ISSUED

DOE/WIPP-16-3567

BASIC DATA REPORT FOR DRILL HOLE AEC-7R (C-3635)

June 2016

Big Guns Installs Surface Casing at AEC-7R

EXECUTIVE SUMMARY

AEC-7R (permitted by the New Mexico State Engineer as C-3635) was drilled and completed from August 11, 2013 to August 27, 2013. The purpose of this well is to provide hydrological information about the Culebra Dolomite Member of the Permian Rustler Formation in an area north-east of the Waste Isolation Pilot Plant (WIPP) facility. AEC-7R is located in section 31, T21S, R32E, in eastern Lea County, New Mexico and was drilled to a total depth (TD) of 891 feet (ft..) below ground level (bgl), based on driller's measurements. The Rustler, Dewey Lake, and Gatuña Formations as well as Mescalero caliche and dune sands were encountered while drilling underneath the caliche pad. AEC-7R was drilled from surface to 141 ft.. bgl with air and then a mist of fresh water and foam was used until TD was reached. Geophysical logs were acquired from AEC-7R before casing was set.

No returns or geophysical data were recovered for the Los Medaños, which was left.. undifferentiated. The Culebra dolomite, which is the monitored member of the Rustler formation, extends from 876 to 856 ft.. bgl. No cuttings were collected from M-3 or the M-4; however, the geophysical log showed a normal stratigraphic sequence consisting of A-2 (856-838 ft.), M-3 (838-814ft.), A-3 (814-744 ft.) in order of deposition. The Magenta Dolomite is 28 ft. thick (744-716 ft.) according to geophysical logs, which is normal for the member. The Forty-niner is represented by a sequence of A-4 (716-698 ft.), M-4 (698-686 ft.), A-5 (686-655 ft.) in order of deposition. Rustler and Dewey Lake contact each other at 655 ft., which appears as a sharp change on the geophysical logs. The Dewey Lake is 549 ft. thick (655-106 ft.) with all three depositional sequences visible on the geophysical logs. Santa Rosa is present from 106-20 ft., which is overlain by five ft. (20-15 ft.) of Gatuña, three ft. (15-12 ft.) of Mescalero caliche, and twelve ft. (12-0 ft.) of sacrificial dune deposits and well pad material.

AEC-7R was drilled with an original diameter of 11.625 inches to the depth of 891 ft. for completion. Fiberglass reinforced plastic (FRP) casing (4.438 inches inside diameter) was placed in the hole with a screened interval (875-855 ft.) across the Culebra Dolomite. Sand was placed in the annulus from total depth to 845 ft., followed by bentonite from 845-833 ft. and Portland type II cement was then added from 833 ft. to the surface.

The first water level recorded by Regulatory and Environmental Services (RES) was measured September 9, 2013, with an initial depth to water of 614.14 ft. below top of casing (TOC).

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Acronyms

amsl	Above Mean Sea Level
bgl	Below Ground Level
DOE	Department of Energy
EPA	Environmental Protection Agency
FRP	Fiberglas Reinforced Plastic
ft..	feet
In	inches
MOC	Management and Operating Contractor
O.D.	Outer Diameter
RES	Regulatory and Environmental Services
SBDC	Stewart Brothers Drilling Co.
SNL	Sandia National Laboratories
TOC	Top of casing
WIPP	Waste Isolation Pilot Plant

Note: All depths are referenced as below ground level unless stated otherwise.

Figure 1-1: AEC-7R Well Pad Configuration

1.0 INTRODUCTION

AEC-7R was drilled in the section 31, T21S, R32E, in eastern Lea County, NM (Fig. 1-1, 1-2). This location places the drill hole north-east of the WIPP site center, and outside the WIPP boundary. AEC-7R was started on August 11, 2013, and completed August 27. This well will be used to monitor groundwater levels in the Culebra Dolomite Member of the Permian Rustler Formation for WIPP in an area of low transmissivity. AEC-7R was permitted by the NM State Engineer as C-3635. Official correspondence regarding permitting and regulatory information must reference this permit number. Most drill holes at WIPP have been described aft.er completion to provide an account of the geology, hydrology, and other basic data acquired during drilling and immediate completion of the drill hole. In addition, the basic data report provides an account of the drilling procedures and activities that may be helpful to later interpretations of data or for further work in the drill hole, including test activities and eventual plugging and abandoning activities. The basic data report also provides a convenient means of reporting information about administrative activities necessary to drill the hole.

1.1 Purpose of WIPP

WIPP is a U.S. Department of Energy (DOE) facility disposing of mixed transuranic waste, byproducts of U.S. defense programs, as certified by the U.S. Environmental Protection Agency (EPA), and under a hazardous waste facility permit issued by the NM Environment Department.

WIPP is located approximately 33 miles east of Carlsbad, New Mexico, in eastern Eddy County (Fig. 1-1). Disposal panels are being excavated in the Permian Salado Formation at a depth of about 2,150 ft..

1.2 Purpose of AEC-7R

AEC-7R serves as a replacement well for AEC-7, which was plugged due to its deteriorating casing and the large amounts of debris in the bottom of the well. Numerous tests were attempted on this well, but were never completed due to this sediment fowling up the equipment.

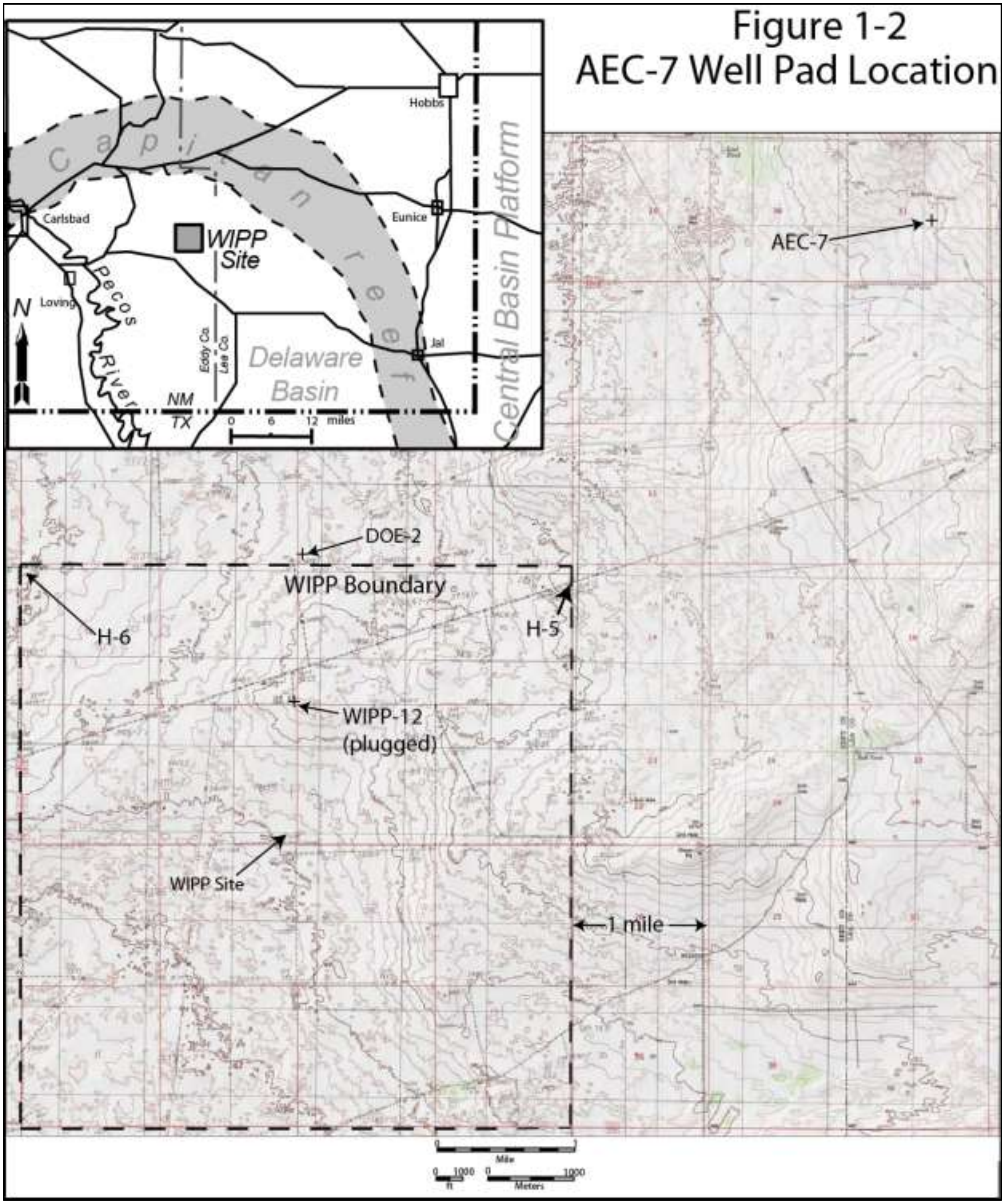


Figure 1-2
AEC-7 Well Pad Location
Hobbs
Carlsbad
Eunice
WIPP
Site
Loving
Pecos
River
N
Eddy Co.
Lea Co.
Delaware
Basin
Jal
NM
TX
0 6 12 miles
Central Basin Platform
Capitan reef
AEC-7
DOE-2
WIPP Boundary
H-6
H-5
WIPP-12
(plugged)
WIPP Site
1 mile
Mile
1000
ft
1000
Meters

1.3 Drilling and Completion

The basic information about drilling and completion of AEC-7R is presented in tabular form (Table 1-1) and graphics (Figs. 1-3, 1-4) for ease of reference. Appendix A includes details based on daily drilling logs.AEC-7R was drilled with air to a depth of 141 ft.. and reached a total depth of 891 ft.. by misting fresh water and foam. There was no borehole lost due to backfill. Cutting recovery was fairly consistent throughout the drilling process except for a lack of return over M-3 and M-4. Geophysical logging was concluded at 879 ft.

In keeping with the recent practice at WIPP, AEC-7R was cased with FRP casing rather than steel to provide longer utility of the well for monitoring and testing. Steel-cased wells at WIPP are expected to be plugged and abandoned, and where necessary, replaced with wells completed with FRP casing.

AEC-7R was completed with a single screened interval across the Culebra Dolomite for monitoring (Fig. 1-3, 1-5, 1-6) on August 26, 2013. With a single completion interval, some of the difficulties associated with multiple intervals can be avoided: expense of buying, placing, and maintaining packers; loss of water-level data when packers fail; mixing of waters of different quality when packers fail; and increased complexity of testing in a well completed to multiple intervals. No wells completed to other intervals have been proposed for the AEC-7R well pad.

Geophysical logs from AEC-7R, especially natural gamma and electric logs, were used to make the final decision regarding completion of AEC-7R (Fig. 1-3) (Appendix E). The drill hole penetrated the uppermost part of the Los Medaños, and the bottom of the Culebra screen was placed at 875 ft.. The top of the screen, at 855 ft., is just above the top of the Culebra. Gravel (6/9) pack was added to the annulus from 891-845 ft., which is in the A-3 in the Tamarisk. Bentonite was placed from 845-833 ft., and the annulus above the bentonite was cemented to the surface to prevent mixing of waters from the Magenta and Culebra.

The surface configuration (Fig. 1-4) provides stability, security, and ready access to the casing for measurement, sampling, or other testing. The surface benchmark is an accessible reference point for future measurements if the well configuration is changed.

A steel surface conductor casing was cemented in place to a depth of 30 ft. below the surface, with the top of the surface casing (3660.41 ft. amsl) 3.15 ft. above pad level (3657.26 ft. amsl) (Fig. 1-5). benchmark control point placed at the drilling pad has an elevation of 3657.00 ft. amsl (survey plat dated December 22, 2015). The FRP casing projects 2.72 ft. above the surveyed gl (Fig. 1-4), and provides the reference point and reference elevation (3659.98ft. amsl) for monitoring water levels.

1.4 Well Development

Following completion of drilling activities, well development began on August 27, 2013, with a few bailing runs. Air lifting was the primary development method, which began on August 28, 2013 and ended on September 4, 2013. Development was completed with a specific gravity of 1.067 g/gm^3.

The first water level recorded by Regulatory and Environmental Services (RES) was measured September 9, 2013; the initial depth to water was 614.14 ft. below top of casing.

1.5 Other Background

AEC-7R was drilled by Stewart Brothers Drilling Co. (SBDC), PO Box 2067, Milan NM, 87021, under contract from Nuclear Waste Partnership (NWP). Geophysical logging was conducted by Al Henderson, Jet West Geophysical Services, LLC, 2550 La Plata Highway, Farmington, NM, 87499-3522, under contract to SBDC .

Formal color designations (e.g., 5YR 5/4: weak red) included in the text and Appendix C are based on the 2000 edition of the Munsell Soil Color Charts. The names may differ from the general color observed; cuttings are compared dry unless otherwise specifically noted.

Figure 1-3: Well AEC-7R Construction and Lithology. Only depths to scale.

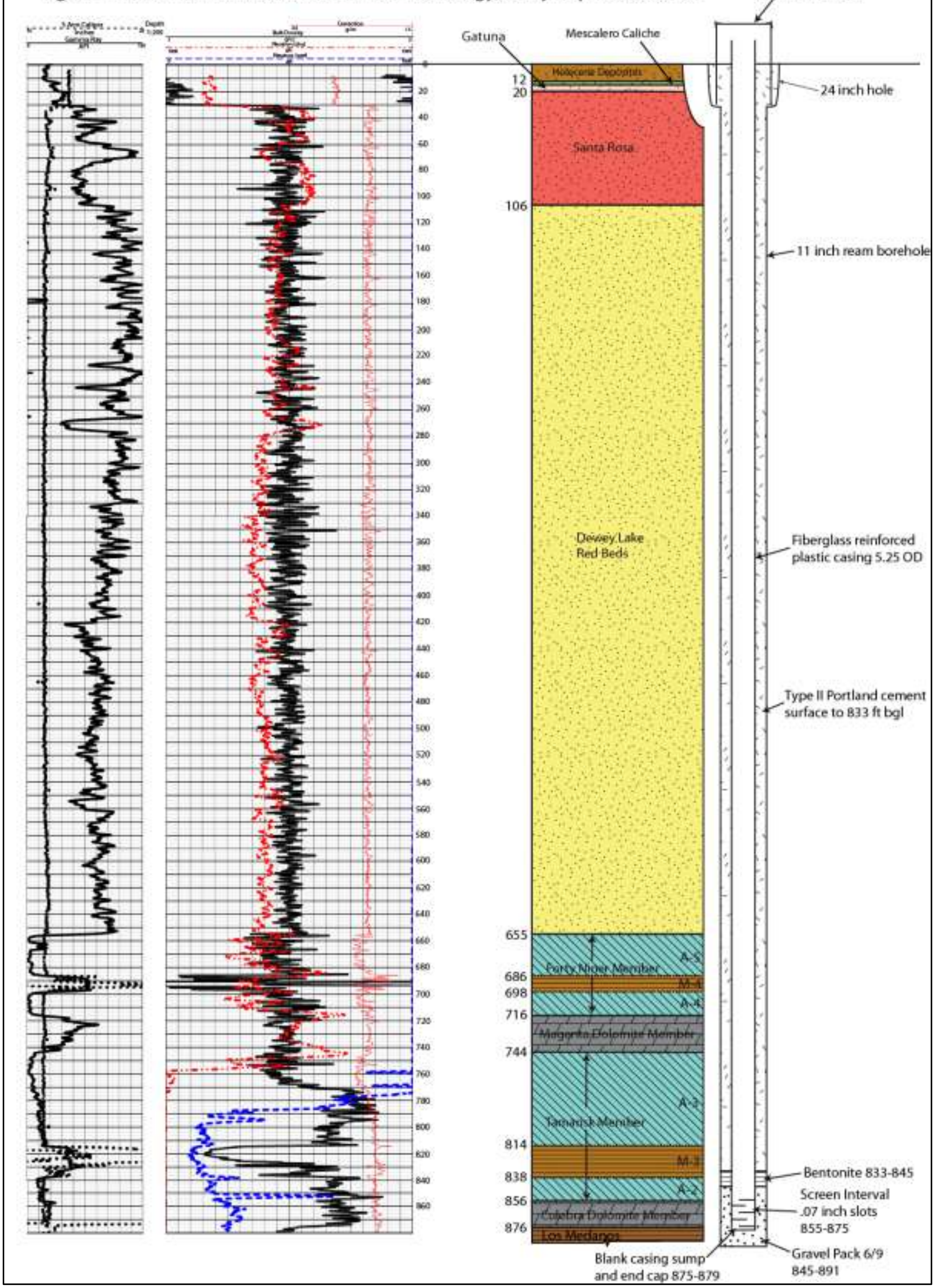


Table 1-1. Summary of Drilling and Well Completion Records for Hydrologic Drill hole AEC-7R (C-3635)

LOCATION: SE ¼ , NE ¼ , SE ¼ , Section 31, Township 21S, Range 32E

SURFACE COORDINATES: The New Mexico State Plane (NAD 27) horizontal coordinates in ft. are 523088.41 North, 732952.66 East. Latitude and Longitude are as follows in NAD 83: 32.436743812 and -103.712001268.

ELEVATION: All depths from geological and geophysical data used for completion were measured from ground level (3657.26 ft. amsl) (Fig. 1-4). The Control Point is set at an elevation of 3657.00. The specified point for data retrieval marked on the FRP was surveyed at 3659.98 ft. amsl. Figures 1-3 and 1-4 show the as-built configuration of AEC-7R.

DRILLING RECORD:

Dates: Geophysical logging was conducted on August 23, 2013, aft.er total depth was achieved at AEC-7R. Plugging of AEC-7 was completed on September 7, 2013. SBDC began drilling AEC-7R August 11, 2011; drill hole reached total depth (891 ft., driller's measurement) on August 22. AEC-7R was cased on August 24, 2011 and final cementation was completed on August 27, 2011.

Circulation Fluid: AEC-7R was drilled to 141 ft. with air and then switched to water and foam mist until TD.

Rig and Drilling Contractor: Stewart Brothers Drilling Co., PO Box 2067, Milan NM, 87021

Table 1.1 continued

Drill hole Record

Size (inches)	From (ft.)	To (ft.)
24	0	30
11.625	30	891

Casing Record

Outside Diameter (inches)	Inside Diameter (inches)	Material	From (ft.)	To (ft.)
13.44	12.824	Steel H-40	-3.15	30
5.313	4.438	FRP Blank	-2.72	855
5.313	4.438	FRP Screen	855	875
5.313	4.438	FRP Blank with end cap	875	879

Note: When casing was inserted into the drill hole, the extra two foot of blank was pressed into the caved in material at the bottom.

Figure 1-4
AEC-7R Surface Configuration and Elevation

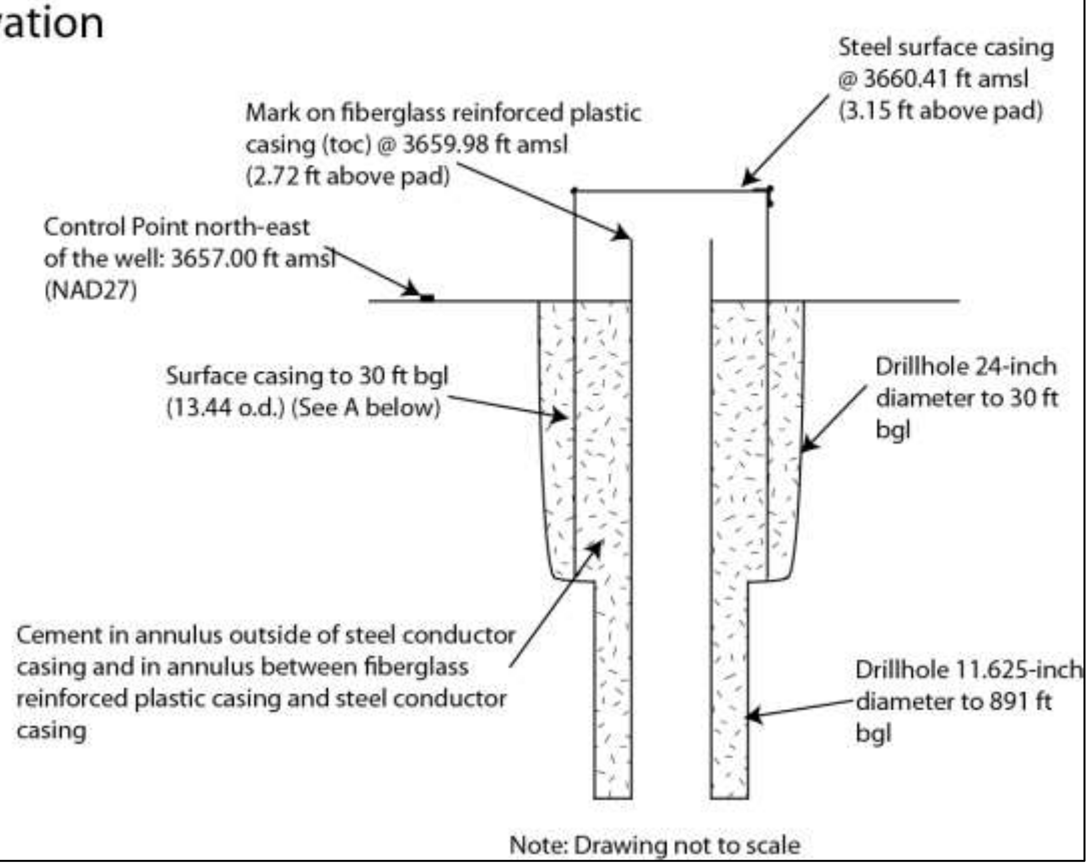


Figure 1-5: .07 Inch Screen Interval

Figure 1-6: FRP

Fig 1-7: AEC-7R Casing Information

Fig 1-8: SBDC Installs casing and centralizers at AEC-7R.

2.0 GEOLOGICAL DATA

2.1 General Geological Background

The geology and hydrology of formations at the WIPP site and surroundings have been intensively investigated since 1975, and the information and interpretations have been reported in numerous documents. The most thorough compilation is certainly the Compliance Certification Application submitted in 1996 by the DOE to the EPA (U.S. DOE, 1996). Some salient features of the broader geological history, as well as more recent work on the geohydrology of the Rustler (e.g., Holt and Yarbrough, 2002; Powers, 2002a, 2003a; Powers and others, 2003), are relevant to understanding the geology and hydrology at AEC-7R.

The Delaware Basin (Fig. 1-1) was a large structural feature that controlled deposition through much of the Paleozoic. By late Permian, the basin connection to the open ocean was restricted, and evaporite minerals were precipitated in abundance to fill the basin. Near the end of the Permian, circulation with the ocean improved, and some of the Rustler Formation, for example, was deposited in saline water rather than brine. As the Permian ended and Triassic began, significant redbeds were deposited in non-marine environments. Although surrounding areas accumulated variable thicknesses of later Mesozoic and Cenozoic age sediments, the WIPP area appears mainly to have been subject to erosion during an extended period. Some basin tilting from middle to late Cenozoic time exposed the evaporite beds to faster solution and erosion, and weathered material began to accumulate. The Pecos River drainage became integrated through the region during this period, and more recent deposits reflect such a sedimentary environment as well as sources of sediment from outside the local area. Although the region continues to be subject to some dissolution of evaporites and erosion, large areas have remained geologically stable for about the last half million years, resulting in the formation and preservation of pedogenic calcrete (caliche) deposits.

2.2 Geological Data from AEC-7R

AEC-7R encountered a normal stratigraphic sequence from ground level to total depth for this location north-east of the WIPP site (Fig. 1-1). Units encountered ranged from the upper portion of the Los Medaños Member of the Permian Rustler Formation up to the unconsolidated surface dune deposits. Sedimentary properties were characterized through the use of borehole cuttings and geophysical logs.

The geologic units encountered in AEC-7R are described from total depth to the surface, in the order in which they were deposited rather than in the order in which they were encountered in the drill hole. Cuttings were described in the field using mainly drilling depth and speed. Geologic logs detailing field observations of cuttings are included in Appendix B. The difference between geophysical log and drilling depth is generally slight. Decisions about placing screen intervals and annulus fillings were based on depths indicated by geophysical logs (Appendix D).

2.2.1 Permian Rustler Formation

The Permian Rustler formation contains the Los Medaños, Culebra, Tamarisk, Magenta and Forty-Niner members. The contact between the Rustler and the overlying Dewey Lake occurs at 665 ft.. TD was reached at 891 ft. aft.er penetrating 236 ft. of the Permian Rustler Formation.

2.2.1.1 Los Medaños Member

The Los Medaños was named by Powers and Holt (1999) based on the rocks described in shafts at the WIPP site. For the area around WIPP, studies of the Rustler have commonly referred to this interval from the base of the Culebra Dolomite Member to the top of the Salado Formation as the unnamed lower member of the Rustler. Holt and Powers (1988) and Powers and Holt (1999) also informally subdivided the Los Medaños into five units: a bioturbated clastic interval at the base, a sandy transition zone, a lower mudstone-halite 1 (M-1/H-1), anhydrite 1 (A-1), and an upper mudstone-halite 2 (M-2/H-2). Halite margins for the Los Medaños below A-1 have been treated as a single composite unit (Powers, 2002a), called M-1/H-1, because halite below A-1 is not restricted to the thinner zone designated M-1/H-1 in these earlier publications.

The Los Medaños was encountered from 876-891 ft.. This depth is estimated from drill rate due to no geophysical log or cutting returns.

2.2.1.2 Culebra Dolomite Member

Based on geophysical logs the Culebra cuttings are marked for a depth of 876-856 ft.. The total thickness of the Culebra Member is 20 ft..

The Culebra is composed of 10YR 7/1 (light gray) (Fig2-1) dolomite which is well consolidated. The rock is vuggy, meaning it contains cavities or voids, making it porous medium for water flow. A large amount of gypsum is also present in this unit.

Fig 2-1: Culebra Dolomite at 862 ft.

2.2.1.3 Tamarisk Member

The natural gamma log of AEC-7R shows that the Tamarisk occurs from 856-744 ft.. The Tamarisk comprises three different informal sub-units: a lower anhydrite (A-2), a middle halite or mudstone (H-3/M-3), and an upper anhydrite (A-3); all three are easily distinguishable on the geophysical log.

The informal unit *anhydrite 2* (A-2) (Fig 2-2) at the base of the Tamarisk is 18 ft. (856-838 ft.) thick based on the geophysical log. This unit is composed of 2.5 YR 5/1 (reddish gray) fine crystalline, very well consolidated material with very low porosity and contains gypsum flakes.

The informal unit *mudstone 3* (M-3) at AEC-7R is 24 ft. (838-814 ft.) thick based on the geophysical logs. Minor amounts of mudstone were recovered. The mudstone was 5 YR 5/4 (reddish brown), very fine grained, well sorted and consolidated, with gypsum present.

The informal unit *Anhydrite 3* (A-3) at AEC-7R is 70 ft. (814-744 ft.) thick according to the geophysical log. The A-3 layer is composed mainly of 2.5 Y 7/1 (light gray) anhydrite (Fig 2-3) consisting of a very well consolidated crystalline matrix with very low porosity and gypsum flakes.

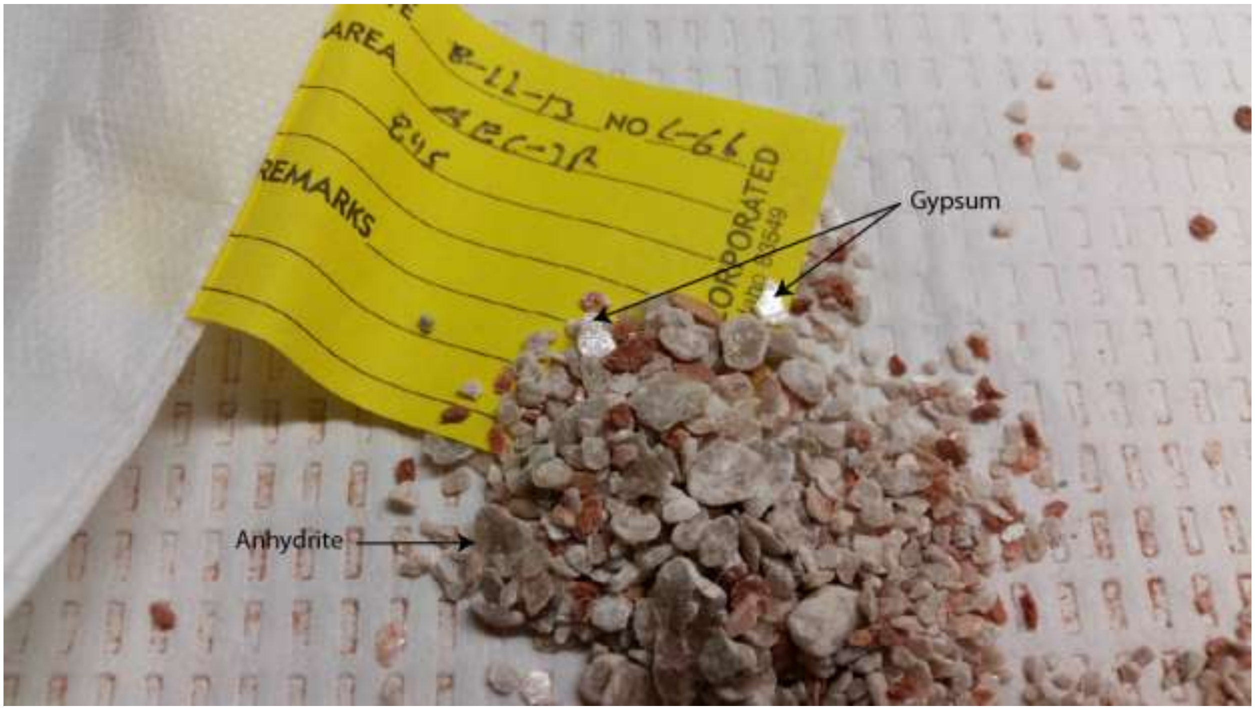


Fig 2-2: A-2 at 845 ft.

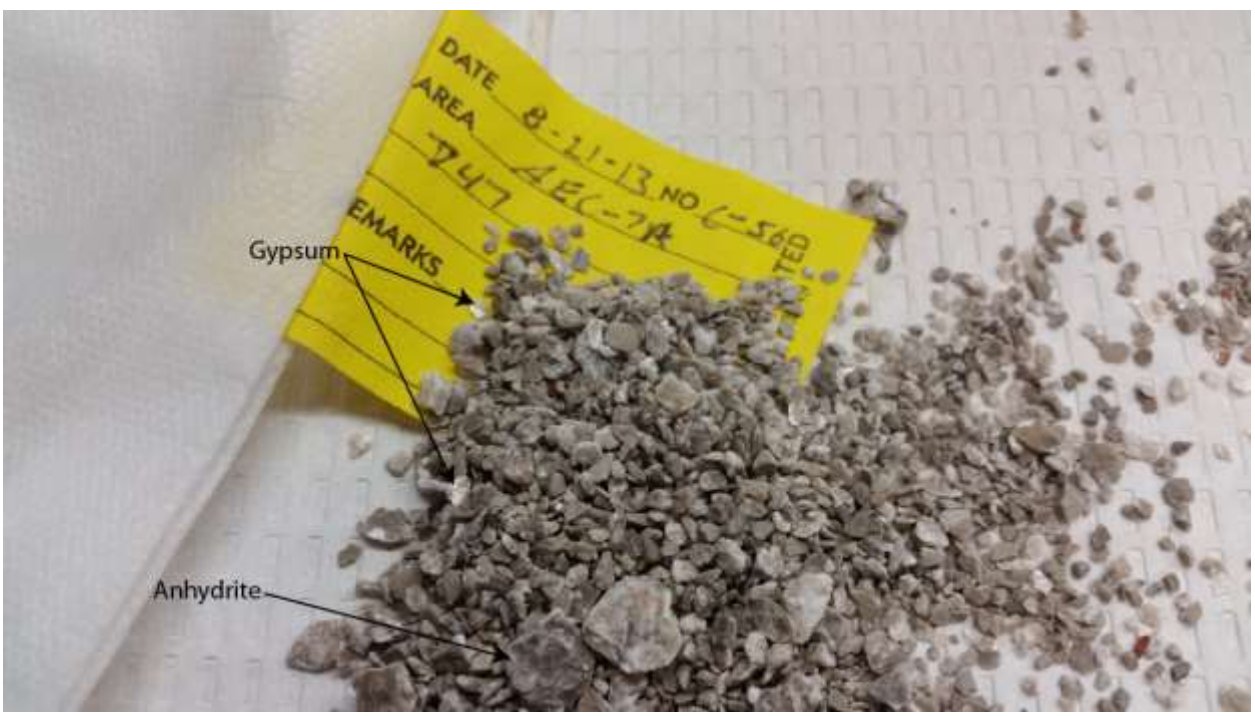


Figure 2-3: A-3 at 747 ft.

2.2.1.4 Magenta Dolomite Member

Based on geophysical logs, the Magenta at AEC-7R is 28 ft. (744-716 ft.) thick, which is a normal thickness for the member. Cuttings (Fig 2-4) at 640 ft. consist of 2.5 YR 7/1 (light gray) micro-crystalline dolomite that is moderately consolidated with the presence of gypsum.

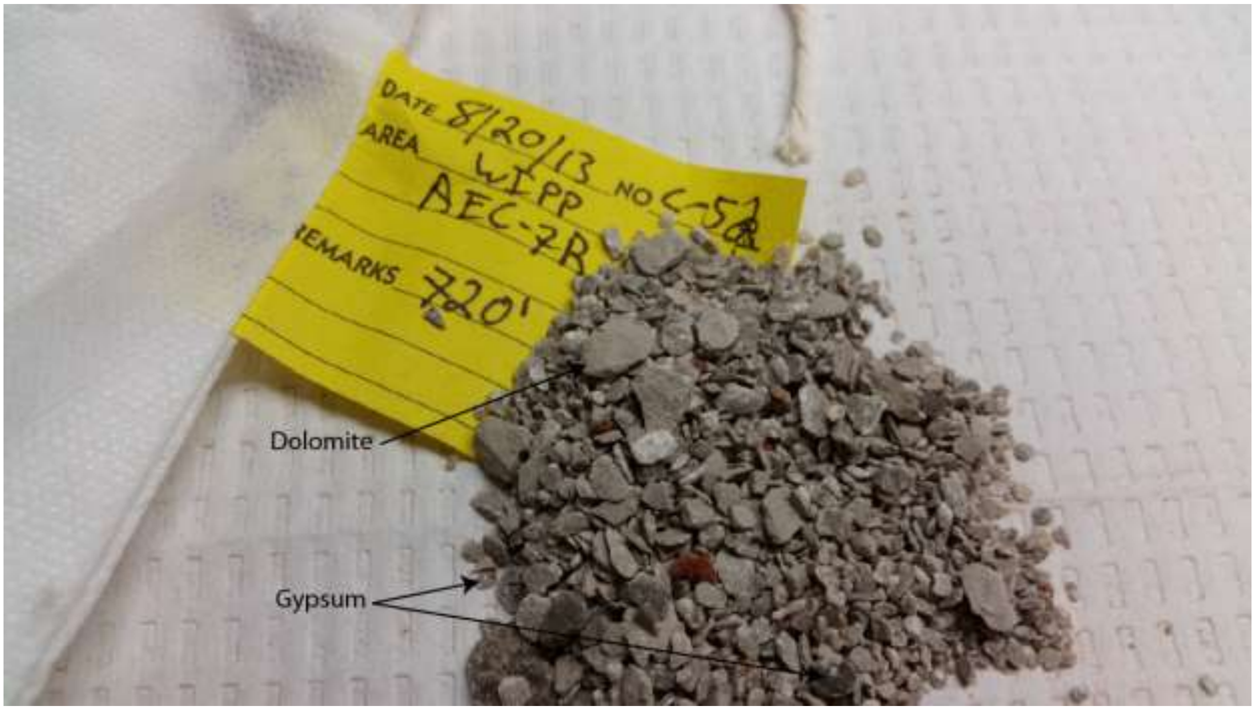


Fig 2-4: Magenta Dolomite at 720 ft.

2.2.1.5 Forty-niner Member

Based on geophysical logs, the Forty-niner at AEC-7R is 61 ft. thick (716-655 ft.). Like the Tamarisk, the Forty-niner consists of upper and lower anhydrites with a middle unit that is a mudstone at AEC-7R. Powers and Holt (2000) informally designated these units as A-4, M-4/H-4, A-5 from bottom to top. They attributed the relationship between the clastic beds (M-4) and halite (H-4) to be depositional facies of mudflat-saline and mudflat-saltpan environments.

The lower anhydrite (A-4) is 18 ft. (716-698 ft.) thick and its color is 2.5 Y 5/1 (gray). A-4 is a very well consolidated crystalline matrix with low porosity and gypsum flakes; the middle mudstone (M-4) is 12 ft. (698-686 ft.) thick and no cutting returns were recovered from this layer.

The upper anhydrite (A-5) (Fig 2-5) is 31 ft. (686-655 ft.) and is the same as A-4 except for a decreased amount of gypsum.

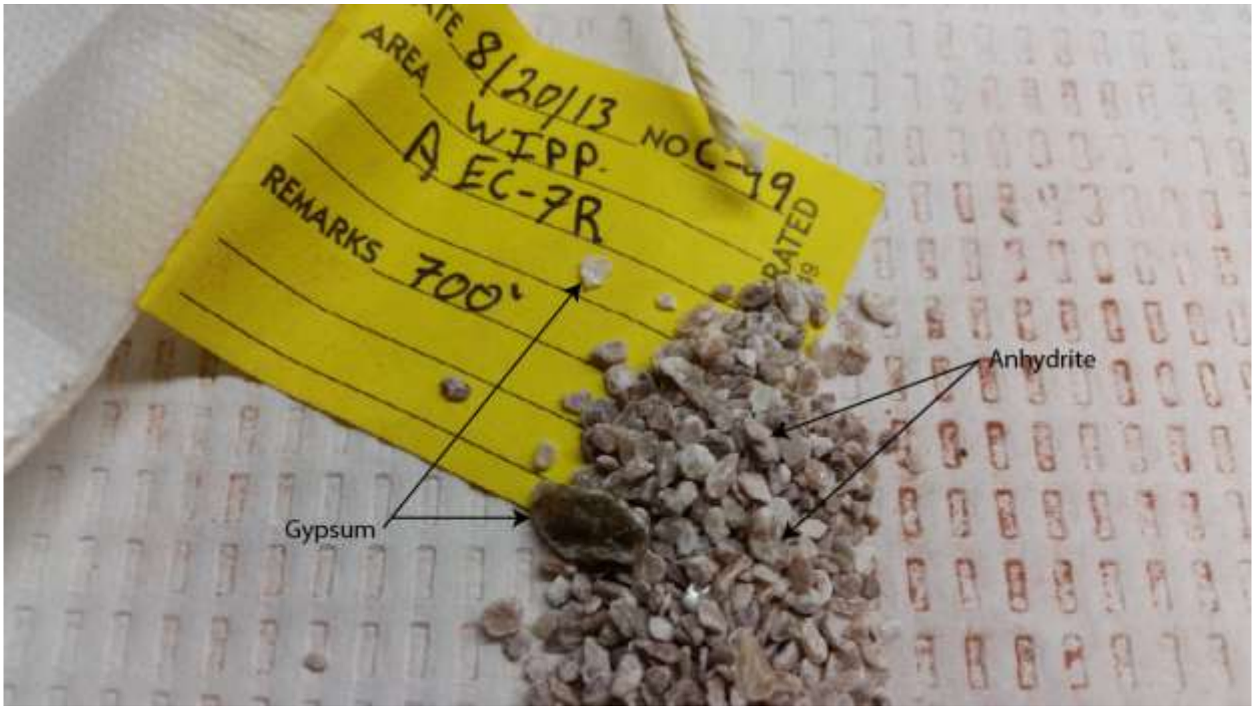


Fig 2-5: A-4 at 700 ft.

2.2.2 Permo-Triassic Dewey Lake Formation

The Dewey Lake Formation has most commonly been assigned to the Permian System (e.g., Hills and Kottlowski, 1983), although there is no direct evidence, either paleontological or radiometric, of age in the vicinity of WIPP. More recently, Renne and others (1996, 2001) obtained radiometric (Ar-Ar) ages from ash beds near the base of lithologically equivalent red beds (Quartermaster Formation) in the Texas panhandle. These ages show that the basal Quartermaster is Permian, but most of the formation is early Triassic in age. Although lithologic contacts are not inherently isochronous, the particular relationships of evaporites to red beds suggest that the Dewey Lake is mainly Triassic in age (e.g., Schiel, 1988, 1994; Powers and Holt, 1999). Lucas and Anderson (1993) have asserted that the Quartermaster, and Dewey Lake, are Permian in age, but more recent direct evidence supersedes their discussion.

At AEC-7R, the Dewey Lake is 549 ft. (655-106 ft.) thick based on geophysical logs, and is composed mainly of 2.5 YR 4/3 (reddish brown) to 7.55 YR 7/2 (pinkish gray) sandstone ranging from coarse to very fine sand sized grains (Fig 2-6, 2-6). Material is well to very well sorted and mostly well consolidated (Fig 2-7). Material varies from calcic to non-calcic throughout the formation with most cuttings containing varying amounts of iron oxides, gypsum, and reduction material. Most of the grains are sub-angular to sub-rounded and sub-equant.

Fig 2-6: Dewey Lake at 420 ft.

Fig 2-7: Dewey Lake at 142 ft.

Geophysical logs can be partially interpreted to indicate different basic sedimentary regimes as well as porosity conditions (e.g., Doveton, 1986). The following information follows the basic template developed for a study of the Dewey Lake hydrology.
All three depositional regimes for the Dewey Lake can be readily distinguished on natural gamma logs of AEC-7R.

The interval from 655-420 ft. in AEC-7R displays the natural gamma features of the basal bedded zone (Powers 2003b). Natural gamma fluctuates around a similar value (~90 API) over this vertical interval. A low in natural gamma indicates the top of this zone.

The interval from 420-194 ft. is marked by a generally increasing gamma above thinner low gamma intervals. These features are interpreted as an interval of fining-upward cycles because of increasing natural gamma (Doveton, 1986; Powers, 2003b).
The interval from 194-106 ft. has a decreasing gamma trend, which consists with coarsening upward material. This interpretation is proposed by Powers (2003b).

2.2.3 Mesozoic Santa Rosa Formation

At many locations, the Santa Rosa formation exhibits channels, overbank deposits and large scale cross-bedding. A common interpretation is that the Santa Rosa is a fluvial deposit that drained to the east-northeast into a low area, forming deltaic deposits.

Cuttings from the Santa Rosa in this location are 86 ft. thick (106-20 ft.) and composed of sandstone ranging from 2.5 YR 4/4 (weak reddish brown) to 2.5 YR 7/3 (pale reddish brown). The sandstone varied from fine grained to sub-angular coarse grained sand. Both varieties were well sorted and consolidated with moderate porosity. The coarse grained material was clast supported calcic material with mica flakes and iron oxides, while they were missing in the fine grained non-calcic cuttings.

Fig 2-8: Santa Rosa at 50 ft.

2.2.4 Miocene-Pleistocene Gatuña Formation

Based completely on cuttings from drilling the surface casing hole, the Gatuña is approximately 5 ft. (20-15 ft.) thick at AEC-7R. The Gatuña is primarily 5 YR 8/3 (pale pink) calcareous sandstone. The material is clast supported with a caliche matrix, well consolidated, well sorted, and low porosity with sub-rounded grains.

Fig 2-9: Gatuña at 15 ft.

2.2.5 Pleistocene Mescalero Caliche

The Mescalero is an informal soil stratigraphic unit defined by Bachman (1973). It is widespread in southeastern New Mexico, and it is a continuous stratigraphic unit at the WIPP site. Uranium-disequilibrium ages indicate the Mescalero formed as a pedogenic unit between ~570,000 (± 100,000) and about 420,000 (±60,000) years ago (Rosholt and McKinney, 1980). The age is further bounded by the Lava Creek B ash, about 600,000 years old, which underlies the Mescalero along Livingston Ridge (Izett and Wilcox, 1982).

At this location the Mescalero is a 3 ft. thick (15-12 ft.) 7.5 YR 8/2 (pinkish white) sandstone that is moderately consolidated and composed of a very fine calcareous matrix which supports coarse grain sized silicate material. The material is well sorted with sub-angular grains and porosity that varies from moderate to low depending on cementation.

2.2.6 Surficial Deposits

From the surface down, drillers encountered 6 inches of pad material and then 11.5 ft. of surficial sand deposits. 5 YR 5/6 (yellowish red) sandstone is mostly unconsolidated with a few poorly consolidated pebbles and is highly porous.

3.0 REFERENCES

Bachman, G.O., 1973, Surficial Features and Late Cenozoic History in Southeastern New Mexico: U.S. Geological Survey Open-file Report USGS-4339-8, 22p.

Doveton, J.H., 1986, Log Analysis of Subsurface Geology: John Wiley & Sons, New York, NY, 273 p.

Hills, J.M., and Kottlowski, F.E. (coordinators), 1983, Southwest/Southwest Mid-Continent Region: American Association of Petroleum Geologists, Correlation Chart Series.

Holt, R.M. and Powers, D.W., 1988, Facies Variability and Post-Depositional Alteration Within the Rustler Formation in the Vicinity of the Waste Isolation Pilot Plant, Southeastern New Mexico: WIPP DOE 88-004, U.S. Department of Energy, Carlsbad, NM, 88221

Holt, R.M., and Yarbrough, L., 2002, Analysis Report, Task 2 of AP-088, Estimating Base Transmissivity Fields. Copy on file in the Sandia National Laboratories WIPP Records Center under ERMS 523889.

Izett, G.A., and Wilcomx, R.E., 1982, Map Showing Loyalties and Inferred Distribution of the Huckleberry Ridge, Mesa Falls and Lava Creek Ash Beds in the Western United States and Southern Canada: U.S. Geological Survey, Miscellaneous Investigations Map I-1325, Scale 1:4,000,000.

Lucas, S.G., and Anderson, O.J., 1993, Stratigraphy of the Permian-Triassic Boundary in Southeastern New Mexico and West Texas, *in* Hawley, J.W., and others, eds., Geology of the Carlsbad Region, New Mexico and West Texas: 44th NMGS Fall Field Conference Guidebook, NM Geological Society, Socorro, NM, p. 219-230.

Powers, D.W., 2002a, Analysis Report, Task 1 of AP-088, Construction of Geologic Contour Maps. Copy on file in the Sandia National Laboratories WIPP Records Center under ERMS 522085.

Powers, D.W., 2003a, Addendum 2 to Analysis Report Task 1 of AP-088, Construction of Geologic Contour Maps. Copy on file in the Sandia National Laboratories WIPP Records Center under ERMS 522085.

Powers, D.W., 2003b, Test Plan, TP 02-05 Geohydrological Conceptual Model for the Dewey Lake Formation in the Vicinity of the Waste Isolation Pilot Plant (WIPP): Sandia National Laboratories.

Powers, D.W., and Holt, R.M., 1999, The Los Medaños Member of the Permian Rustler Formation: *New Mexico Geology*, v. 21, no. 4, p. 97-103.

Powers, D.W., and Holt, R.M., 2000, The Salt That Wasn't There: Mudflat Facies Equivalents to Halite of the Permian Rustler Formation, Southeastern New Mexico: *Journal of Sedimentary Research*, v. 70, no. 1, p. 29-36.

Powers, D.W., Holt, R.M., Beauheim, R.L., and McKenna, S.A., 2003, Geological Factors Related to the Transmissivity of the Culebra Dolomite Member, Permian Rustler Formation, Delaware Basin, Southeastern New Mexico, *in* Johnson, K.S., and Neal, J.T., eds., Evaporite Karst and Engineering/Environmental Problems in the United States: Oklahoma Geological Survey Circular 109, p. 211-218

Renne, P.R., Steiner, M.B., Sharp, W.D., Ludwig, K.R., and Fanning, C.M., 1996, $^{40}Ar/^{39}Ar$ and U/Pb SHRIMP Dating of Latest Permian Tephras in the Midland Basin, Texas: *EOS*, Transactions, American Geophysical Union, v. 77, p. 794.

Renne, P.R., Sharp, W.D., Montañez, I.P., Becker, T.A., and Zierenberg, R.A., 2001, $^{40}Ar/^{39}Ar$ Dating of Later Permian Evaporites, Southeastern New Mexico, USA: *Earth and Planetary Science Letters*, v. 193, p. 539-547.

Rostolt, J.N., McKinney, C.R. 1980, Uranium Series Disequilibrium Investigations Related to the WIPP Site, New Mexico Part II: Uranium Trent Dating of Surficial Deposits and Gypsum Spring Deposit near WIPP Site, New Mexico: U.S. Geological Survey Open-file Report 80-879, p. 7-16.

Schiel, K.A., 1988, The Dewey Lake Formation: End Stage Deposit of a Peripheral Foreland Basin [unpublished M.S. Thesis]: El Paso, TX, University of Texas at El Paso, 181 p.

Schiel, K.A., 1994, A New Look at the Age, Depositional Environment and Paleogeographic Setting of the Dewey Lake Formation (Late Permian?): *West Texas Geological Society Bulletin*, v. 33, no. 9, p. 5-13.

U.S. Department of Energy, 1996, Title 40 CFR Part 191 Compliance Certification Application for the Waste Isolation Pilot Plant: DOE/CAO-1996-2184, U.S. Department of Energy, Carlsbad, NM.

Appendix A

Abridged Borehole History

Note: The abridged drill hole history provided here has been compiled from the daily records produced by Regulatory and Environmental Services (RES).

8-8-13

SBDC arrives at the WIPP site for the kick start/safety meeting at 0800. Once SBDC and RES personnel arrived on the AEC-7 pad at 0843 a pre job safety meeting was performed. 0935 equipment inspections commence. A cover for the mud pump was added. The doghouse was cleaned, forklift. maintenance occurred, and the trucks were repaired. At 1357 the mud supply truck arrived in case it was needed. Repairs and equipment unloading continued. 1918 Rig arrives. The site was cleared and the CMR called at 1930.

8-9-13

SBDC arrives on drill site at 0654 and a pre job safety meeting is conducted. TFH arrives with the first two frac tanks at 0820 followed by the two compressors. Big Guns Rathole and Foundation out of Hobbs arrives to install the surface casing at 0858. The surface casing hole was completed at 1022. TFH delivered the third frac tank at 1050. The cement to complete the surface casing arrives at 1255 and is set at 1304. 1419 SBDC begins prepping rig to drill. Pad work stopped and CMR called at 1715.

8-10-13

SBDC arrives on well pad at 0657 and a pre-job meeting is conducted followed by general drilling prep. The surface casing is cut off at 0800. TFH arrives with two fresh water trucks at 0843, but the tank has a leaky valve. At 0955 SBDC begins to move the rig into place and attaches monkey board. TFH arrives to repair the valve and unload the water trucks. At 1057 the rig is in place with plastic placed below. SBDC rigged up over AEC-7R at 1451. The flow nipple was installed and the roll offs moved into place. At 1645 the drillers platform was installed and roll offs were sealed. More plastic was laid down and the compressors moved into place at 1723. SBDC left. the pad at 1928 and the CMR was notified.

8-11-13

SBDC arrives on site at 0648 and a pre-job was conducted at 0652. Final rig preparations began at 0655 and the roll offs were lined. Randy Stewart arrived on site at 0922 to do a walk around and noticed a galvanized joint being used. The drill crew replaced the valve and measured collars. At 1216 SBDC began to trip in collars. Drilling began at 1327 at a depth of 31 feet bgl. Drilling was stopped at 118 ft. bgl and CMR called at 1919.

8-12-13

SBDC arrives on well pad at 0652 and a safety briefing is conducted at 0658. Trip in began at 0726 and the hole was blown out at 0734. No fill in was found in the bottom of the hole. At 0747 drilling was resumed at a depth of 118 ft. bgl. Drilling was paused at 0839 141 ft. bgl in order to switch from air to mist and foam and drilling was resumed at 0956. Drilling was stopped at 300 ft. bgl. Sticks were tripped out at 1900 and SBDC left. the pad at 1914. CMR was called and notified.

8-13-13

The casing arrives on site at 0650 along with SBDC. A pre-job was conducted at 0658. The casing was unloaded and the water pump was switched from the bean pump to the hydraulic pumps due to a missing safety guard on the bean pump. At 1206 a sump pit was dug, a railing was installed on the stairs, the roll offs were pumped out and the bean pump was tagged out. Tripping in began at 1258 and drilling was resumed at 1341. At 1826 SBDC hit 380 ft. bgl and tripped out. SBDC left. the pad and the CMR was called at 1908.

8-14-13

SBDC arrives on the well pad and conducts a pre-job briefing at 0703. At 0727 we tripped in and tagged bottom. There was no hole fill. Drilling began at 0759 aft.er tagging bottom at 379 ft. bgl. At 1037 it was noticed that mud was leaking out of the enclosure below the turn table so drilling was paused to reseal the openings. SBDC reached 621 ft. bgl at 1826 and began to trip out. The pad was clear of personnel and the CMR was notified.

8-15-13

0651 SBDC arrives on site and a pre-job is conducted at 0656, followed by a site walk around. Tripping in began at 0709 and drilling was resumed at 0753. The cuttings were spread in the roll offs to reduce overspray. At 656 ft. bgl rig chatter was noticed, indicating the contact with anhydrite. At 1106 SBDC reached 672 ft. bgl and circulated. Aft.er circulation the sticks were tripped out and the CMR called at 1159.

8-20-13

SBDC arrived on site at 1015 and a pre-job was performed at 1020. At 1116 TFH delivered a load of fresh water. SBDC began tripping in pipe at 1127 and resumed drilling at 1203. There was no hole loss due to fill. Drilling stopped at 1651 and pipes were tripped out from the bottom of the hole at 722. The CMR was notified at 1826.

8-21-13

SBDC crew arrived on pad and held a safety briefing at 0710 followed by tripping in at 0810. Drilling resumed at 0842. Drilling was stopped at 1801 aft.er reaching a depth of 802. SBDC finished tripping out at 1855 and the CMR was notified at 1935.

8-22-13

SBDC arrives on the pad at 0655 and a pre job is conducted at 0703. A pad walk around was completed at 0710 and the trip in began at 0731. Drilling was resumed at 0759 and stopped at 1349 aft.er reaching a TD of 891. The casing was prepared to be installed and the sticks were tripped out at 1436. At 1539 SBDC prepped the equipment for casing install and the CMR was notified aft.er all personnel left. the pad at 1649.

8-23-13

SBDC arrives on site at 0655 and conducts a pre-job briefing. At 0720 SBDC tripped in to check for hole loss and found wall swelling but no fill and then tripped out at 0825. Jet West arrived at 1043 to begin geophysical logging. The geophysical logging was set to 880 for the bottom of the hole. Logging was completed at 1648. At 1707 all hands left. the well pad and the CMR was notified at 1814 aft.er Jet West and tool pusher left..

8-24-13

SBDC arrived on site at 0648 and conducted a pre-job briefing at 0659. Stanley and the tremmi pipe arrived at 0717. SBDC tripped in to check for hole loss and none was found. Sticks were tripped out and tremmi was tripped in at 1236. Casing was tripped in at 1445. At 1915 correct casing depth was set and a bridal collar was installed. The site was secured and the CMR was called at 1937.

8-25-13

SBDC arrived on site at 0652 and a pre-job was conducted. At 0706 equipment was configured for gravel packing. Gravel packing began at 0941. The gravel pack was tagged with the tremmi pipe and found to be at 845 ft. bgl. A bentonite plug was placed in the annulus on top of the gravel pack. Bentonite was then tagged at 833. A hot plug was set 1813 with 14 wt Portland Type II cement. Tremmi was tripped out at 1831 and the CMR was notified at 1935 when all personnel were clear of the work site.

Screened Interval = 875-855 ft. (0.070 in slot)

Sand = TD to 845 ft. using 17.5 ft.^{3} of 6/9 sand

Bentonite = 845 to 833 ft. using 4 buckets HolePlug®

Cement = 833 ft. to surface.

<u>8-26-13</u>

SBDC arrived on site and held a safety briefing at 0655. At 0728 they began house cleaning. Tremmi was tripped in at 0738 and the hot plug was tagged at 760. SBDC continued cleaning the site until cement arrived at 1302. Site cleaning was resumed at 1410 and the CMR was called once the site was secured at 1611.

<u>8-27-13</u>

SBDC arrived on site at 0658 and a pre-job was conducted. Cement arrived at 0753 and had a weight of 14.8. Cleaning was resumed until a second cement truck arrived at 1541. At 1604 SBDC tripped out and cleaned the tremmi and any cement spillage. Water was tagged at 562.40. At 1648 air lifting equipment was set up. Bailing began at 1701 and paused to check water level (857 ft.) at 1801. Bailing was continued until the site was clear of personnel and the CMR was called at 1920.

<u>8-28-13</u>

SBDC arrives on pad at 0701 and holds a safety meeting. They tagged the bottom of the well at 858 and water at 580. Tremmi pipe was tripped in at 0938. At 1230 all air lifting equipment was hooked up and air lifting began. Mostly air was being produced with little water so another pipe was added. At 1313 the well was producing a fine, silty mud-like water. The production was still low so another tremmi pipe was added. 1336 air lifting resumed 6 ft. off the bottom. Aft.er circulating for 10 mins SBDC tagged bottom at 879 ft. and took a break to recharge. 1511 a pipe was removed to put the tremmi at the top of screen. At 1615 air lifting was resumed with little water production. Water was silty with a fluid density of 1.055 g/cm^3. Air lifting was continued while SBDC resumed pad clean up. At 1715 air lifting was stopped with a fluid density of 1.063 g/cm^3. At 1804 the pad was secured and CMR was contacted.

<u>8-29-13</u>

SBDC arrives on site at 0652 and performs a safety meeting. At 0710 the crew began by warming up equipment, checking hoses and general prep for the day. 0730 water level was at 648 ft. bgl. SBDC set the tremmi pipe at 714 ft. bgl and becan air lifting at 0824. The fluid density was 1.103. Compressor ran out of coolant so equipment was switched to the spare at 1104. Air lifting was resumed at 1115 and shut down at 1145 due to a dry hole. SBDC was off site at 1158 and the CMR was informed.

9-3-13

SBDC arrived on site at 1041 and a pre-job meeting was conducted. The crew set up to air lift. and began lifting at 1104. The initial water level was 624.65. The density was 1.060 before the well dried out. Lifting was paused to allow recharge and then resumed. Density was checked at 1829 and found to be 1.074. SBDC shut down lifting at 1834 and left. the site at 1847. The CMR was notified.

9-4-13

SBDC arrived on site at 0657 and a tailgate safety meeting took place. Water was tagged at 636.91 ft. bgl and air lifting began at 0724. The first density measurement was 1.063. At 0843 the final density measurement was taken with a reading of 1.067. This was .001 off the previous wells measurements. At 1000 the tremmi pipe was tripped out. The rig was broken down at 1128 and rigged down. The surface casing was removed from AEC-7 and the rig put into place at 1519. At 1615 SBDC rigged up over AEC-7 followed by moving compressors and trucks. 1803 marked the end of the day and the CMR was called.

Appendix B

Geologic Logs

Note: The field descriptions were related to depth based on drilling information and cutting recovery as best determined in the field. Sample footages are marked accordingly and can vary somewhat from depths determined for stratigraphic units based on geophysical logs. Depths used for completing the well are based on geophysical logs.

Well Cuttings Log			Page 1 of 5
Hole ID: AEC-7R		Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R32E	
Drill Date: 8-11-13 to 8-22-13 Drill Co: Stewart Brothers Drilling Company	Drilling Method: Hollow-Stem/Air Rotary Hole Diameter: 11 Inch Hole Depth: 891 Feet bgl Hole Orientation: Vertical	Drill Make/Model: NA Barrel Specs: NA Drill Fluid: NA Core Preserve: NA	
Logged by: Brett Seal	Date: 9/23/14	Scale: NA	

	Northing	Easting	Elevation (ft amsl)
Survey Coordinate (Ft):	523088.41	732952.66	3657.35

Comments: Depths to unit contacts are derived from geophysical logs. Lithology comes from cuttings.

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-1		Surficial Deposites			Mostly unconsolidated dune sands, with a few very poorly consolidated pebble sized cuttings. 5 YR 5/6 (yellowish red), well sorted rounded grains with high porosity	
C-2	10	Mescalero			Sandstone, 7.5 YR 8/2 (pinkish white) moderately consolidated and well sorted. Consists of sedimentary grains supported by a caliche matrix. Highly effervescent when exposed to HCl.	
C-3		Gatuña			Sandstone, 5 YR 8/3 (Pale pink), well consolidated, very well sorted silica grains, clast supported with a caliche matrix, highly effervescent when exposed to HCl, low porosity.	
C-4	20	Santa Rosa			Sandstone, 2.5 YR 5/6 (reddish brown) well consolidated, very well sorted, calcic cement	
	30					
C-5	40				Sandstone, 2.5 YR 4/4 (weak reddish brown), cuttings powdered, medium and fine rounded grains, very well sorted, calcareous cement, scarce mica flakes and iron oxides.	
C-6	50				Sandstone, 2.5 YR 7/3 (pale reddish brown) two varieties of sandstone are present, First is very fine grained, well sorted, non-calcic with moderate porosity. The second is coarse sand sized grains exhibiting moderate sphericity and are sub-angular, well sorted with calcic cement and low porosity, clast supported. The coarse grained rock contains iron oxides and mica flakes while the fine grained does not. Description applies to 50' and 60' samples.	
C-7	60					
	70					
C-8	80				Sandstone, 2.5 YR 6/4 (pale reddish brown), well sorted with coarse, sub-rounded, and sub-equant grains, clast supported with calcic cement and low porosity. Sparse mica flakes and more abundant iron oxides. Few fine grained cuttings from above.	
	90					
C-9	100				Sandstone, same as above with no fine grained pieces.	
	110	Dewey Lake				
C-11	120				Sample contains a lot of fall down contamination from the Santa Rosa above. New material: Sandstone, 5 YR 8/2 (pinkish white) very fine grained and very well consolidated with low porosity, calcic material with a few specs of iron ozides.	
	130					
C-13	140				Sandstone, 2.5 YR 4/4 (weak reddish brown) two varieties present. First is coarse grained, equant, sub-angular, well sorted moderately consolidated and calcic, with iron oxides and moderate porosity. Second is a fine grained well sorted sandstone with low porosity and contains reduction spots, no calcic material. Minute amounts of fiberous gypsum.	
	150					
C-15	160				Sandstone, two lithologies, 2.5 YR 3/4 (dusky red) very fine grained and well sorted, well consolidated, non-calcic. 2.5 YR 5/6 (red) medium sized well sorted grains, equant sub-rounded grains, well consolidated, non-calcic with iron oxides and reduction spots. Gypsum is present.	

Well Cuttings Log Page 2 of 5

Hole ID: AEC-7R Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-16	170	Dewey Lake			Large increase in reduction material from above. Makes up 10-15% of material.	
C-18	180				Increase in the amount of Gypsum and a reduction in the amount of reduction material.	
	190					
C-20	200				Same as sample C-15 but with reduced Gypsum and reduction material.	
	210					
C-21					Sanstone, 7.5 YR 7/2 (Pinkish Gray) coarse grained, equant , sub-angular well sorted grains slightly calcic with iron oxides, well consolidated. No gypsum present.	
C-22	220				Sandstone, 2.5 YR 3/4 (dark reddish brown) very fine grained and well sorted, well consoildated with low porosity. Iron oxides are present along with minor amounts of reduction material and gypsum.	
	230					
C-23	240				Sandstone, 2.5 YR 4/3 (reddish brown) medium grained, well sorted, sub-angular grains, well consolidated with low porosidty. Sample is slightly calcic with iron oxides present. No gypsum or reduction material present.	
	250					
C-24	260				Sandstone, 2.5 YR 4/4 (reddish brown) fine grained, very well sorted with low porosity, moderately consolidated. Sample is slightly calcic with iron oxides and contains gypsum and reduction spots.	
	270					
C-25	280				Increase in gypsum.	
	290					
C-26	300				Same as above.	
	310					
C-27	320				Sandstone, 2.5 YR 4/4 (reddish brown) medium grained, well sorted and consolidated, sub-angular grains with low porosity. Iron oxides, sparse reduction material and minor amounts of gypsum presnt. Slightly calcic.	
	330					
C-28	340				Increase in gypsum and reduction material from C-27.	
	350					
C-29	360				Increase in gypsum and reduction material from C-28.	
	370					
C-30	380				Increase in gypsum and reduction material from C-29.	

Well Cuttings Log Page 3 of 5

Hole ID: AEC-7R Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
	390					
C-31	400				Decrease in the amount of reduction material.	
	410					
C-32	420				Sandstone, 2.5 YR 4/3 (reddish brown) fine grained, very well sorted and consolidated with low porosity. Reduction spots, iron oxides and gypsum present. Sample is non-calcic.	
	430					
C-33	440				Large increase in reduction material and gypsum, and sample is calcic.	
	450					
C-34	460				No change	
	470					
C-35	480				Decrease in reduction material.	
	490	Dewey Lake				
C-36	500				No change.	
	510					
C-37	520				No Change.	
	530					
C-38	540				No Change.	
	550					
C-39	560				Sandstone, 2.5 YR 4/6 (red) medium grained, well sorted and consolidated, grains are equant and sub-rounded, porosity is low. Reduction spots, iron oxides and gypsum are present in the sample. Sample is calcic.	
	570					
C-40	580				No Change.	
	590					
C-41	600				Sandstone, 2.5 YR 4/4 (reddish brown) fine grained, very well sorted and consolidated with low porosity, reduction spots, iron oxides and gypsum are present. Material is non-calcic.	
	610					

Well Cuttings Log — Page 4 of 5

Hole ID: AEC-7R — Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-42	620	Dewey Lake			No Change.	
	630					
C-43	640				No Change.	
	650					
C-45					Large amounts of gypsum.	
C-46B	660	Rustler	Forty-Niner	A-5	Anhydrite, 2.5 Y 5/1 (gray) fine crystalline structure with low porosity.	
	670					
C-46	680				Minor amounts of gypsum present.	
	690			M-4	No samples collected.	
C-49	700			A-4	Anhydrite, 2.5 Y 5/1 (gray) fine crystalline structure with low porosity and gypsum present.	
C-50	710				No change.	
C-52	720		Magenta		Dolomite, 2.5 YR 7/1 (light gray) microcrystaline, gypsum present.	
C-53	730				No Change.	
	740					
C-56			Tamarisk	A-3	Anhydrite, 2.5 Y 5/1 (gray) fine crystalline structure with low porosity and gypsum present.	
	750					
	760					
C-58	770				No gypsum.	
	780					
C-59	790				Anhydrite, 2.5 Y 5/1 (gray) to 2.5 Y 7/1 (light gray) fine crystalline structure with low porosity and gypsum present.	
	800					
C-60	810				Large increase in gypsum.	
C-61	820			M-3	Large amounts of anhydrite and dolomite fall down contamination with trace amounts of mudstone material. Gypsum present.	
C-62	830				Large amount of fall down contamination. Minor amounts of mudstone, 5 YR 5/4 (reddish brown) very fine grained and well sorted, well consolidated. Gypsum present.	

Well Cuttings Log — Page 5 of 5

Hole ID: AEC-7R — Location: SW 1/4, SW 1/4, NE 1/4, Section 31, T21S, R31E

Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
		Rustler	Tamarisk	M-3		
	840	Rustler	Tamarisk	A-2		
C-66		Rustler	Tamarisk	A-2	Anhydrite, 2.5 YR 5/1 (reddish gray) to 7.5 Y 7/1 (light gray) fine crystalline structure with low porosity and gypsum present.	
	850	Rustler	Tamarisk	A-2		
C-67		Rustler	Tamarisk	A-2	No change.	
C-70	860	Rustler	Culebra		Dolomite, 10 YR 7/1 (light gray) vuggy texture, microcrystaline matrix, large amount of gypsum.	
	870	Rustler	Culebra			
					End of Geophysical Log	
	880	Rustler	Los Medaños			
	890	Rustler	Los Medaños			
	900					

Appendix C

Permitting and Completion Information

A case file for AEC-7R (C-3635) containing official documents is maintained by Environmental Monitoring and Hydrology section of Regulatory and Environmental Services for the WIPP Project. Selected documents are reproduced here for ease of access. Originals have been reduced to fit page formats.

All official correspondence concerning permitting and regulatory matters should refer to the New Mexico State Engineer Permit Number C-3635.

Scott A Verhines, P.E.
State Engineer

.900 West Second Street
Roswell, NM 88201
575-622-6521
Fax: 575-623-8559

STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER

April 24, 2013

U S DEPARTMENT OF ENERGY
C/O GEORGE BASABILVAZO
PO BOX 3090
CARLSBAD, NM 88221-3090

RE: Amended Conditions of Approval for Application for Permit to Drill a Well with no Consumptive use of Water in the State of New Mexico,
File Nbr. **C-3635**

Greetings:

Enclosed find your copy of the amended conditions of approval for the above referenced permit. Attach this letter and conditions to your copy of the Permit for future reference.

Please accept my apologies for any inconvenience this may have caused.

Sincerely,

Tim Williams

Tim Williams
Carlsbad Basin Water Master
575-622-6521

cc: Santa Fe
File

UNIQUE #	DOE UFC	DATE REC'VD	ADDRESSEES
1300941	548700	APR 29 2013	G. Basabilvazo S. McCauslin

NEW MEXICO STATE ENGINEER OFFICE
PERMIT TO EXPLORE

SPECIFIC CONDITIONS OF APPROVAL

2 The well shall be constructed to artesian well specifications and the State Engineer shall be notified before casing is landed or cemented

4 No water shall be appropriated and beneficially used under this permit.

6 The well shall be plugged upon completion of the permitted use, and a plugging report shall be filed with the State Engineer within 10 days.

B The well shall be drilled by a driller licensed in the State of New Mexico in accordance with Section 72-12-12 New Mexico Statutes Annotated.

C Driller's well record must be filed with the State Engineer within 20 days after the well is drilled or driven. Well record forms will be provided by the State Engineer upon request.

G If artesian water is encountered, all rules and regulations pertaining to the drilling and casing of artesian wells shall be complied with.

P The well shall be constructed, maintained, and operated to prevent inter-aquifer exchange of water and to prevent loss of hydraulic head between geologic zones.

LOG The Point of Diversion C 03635 POD1 must be completed and the Well Log filed on or before 04/30/2014.

Trn Desc: C-3635 MONITOR

File Number: C 03635
Trn Number: 526555

page: 1

NEW MEXICO STATE ENGINEER OFFICE
PERMIT TO EXPLORE

ACTION OF STATE ENGINEER

Notice of Intention Rcvd: Date Rcvd. Corrected:
Formal Application Rcvd: 04/08/2013 Pub. of Notice Ordered:
Date Returned - Correction: Affidavit of Pub. Filed:

This application is approved provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare of the state; and further subject to the specific conditions listed previously.

Witness my hand and seal this 23 day of Apr A.D., 2013

Scott A. Verhines, P.E., State Engineer

By: Tim Williams
Tim Williams

Trn Desc: C-3635 MONITOR

File Number: C 03635
Trn Number: 526555

page: 2

Scott A. Verhines, P.E.
State Engineer

Roswell Office
1900 WEST SECOND STREET
ROSWELL, NM 88201

STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER

Trn Nbr: 526555
File Nbr: C 03635

Apr. 23, 2013

GEORGE BASABILVAZO
U S DEPARTMENT OF ENERGY
PO BOX 3090
CARLSBAD, NM 88221-3090

Greetings:

Enclosed is your copy of the above numbered permit that has been approved subject to the conditions set forth on the approval page. In accordance with the conditions of approval, the well can only be tested for 10 cumulative days, and the well is to be plugged on or before 04/30/2014, unless a permit to use the water is acquired from this office.

A Well Record & Log (OSE Form wr-20) shall be filed in this office within twenty (20) days after completion of drilling, but no later than 04/30/2014.

Appropriate forms can be downloaded from the OSE website www.ose.state.nm.us or will be mailed upon request.

Sincerely,

Tim Williams

Tim Williams
(575) 622-6521

Enclosure

UNIQUE #	DOE UFC	DATE REC'VD	ADDRESSEES
1300900	5400.00	APR 24 2013	G. Basabilvazo w/orig S McCauslin

File No.

NEW MEXICO OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: http://www.ose.state.nm.us/

2-32855

Purpose:	☐ Pollution Control And / Or Recovery	☐ Geo-Thermal
☐ Exploratory	☐ Construction Site De-Watering	☐ Other (Describe):
☒ Monitoring	☐ Mineral De-Watering	

A separate permit will be required to apply water to beneficial use.

☐ Temporary Request - Requested Start Date: Requested End Date:

Plugging Plan of Operations Submitted? ☒ Yes ☐ No

1. APPLICANT(S)

Name: **U.S. Department of Energy**		Name:	
Contact or Agent: **George Basabilvazo**	check here if Agent ☐	Contact or Agent:	check here if Agent ☐
Mailing Address: **PO Box 3090**		Mailing Address:	
City: **Carlsbad**		City:	
State: **NM**	Zip Code: **88221-3090**	State:	Zip Code:
Phone: Phone (Work): **(575)234-7488**	☐ Home ☐ Cell	Phone: Phone (Work):	☐ Home ☐ Cell
E-mail (optional): **George.Basabilvazo@wipp.ws**		E-mail (optional):	

2013 MAR -8 P 2:00
STATE ENGINEER OFFICE

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 4/12/12

File Number: C-3635	Trn Number: 526555
Trans Description (optional): Monitor Pod 1	
Sub-Basin:	
PCW/LOG Due Date: 4-30-14	

Page 1 of 3

2. WELL(S) Describe the well(s) applicable to this application.

Location Required: Coordinate location must be reported in NM State Plane (NAD 83), UTM (NAD 83), or Latitude/Longitude (Lat/Long - WGS84).
District II (Roswell) and District VII (Cimarron) customers, provide a PLSS location in addition to above.

☐ NM State Plane (NAD83) (Feet)
☐ NM West Zone
☐ NM East Zone
☐ NM Central Zone

☐ UTM (NAD83) (Meters)
☐ Zone 12N
☐ Zone 13N

☒ Lat/Long (WGS84) (to the nearest 1/10th of second)

Well Number (if known):	X or Easting or Longitude:	Y or Northing or Latitude:	Provide if known: -Public Land Survey System (PLSS) (*Quarters or Halves , Section, Township, Range*) OR - Hydrographic Survey Map & Tract; OR - Lot, Block & Subdivision; OR - Land Grant Name
C-2742 (AEC-7)	32 deg 26' 11.9"	-103 deg 42' 44.1"	

NOTE: If more well locations need to be described, complete form WR-08 (Attachment 1 – POD Descriptions)
Additional well descriptions are attached: ☐ Yes ☐ No If yes, how many______

Other description relating well to common landmarks, streets, or other:

Well is on land owned by: **U.S. Bureau Of Land Management**

Well Information: NOTE: If more than one (1) well needs to be described, provide attachment. Attached? ☐ Yes ☒ No
If yes, how many______

Approximate depth of well (feet): **888.00**	Outside diameter of well casing (inches): **5.50**
Driller Name: **Stewart Brothers Drilling Co.**	Driller License Number: **WD-331**

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

See Attached Plan of Operation and Statement of Work

2013 APR -8 P 5:00

ROSWELL
STATE ENGINEER OFFICE

FOR OSE INTERNAL USE

Application for Permit, Form wr-0

File Number: C-3635 Trn Number: 526555

Page 2 of

4. SPECIFIC REQUIREMENTS: The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

Exploratory:
☐ Include a description of any proposed pump test, if applicable.

Monitoring:
☒ Include the reason for the monitoring well, and,
☒ The duration of the planned monitoring.

Pollution Control and/or Recovery:
☐ Include a plan for pollution control/recovery, that includes the following:
☐ A description of the need for the pollution control or recovery operation.
☐ The estimated maximum period of time for completion of the operation.
☐ The annual diversion amount.
☐ The annual consumptive use amount.
☐ The maximum amount of water to be diverted and injected for the duration of the operation.
☐ The method and place of discharge.
☐ The method of measurement of water produced and discharged.
☐ The source of water to be injected.
☐ The method of measurement of water injected.
☐ The characteristics of the aquifer.
☐ The method of determining the resulting annual consumptive use of water and depletion from any related stream system.
☐ Proof of any permit required from the New Mexico Environment Department.
☐ An access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.

Construction De-Watering:
☐ Include a description of the proposed dewatering operation,
☐ The estimated duration of the operation,
☐ The maximum amount of water to be diverted,
☐ A description of the need for the dewatering operation, and,
☐ A description of how the diverted water will be disposed of.

Geo-Thermal:
☐ Include a description of the geothermal heat exchange project,
☐ The amount of water to be diverted and re-injected for the project,
☐ The time frame for constructing the geothermal heat exchange project, and,
☐ The duration of the project.
☐ Preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.

Mine De-Watering:
☐ Include a plan for pollution control/recovery, that includes the following:
☐ A description of the need for mine dewatering.
☐ The estimated maximum period of time for completion of the operation.
☐ The source(s) of the water to be diverted.
☐ The geohydrologic characteristics of the aquifer(s).
☐ The maximum amount of water to be diverted per annum.
☐ The maximum amount of water to be diverted for the duration of the operation.
☐ The quality of the water.
☐ The method of measurement of water diverted.
☐ The recharge of water to the aquifer.
☐ Description of the estimated area of hydrologic effect of the project.
☐ The method and place of discharge.
☐ An estimation of the effects on surface water rights and underground water rights from the mine dewatering project.
☐ A description of the methods employed to estimate effects on surface water rights and underground water rights.
☐ Information on existing wells, rivers, springs, and wetlands within the area of hydrologic effect.

ACKNOWLEDGEMENT

I, We (name of applicant(s)), George T. Basabilvazo
Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

George T. Basabilvazo
Applicant Signature

Applicant Signature

ACTION OF THE STATE ENGINEER

This application is:

☒ approved ☐ partially approved ☐ denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval.

Witness my hand and seal this 23rd day of April 20 13, for the State Engineer,

Scott A Verhines, P.E., State Engineer

By: Tim Williams
Signature

Print

Title: Tim Williams, Carlsbad Basin Water Master
Print

Application for Permit, Form wr-07

FOR OSE INTERNAL USE

File Number: C-3635 | Trn Number: 526555

Page 3 of 3

NEW MEXICO STATE ENGINEER OFFICE
PERMIT TO ~~EXPLORE~~ MONITOR

SPECIFIC CONDITIONS OF APPROVAL

2 The well shall be constructed to artesian well specifications and the State Engineer shall be notified before casing is landed or cemented

4 No water shall be appropriated and beneficially used under this permit.

6 The well shall be plugged upon completion of the permitted use, and a plugging report shall be filed with the State Engineer within 10 days.

B The well shall be drilled by a driller licensed in the State of New Mexico in accordance with Section 72-12-12 New Mexico Statutes Annotated.

C Driller's well record must be filed with the State Engineer within 20 days after the well is drilled or driven. Well record forms will be provided by the State Engineer upon request.

C2 No water shall be diverted from this well except for testing purposes which shall not exceed ten (10) cumulative days, and well shall be plugged or capped on or before , unless a permit to use water from this well is acquired from the Office of the State Engineer.

G If artesian water is encountered, all rules and regulations pertaining to the drilling and casing of artesian wells shall be complied with.

P The well shall be constructed, maintained, and operated to prevent inter-aquifer exchange of water and to prevent loss of hydraulic head between geologic zones.

Trn Desc: C-3635 MONITOR

File Number: C 03635
Trn Number: 526555

page: 1

NEW MEXICO STATE ENGINEER OFFICE
PERMIT TO ~~EXPLORE~~ MONITOR

SPECIFIC CONDITIONS OF APPROVAL (Continued)

LOG The Point of Diversion C 03635 POD1 must be completed and the Well Log filed on or before 04/30/2014.

ACTION OF STATE ENGINEER

Notice of Intention Rcvd:	Date Rcvd. Corrected:
Formal Application Rcvd: 04/08/2013	Pub. of Notice Ordered:
Date Returned - Correction:	Affidavit of Pub. Filed:

This application is approved provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare of the state; and further subject to the specific conditions listed previously.

Witness my hand and seal this 23rd day of Apr A.D., 2013

Scott A. Verhines, P.E., State Engineer

By: Tim Williams
Tim Williams

Trn Desc: C-3635 MONITOR

File Number: C 03635
Trn Number: 526555

page: 2

Locator Tool Report

General Information:

Application ID:384 Date: 04-22-2013 Time: 14:55:34

WR File Number: C-MON
Purpose: POINT OF DIVERSION

Applicant First Name: US DEPT OF ENERGY
Applicant Last Name: GEORGE BASABILVAZO

GW Basin: CARLSBAD
County: LEA

Critical Management Area Name(s): NONE
Special Condition Area Name(s): NONE
Land Grant Name: NON GRANT

PLSS Description (New Mexico Principal Meridian):

PLSS description is not available for this location. SW SW NE
31-21S-32E

Coordinate System Details:

Geographic Coordinates:

Latitude:	32 Degrees	26 Minutes	11.9 Seconds	N
Longitude:	103 Degrees	42 Minutes	44.1 Seconds	W

Universal Transverse Mercator Zone: 13N

NAD 1983(92) (Meters)	N: 3,589,565	E: 621,059
NAD 1983(92) (Survey Feet)	N: 11,776,765	E: 2,037,592
NAD 1927 (Meters)	N: 3,589,363	E: 621,108
NAD 1927 (Survey Feet)	N: 11,776,102	E: 2,037,752

State Plane Coordinate System Zone: New Mexico East

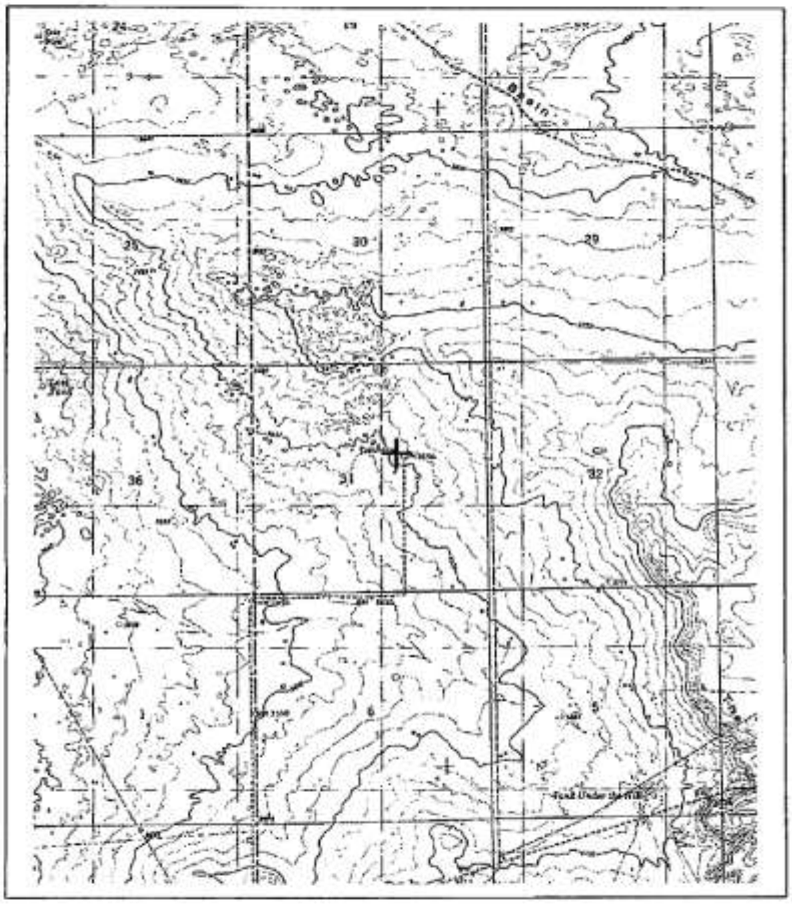
NAD 1983(92) (Meters)	N: 159,453	E: 223,403
NAD 1983(92) (Survey Feet)	N: 523,137	E: 732,950
NAD 1927 (Meters)	N: 159,434	E: 210,851
NAD 1927 (Survey Feet)	N: 523,076	E: 691,768

C-3635
526555

Page 1 of 2 Print Date: 04/22/2013

NEW MEXICO OFFICE OF STATE ENGINEER

Locator Tool Report



WR File Number: C-MON Scale: 1:39,661

Northing/Easting: UTM83(92) (Meter): N: 3,589,565 E: 621,059

Northing/Easting: SPCS83(92) (Feet): N: 523,137 E: 732,950

GW Basin: Carlsbad

Page 2 of 2

C-3635
526555

Print Date: 04/22/2013

Appendix D

Survey Data

Survey data was collected on December 22, 2015 in NAD27 and NAD83 by Souder Miller & Associates. 500 N Main St #504, Roswell, NM 88201

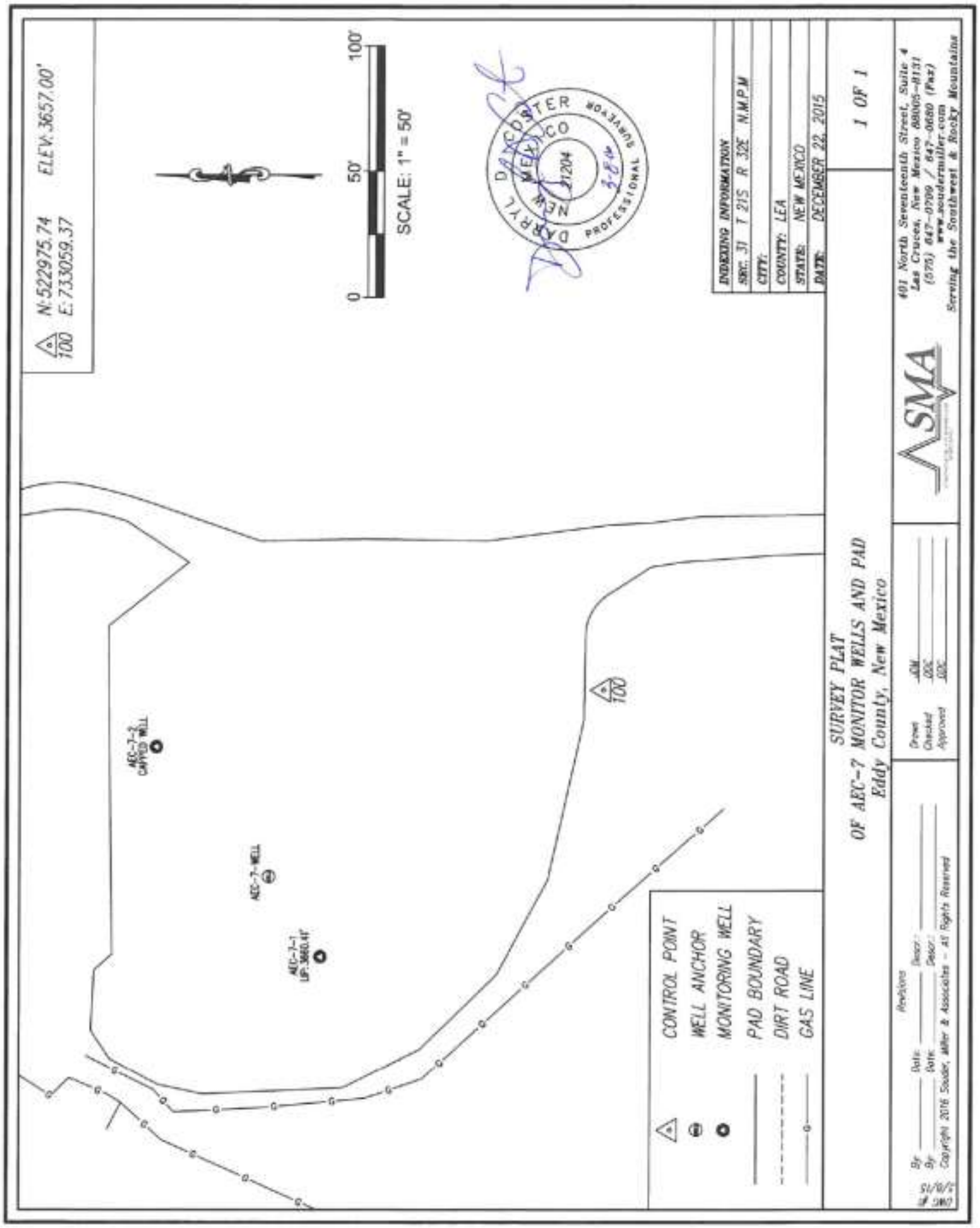

100 N:522975.74 E:733059.37 ELEV: 3657.00'
0
50'
100'
SCALE: 1" = 50'
NEW MEXICO
21204
PROFESSIONAL SURVEYOR
INDEXING INFORMATION
SEC. 31 T 21S R 32E N.M.P.M.
CITY:
COUNTY: LEA
STATE: NEW MEXICO
DATE: DECEMBER 22, 2015
1 OF 1
401 North Seventeenth Street, Suite 4
Las Cruces, New Mexico 88005-8131
(575) 647-0799 / 647-0680 (Fax)
www.soudermiller.com
Serving the Southwest & Rocky Mountains
SMA
SURVEY PLAT
OF AEC-7 MONITOR WELLS AND PAD
Eddy County, New Mexico
Drawn
Checked
Approved
Revisions
Copyright 2016 Souder, Miller & Associates - All Rights Reserved
AEC-7-2 CAPPED WELL
AEC-7-WELL
AEC-7-1
CONTROL POINT
WELL ANCHOR
MONITORING WELL
PAD BOUNDARY
DIRT ROAD
GAS LINE

TABLE 1 - 1 (SUPPLEMENTAL)
MONITOR WELL ELEVATIONS AND CASING DIAMETERS
NAD27 HORIZ & NGVD29 VERT(FEET)
NEW MEXICO EAST STATE PLANE COORDINATES
AEC-7

	NAD27		SURFACE CASING		INNER CASING		GROUND
MONITOR WELL	NORTH	EAST	DIA(FEET)	ELEV	DIA(FEET)	ELEV	ELEV
AEC-7-WELL	523065.68	733136.23					3656.1
AEC-7-1	523044.72	733104.172		3658.78		3658.353	3655.63
AEC-7-2	523005.73	732990.43		CAPPED WELL			3657.23
CP 100	522844.95	733004.79					3655.37

MONITOR WELL ELEVATIONS AND CASING DIAMETERS
NAD83 HORIZ & NGVD88 VERT(FEET)
NEW MEXICO EAST STATE PLANE COORDINATES
AEC-7

	NAD83		SURFACE CASING		INNER CASING		GROUND
MONITOR WELL	NORTH	EAST	DIA(FEET)	ELEV	DIA(FEET)	ELEV	ELEV
AEC-7-WELL	523109.37	732984.72					3657.73
AEC-7-1	523088.41	732952.66		3660.41		3659.98	3657.26
AEC-7-2	523154.77	733036.72		CAPPED WELL			3658.86
CP 100	522975.74	733059.37					3657.00

MONITOR WELL ELEVATIONS AND CASING DIAMETERS
NAD83 HORIZ & NGVD88 VERT(METERS)
NEW MEXICO EAST STATE PLANE COORDINATES
AEC-7

	NAD83		SURFACE CASING		INNER CASING		GROUND
MONITOR WELL	NORTH	EAST	DIA(FEET)	ELEV	DIA(FEET)	ELEV	ELEV
AEC-7-WELL	159444.055	223414.189					1114.878
AEC-7-1	159437.665	223404.417		1115.695		1115.564	1114.735
AEC-7-2	159457.893	223430.039		CAPPED WELL			1115.223
CP 100	159409.56	223433.89					1114.66

Appendix E

Geophysical Logs

Geophysical logging of AEC-7R was conducted by Jet West Geophysical Services, LLC, 2550 La Plata Highway, Farmington, NM, 87499-3522 on August 23, 2013 aft.er TD was reached on AEC-7R. The operator was Al Henderson. Copies of the logs are maintained by Regulatory and Environmental Services, Environmental Monitoring and Hydrology Section, for the WIPP project. A CD-ROM is being retained that includes.

1) Electronic copies of logs produced by Jet West Geophysical Logging Services.
2) WellCAD Reader to open electronic logs, and
3) Electronic data files in both .txt and .las formats.
   The following geophysical Logs were obtained:

- Caliper (neutron density)
- Natural Gamma
- Density-porosity
- Resistivity
- Spontaneous potential

AEC-7R was drilled to 891 ft. and logged to a depth of 876 ft.. A conductor casing had been placed to a depth of 30 ft.. AEC-7R was drilled with air and water, and the apparent water level was 780 ft. during logging.

The caliper log was used for estimating material volume to be placed in the annulus between fiberglass reinforced plastic casing and the drill hole wall.

A benchmark placed near AEC-7R aft.er completion has an elevation of 3409.63 ft. amsl. The rounded elevation of 3332 ft. amsl for the reference point is appropriate for the measurements and elevations of units for later studies.

Figure D-1
Well Record AEC-7R (C-3635)

Company: Nuclear Waste Partnership
Well: AEC-7R (C-3635)
Section: 31 Twp: 21s Rge: 32E
Location: SW1/4, SW1/4, NE1/4

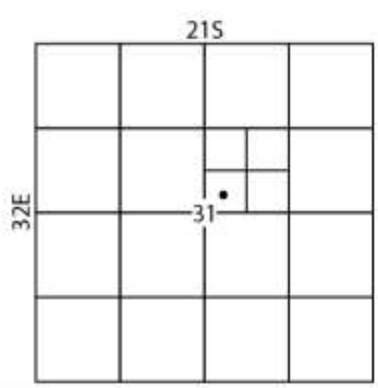
Reference Point
Log measured from: ground level
Drilling measured from: ground level
Permanent Datem: Benchmark

Drilling Contractor: Stewart Bros Drilling
Geophysical Logs: Al Henderson
Jet West Geophysical Setvice LLC
Geologist: Brett Seal
Spud Date: 8-9-13
Completion Date: 8-27-13
Total Depth (TD): 891 ft bgl

Elevation - ft amsl

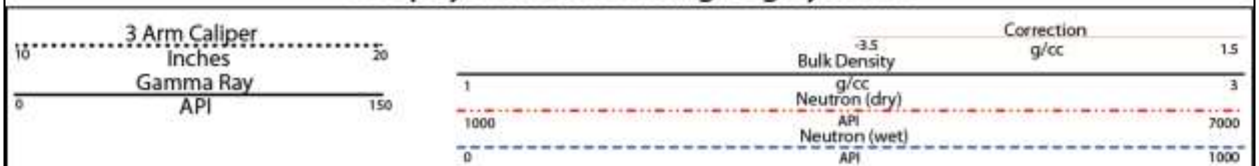
TOC: 3659.98
CP: 3657.00
GL: 3657.26

Geophysical Log
Date: 8-23-13
Gamma: 0-891 ft bgl
Density: 0-891 ft bgl



Casing Record
Conductor: 14 in OD steel to 30 ft bgl
Casing: 5.25 in OD fiberglass reinforced
plastic to 878.70 ft bgl
Screen: 855-875 ft bgl

Geophysical and Cutting Log Symbols



Lithologic Symbols

- Dune Sands
- Caliche
- Sandstone
- Anhydrite
- Mudstone
- Dolomite

Stratigraphic color guide

- Dune Sands
- Mescalero Caliche
- Gatuña
- Santa Rosa
- Dewey Lake
- Anhydrite (A-2, A-3, A-4, A-5)
- Mudstone (M-3, M-4)
- Dolomite (Magenta, Culebra)

Feet amsl
ELEVATION

Ground Level:

Log depths are feet bgl

Stratigraphy

Formation
Member
Informal Unit

Figure D-2: Geophysical Log and Drill Rate