

ISSUED

DOE/WIPP-16-3559

BASIC DATA REPORT FOR DRILL HOLE H-12R (C-3749 POD-1)

Revision 0

16-3559

October 2016



U.S. Department of Energy
Carlsbad Field Office

TABLE OF CONTENTS

EXECUTIVE SUMMARY.....	4
ACRONYMS	6
1.0 INTRODUCTION.....	8
1.1 Purpose of WIPP	8
1.2 Purpose of H-12R	8
1.3 Drilling and Completion.....	10
1.4 Well Development.....	11
1.5 Other Background.....	11
2.0 GEOLOGICAL DATA	20
2.1 General Geological Background	20
2.2 Geological Data from H-12R	20
3.0 REFERENCE CITED.....	32
APPENDIX A.....	34
APPENDIX B.....	40
APPENDIX C	46
APPENDIX D	55
Figure 1-1: H-12R Well pad configuration	7
Figure 1-2: H-12R Well pad location	9
Figure 1-3: Well H12R Construction and Lithology	12
Figure 1-3A: H-12R Well screen close up	13
Figure 1-4: H-12R Surface Configuration and Elevation	16
Figure 1-5: .07 inch screen interval	17
Figure 1-6: Close-up of the screen.....	17
Figure 1-7: Fiberglass reinforced plastic casings	18
Figure 1-8: Roll-off with H-12R water and cuttings	19
Figure 2-1: Culebra Dolomite at 840 ft.	22
Figure 2-2: A-2(Anhydrite) of the tamarisk Member at 765 ft.	23
Figure 2-3: Magenta Dolomite at 693 ft.	24
Figure 2-4: A-5, the upper anhydrite layer of the Forty-Niner Member at 641 ft.	25
Figure 2-5: Dewey Lake Formation at 613 ft.	26
Figure 2-6: Dewey Lake Formation at 240 ft.	27
Figure 2-7: Dewey Lake Formation at 100 ft.	27
Figure 2-8: Santa Rosa Formation at 50 ft.	29
Figure 2-9: Mescalero caliche at 9 ft.	30
Figure 2-10: Surficial Deposits at 5 ft.	31

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

Figure D-1: Well Record H-12R (C-3749 POD-1) 56

Table 1-1: Summary of Drilling and Well Completion Records for Hydrologic Drillhole H-12R (C-3749 POD-1)..... 14

EXECUTIVE SUMMARY

H-12R (permitted by the New Mexico State Engineer as C-3749) was drilled and completed from July 10, 2014 to August 5, 2014. The purpose of this well is to provide hydrological information about the Culebra Dolomite Member of the Permian Rustler Formation in an area south-east of the Waste Isolation Pilot Plant (WIPP) facility. H-12R is located in section 15, T23S, R31E, in eastern Eddy County, New Mexico and was drilled to a total depth (TD) of 865 feet (ft.) below ground level (bgl), based on driller's measurements. The Rustler, Dewey Lake, Santa Rosa, and Gatuña Formations as well as Mescalero caliche and dune sands were encountered while drilling underneath the caliche pad. H-12R was drilled from surface to 203ft bgl with air and then mist was injected until TD was reached. Geophysical logs were acquired from H-12R before casing was set.

The deepest member penetrated during drilling was the M-2 of the Los Medanos. The Culebra dolomite, which is the monitored formation, extends from 846 to 819 ft. Cuttings were consistently taken during the drilling process to help in the identification of formation depths. The geophysical log showed a normal stratigraphic sequence of the Rustler Formation from oldest to youngest: Los Medanos member, Culebra member, Tamarisk Member consisting of anhydrite A-2 (819-773 ft.), mudstone M-3 (773-756 ft.), anhydrite A-3 (756-702 ft.) in order of deposition. The Magenta Dolomite is 25 ft. thick (702-677 ft.) according to geophysical logs, which is normal for the member. The Forty-niner is represented by a sequence of anhydrite A-4 (677-663 ft.), mudstone M-4 (663-648ft), anhydrite A-5 (648-620ft) in order of deposition. Rustler and Dewey Lake contact each other at 620 ft., which appears as a sharp change on the geophysical logs. The Dewey Lake is 548 ft. thick (620-72 ft.) with all three depositional sequences visible on the geophysical logs. Santa Rosa is present from 72-19 ft., which is overlain by eight ft. (19-11 ft.) of Gatuña, five ft. (11-6 ft.) of Mescalero caliche, and six ft. (6-0 ft.) of surficial dune deposits and well pad material.

H-12R was drilled with an original diameter of 10.5 inches to the depth of 865 ft. for completion. Fiberglass reinforced plastic (FRP) casing (4.75 inches inside diameter) was placed in the hole with a screened interval (846-821.5 ft.) across the Culebra Dolomite. Gravel pack was placed in the annulus from total depth to 857ft, followed by bentonite from 857-856.5 ft. and Gelacryl superflex seal from 856.5-851.5ft. After the Gelacryl seal had cured, 8x12 gravel pack was placed from 851.5-816 ft. bgl. Above the gravel pack is sugar sand from 816-815.5 ft., bentonite from 815.5-815 ft., and gelacryl superflex seal from 815-811 ft. Portland type II cement was then added from 811 ft. to the surface.

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

The first water level recorded by Regulatory and Environmental Services (RES) was measured August 12, 2014, with an initial depth to water of 459.99 ft. below top of casing (TOC).

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
NMED	New Mexico Environment Department
O.D.	Outer Diameter
O.S.E	Office of the State Engineer
RES	Regulatory and Environmental Services
SBDC	Stewart Brothers Drilling Co.
SNL	Sandia National Laboratories
TOC	Top of casing
WIPP	Waste Isolation Pilot Plant

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0



Figure 1-1: H-12R Well pad configuration

1.0 INTRODUCTION

H-12R was drilled in the section 15, T23S, R31E, in eastern Eddy County, NM (Fig. 1-1, 1-2). This location places the drillhole south-east of the WIPP site center, and outside the WIPP Land Withdrawal boundary. H-12R was started on July 10, 2014, and completed August 5, 2014. This well will be used to monitor groundwater levels in the Culebra Dolomite Member of the Permian Rustler Formation for WIPP.

H-12R was permitted by the NM State Engineer as C-3749-POD-1. Official correspondence regarding permitting and regulatory information must reference this permit number.

Most drillholes at WIPP have been described after completion to provide an account of the geology, hydrology, and other basic data acquired during drilling and immediate completion of the drillhole. 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 drillhole, 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 transuranic and mixed waste, byproducts of U.S. defense programs, as certified by the U.S. Environmental Protection Agency (EPA), and under a permit issued by the New Mexico Environment Department (NMED).

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

1.2 Purpose of H-12R

H-12R serves as a replacement well for H-12, which was plugged due to the well repeatedly plugging equipment for pump tests with debris and as well as having a deteriorating steel casing. Debris is thought to have entered the well through the bottom from the open hole completion.

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

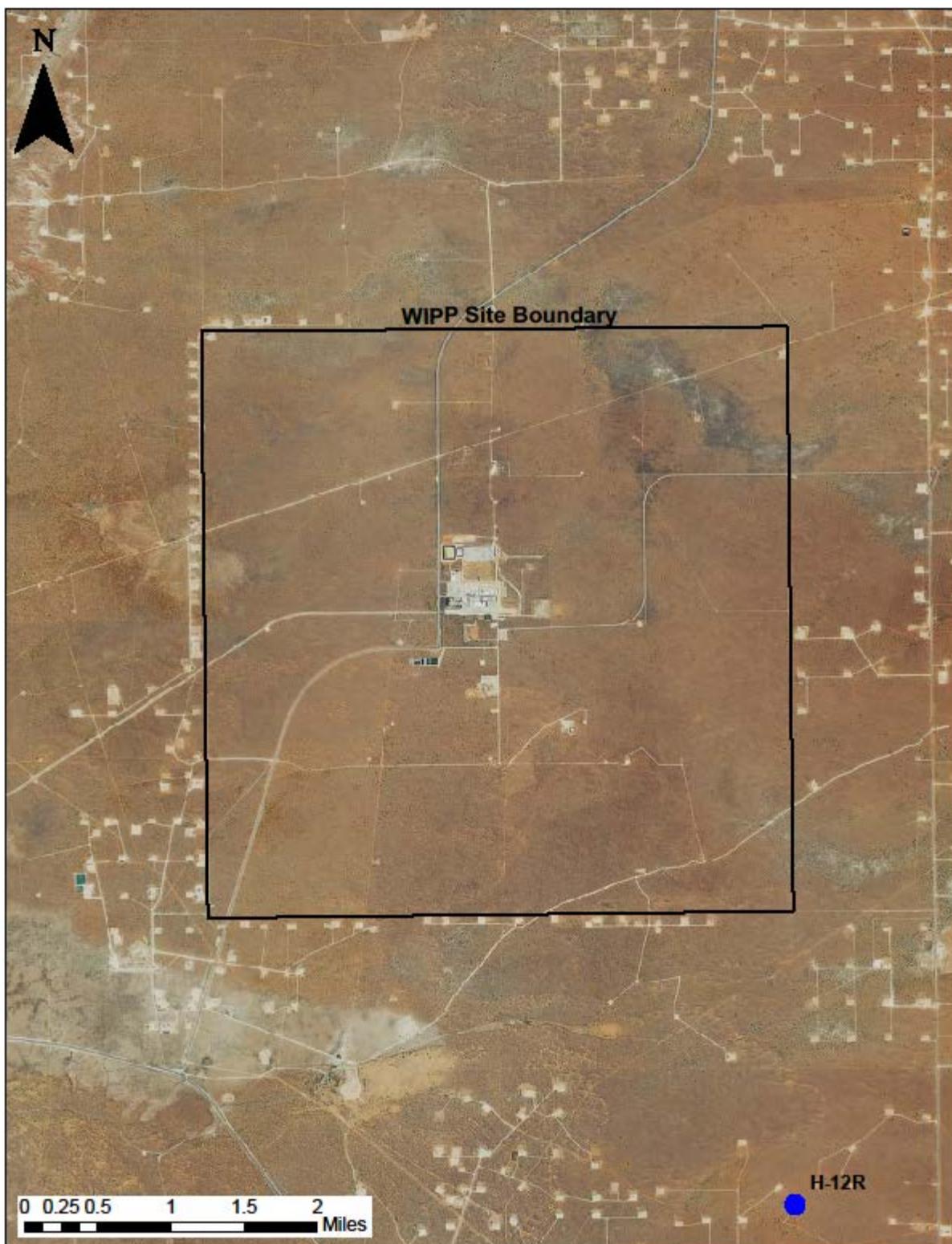


Figure 1-2: H-12R Well pad location

1.3 Drilling and Completion

The basic information about drilling and completion of H-12R is presented in tabular form (Table 1-1) and graphics (Figs. 1-3, 1-3A, 1-4) for ease of reference. Appendix A includes details based on daily drilling logs. H-12R was drilled with air to a depth of 203 ft. and reached a total depth of 865 ft. by injecting mist. There was no borehole lost due to backfill. Cutting recovery was fairly consistent throughout the drilling process. Geophysical logging was ended at 860 ft.

In keeping with the recent practice at WIPP, H-12R 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.

H-12R was completed with a single screened interval across the Culebra Dolomite for monitoring (Fig. 1-3, 1-3A, 1-5, and 1-6) on August 5, 2014. 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 are planned for the H-12R well pad.

Geophysical logs from H-12R, especially natural gamma were used to make the final decision regarding completion of H-12R (Fig. 1-3 and Appendix D). The drillhole penetrated the uppermost part of the Los Medaños, and the bottom of the Culebra screen was placed at 846 ft. The top of the screen, at 821.5 ft., is just below the top of the Culebra. Gravel pack (8-12) was added to the annulus from 865-857 ft., followed by bentonite from 857-856.5 ft. in the M2, Los Medaños unit. A Gelacryl Superflex seal was placed in the annulus above the bentonite from 856.5-851.5 ft. and it is in M-2 (Los Medaños). Another 8-12 gravel pack is above the seal from 851.5-816 ft. and spans the following units: M-2 (Los Medaños), Culebra, and A-2 (Tamarisk). Sugar sand is above the gravel pack from 816-815.5 ft. and is located in A-2 of the Tamarisk. Above the sugar sand is another bentonite seal from 815.5-815 ft. Gelacryl Superflex seal was placed above the bentonite from 815-811 ft. and it is in A-2, which is the Tamarisk. The remainder of the annulus was cemented to the surface to prevent mixing of waters from the Magenta and Culebra. A representative of the NMOSE witnessed the well construction and completion.

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 (3430.66 ft. amsl), 2.29 ft. above pad level (3428.37 ft. amsl). The control point placed at the drilling pad has an elevation

of 3428.37 ft. amsl (survey plat dated January 15, 2016). The FRP casing (Fig 1-7) projects 2.19 ft. above the surveyed gl (Fig 1-4), and provides the reference point and reference elevation for monitoring water levels.

1.4 Well Development

Following completion of drilling activities, well development began on July 30, 2014, using a bailer. Air lifting was the primary development method, which began on August 6, 2014 and ended on August 7, 2014. Development was completed with a specific gravity of 1.146 g/gm³.

The first water level recorded by Regulatory and Environmental Services (RES) was measured August 12, 2014; the initial depth to water was 495.99 ft. below top of casing.

1.5 Other Background

H-12R was drilled by Stewart Brothers Drilling Co. (SBDC), PO Box 2067, Milan NM, 87021, under contract from 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.

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

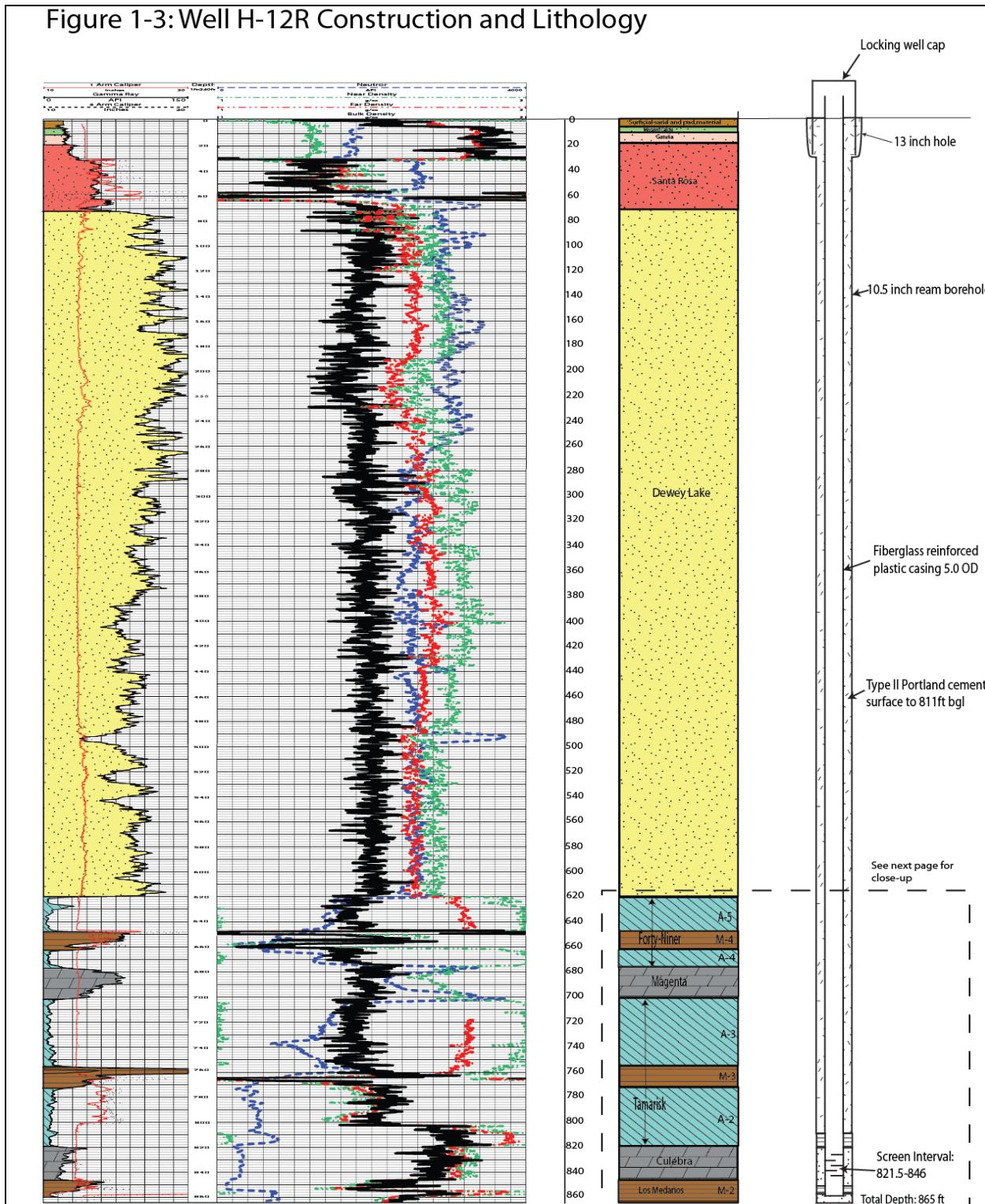


Figure 1-3: Well H12R Construction and Lithology

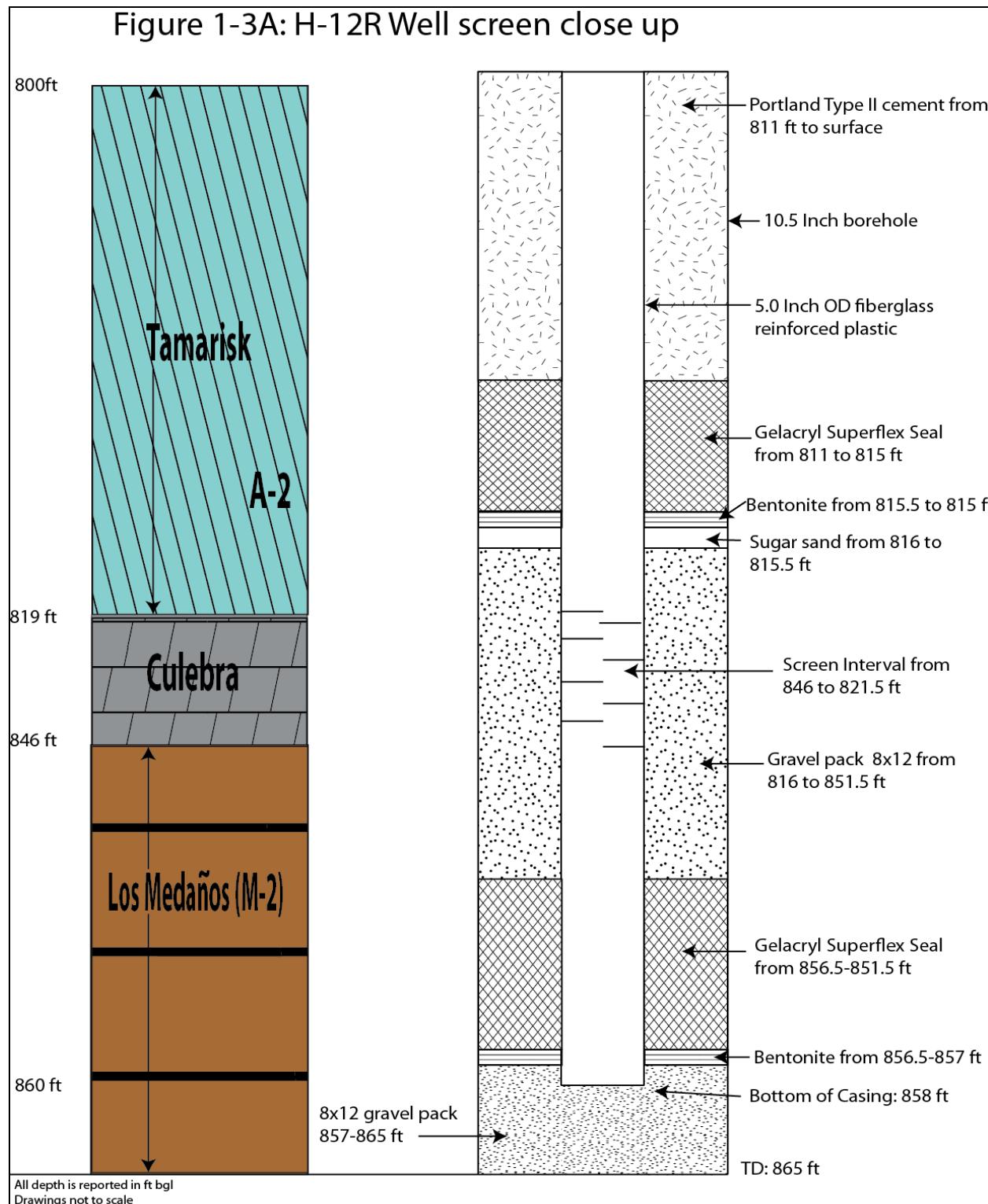


Figure 1-3A: H-12R Well screen close up

**Table 1-1: Summary of Drilling and Well Completion Records for
Hydrologic Drillhole H-12R (C-3749 POD-1)**

LOCATION: NE ¼ , NE ¼ , NE ¼ , Section 15, Township 23S, Range 31E

SURFACE COORDINATES: The New Mexico State Plane (NAD 83) horizontal coordinates in ft. are 477560.904North, 719304.395 East. Latitude and Longitude are as follows in NAD 83: 32.31157 and -103.75529.

ELEVATION: All depths from geological and geophysical data used for completion were measured from ground level (3428.37 ft. amsl) (Fig. 1-4). The control point is set at an elevation of 3428.37. The specified point for data retrieval marked on the FRP was surveyed at 3430.56 ft. amsl. Figure 1-4 shows as-built configuration of H-12R.

DRILLING RECORD:

DATES: Geophysical logging was conducted on July 25, 2014, after total depth was achieved at H-12R. Plugging of H-12 was completed on August 8, 2014. SBDC began drilling H-12R July 10, 2014; drillhole reached total depth (865 ft., driller's measurement) on July 24. H-12R was cased on July 26, 2014 and final cementation was completed on August 5, 2014.

CIRCULATION FLUID: H-12R was drilled to 203 ft. with air and then switched to air and mist until TD.

RIG AND DRILLING CONTRACTOR: Stewart Brothers Drilling Co., PO Box 2067, Milan NM, 87021

DRILLHOLE RECORD

Size (Inches)	From (ft)	To (ft)
13	0	30
10.5	30	865

CASING RECORD

Outside Diameter (inches)	Inside Diameter (inches)	Material	From (ft)	To (ft)
11	10.75	STEEL H-40	-2.29	30
5	4.75	FRP Blank	-2.18	821.5
5	4.75	FRP Screen	821.5	846
5	4.75	FRP Blank with end cap	846	865

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

Figure 1-4

H-12R Surface Configuration

and Elevation

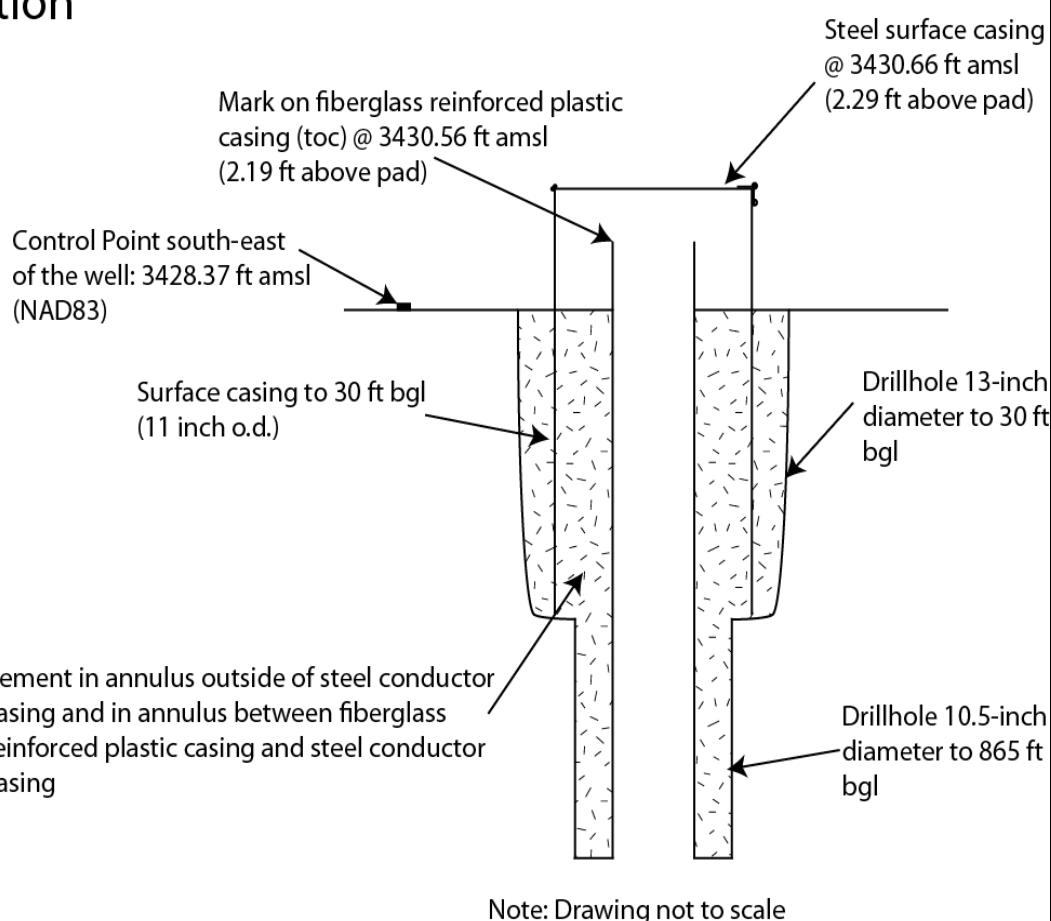


Figure 1-4: H-12R Surface Configuration and Elevation

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0



Figure 1-5: .07 inch screen interval



Figure 1-6: Close-up of the screen

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0



Figure 1-7: Fiberglass reinforced plastic casings

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0



Figure 1-8: Roll-off with H-12R water and cuttings

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 H-12R.

The Delaware Basin 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 H-12R

H-12R encountered a normal stratigraphic sequence from ground level to total depth for this location south-east of the WIPP site. Units encountered ranged from the upper portion of the Los Medaños Member of the Permian Rustler Formation at TD up to the unconsolidated surface dune deposits. Sedimentary properties were characterized through the use of borehole cuttings.

The geologic units encountered in H-12R 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 drillhole. Formation depth determinations were supplemented with the rate of drilling and drill rig response (i.e., rig chatter in harder lithology). Geologic logs detailing field observations of cuttings are included in Appendix C. The difference between geophysical log and drilling depth is generally slight. Decisions about placing screen intervals and annular material were based on depths indicated by

geophysical logs (Appendix D).

2.2.1 Permian Rustler Formation

The Permian Rustler Formation contains the Los Medaños Member, Culebra Member, Tamarisk Member, Magenta Member and Forty-Niner Member. The contact between the Rustler and the overlying Dewey Lake occurs at 620 ft. TD was reached at 865 ft. after penetrating 245 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 formations 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 (salt) 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 846-865 ft. This depth is estimated from drill rate and pipe tally due to no geophysical log or cutting returns.

2.2.1.2 Culebra Dolomite Member

Based on geophysical logs, the Culebra dolomite stretches from 846-819 ft bgl making it 27 ft thick. It is composed of 10YR 5/1 (gray) dolomite with minor amounts of gypsum present. The predominate feature is the vuggy texture, which allows for groundwater transport.

Figure 2-1: Culebra Dolomite at 840 ft.

2.2.1.3 Tamarisk Member

The natural gamma log of H-12R shows that the Tamarisk occurs from 819-702 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) at the base of the Tamarisk is 46 ft. (819-77 ft.) thick based on the geophysical log (Figure 2-2). This unit is composed of GLEY 1 6/N (gray) fine crystalline, moderate to poor consolidated material with very low porosity and contains halite.

The informal unit *mudstone 3* (M-3) at H-12R is 17 ft. (773-756 ft.) thick based on the geophysical logs. The mudstone was 5 YR 6/1 (gray), very fine grained with low porosity.

The informal unit *Anhydrite 3* (A-3) at H-12R is 54 ft. (756-702 ft.) thick according to the geophysical log. The A-3 layer is composed mainly of 7.5 Y 6/1 (gray) anhydrite which has a fine crystalline matrix with very low porosity and has some gypsum flakes present.

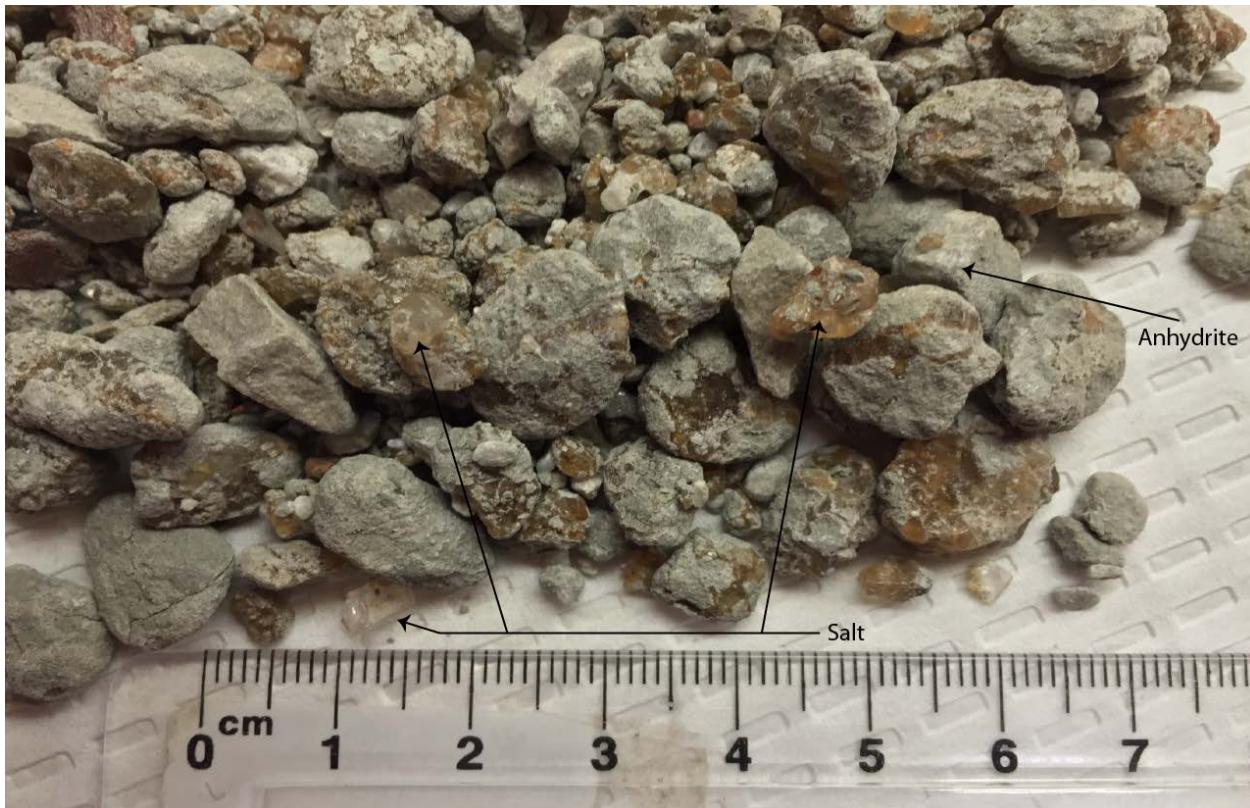


Figure 2-2: A-2(Anhydrite) of the tamarisk Member at 765 ft.

2.2.1.4 Magenta Dolomite Member

Based on geophysical logs, the Magenta at H-12R is 25 ft. (702-677 ft.) thick, which is a normal thickness for the member. Cuttings (Figure 2-3) at 693 ft. consist of 10 YR 7/1 (light gray) microcrystalline dolomite with minor amounts of gypsum.



Figure 2-3: Magenta Dolomite at 693 ft.

2.2.1.5 Forty-niner Member

Based on geophysical logs, the Forty-niner at H-12R is 57 ft. thick (677-620 ft.). Like the Tamarisk, the Forty-niner consists of upper and lower anhydrites with a middle unit that is a mudstone at H-12R. 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 14 ft. (677-663 ft.) thick and its color is 7.5 Y 6/1 (gray). A-4 has a fine crystalline matrix and low porosity.

The middle mudstone (M-4) is 15 ft. (663-648 ft.) thick and no returns were returned from this layer.

The upper anhydrite (A-5) (Figure 2-4) is 28 ft. (648-620 ft.) and is the same as A-4 except for a minor amount of gypsum being present.



Figure 2-4: A-5, the upper anhydrite layer of the Forty-Niner Member at 641 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 H-12R, the Dewey Lake is 548 ft. (620-72 ft.) thick based on geophysical logs, and is composed mainly of 2.5 YR 5/4 (reddish brown) to 2.5 YR 5/6 (red) sandstone ranging from fine to very fine sand sized grains (Figures 2-5, 2-6, 2-7). Material is poor to moderately sorted and poor to well consolidated (Figures 2-5, 2-6, 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.



Figure 2-5: Dewey Lake Formation at 613 ft.



Figure 2-6: Dewey Lake Formation at 240 ft.



Figure 2-7: Dewey Lake Formation at 100 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 H-12R.

The interval from 620-404 ft. in H-12R displays the natural gamma features of the basal bedded zone (Powers 2003b). Natural gamma values fluctuate from 45-120 API over this vertical interval. A low in natural gamma indicates the top of this zone.

The interval from 404-202 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 202-72 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.

The Santa Rosa at this location is 53 ft. thick (72-19 ft.) and composed of sandstone ranging from 2.5 YR 6/4 (light reddish brown) to 2.5 YR 5/4 (reddish brown) to 2.5 YR 5/6 (red). The sandstone (Figure 2-8) varied from fine grained to sub-angular coarse grained sand. Both varieties were poorly sorted and consolidated with low to moderate porosity. The grains are held together by calcic cement and there are both manganese oxide flakes and iron oxides present.



Figure 2-8: Santa Rosa Formation at 50 ft.

2.2.4 Miocene-Pleistocene Gatuña Formation

Based completely on cuttings from drilling the surface casing hole, the Gatuña is approximately 8 ft. (19-11 ft.) thick at H-12R. 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.

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 (\pm 100,000) and about 420,000 (\pm 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 H-12R the Mescalero is a 5 ft. thick (11-6 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.



Figure 2-9: Mescalero caliche at 9 ft.

2.2.6 Surficial Deposits

From the surface down, drillers encountered 6 inches of pad material and then 6 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.



Figure 2-10: Surficial Deposits at 5 ft.

3.0 REFERENCE CITED

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 Wilcox, 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, $^{40}\text{Ar}/^{39}\text{Ar}$ 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, $^{40}\text{Ar}/^{39}\text{Ar}$ 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 Tritium 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.

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

APPENDIX A

Abridged Borehole History

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

7-9-14

SBDC arrived at the drill site for the kick start/safety meeting at 0730. At 0800, the pre-job safety meeting was performed. The doghouse was cleaned at 0827 and the first roll off arrived at 0847. At 0913, SBDC performs maintenance on the rig. The second and third roll offs arrive at 1044. The forklift arrived at 1141 and ten minutes later is inspected as the frac tanks start arriving. At 1233, the trailers are unloaded of screen and casing which included: 31 sticks (28 30 ft. sticks), 1 30 foot stick with 24.5 ft. of screen interval, and 1 20 foot stick. At 1439, the surface casing arrived and at 1621, so does the final frac tank. Jimmy arrived and performed his frac tank inspection at 1704. At 1723, SBDC left and CMR is called.

7-10-14

SBDC arrived on drill site at 0700 and a pre job safety meeting is conducted. Rig maintenance occurred at 0710 and the kelly arrived at 0714. Big Guns Rathole and Foundation out of Hobbs arrived and performed a safety and equipment check at 09:37. Big Guns left the well pad site at 1055 moved the rig and set casing at 30 feet. From 0937-1055 Big Guns installed the well casing to 30 feet. At 1218 two water trucks arrived as the rig gets ready. At 1345 the mud engineer arrived. At 1543, the third water truck arrived. At 1612, the handrails for the platform have been built and the cables on the rig have been straightened. At 1801, SBDC left the pad site and CMR is called.

7-11-14

SBDC arrived on well pad at 0700 and a pre-job meeting is conducted. At 0715, SBDC worked on the driller's platform and rails and at 0747 worked on the head. SBDC put plastic around the head, dug a sump, and lined the sump at 0813. The roll off is sealed at 0851. The compressor arrived at 1055. There is a new hands safety meeting that takes place at 1352 and at 1850, SBDC left the pad and CMR is called.

7-12-14

SBDC arrived on site at 0653 and a pre-job was conducted at 0658. Stairs were put up a minute later at 0659. SBDC began to trip in collars at 0847 and at 0912 hooked up the hoses. At 1000, SBDC blew out the hole and began to drill. At 1740, after reaching a depth of 143 feet, blew out the hole. At 1800, shut down occurred due to weather and CMR is called.

7-13-14

SBDC arrived on well pad 0718 and a pre-job safety briefing is conducted at 0718. Oil and water is checked at 0724. The compressor is fueled and cuttings cleaned up at 0747. Work is stopped at 0810 as someone had to go get fuel and a bean pump battery. At 1013, the compressors were fueled. At 1025, a caution barrier around the sump was set up. SBDC trip in began at 1050 and drilling resumed at 1134 with a depth of 143 ft. bgl. The pad was cleared and CMR was called at 1840.

7-14-14

SBDC arrived on well pad site and promptly performed a safety meeting at 0720. At 0737, rig repairs began. At 0835, the rig is running. At 1033 circulation started on hole and cleared hole sediment debris. Drilling re-commenced at 203 feet. At 10:51, Isella and John arrived on the pad and a pre-job safety briefing was held. The mist pump was set up at 1203 as 10 feet of fill won't clean up. At 1300, hole was blown and mist was circulated post blow. At 1314, resonance drilling commenced. Trip out began at 1742 and SBDC left the pad site and CMR is called at 1848.

7-15-14

SBDC arrived on the well pad and conducted a pre-job briefing at 0712. Re-plumbing of cutting recovery hoses occurred at 0719. Tripping began at 1243. Circulation began at 1254 followed by drilling at 1308. At 1732, rig chatter is noticed and tripping out began. Bit is broken when pulled out of hole at 1907 and rig is fueled. At 1937 SBDC left site and CMR is called.

7-16-14

At 0732, SBDC arrived on site and conducted a pre-job briefing. At 0737 they cleaned up site. At 0803, water is pumped into roll-off (Fig1-8). At 0907 the trucks are fueled and sump work began. At 1008, the rig is greased up and at 1207 SBDC left the pad and CMR is called.

7-20-14

SBDC arrived on site at 1128 and conducted a pre-job at 1132. At 1137, they cleaned up around the tank, prepped to drill and lined the sump hole. At 1448, a new bit was delivered. At 1508, a trash basket was built. At 1708, vehicles were fueled and water trucks were filled with water. 1746 SBDC leaves pad and CMR is called.

7-22-14

SBDC crew arrived on site at 0654. At 0658 a safety briefing was performed. At 0704, they prepped a trash basket for fishing. At 0713, SBDC tripped in the basket and it was tripped out at 0843. At 0950, there was not any trash removed (The thought is the bit brushed into the wall and tried going in with the bit). At 1003, SBDC tripped in with the old bit to try and knock tooth out. At 1108, the handle on the clamp broke and there was a pause to fix it. SBDC was at the bottom of the hole by 1133. At 1533, the other roll-off was lined. At 1555 SBDC moved the hoses to the other roll-off. At 1653, the pipe was tripped out. By 1717 the trip out was completed. At 1735, SBDC worked on the bushing of the kelly. At 1900, SBDC left the pad and CMR is called.

7-23-14

SBDC arrived on the pad at 0656 and conducted a safety meeting. At 0703, SBDC performed maintenance on the kelly and pumped out the roll-offs into the frac tanks. At 0753 there was a check on the hydrogen sulfide monitor as the area smelled of gas. There was an additional safety meeting at this time. Tripping in began at 0906 and drilling began at 0953 at a depth of 543 feet. At 1707, SBDC started to trip out and at

1751 tripping was completed. At 1755 SBDC cleaned up and left the pad at 1803, which is when CMR was called.

7-24-14

SBDC arrived on site and conducted a safety meeting at 0710 and then prepped for work at 0715. Rolloffs were pumped at 0727 and the sump is cleaned out at 0750. At 0856 SBDC greased and oiled the equipment and began tripping in at 0950. At 1016 circulation began. Drilling at 721 ft. started at 1022. At 1430, Rick Salness arrived on-site and completed the pre-job briefing. Total depth is reached at 865ft at 1559. At 1604 SBDC tripped out and at 1817, SBDC left the pad and CMR is called.

7-25-14

SBDC arrived on site at 0658 and conducted a pre-job briefing. At 0703 SBDC fueled up and at 0714 began to trip in. At 0802, SBDC tripped in to check for hole loss and none was found. At 0845, SBDC tripped out sticks and collars at 0915. Jet West arrived at 0916 on site to conduct geophysical logging. At 1034, Jet West set the geophysical logging to 865 for the bottom of the hole. One arm logging began at 1130 and three arm at 1345. Jet West removed and rinsed of their equipment at 1513. Target depth was never reached. SBDC tripped in drilling pipe at 1604 in order to check for a cave in and tripped out at 1653. SBDC left pad at 1858 and CMR was called.

7-26-14

SBDC arrived on site at 0700 and a pre-job was conducted at 0705. At 0710 equipment was moved. At 0820, Clint arrived on site with the Gelacryl seal. At 0930, SBDC began to trip tremmi into the hole. At 1031, SBDC began to trip in a 30 foot casing with a screen. At 1106, SBDC began tripping in casing. At 1124, the sump in the hole is 9.70 ft long and the screen in the bottom goes to 840 ft. At 1628, casing is in the bottom at 858 ft. At 1715, it was decided there is not enough time to apply the Gelacryl seal and clean up began. At 1745, SBDC left the pad and CMR is called.

7-27-14

SBDC and the OSE arrived on site at 0704. At 0708, a safety meeting was held. At 0710, SBDC oiled and checked the rig before starting it up. At 0715 the gravel pack was prepped. At 0717, Clint (the mud guy) arrived on site. At 0737, the annulus was tagged at 862ft (lost about 3 feet). The static water level was measured at 639ft at 0752. At 0837 SBDC hooked up their bean pump and at 1015 added gravel. Bentonite was added above the gravel pack. At 1130, the pipe is plugged and tripping out tremmi begins. At 1253 bentonite was found in the end of the tremmi and no gravel made its way into the hole. At 1323, trip in began after bentonite obstruction was cleared. At 1613, the annulus was tagged at 851 ft. At 1618, the water level is tagged at 857 ft. At 1628, they began to mix the Superflex, which was a mixture of sodium chloride and sodium persulfate. At 1640, the seal was pumped down hole and the 1.5 hour cure wait time began. At 1758, circulation began and tagging could not be done as the seal still could be wet. At 1805, the gravel pack was inserted into the hole. At 1934, 32 bags added and packed to leave. At 1945, pad is cleared and CMR is called.

7-28-14

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

SBDC arrived on site at 0715 and conducted a safety meeting at 0718. The sand pack was tagged at 816 ft. at 0739. At 0758, SBDC bailed in casing to settle the sand pack. Tagged pack at 816ft at 0822. Sugar sand and bentonite were added at 0828. At 0901, gravel was added for the seal. At 0922 gravel was tagged at 822 ft. and water in the annulus was tagged at 297 ft. At 0950 the seal was added. At 1015, clean up started and some tremmi was tripped out. At 1348, SBDC left the pad and CMR was called.

7-29-14

SBDC arrived on site at 0801 and conducted a safety meeting. At 0808, the mud pump was set up. At 0833, the cement truck arrived on site and put 18wt (3yds) down the annulus. At 0852, tripped out some clean tremmi pipe and at 1225 added 18wt (4yds) cement. At 1248, tripped out the tremmi pipe. At 1333 SBDC left the site.

7-30-14

SBDC arrived and conducted a safety meeting at 0700. At 0830, bailing is finished with about 25 gallons and the sand was cleaned up well. Cement was tagged at 430 ft. at 0830. At 0905, SBDC left the site to get the hitch and CMR is called.

8-4-14

SBDC arrived on site at 0703 and safety meeting was conducted at 0710. At 0715 cement was prepped and the site cleaned to resolve safety issues (on ground). At 0951, the cement truck arrived. At 0956 tremmi pipe is tripped out. At 1058, SBDC began bailing. At 1136, bailing ends. At 1812 SBDC left pad and CMR called.

8-5-14

SBDC arrived on site at 0702 and a safety meeting took place. At 0710, SBDC set up for the cement and began to trip in. Francine and Lynn are out at the site to sample at 0903 and have to wait on the cement. At 1332 the cement arrived on site. At 1410, tremmi is tripped out and the annulus is still not full. At 1508 SBDC left the pad and CMR is called.

8-6-14

At 0703, SBDC arrived on site and performed a safety meeting. At 0709 the air lift was set up. At 0800, the tremmi was tripped in. Hoses were hooked up at 0958. Three joints were pulled due to too much head at 1043. Air lifting began at 1135. At 1245, SBDC began to pack up. Sample times and densities are listed below:

Time	Density
1253	1.156
1344	1.182
1500	1.178
1600	1.184
1630	1.171
1730	1.163
1800	1.159
1845	1.159

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

At 1900 SBDC left the pad and CMR is called.

8-7-14

At 0702, SBDC arrived on site and conducted a safety meeting. At 0713 SBDC started air lifting. The following table lists times and densities respectively:

Time	Density
0715	1.116
0733	1.108
0806	1.118
0817	1.124
0845	1.134
0915	1.143
1000	1.145
1030	1.146

At 1117, lifting stopped and SBDC started breaking down the lift equipment. At 1330, the rig was prepped to move over to H-12. The rig was put down at 1340. The rig was moved at 1347. At 1402, SBDC began the set up to plug the well hole. The scraper was tripped in at 1455. At 1544 the scraper was tripped out. Tremmi was tripped in at 1623 and at 1715 SBDC left the site and CMR is called.

8-8-14

At 0700 SBDC arrived on site and conducted a safety meeting. At 0710 SBDC set up to circulate at H-12 and cut off the flow nipple at H-12R. At 0800, circulation began. At 0815, the pad was cleaned up, the road was patched, and the site was prepped for cement. The cement truck arrived at 1356. The rig was put down at 1544. At 1546, the monkey board is removed and the site is cleaned up. SBDC left the pad and CMR is called at 1900.

8-9-14

At 0730, SBDC arrived on site and performed a safety meeting. At 0737 cleaning the pad resumed. At 0945 the lid was welded on for H-12R vault and the monument was built for H-12. At 1121 the equipment was moved to H-3 for short term storage.

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.

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

Well Cuttings Log						Page <u>1</u> of <u>5</u>
Hole ID: <u>H-12R, C-3749</u>						Location: <u>NE 1/4, NE 1/4, NE 1/4, Section 15, T23S, R31E</u>
Drill Date: <u>7-12-14 to 7-24-14</u>	Drilling Method: <u>Hollow-Stem/Air Rotary</u>	Drill Make/Model: <u>NA</u>				
Drill Co: <u>Stewart Brothers</u> <u>Drilling Company</u>	Hole Diameter: <u>10.5 Inch</u>	Barrel Specs: <u>NA</u>				
	Hole Depth: <u>865 Feet bgl</u>	Drill Fluid: <u>NA</u>				
	Hole Orientation: <u>Vertical</u>	Core Preserve: <u>NA</u>				
Logged by: <u>Brett Seal</u>	Date: <u>6/8/15</u>	Scale: <u>NA</u>				
	Northing	Easting				Elevation
Survey Coordinate (Ft):						
Comments:	Depths to unit contacts are derived from geophysical logs. Lithology comes from cuttings. S sample depths were adjusted to correlate with units					
Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-51				Surficial Deposits	Mostly unconsolidated dune sands, with a few very poorly consolidated pebble sized cuttings.	
C-53	10	Mescalero			5 YR 5/8 (yellowish red), well sorted rounded grains with high porosity Caliche, 5 YR 8/3 (Pale pink), poorly sorted, highly effervescent when exposed to HCl, high porosity	
C-54	20	Gatunia			Sandstone, 2.5 YR 5/4 (Reddish brown), poorly sorted grains, clast supported with a calcic matrix, contains caliche from the above Mescalero, manganese oxide staining present, effervescent when exposed to HCl, low porosity.	
C-55	30				Sandstone, 2.5 YR 5/6 (red) moderately consolidated, poorly sorted, calcic cement, effervescent when exposed to HCl	
C-2	40	Santa Rosa			Sandstone, 2.5 YR 5/6 (red), cuttings powdered, fine grained, subrounded and subangular, poorly sorted, calcareous cement, effervescent when exposed to HCl	
C-3	50				Sandstone, 2.5 YR 4/6 (red), coarse to fine grained, poorly consolidated, calcareous cement, effervescent with HCl, moderately sorted, low porosity	
C-4	60				Sandstone 2.5 YR 6/4 (light reddish brown), fine grained, poorly consolidated, low porosity, manganese oxide flakes present	
C-5	70				Sandstone, 2.5 YR 5/4 (reddish brown), calcareous cement, fine grained, subangular to subrounded, low porosity, poorly consolidated, iron oxides present	
C-6	80				Sandstone, same as above	
C-7	90				Sandstone, same as above, poor to moderate consolidation, reduction spots are visible.	
C-8	100	Dewey Lake			Sandstone same as above, reduction material present, minimal manganese oxides present.	
C-9	110					
C-10	120					
	130					
	140					
	150					
	160					

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

Well Cuttings Log					Page <u>2</u> of <u>5</u>	
Hole ID: <u>H-12R</u>				Location: <u>Section 15, T23S, R31E</u>		
Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-11	170				Sandstone, 2.5 YR 5/4 (reddish brown), slightly calcic cement, fine grained, low porosity, minimal amounts of fibrous gypsum	
C-11	180					
C-11	190					
C-11	200					
C-12	210				Sanstone, 2.5 YR 4/6 (red) fine grained, low porosity, sub-angular and sub-rounded moderately sorted grains, slightly calcic cement, poor to moderate consolidated, reduction spots visible. No gypsum present.	
C-13	220				Sandstone, 2.5 YR 5/6 (red) , fine grained and moderately sorted, poor to moderate consolidation, low porosity, reduction spots, slightly calcic. No gypsum present.	
C-14	230					
C-14	240				Sandstone, 2.5 YR 5/6 (red), fine grained, moderately sorted, sub-angular and sub-rounded grains, poor to moderate consolidation, low porosity, reduction spots. Sample is slightly calcic. Fibrous gypsum is present in layers of sandstone.	
C-14	250					
C-15	260				Sandstone, 2.5 YR 5/4 (reddish brown), fine grained, well sorted with low porosity, poor to moderate consolidation. Sample is slightly calcic and contains minute amounts of gypsum and has reduction spots.	
C-15	270					
C-16	280	Dewey Lake			Sandstone, 2.5 YR 5/4 (reddish brown), fine grained, moderately sorted, low porosity, moderate consolidation, slightly calcic, reduction spots. No gypsum present	
C-16	290					
C-16	300					
C-16	310					
C-18	320				Sandstone, 2.5 YR 5/4 (reddish brown) fine grained, moderately sorted and consolidated, sub-angular and sub-rounded grains with low porosity. Reduction material and spots present. Minor in amounts of gypsum present.	
C-18	330					
C-19	340				Sandstone, 2.5 YR 5/4 (reddish brown) fine grained, moderately sorted and consolidated, sub-angular and sub-rounded grains with low porosity. Reduction spots present. Minor in amounts of gypsum present.	
C-19	350					
C-19	360					
C-19	370					
C-21	380				Same as C-19, slightly calcic.	

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

Well Cuttings Log					Page <u>3</u> of <u>5</u>	
Hole ID: <u>H-12R</u>				Location: <u>Section 15, T23S, R31E</u>		
Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-22	390	Dewey Lake			Increase in the amount of reduction material and spots.	
	400					
	410					
	420				Increase in reduction spots	
	430					
	440				Sandstone, 2.5 YR 4/4 (reddish brown), low porosity, medium to high consolidation, reduction spots present, sub-angular to sub-rounded, minor amounts of gypsum. Non calcic cement.	
	450					
	460				Sandstone, 2.5 YR 4/6 (red), low porosity, medium to high consolidation, moderately sorted, reduction material and spots, gypsum present. Non calcic cement.	
	470					
	480				Decrease in reduction material and poorly sorted.	
	490				Sandstone, 2.5 YR 6/4 (light reddish brown), low porosity, medium to high consolidation, reduction spots, non calcic cement. Sandstone, 10 YR 8/1 (white), low porosity, low to high consolidation, no reduction spots, non calcic cement, minimal gypsum present. Poorly sorted.	
C-28	500				Sandstone, 2.5 YR 5/4 (reddish brown), low porosity, medium to high consolidation, reduction spots and material, non calcic cement, poorly sorted, minimal gypsum.	
	510					
	520				No reduction material and poorly sorted. Gypsum present.	
	530					
	540				Same as above	
	550					
	560				Sandstone, 2.5 YR 4/4 (reddish brown), well sorted, poor to medium consolidation, sub-angular to sub-rounded, low porosity, reduction spots, non calcic cement, gypsum present.	
	570				No Change.	
	580					
	590				Sandstone, 2.5 YR 5/4 (reddish brown), low porosity, moderately sorted, low consolidation, sub-angular to sub-rounded, reduction material and spots, non calcic cement, gypsum present.	
	600					
	610				No reduction material	

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

Well Cuttings Log						Page <u>4</u> of <u>5</u>
Hole ID: <u>H-12R</u>				Location: <u>Section 15, T23S, R31E</u>		
Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-35					Sandstone, 2.5 YR 5/4 (reddish brown), low porosity, moderate sorting, poor consolidation, sub-angular to sub-rounded, non calcic cement, gypsum.	
C-36	620				Anhydrite, 7.5 YR 6/1 (gray), low porosity, fine crystalline structure, minimal gypsum present. Fall down Dewey Lake sandston present with reduction spots.	
C-37	630			A-5	Anhydrite, 7.5 YR 6/1 (gray), fine crystalline structure with low porosity. Minimal Dewey Lake falldown.	
C-38	640					
C-39	650			M-4		
C-40	660				Anhydrite, 7.5 YR 6/1 (gray), fine crystalline structure with low porosity.	
C-41	670				Same as above.	
C-42	680			A-4	No change.	
C-43	690				Dolomite, 10 YR 6/1 (gray), microcrystalline, minor amounts of anhydrite present.	
C-44	700				Dolomite, 10 YR 7/1 (light gray), microcrystalline, minor amounts of gypsum present.	
C-45	710				Anhydrite, 7.5 YR 6/1 (gray) fine crystalline structure with low porosity and gypsum present. Dolomite fall down present.	
C-46	720				Anhydrite, 7.5 YR 6/1 (gray), fine crystalline structure with low porosity.	
C-47	730			A-3	Same as above.	
C-48	740				No Change.	
C-49	750				No Change.	
C-50	760	Rustler			Anhydrite, 10 YR 7/1 (light gray) fine crystalline structure with low porosity.	
C-51	770				Anhydrite, GLEY 1 7/N (light greenish gray), fine crystalline structure with low porosity.	
C-52	780				Mudstone, 5 Y 6/1 (gray), very fine grained, low porosity, some samples with specs of pyrite	
C-53	790	Tamarisk		M-3	Anhydrite fall down present.	
C-54	800				Anhydrite, GLEY 1 6/N (gray), fine crystallin structure with low porosity, moderately sorted, poor to moderate consolidation. Halite present.	
C-55	810				Salt, 2.5 YR 6/1 (reddish gray), well sorted, some anhydrite fall down present.	
C-56	820			A-2	Salt, 5 YR 4/2 (dark reddish gray) to clear, well sorted.	
C-57	830				Salt, 5 YR 6/2 (pinkish gray) to clear, well sorted.	
C-58		Culebra			Anhydrite, 10 YR 5/2 (grayish brown), poor to moderate consolidation, moderately sorted, some halite present.	
					Anhydrite, 10 YR 5/1 (gray), moderately sorted, fine crystalline structure with low porosity. Small amount of dolomite present.	
					Dolomite, 10 YR 7/1 (light gray), poor to medium consolidation, microcrystalline.	

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

Well Cuttings Log						Page <u>5</u> of <u>5</u>
Hole ID: <u>H-12R</u>			Location: <u>Section 15, T23S, R31E</u>			
Sample Number	Depth (Ft bgl)	Formation	Member	Informal Unit	Description	Lithology
C-60	840	Rustler	Culebra		Dolomite, 10 YR 7/2 (light gray), vuggy texture, microcrystalline matrix, and minor amounts of gypsum present.	
C-61	850				Dolomite, 10 YR 5/1 (gray), microcrystalline matrix. Dolomite, 10 YR 7/2 (light gray), vuggy texture, microcrystalline matrix. Minor amount of anhydrite fall down.	
C-62	860				Dolomite, 10 YR 5/1 (gray), microcrystalline matrix, well sorted. Gypsum present in minor amounts.	
C-63	860				Anhydrite, 5 YR 6/2 (pinkish gray), fine crystalline structure, minor amounts of dolomite and gypsum.	
C-64	870				End of Geophysical Log	
	880				Salt, 5 YR 5/3 (reddish brown), moderately sorted. Minor amounts of anhydrite and dolomite from fall down.	
	890					
	900					

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

APPENDIX C

Permitting and Completion Information

A case file for H-12 R (C-3749-POD-1) 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-3749.

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

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: 548076
File Nbr: C 03749 POD1 EXPL/MON

Jun. 24, 2014

GEORGE BASABILVAZO
US 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 06/30/2015, 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 06/30/2015.

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

Sincerely,

YM
Andy Morley
(575) 622-6521

Enclosure

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

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/>

Purpose:	<input type="checkbox"/> Pollution Control And / Or Recovery	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Exploratory	<input type="checkbox"/> Construction Site De-Watering	<input type="checkbox"/> Other (Describe):
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Mineral De-Watering	
A separate permit will be required to apply water to beneficial use.		
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:
Plugging Plan of Operations Submitted? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No		

1. APPLICANT(S)

Name: U.S. Department of Energy	Name:			
Contact or Agent: George Basabilvazo	check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>		
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	<input type="checkbox"/> Home	<input type="checkbox"/> Cell	<input type="checkbox"/> Home	<input type="checkbox"/> Cell
E-mail (optional): George.Basabilvazo@wipp.ws	E-mail (optional):		2014	JUN - 2 PM 2:

FOR OSE INTERNAL USE Application for Permit, Form wr-09 Rev 4/12/12

File Number	C-3749	Trm Number	548076
Trans Description (optional):	POD 1	Expl / Monitor	
Sub-Basin:	CVB		
PCW/LOG Due Date:	6-30-15		

Page 1 of 3

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

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.

- | | | |
|--|---|--|
| <input type="checkbox"/> NM State Plane (NAD83) (Feet) | <input type="checkbox"/> UTM (NAD83) (Meters) | <input checked="" type="checkbox"/> Lat/Long (WGS84) (to the nearest 1/10 th of second) |
| <input type="checkbox"/> NM West Zone | <input type="checkbox"/> Zone 12N | |
| <input type="checkbox"/> NM East Zone | <input type="checkbox"/> Zone 13N | |
| <input type="checkbox"/> NM Central Zone | | |

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-2777 (H-12) C-3749 POD1	32 deg 18'42.0588	-103 deg 45'26.7078	-

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): 860.00 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

FOR OSE INTERNAL USE

File Number.

C-3749

Application for Permit, Form wr-07

Tm Numbe: 848076

Page 2 of 3

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

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: <input type="checkbox"/> Include a description of any proposed pump test, if applicable.	Pollution Control and/or Recovery: <input type="checkbox"/> Include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> A description of the need for the pollution control or recovery operation. <input type="checkbox"/> The estimated maximum period of time for completion of the operation. <input type="checkbox"/> The annual diversion amount. <input type="checkbox"/> The annual consumptive use amount. <input type="checkbox"/> The maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> The method and place of discharge. <input type="checkbox"/> The method of measurement of water produced and discharged. <input type="checkbox"/> The source of water to be injected. <input type="checkbox"/> The method of measurement of water injected. <input type="checkbox"/> The characteristics of the aquifer. <input type="checkbox"/> The method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> Proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> 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: <input type="checkbox"/> Include a description of the proposed dewatering operation, <input type="checkbox"/> The estimated duration of the operation, <input type="checkbox"/> The maximum amount of water to be diverted, <input type="checkbox"/> A description of the need for the dewatering operation, and, <input type="checkbox"/> A description of how the diverted water will be disposed of.	Mine De-Watering: <input type="checkbox"/> Include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> A description of the need for mine dewatering. <input type="checkbox"/> The estimated maximum period of time for completion of the operation. <input type="checkbox"/> The source(s) of the water to be diverted. <input type="checkbox"/> The geohydrologic characteristics of the aquifer(s). <input type="checkbox"/> The maximum amount of water to be diverted per annum. <input type="checkbox"/> The maximum amount of water to be diverted for the duration of the operation. <input type="checkbox"/> The quality of the water. <input type="checkbox"/> The method of measurement of water diverted. <input type="checkbox"/> The recharge of water to the aquifer. <input type="checkbox"/> Description of the estimated area of hydrologic effect of the project. <input type="checkbox"/> The method and place of discharge. <input type="checkbox"/> An estimation of the effects on surface water rights and underground water rights from the mine dewatering project. <input type="checkbox"/> A description of the methods employed to estimate effects on surface water rights and underground water rights. <input type="checkbox"/> Information on existing wells, rivers, springs, and wetlands within the area of hydrologic effect.
---	--	---	---

ACKNOWLEDGEMENT

I, We (name of applicant(s)),

George T. Basabillazo

Print Name(s)

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

George T. Basabillazo

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 04 day of June 20 14, for the State Engineer,

Scott A Verhines, P.E., State Engineer

By:

Signature

Andy Morley

Print

Title: Andy Morley, District II Manager

Print

2014 JUN -2 PM 2:28

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number: <u>C-3749</u>	Trn Number: <u>548076</u>
----------------------------	---------------------------

Page 3 of 3

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

**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.
- 7 The Permittee shall utilize the highest and best technology available to ensure conservation of water to the maximum extent practical.
- 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.
- 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 03749 POD1 must be completed and the Well Log filed on or before 06/30/2015.

Trn Desc: C 03749 POD1 EXPL/MON

File Number: C 03749

Trn Number: 548076

page: 1

ISSUED

**Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0**

**NEW MEXICO STATE ENGINEER OFFICE
PERMIT TO EXPLORE**

SPECIFIC CONDITIONS OF APPROVAL (Continued)

THE SCREENED INTERVAL AND FILTER PACK SHALL BE CONSTRAINED TO THE CULEBRA MEMBER OF RUSTLER FORMATION.

ACTION OF STATE ENGINEER

Notice of Intention Rcvd:	Date Rcvd. Corrected:
Formal Application Rcvd: 06/02/2014	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 24 day of Jun A.D., 2014

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

By: Andy Morley
Andy Morley

Trn Desc: C 03749 POD1 EXPL/MON

File Number: C 03749

Trn Number: 548076

page: 2

ISSUED

**Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0**

Locator Tool Report

General Information:

Application ID:29 Date: 06-24-2014 Time: 16:51:12

WR File Number: C-03749-POD1
Purpose: POINT OF DIVERSION

Applicant First Name: US DEPT OF ENERGY
Applicant Last Name: WIPP

GW Basin: CARLSBAD
County: EDDY

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

PLSS Description (New Mexico Principal Meridian):

SE 1/4 of SE 1/4 of SE 1/4 of SE 1/4 of Section 10, Township 23S, Range 31E.

Coordinate System Details:

Geographic Coordinates:

Latitude: 32 Degrees 18 Minutes 42.1 Seconds N
Longitude: 103 Degrees 45 Minutes 26.7 Seconds W

Universal Transverse Mercator Zone: 13N

NAD 1983(92) (Meters)	N: 3,575,662	E: 616,974
NAD 1983(92) (Survey Feet)	N: 11,731,152	E: 2,024,188
NAD 1927 (Meters)	N: 3,575,460	E: 617,022
NAD 1927 (Survey Feet)	N: 11,730,490	E: 2,024,347

State Plane Coordinate System Zone: New Mexico East

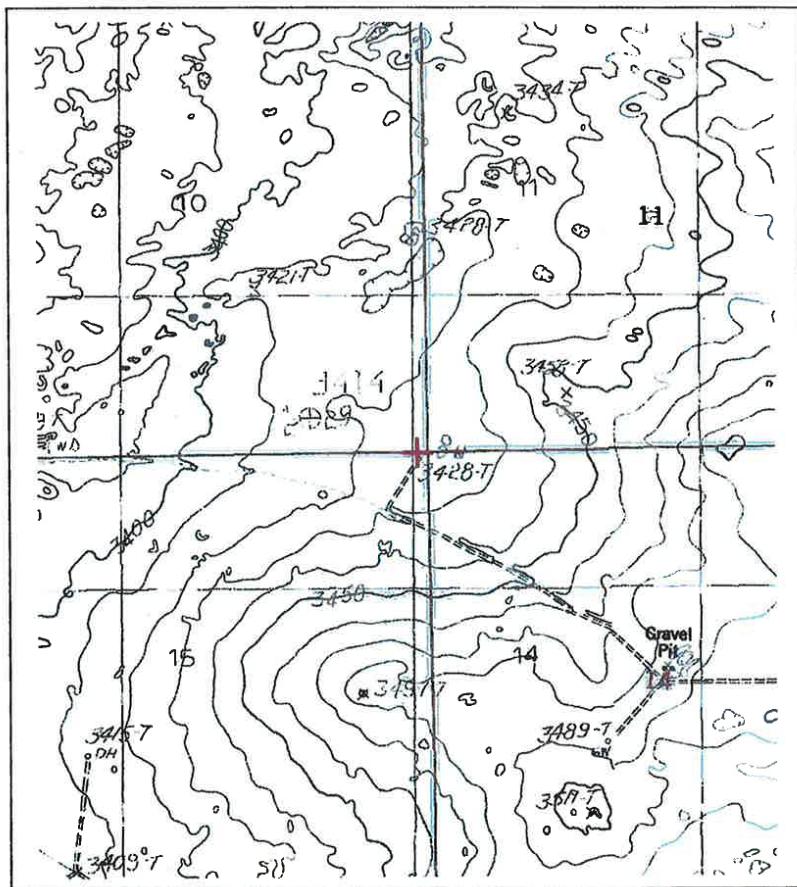
NAD 1983(92) (Meters)	N: 145,573	E: 219,231
NAD 1983(92) (Survey Feet)	N: 477,601	E: 719,259
NAD 1927 (Meters)	N: 145,555	E: 206,678
NAD 1927 (Survey Feet)	N: 477,541	E: 678,076

ISSUED

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

NEW MEXICO OFFICE OF STATE ENGINEER

Locator Tool Report



WR File Number: C-03749-POD1 Scale: 1:19,134

Northing/Easting: UTM83(92) (Meter): N: 3,575,662 E: 616,974

Northing/Easting: SPCS83(92) (Feet): N: 477,601 E: 719,259

GW Basin: Carlsbad

Page 2 of 2

Print Date: 06/24/2014

APPENDIX D

Geophysical Logs

Geophysical logging of H-12R was conducted by Jet West Geophysical Services, LLC, 2550 La Plata Highway, Farmington, NM, 87499-3522 on July 25, 2014 after TD was reached on H-12R. 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

H-12R was drilled to 865ft and logged to a depth of 864 ft. A conductor casing had been placed to a depth of 30 ft. H-12R was drilled with air and water, and the apparent water level was 785 during logging.

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

The rounded elevation of 3428ft amsl for the control point is appropriate for the measurements and elevations of units for later studies.

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

Figure D-1
Well Record H-12R (C-3749 POD-1)

Company: Nuclear Waste Partnership Well: H-12R (C-3749 POD-1) Section: 15 Twp: 23S Rge: 31E Location: NE1/4, NE1/4, NE1/4	Elevation - amsl TOC: 3430.60 CP: 3428.37 GL: 3428.37	23S 31E 15
Reference Point Log measured from: ground level Drilling measured from: ground level Permanent Datum: Benchmark	Geophysical Log Date: 7-25-2014 Gamma: 0-865ft bgl Density: 0-865ft bgl	
Drilling Contractor: Stewart Bros Drilling Geophysical Logs: Al Henderson Jet West Geophysical Setvice LLC Geologist: Brett Seal Spud Date: 7-25-14 Completion Date: 7-25-14 Total Depth (TD): 865ft bgl	Casing Record Conductor: 13in OD steel to 30ft bgl Casing: 5.5 in OD fiberglass reinforced plastic to 865ft bgl Screen: 823-846ft bgl	

Geophysical and Cutting Log Symbols

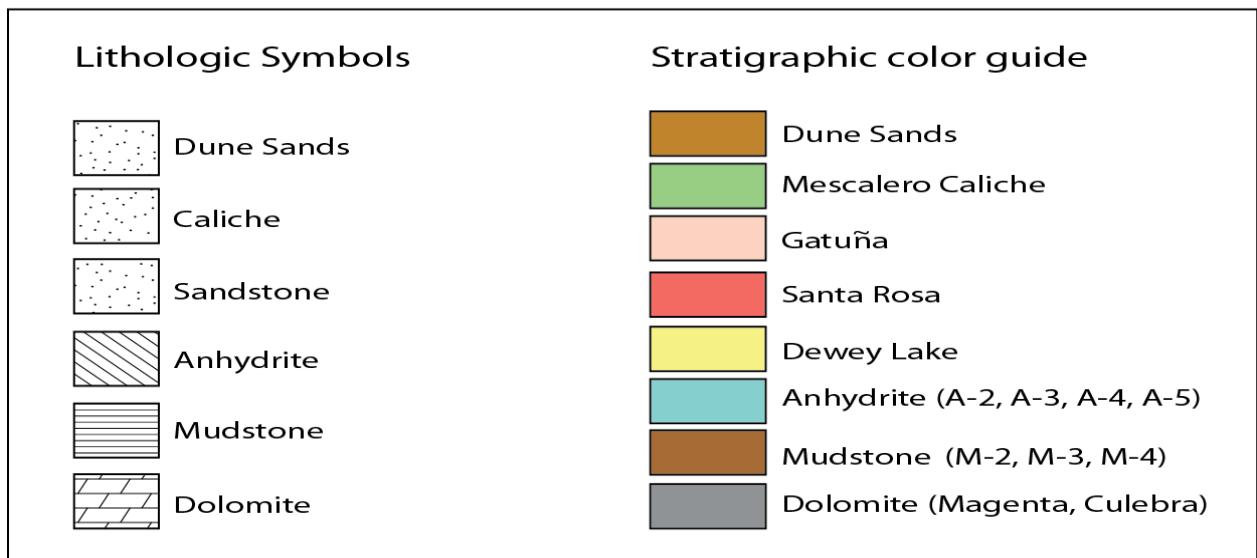


Figure D-1: Well Record H-12R (C-3749 POD-1)

Basic Data Report for Drillhole H-12R (C-3749 POD-1)
DOE/WIPP-16-3559, Rev. 0

