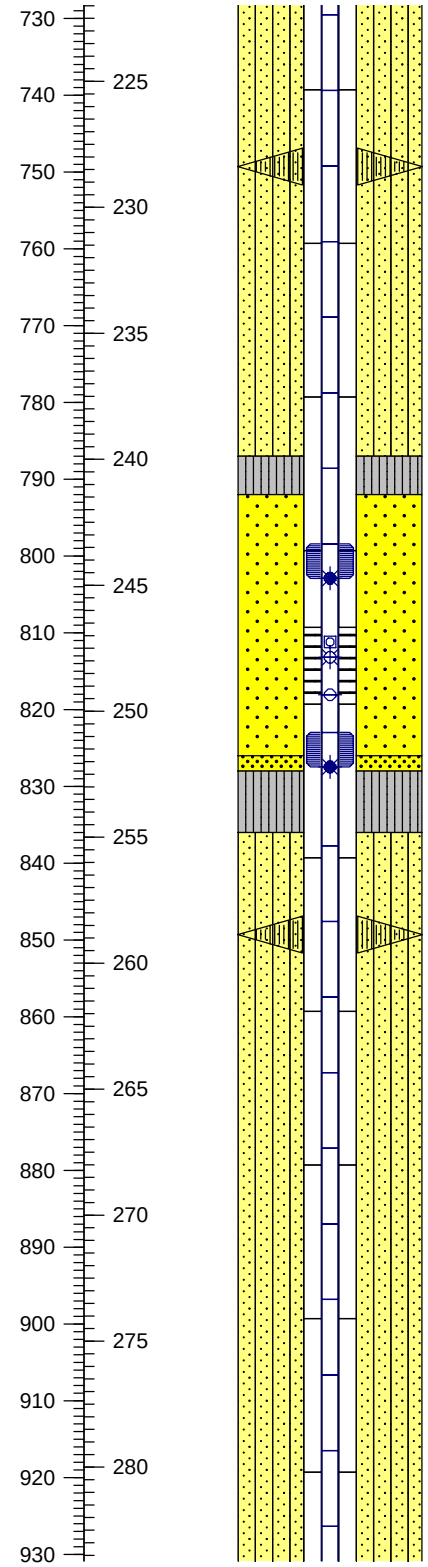
Casing Explanation:

- Surface Casing
  14" OD Steel
- Conventional Casing
  5.30" ID SCH 10 Stainless Steel
- Conventional Screen
  5.30" ID SCH 10 Stainless Steel
  0.020"-slot
- Conventional End Cap
  5.30" ID SCH 10 Stainless Steel
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Stainless steel bolted cage centralizer attached to casing at ~749.3' (~228.39 m)

Packer Depth = 798.43-802.90' (243.68-245.04 m)

MP Depth (with Filter Sock) = 802.90' (245.04 m)

Top of Conventional Screen = 809.30' (246.67 m)

Magnetic Collar Depth = ~811.19' (~247.63 m)(Exact Location Not Recorded)

Sampling MP Depth = 813.19' (248.24 m)

300 to 600 Series Westbay® well casing adapter below the pumping port

Bottom of Conventional Screen = 819.30' (249.72 m)

PP Depth = 818.06' (249.73 m)

Packer Depth = 822.98-827.45' (251.21-252.57 m)

MP Depth (with Filter Sock) = 827.45' (252.57 m)

Stainless steel bolted cage centralizer attached to casing at ~849.3' (~258.87 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 787' (239.9 m)

Top of 10/20 Sand = 792' (241.4 m)

Top of Lower 30/70 Sand = 826' (251.8 m)

Top of Lower Bentonite Seal = ~828' (~252.4 m)(Exact location not measured)

Top of 10/20 Sand/Bentonite Mix = 836' (254.8 m)

Surface Casing
14" OD Steel
Conventional Casing
5.30" ID SCH 10 Stainless Steel
Conventional Screen
5.30" ID SCH 10 Stainless Steel
0.020"-slot
Conventional End Cap
5.30" ID SCH 10 Stainless Steel
Bolted Steel Centralizers

Water Table

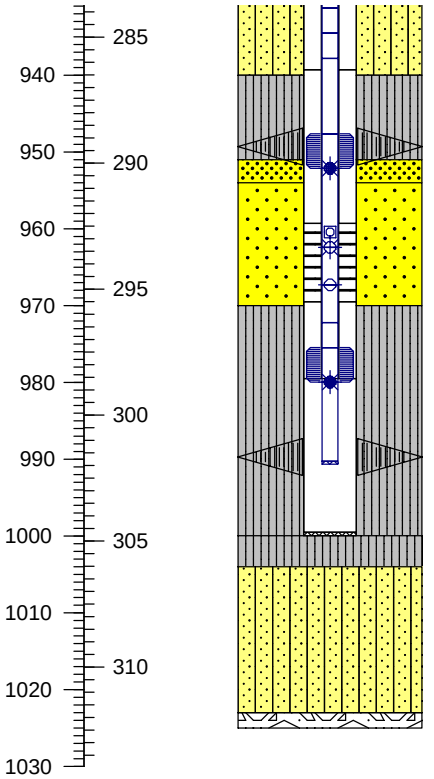
Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 947.65-952.12' (289.17-290.53 m)

MP Depth (with Filter Sock) = 952.12' (290.53 m)
Top of Conventional Screen = 959.30' (292.39 m)
Magnetic Collar Depth = ~960.41' (~292.97 m)(Exact Location Not Recorded)
Sampling MP Depth = 962.41' (293.58 m)
300 to 600 Series Westbay® well casing adapter below the pumping port
Bottom of Conventional Screen = 969.50' (295.50 m)
PP Depth = 967.29' (295.07 m)
Packer Depth = 975.48-979.95' (297.55-298.91 m)
MP Depth (with Filter Sock) = 979.95' (298.91 m)
Westbay® MP 55 Casing TD = 990.65' (301.95 m)

Stainless steel bolted cage centralizer attached to casing at ~989.7' (~301.66 m)

Conventional 5.30" ID 304L Stainless Steel Well TD = 999.95' (304.78 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 940' (286.5 m)

Top of Upper 30/70 Sand = ~951' (~289.9 m)(Exact location not measured)

Top of 10/20 Sand = ~954' (~290.8 m)(Exact location not measured)

Top of Lower Bentonite Seal = 970' (295.7 m)

Top of 10/20 Sand/Bentonite Mix = 1,004' (306.0 m)

Top of Slough = 1,023' (311.8 m) from Geophysics

12 1/4" Borehole Total Depth = 1,025' (312.4 m)

Figure 5 ST-5 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **ST-5**

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

Township and Range: **SW 1/4 SW 1/4 NW 1/4 Sec. 32, T20S, R3E**
NM State Plane Coordinates (NAD 83 in meters): **169288.64N 461195.83E**
Elevation (Brass Cap): **1359.65 m AMSL**
Elevation (Top of Casing): **1360.13 m**
Drilling Contractor: **Larjon Drilling Company**
Driller: **J. Gower, J. Clanton, D. Sanchez**
Total Depth of Borehole (bgs): **1,210' (368.81 m)**
Borehole Diameter: **12 1/4" 0-1,210'; reamed 16 1/2" 0-80'**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **389.97' (118.86 m) TOC (6/24/93)**
Total Depth Surface Casing (bgs): **80' (24.4 m)**
Diameter and Type Surface Casing: **14" OD Steel**
Date(s) Well Installed: **CW = 4/22/93 - 4/27/93; WB = 6/24/93 - 6/29/93**
Date(s) Well Developed: **CW = 4/28/93 - 6/23/93; WB = Not Recorded**

Field Representative(s): **Canavan, Contaldo, Egan, Menzie, Summers**
Total Depth Well Casing(s) (bgs): **CW: 1,200.4' (365.88 m) WB: 1,195' (364.24 m)**
Type of Casing(s): **CW = Stainless Steel; WB = MP 38 PVC**
Diameter Well Casing(s): **CW = 4" ID/4.5" OD; WB = 1.5" ID, 1.9" OD**
Casing Schedule: **10 (CW) (CW = Conventional Well WB = Westbay® Well)**
CW Screened Zone(s) (bgs): **480.1-490' (146.3-149.4 m); 650-660.1' (198.1-201.2 m); 810-820' (246.9-249.9 m); 979.9-989.9' (298.7-301.7 m); 1,170.1-1,180.1' (356.6-359.7 m)**
WB Sampling Port(s) (bgs): **485' (148.56 m); 655' (200.35 m); 815' (249.07 m); 985' (300.76 m); 1,175' (358.45 m)**
WB Packer Zone(s) (bgs): **475-495' (145.52-151.62 m); 645-665' (197.30-203.43 m); 805-825' (246.02-252.10 m); 975-995'**
Comments: **WB depths (m) calculated from piez. depths at MP's.**

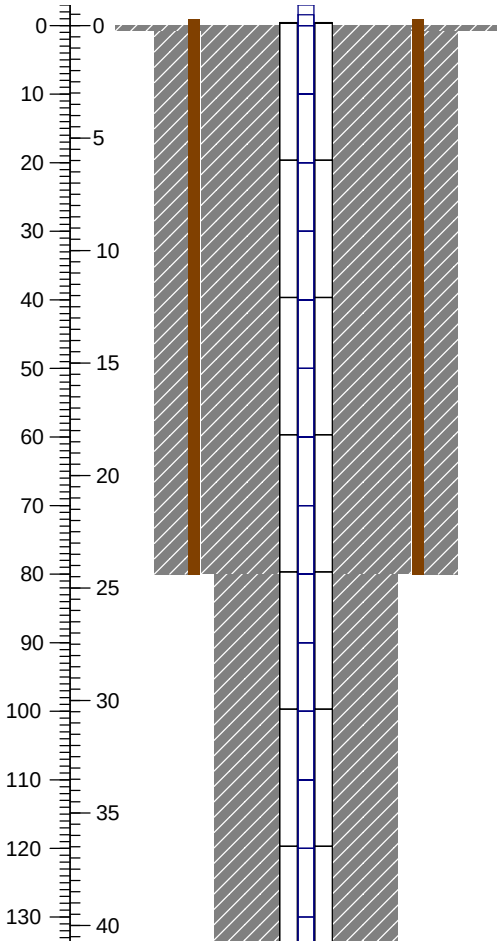
Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.6' (0.483 m)
Conventional Well Stick-Up = ~0.48' (~0.15 m). Original stick-up measured at installation was 2.38'. Casing cut to present level following installation.
Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)
Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

14" OD Steel Surface Casing Depth = 80' (24.38 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Cement Grout (Neat Cement with 5% Bentonite) = 0'

16 1/2" Borehole Cemented to 80' (24.4 m)

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

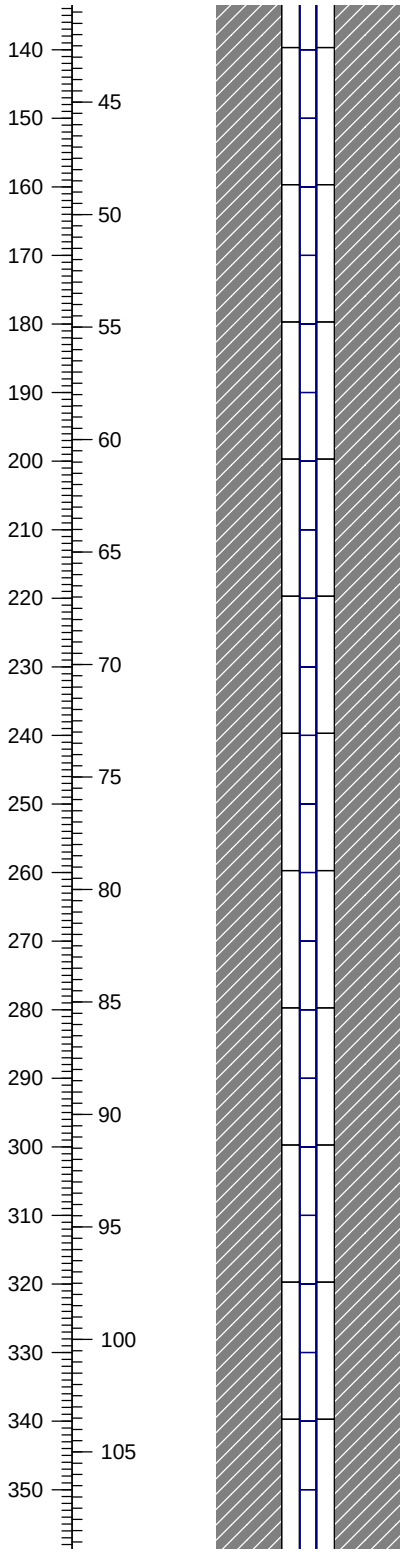
Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

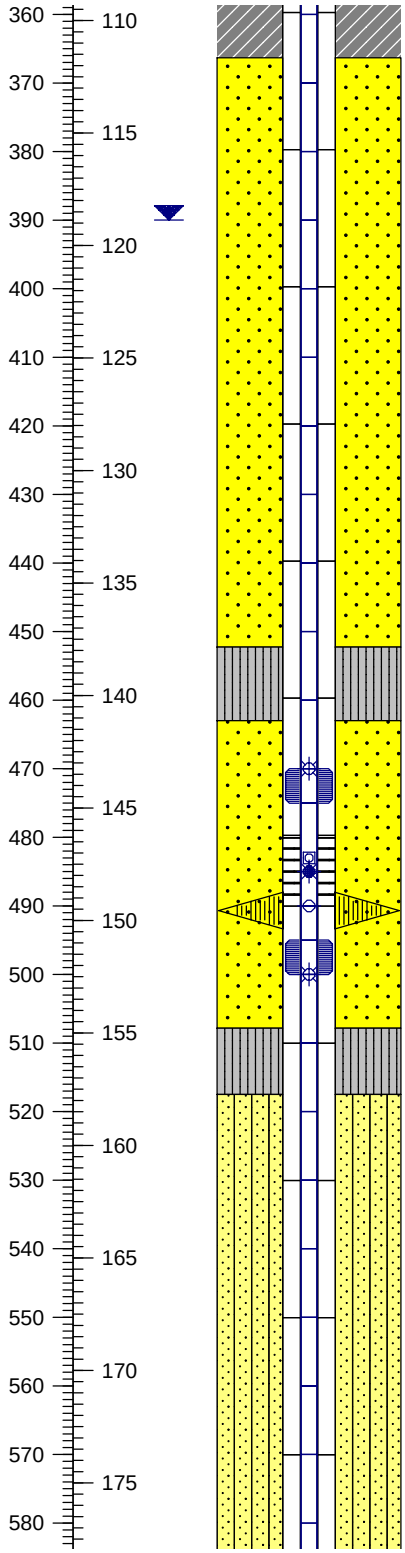
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Water Table = 389.97' (118.86 m) TOC measured 6/24/93 prior to Westbay® well casing installation.

MP Depth = 470' (144.00 m)
Packer Depth = 470'-475' (144.00-145.52 m)
Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 480.1' (146.3 m)
Crossover thread adapter on the 4" ID Schedule 10 Stainless Steel Conventional Casing = 479.7' (146.2 m)(for extra strength screens)

Magnetic Collar Depth = 484.6' (148.44 m)(0.4' above sampling MP)
Sampling MP Depth (with Filter Sock) = 485' (148.56 m)
PP Depth = 490' (150.08 m)
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 490.0' (149.4 m)
Three steel centralizers welded to casing at ~490.4' (~149.5 m) (0.4' below screen)
Packer Depth = 495'-500' (151.62-153.14 m)
MP Depth = 500' (153.14 m)

Top of 8/20 Sand = 366.3' (111.6 m)

Top of Upper Bentonite Seal = 452.3' (137.9 m)

Top of 8/20 Sand = 463' (141.1 m)

Top of Lower Bentonite Seal = 507.8' (154.8 m)

Top of 8/20 Sand/Bentonite Drilling Mud Mix = 517.5' (157.7 m)

Casing Explanation:

- Surface Casing — **14" OD Steel**
- Conventional Casing — **4" ID Stainless Steel**
- Conventional Screen — **4" ID Stainless Steel 0.020"-Slot**
- Conventional End Cap — **4" ID Stainless Steel**
- **Steel Welded Centralizers**
- Water Table
- **1.5" ID Westbay® MP 38 Casing**
- **1.5" ID Westbay® MP 38 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 8/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters

Well Descriptions All depths listed are bgs (unless noted)	Annular/Borehole Descriptions All depths listed are bgs
	Top of Upper Bentonite Seal = 620.2' (189.0 m)
	Top of 8/20 Sand = 631.8' (192.6 m)
Packer Depth = 640'-645' (195.78-197.30 m)	
Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 650.0' (198.1 m)	
Magnetic Collar Depth = 654.6' (200.23 m)(0.4' above sampling MP)	
Sampling MP Depth (with Filter Sock) = 655' (200.35 m)	
PP Depth = 660' (201.87 m)	
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 660.1' (201.2 m)	
Three steel centralizers welded to casing at ~660.5' (~201.3 m) (0.4' below screen)	
Packer Depth = 665'-670' (203.43-204.95 m)	Top of Lower Bentonite Seal = 674' (205.4 m)
MP Depth = 670' (204.95 m)	
	Top of 8/20 Sand/Bentonite Drilling Mud Mix = 688.5' (209.9 m)
	Top of Upper Bentonite Seal = 771.8' (235.2 m)
Packer Depth = 800'-805' (244.50-246.02 m)	Top of 8/20 Sand = 792.4' (241.5 m)
Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 810.0' (246.9 m)	

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

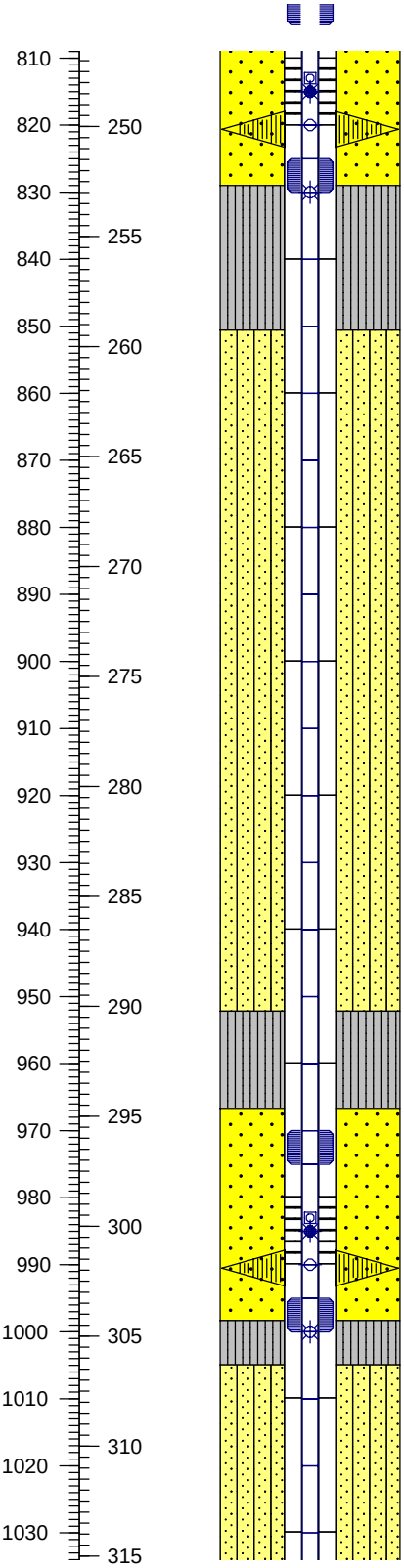
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Magnetic Collar Depth = 814.6' (248.95 m)(0.4' above sampling MP)
Sampling MP Depth (with Filter Sock) = 815' (249.07 m)
PP Depth = 820' (250.59 m)
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 820.0' (249.9 m)
Three steel centralizers welded to casing at ~820.4' (~250.0 m) (0.4' below screen)
Packer Depth = 825'-830' (252.10-253.62 m)
MP Depth = 830' (253.62 m)

Top of Lower Bentonite Seal = 829' (252.7 m)

Top of 8/20 Sand/Bentonite Drilling Mud Mix = 850.6' (259.3 m)

Top of Upper Bentonite Seal = 952.2' (290.2 m)

Packer Depth = 970'-975' (296.19-297.71 m)

Top of 8/20 Sand = 966.7' (294.7 m)

Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 979.9' (298.7 m)
Magnetic Collar Depth = 984.6' (300.64 m)(0.4' above sampling MP)
Sampling MP Depth (with Filter Sock) = 985' (300.76 m)
PP Depth = 990' (302.28 m)
Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 989.9' (301.7 m)
Three steel centralizers welded to casing at ~990.3' (~301.8 m) (0.4' below screen)
Packer Depth = 995'-1,000' (303.78-305.30 m)
MP Depth = 1,000' (305.30 m)

Top of Lower Bentonite Seal = 998.3' (304.3 m)
Top of 8/20 Sand/Bentonite Drilling Mud Mix = 1,104.9' (306.3 m)

Surface Casing
14" OD Steel
Conventional Casing
4" ID Stainless Steel
Conventional Screen
4" ID Stainless Steel
0.020"-Slot
Conventional End Cap
4" ID Stainless Steel
Steel Welded Centralizers

Water Table

Casing Explanation:

1.5" ID Westbay® MP 38 Casing
1.5" ID Westbay® MP 38 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

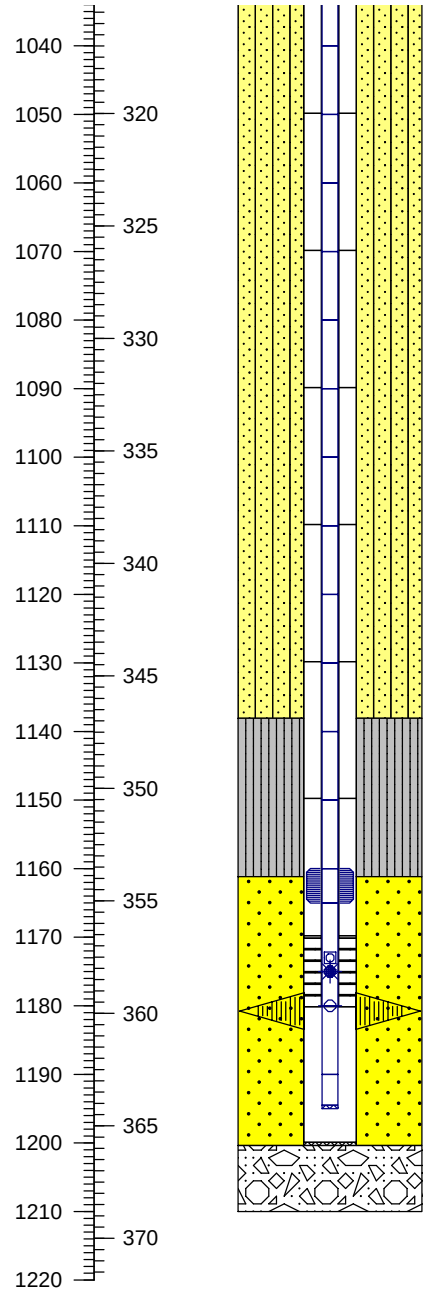
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
8/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Packer Depth = 1,160'-1,165' (353.88-355.40 m)

Top of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 1,170.1' (356.6 m)

Magnetic Collar Depth = 1,174.6' (358.33 m)(0.4' above sampling MP)

Sampling MP Depth (with Filter Sock) = 1,175' (358.45 m)

PP Depth = 1,180' (359.97 m)

Bottom of 4" ID Schedule 10 Stainless Steel 0.020" - Slot Extra Strength Screen = 1,180.1' (359.7 m)

Three steel centralizers welded to casing at ~1,180.5' (~359.8 m) (0.4' below screen)

Westbay® MP 38 Casing TD = 1,195' (364.2 m)

Conventional 4" ID Stainless Steel Well TD = 1,200.4' (365.88 m)

Top of Upper Bentonite Seal = 1,138.1' (346.9 m)

Top of 8/20 Sand = 1,161.2' (353.9 m)

Top of Slough = 1,200' (365.8 m) 4/22/93 (just prior to conventional casing installation)

12 1/4" Borehole TD = 1,210' (368.81 m)

Figure 6 WW-3 Westbay Well Completion Diagram

(SEE NEXT PAGE)

WELL COMPLETION DIAGRAM

RETROFIT WESTBAY® MONITORING WELL

Location ID: **WW-3** Site ID: **NASA-WSTF, Doña Ana County, NM**

Township and Range: **NE 1/4 SE 1/4 SE 1/4 Sec. 31, T20S, R3E**
NM State Plane Coordinates (NAD 83 in meters) **168705.18N 460826.37E**
Elevation (Brass Cap): **1354.97 m AMSL**
Elevation (Top of Casing): **1355.55 m AMSL**
Drilling Contractor: **Stewart Brothers Drilling Company**
Driller: **D. Gaddy**
Total Depth of Borehole (bgs): **1,025' (312.42 m)**
Borehole Diameter: **17 1/2" (0 - 115'); 12 1/4" (115 - 1,025')**
Depth to Bedrock (bgs): **Not Reached**
Depth to Groundwater: **~386' (~117.65 m) (4/29/01)**
Total Depth Surface Casing (bgs): **112' (34.14 m)**
Diameter and Type Surface Casing: **13 1/2" ID; 14" OD Carbon Steel**
Date(s) Well Installed: **CW = 3/1/01-3/8/01; WB = 4/27/01-4/29/01**
Date(s) Well Developed: **CW = 4/2/01 - 4/26/01; WB = Not Recorded**

Field Representative(s): **M. Canavan, G. Giles, J. Pearson, (see comments)**
Total Depth Well Casing(s) (bgs): **CW=1,014.08'; WB=1,002.78'**
Type of Casing(s): **PVC Conventional Well (CW) and Westbay® Well (WB)**
Diameter Well Casing(s): **4.75" ID / 5.5" OD (CW); 2.25" ID/ 2.9" OD (WB)**
Casing Schedule: **CW = 80 WB = MP55**
CW Screened Zone(s) (bgs): **463.8-473.8' (141.37-144.40 m); 564.7-574.7' (172.12-175.15 m); 706.0-716.0' (215.17-218.22 m); and 973.4-983.4' (296.70-299.75 m)**
WB Sampling Zone(s) (bgs): **468.78' (142.88 m); 568.84' (173.38 m); 709.91' (216.38 m); 977.28' (297.87 m)**
WB Packer Zone(s) (bgs): **458.93-478.62' (139.88-145.88 m); 560.64-578.68' (170.88-176.68 m); 704.99-719.75' (214.88-219.38 m); 964.16-987.12' (293.88-300.87 m)**
Comments: **Field Reps. cont'd: L. Hunnicutt-Mack, M. Stepro, R. Weaver**

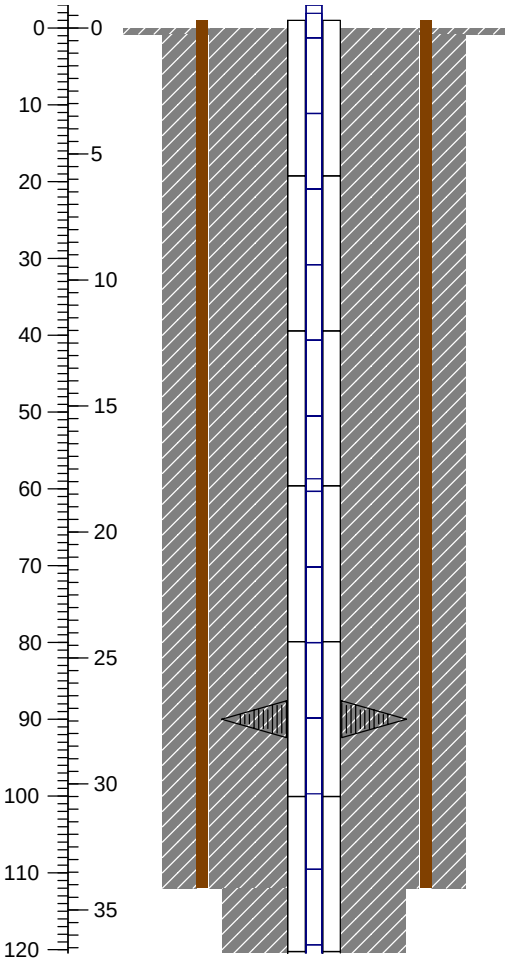
Casing Explanation:

- Surface Casing **14" OD Steel**
- Conventional Casing **4.75" ID Schedule 80 PVC**
- Conventional Screen **4.75" ID Schedule 80 PVC 0.020"-slot**
- Conventional End Cap **4.75" ID Schedule 80 PVC**
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Westbay® Well Stick-Up = ~1.92' (0.584 m)
Conventional Well Stick-Up = ~1.0' (~0.3 m)(Exact Stick-Up Not Surveyed)

Surface Casing Stick-Up = ~1' (~0.3 m)(Exact Stick-Up Not Measured or Surveyed)

Well completed with ~3' x ~3' cement pad, barrier posts, and locking steel well cap surrounding the casings above ground surface

Stainless steel bolted cage centralizer attached to casing at ~90.0' (~27.4 m)

14" OD Steel Surface Casing Depth = 112' (34.14 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Cement Grout (Portland II Cement with 5% Bentonite) = 0'

Comments continued: bgs = below ground surface; TOC = Top of Casing; Casing Depths = CW = 1,014.1' (309.09 m); WB = 1,002.78' (305.65 m); Depths (meters) for WB components and zones are based on field notes.

Geologic Formation = Santa Fe Group Alluvium 0 - 600' (0 - 182.88 m)

17 1/2" Borehole Cemented to 115' (35.05 m)

Surface Casing
14" OD Steel
Conventional Casing
4.75" ID Schedule 80 PVC
Conventional Screen
4.75" ID Schedule 80 PVC
0.020"-slot
Conventional End Cap
4.75" ID Schedule 80 PVC
Bolted Steel Centralizers

Water Table

Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

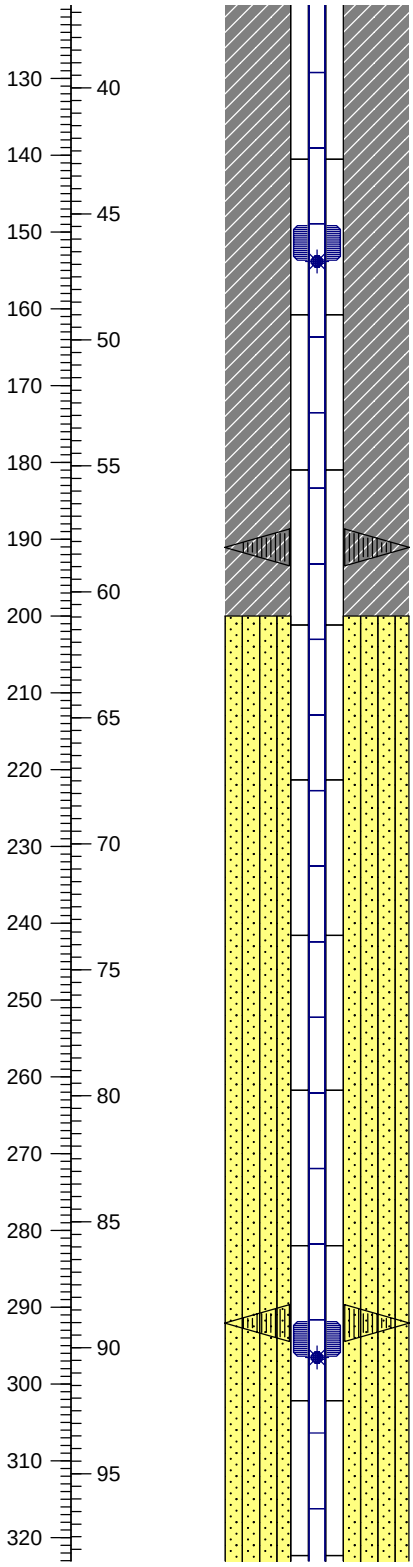
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Stabilizing Packer Depth = 148.91-153.83' (45.39-46.89 m)

MP Depth (with Filter Sock) = 153.83' (46.89 m)

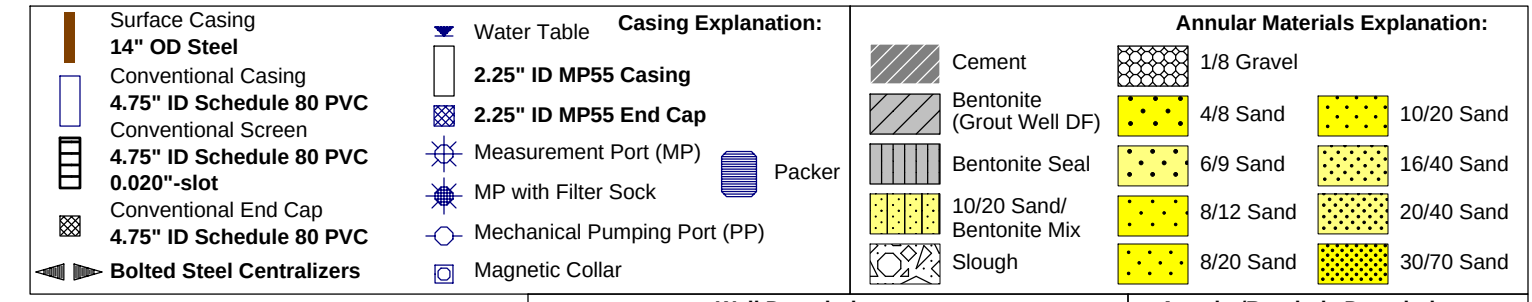
Stainless steel bolted cage centralizer attached to casing at ~191.1' (~58.2 m)

Top of 10/20 Sand/Bentonite Mix = 200' (60.96 m)

Stainless steel bolted cage centralizer attached to casing at ~292.1' (~89.0 m)

Stabilizing Packer Depth = 291.62-296.54' (88.89-90.39 m)

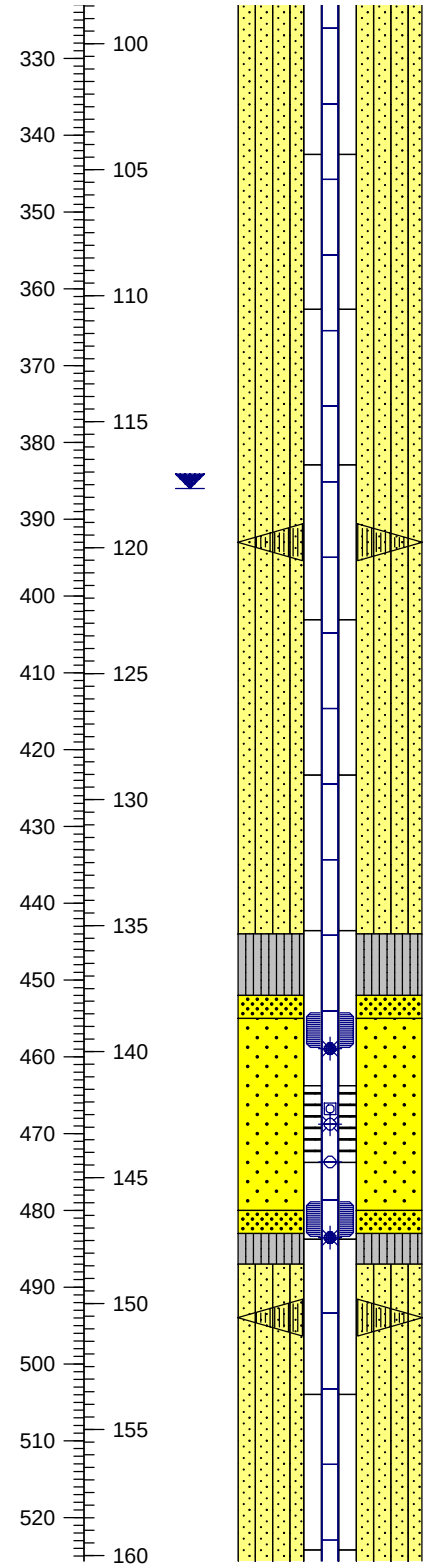
MP Depth (with Filter Sock) = 296.54' (90.39 m)



Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



Water Table = ~386' (117.7 m; measured 4/29/01 during Westbay® well casing installation; TOC)

Stainless steel bolted cage centralizer attached to casing at ~393.0' (~119.8 m)

Packer Depth = 454.01 - 458.93' (138.38 - 139.88 m)

MP Depth (with Filter Sock) = 458.93' (139.38 m)

Magnetic Collar Depth = ~466.78' (~142.27 m)(Exact Location Not Recorded)

Top of Conventional Screen = 463.8' (141.37 m)

Sampling MP Depth = 468.78' (142.27 m)

PP Depth = 473.70' (144.38 m)

Bottom of Conventional Screen = 473.8' (144.41 m)

Packer Depth = 478.62 - 483.54' (145.88 -147.38 m)

MP Depth (with Filter Sock) = 483.54' (147.38 m)

Stainless steel bolted cage centralizer attached to casing at ~494.0' (~150.6 m)

Top of Upper Bentonite Seal = 444' (135.33 m)

Top of Upper 30/70 Sand = 452' (137.77 m)

Top of 10/20 Sand = 455' (138.68 m)

Top of Lower 30/70 Sand = 480' (146.30 m)

Top of Lower Bentonite Seal = 483' (147.22 m)

Top of 10/20 Sand/Bentonite Mix = 487' (148.44 m)

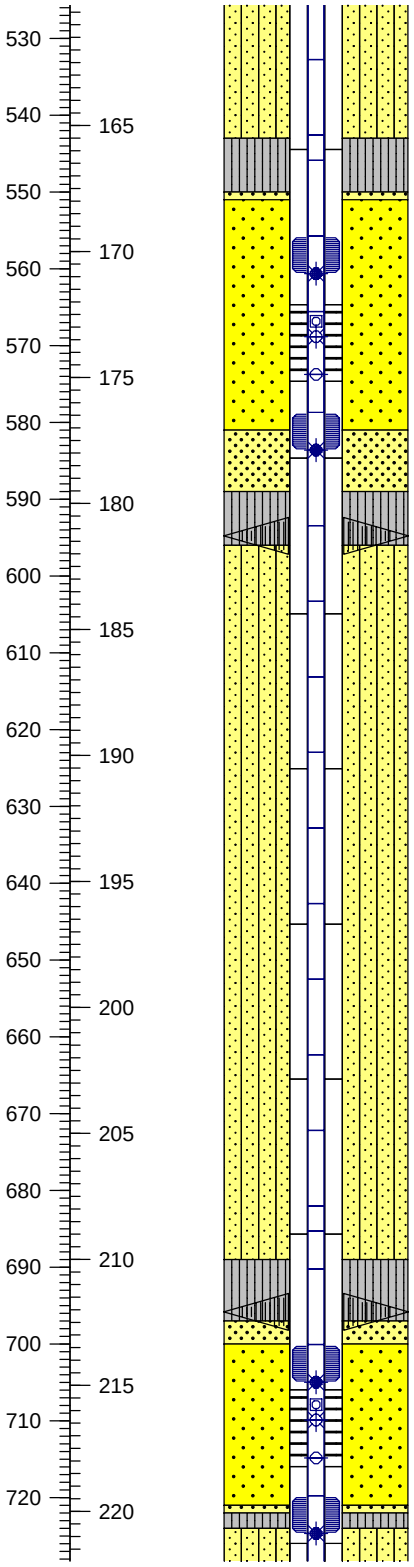
Casing Explanation:

- Surface Casing **14" OD Steel**
- Conventional Casing **4.75" ID Schedule 80 PVC**
- Conventional Screen **4.75" ID Schedule 80 PVC 0.020"-slot**
- Conventional End Cap **4.75" ID Schedule 80 PVC**
- **Bolted Steel Centralizers**
- Water Table
- **2.25" ID MP55 Casing**
- **2.25" ID MP55 End Cap**
- Measurement Port (MP)
- MP with Filter Sock
- Mechanical Pumping Port (PP)
- Magnetic Collar
- Packer

Annular Materials Explanation:

- Cement
- Bentonite (Grout Well DF)
- Bentonite Seal
- 10/20 Sand/ Bentonite Mix
- Slough
- 1/8 Gravel
- 4/8 Sand
- 6/9 Sand
- 8/12 Sand
- 8/20 Sand
- 10/20 Sand
- 16/40 Sand
- 20/40 Sand
- 30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 555.71 - 560.64' (169.38 - 170.88 m)

MP Depth (with Filter Sock) = 560.64' (170.88 m)

Magnetic Collar Depth = ~566.84' (~172.77 m)(Exact Location Not Recorded)

Top of Conventional Screen = 564.7' (172.12 m)

Sampling MP Depth = 568.84' (173.38 m)

PP Depth = 573.76' (174.88 m)

Bottom of Conventional Screen = 574.7' (175.17 m)

Packer Depth = 578.68 - 583.60' (176.38 - 177.88 m)

MP Depth (with Filter Sock) = 583.60' (177.88 m)

Stainless steel bolted cage centralizer attached to casing at ~594.8' (~181.3 m)

Stainless steel bolted cage centralizer attached to casing at ~695.8' (~212.1 m)

Packer Depth = 700.06 - 704.99' (213.38 - 214.88 m)

MP Depth (with Filter Sock) = 704.99' (214.88 m)

Magnetic Collar Depth = ~707.91' (~215.77 m)(Exact Location Not Recorded)

Top of Conventional Screen = 706.0' (215.19 m)

Sampling MP Depth = 709.91' (216.38 m)

PP Depth = 714.83' (217.88 m)

Bottom of Conventional Screen = 716.0' (218.24 m)

Packer Depth = 719.75 - 724.67' (219.38 - 220.88 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = 543' (165.51 m)

Top of Upper 20/40 Sand = 550' (167.64 m)

Top of 10/20 Sand = 551' (167.94 m)

Top of Lower 20/40 Sand = 581' (177.09 m)

Top of Lower Bentonite Seal = 589' (179.53 m)

Top of 10/20 Sand/Bentonite Mix = 596' (181.66 m)

Geologic Formation = Volcanic-Rich Santa Fe Group Alluvium 600 - 1,025' (182.88 - 312.42 m)

Top of Upper Bentonite Seal = 689' (210.01 m)

Top of Upper 20/40 Sand = 697' (212.45 m)

Top of 10/20 Sand = 700' (213.36 m)

Top of Lower 20/40 Sand = 721' (219.76 m)

Top of Lower Bentonite Seal = 722' (220.07 m)

Surface Casing
14" OD Steel
Conventional Casing
4.75" ID Schedule 80 PVC
Conventional Screen
4.75" ID Schedule 80 PVC
0.020"-slot
Conventional End Cap
4.75" ID Schedule 80 PVC
Bolted Steel Centralizers

Water Table

Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

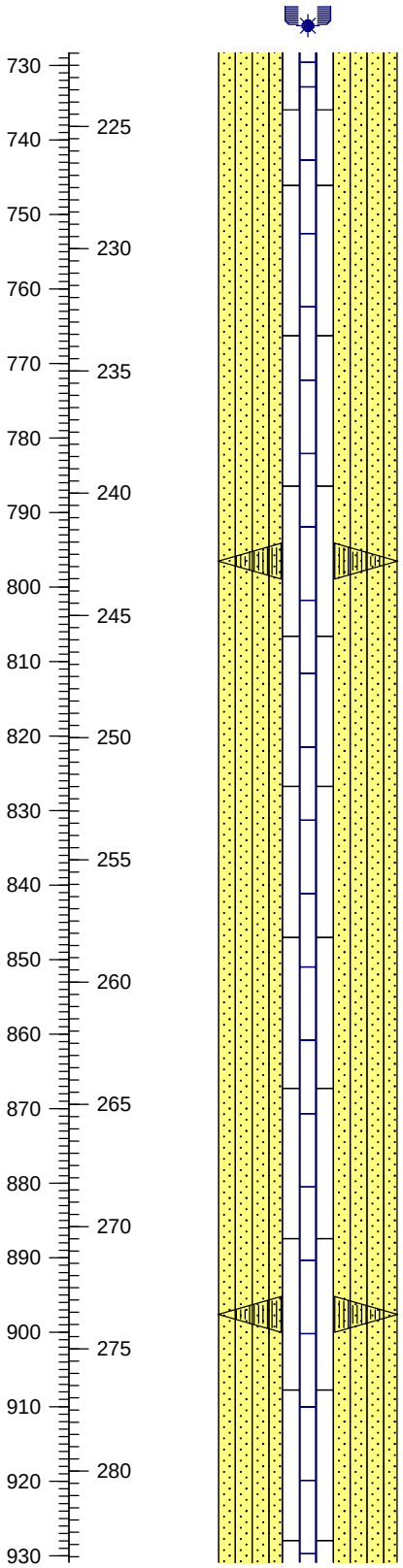
Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters

Well Descriptions
All depths listed are bgs (unless noted)

Annular/Borehole Descriptions
All depths listed are bgs



MP Depth (with Filter Sock) = 724.67' (220.88 m)

Stainless steel bolted cage centralizer attached to casing at ~796.5' (~242.8 m)

Stainless steel bolted cage centralizer attached to casing at ~897.6' (~273.6 m)

Top of 10/20 Sand/Bentonite Mix = 724' (220.68 m)

Surface Casing
14" OD Steel
Conventional Casing
4.75" ID Schedule 80 PVC
Conventional Screen
4.75" ID Schedule 80 PVC
0.020"-slot
Conventional End Cap
4.75" ID Schedule 80 PVC
Bolted Steel Centralizers

Water Table

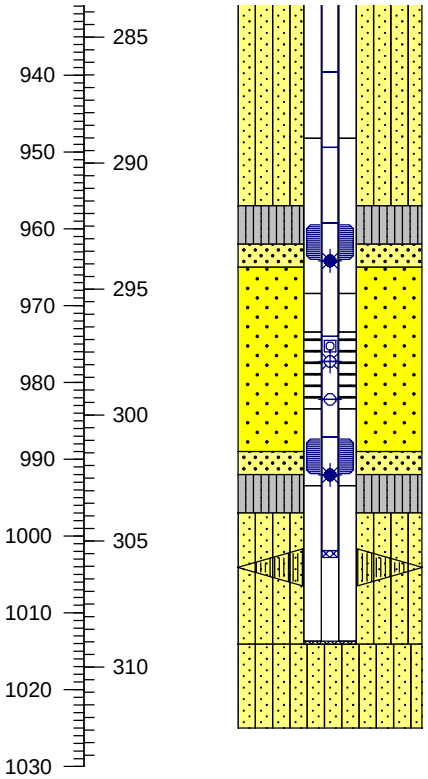
Casing Explanation:

2.25" ID MP55 Casing
2.25" ID MP55 End Cap
Measurement Port (MP)
MP with Filter Sock
Mechanical Pumping Port (PP)
Magnetic Collar
Packer

Annular Materials Explanation:

Cement
Bentonite (Grout Well DF)
Bentonite Seal
10/20 Sand/ Bentonite Mix
Slough
1/8 Gravel
4/8 Sand
6/9 Sand
8/12 Sand
8/20 Sand
10/20 Sand
16/40 Sand
20/40 Sand
30/70 Sand

Feet/Meters



Well Descriptions
All depths listed are bgs (unless noted)

Packer Depth = 959.24 - 964.16' (292.38 - 293.88 m)

MP Depth (with Filter Sock) = 964.16' (293.88 m)

Magnetic Collar Depth = ~975.28' (~297.27 m)(Exact Location Not Recorded)

Top of Conventional Screen = 973.4' (296.69 m)

Sampling MP Depth = 977.28' (297.87 m)

PP Depth = 982.20' (299.37 m)

Bottom of Conventional Screen = 983.4' (299.74 m)

Packer Depth = 987.12 - 992.04' (300.87 - 302.37 m)

MP Depth (with Filter Sock) = 992.04' (302.37 m)

Westbay® MP 55 Casing TD = 1,002.78' (305.65 m)

Stainless steel bolted cage centralizer attached to casing at ~1,004.08' (~306.0 m)

Conventional 4" 304 Stainless Steel Well TD = 1,014.1' (309.09 m)

Annular/Borehole Descriptions
All depths listed are bgs

Top of Upper Bentonite Seal = ~957' (~291.7 m)(Exact Location Not Measured)

Top of Upper 20/40 Sand = ~962' (~293.2 m)(Exact Location Not Measured)

Top of 10/20 Sand = 965' (294.13 m)

Top of Lower 20/40 Sand = ~989' (~301.4 m)(Exact Location Not Measured)

Top of Lower Bentonite Seal = ~992' (~302.4 m)(Exact Location Not Measured)

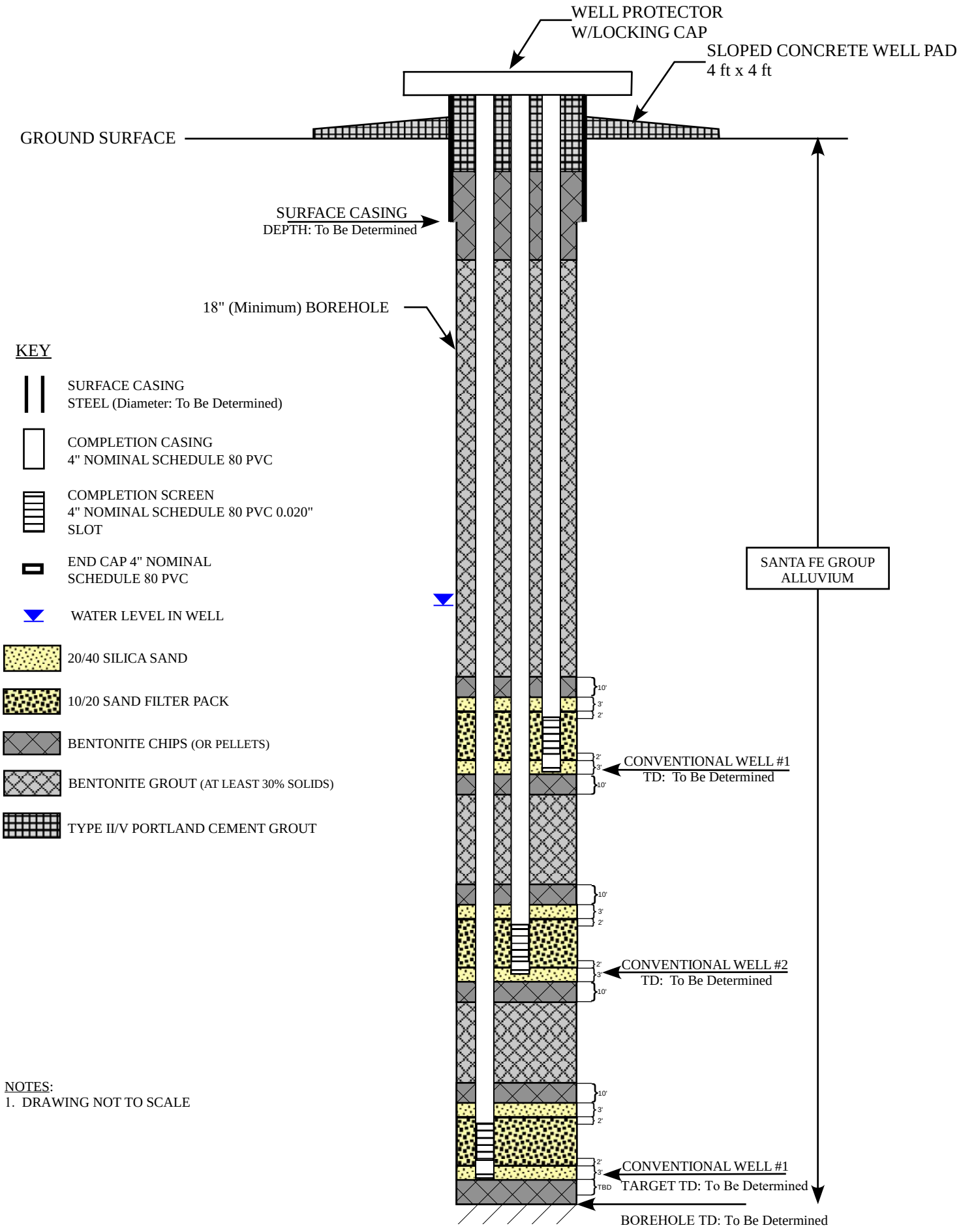
Top of 10/20 Sand/Bentonite Mix = 997' (303.89 m)

Slough not measured

12 1/4" Borehole TD = 1,025' (312.42 m)

Figure 7 Conventional Nested Well Design

(SEE NEXT PAGE)



NOTES:
1. DRAWING NOT TO SCALE

WELL DIAGRAM: CONVENTIONAL NESTED WELL EXAMPLE