A & M Engineering and
Environmental Services, Inc.
Consulting - Design - Construction - Remediation

February 5, 2025

Ms. Hillary Young, P.E.
Chief Engineer
Land Protection Division
Oklahoma Department of Environmental Quality
P. O. Box 1677
Oklahoma City, Oklahoma 73101-1677

RE: Response to Notice of Deficiency (NOD) Letter Dated October 31, 2024
Class I Non-Hazardous Injection Well Operating Permit Renewal Application
Well ID: MES #1
Mid-Way Environmental Services, Inc.
Lincoln County, Oklahoma
Operating Permit No. IW-NH-41001-OP

Dear Ms. Young:

On behalf of Mid-Way Environmental Services, Inc. (MES), A & M Engineering and Environmental Services, Inc. (A & M) respectfully submits this letter and attachments in response to the Notice of Deficiency (NOD) letter dated October 31, 2024, regarding MES's Class I Non-Hazardous Injection Well Operating Permit Renewal Application.

The format utilized in responding to the NODs includes a citation of the individual NOD and the prepared response. For convenience of review and where applicable, revised figures and tables are included with the individual NOD response.

If you have any questions on this matter, or if you require any additional information, please do not hesitate to call me on (918) 665-6575 or email me at omohammad@aandmengineering.com.

Sincerely,
A & M Engineering and Environmental Services, Inc.

Orphius Mohammad, PhD., P.E.
Senior Environmental Engineer

cc: Tolga Ertugrul, P.E., President, MES

Enclosed: NOD Response

MID-WAY ENVIRONMENTAL SERVICES, INC.

CLASS I NON-HAZARDOUS WASTE INJECTION WELL
MES #1
PERMIT NO. IW-NH-41001-OP

RESPONSE TO NOTICE OF DEFICIENCY LETTER
DATED OCTOBER 31, 2024

PREPARED FOR:

MID-WAY ENVIRONMENTAL SERVICES, INC.
120 NORTH 8TH AVENUE
STROUD, OKLAHOMA 74079

FEBRUARY 5, 2025

PREPARED BY:

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.
10010 EAST 16TH STREET
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CERTIFICATE OF AUTHORIZATION NUMBER 1326

A & M Engineering and
Environmental Services, Inc.
Consulting - Design - Construction - Remediation

MID-WAY ENVIRONMENTAL SERVICES, INC.
PERMIT RENEWAL APPLICATION
OPERATING Permit No. IW-NH-41001-OP
FOR MES #1

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APPENDIX A	Adjacent Well Log
APPENDIX B	Monitoring Well Log
APPENDIX C	Report: Plugging Efficiency of the Nearby Wells, and Hydraulic Interference Possibility by Evren M. Ozbayoglu, PhD

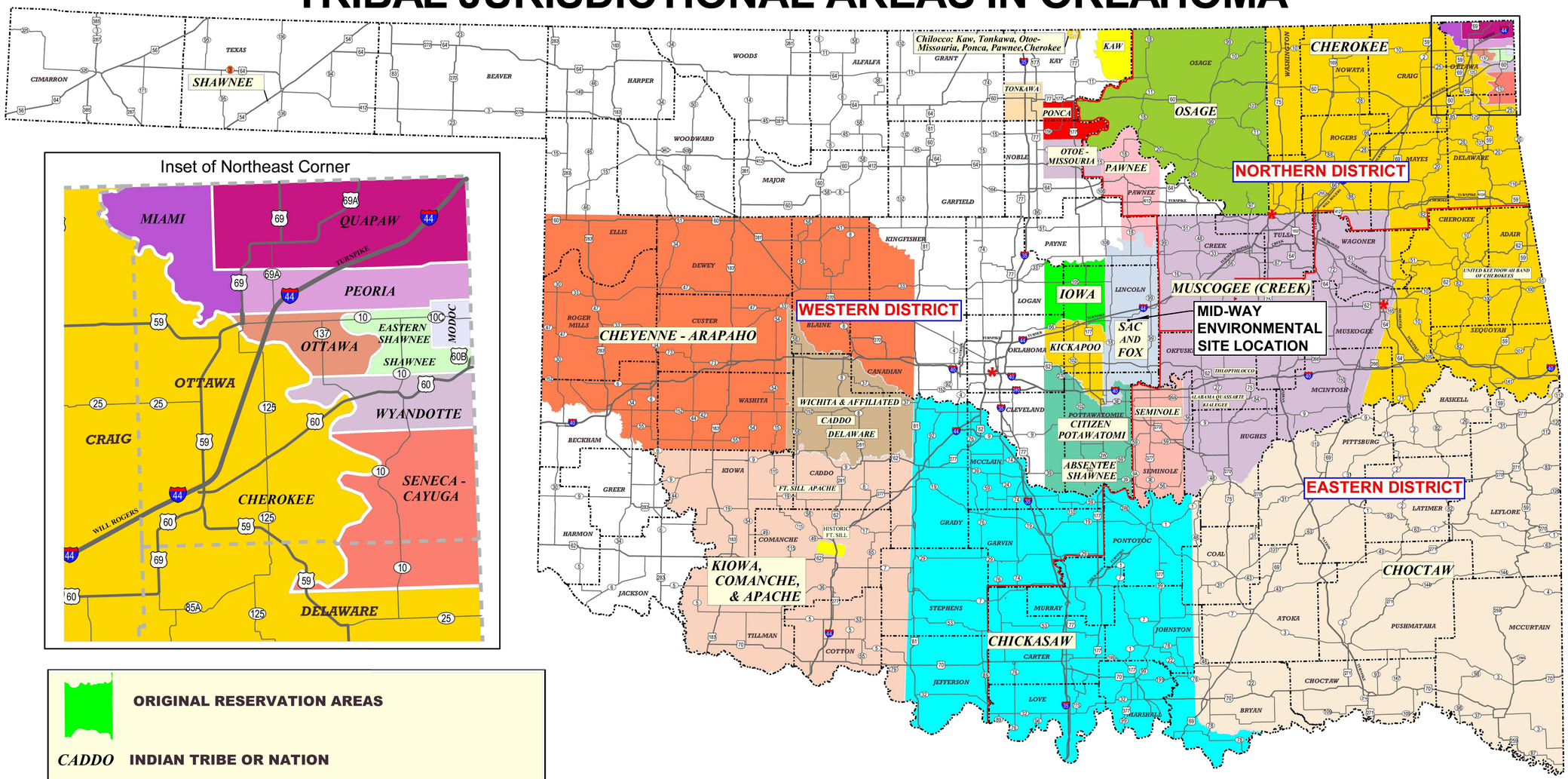
DEFICIENCY NO 1

The Application does not state whether the facility is located on Indian lands. Please provided this information in accordance with 40 C.F.R. § 144.31(e)(5).

RESPONSE:

Mid-Way Environmental Services, Inc. (MES) is located within the boundary of the Sac and Fox Nation tribal jurisdictional area as shown on the attached map (**Figure 1**). However, this area is not a federally administered reservation and only tribal trust lands located within this boundary are considered Indian Land as defined under 40 C.F.R. § 144.3. MES is not located on tribal trust land and therefore is not located on Indian Land.

TRIBAL JURISDICTIONAL AREAS IN OKLAHOMA



Inset of Northeast Corner

	ORIGINAL RESERVATION AREAS
CADDO	INDIAN TRIBE OR NATION
*	FEDERAL COURTHOUSE & U.S. ATTORNEY'S OFFICE
KAY	COUNTY
WESTERN DISTRICT	FEDERAL JUDICIAL DISTRICTS

INDIAN COUNTRY PARCELS SUBJECT TO FEDERAL & TRIBAL JURISDICTION MAY BE FOUND WITHIN THE COLORED REGIONS
(Unless tribal reservation boundaries are recognized, each parcel must independently qualify as Indian country for federal and tribal jurisdiction to exist)

Indian Country as defined by 18 U.S.C. Section 1151 (a), (b) & (c) -
(a) formal [recognized reservation boundaries] & informal [tribal trust lands] reservations (including rights-of-way/roads running through the same), (b) dependent Indian communities, & (c) Indian allotments held in trust or restricted status (including rights-of-way/roads running through the same).

JULY 20, 2020 Adopted from a Map by the Oklahoma Department of Transportation

PATH: C:\Midway\NOD 12-28-2024\
FILE: TIRBAL JURISDICTION MAP.dwg
DATE: Jan 06, 2025 - 7:20AM

GENERAL NOTES

REVISIONS

NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE

A & M Engineering and Environmental Services, Inc.
Consulting - Design - Construction - Remediation

TRIBAL JURSIDICTION MAP

MID-WAY ENVIRONMENTAL, INC.
DAVENPORT, OKLAHOMA

DRAWN:	CHECKED BY:	MATERIALS BY:	ENGINEER:	APPROVED BY:	SCALE:	PROJECT NUMBER:	DRAWING NUMBER:	REV.:
ALB				OM	GRAPHIC	1706-0046-012	FIGURE NO. 1	
DATE: 12/30/2024	DATE:	DATE:	DATE:	DATE: 12/30/2024				

DEFICIENCY NO 2

The Application does not list other existing permits for the facility. Please provide this information in accordance with 40 C.F.R. § 144.31(e)(6).

RESPONSE:

Mid-Way Environmental Services, Inc. (MES) operates a non-hazardous industrial waste processing facility and was issued the solid waste processing facility permit by Department of Environmental Quality, Land Protection Division in July 2009. The Solid Waste Permit Number is 3541017.

DEFICIENCY NO 3

The Application does not include information on recordkeeping. In accordance with 40 C.F.R. § 144.31(f), applicants shall keep records of all data used to complete permit applications and any supplemental information submitted under this section for a period of at least three (3) years from the date the application is signed.

RESPONSE:

As mentioned in this operating permit (Permit No. IW-NH-41001-OP, Permit), MES retains records of all monitoring information, including the following:

1. Calibration and maintenance records and all original circular chart recordings for continuous monitoring instrumentation, copies of all reports required by this permit, and records of all data used to complete the application for this permit, for a period of at least 3 years from the date of the sample, measurement, report, or application. This period may be extended by the request of the Director at any time; and

2. The nature and composition of all injected fluids until three (3) years after the completion of any plugging and abandonment procedures specified under 40 CFR Sec. 144.52(a)(6), or under 40 CFR part 146 subpart G as appropriate.

DEFICIENCY NO 4

No information on the Area of Review (AOR) was provided in the Application. In accordance with 40 C.F.R. § 146.6, the AOR shall be determined by either the zone of endangering influence computation or a fixed radius around the well of not less than one-fourth (1/4) mile.

RESPONSE:

In 2014, when this Permit was approved and issued by DEQ, MES opted for a fixed radius of one mile around the well for Area of Review (AOR). MES will maintain the same option and submit well information within one-fourth (1/4) mile, half (1/2) mile, and one (1) mile radius around the injection well (See Response to Deficiency 5 and 6).

DEFICIENCY NO 5

In accordance with 40 C.F.R. § 144.55, Applicants for Class I injection well permits shall identify the location of all known wells within the injection well's AOR which penetrate the injection zone. Please make a determination of the AOR and provide all relevant information on wells within the AOR, including a plan to prevent movement of fluid into underground sources of drinking water (USDWs) for such wells which may be improperly sealed, completed, or abandoned.

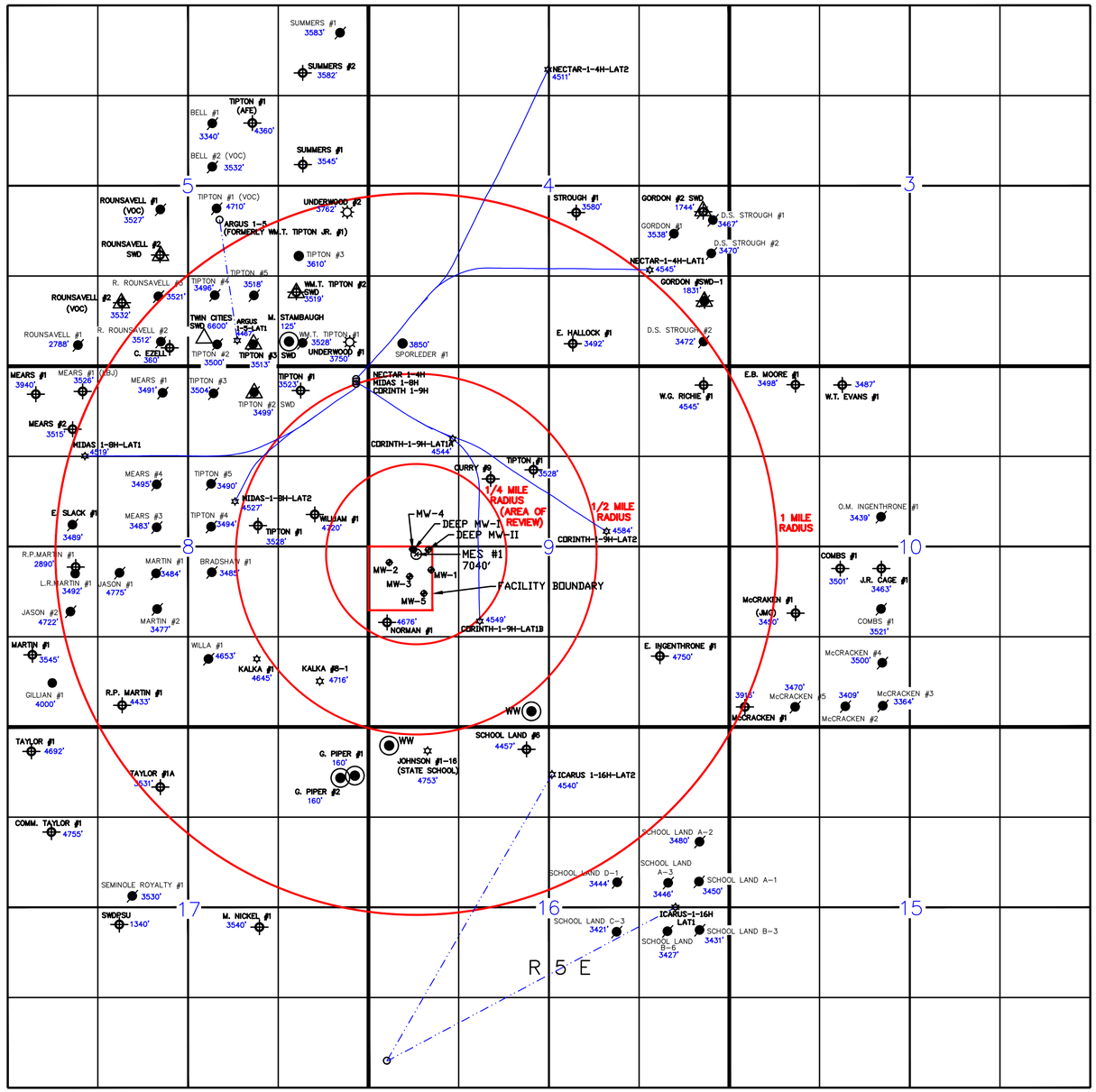
RESPONSE:

As mentioned in response to Deficiency 4, in 2014, when this Permit was approved and issued by DEQ, MES opted for a fixed radius around the well for Area of Review (AOR). MES will maintain the same option and include adjacent well information within one-fourth (1/4) mile, half (1/2) mile, and one (1) mile radius around the injection well as follows.

ADJACENT WELL INVENTORY

WATER WELLS

There is no water wells located within the 0.25-mile radius area of review surrounding the MES Injection Well (MES#1). Additionally, there are no water wells located within a 0.50-mile radius of the injection well. There are six (6) domestic water wells within a one (1)-mile radius of the injection well. The logs of these six wells are included in **Appendix A** and their locations are shown in **Figure 2**. The owner, location, total depth, and depth to water (if known) are listed in **Table 1**.



0 500 1000 2000

LEGEND

- DRY HOLE (PLUGGED)
- OIL WELL
- GAS WELL
- SURFACE LOCATION
- PLUGGED OIL WELL
- SALTWATER DISPOSAL WELL
- DRY HOLE CONVERTED TO SALTWATER DISPOSAL WELL
- PLUGGED SALTWATER DISPOSAL WELL
- E. HALLOCK #1 3492' NAME OF WELL TOTAL DEPTH
- WW WATER WELL
- MW-1 MONITOR WELL
- MONITOR WELL (ACTUAL COURSE)
- HORIZONTAL WELL (CONCEPTUAL COURSE)

GENERAL NOTES

REFERENCE:

1) OIL AND GAS WELL DATA OBTAINED FROM THE OKLAHOMA CORPORATION COMMISSION.
2) WATER WELL DATA OBTAINED FROM THE OKLAHOMA WATER RESOURCES BOARD.

REVISIONS

NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE

A & M Engineering and Environmental Services, Inc.
Consulting - Design - Construction - Remediation

PLOTTED OIL AND GAS WELLS, WATER WELLS AND MONITOR WELLS WITHIN ONE MILE OF MES #1
MID-WAY ENVIRONMENTAL, INC.
DAVENPORT, OKLAHOMA

DRAWN:	CHECKED BY:	MATERIALS BY:	ENGINEER:	APPROVED BY:	SCALE:	PROJECT NUMBER:	DRAWING NUMBER:	REV.:
ALB				OM	GRAPHIC	1706-0046-012	FIGURE 2	
DATE: 1/22/2025	DATE:	DATE:	DATE:	DATE: 1/22/2025				

PATH: C:\Midway\NOD 12-28-2024\
FILE: 1-10 Well Depths -ALB.dwg
DATE: Feb 03, 2025 - 10:15AM

Table 1: List of Water Wells Within 1 -Mile Radius of MES #1

Owner	Location	Total Depth	Depth to Water
Charlie Ezell	5-14N-5E SESESW	360’	Unknown
Melissa Stanbaugh	5-14N-5E SWSESE	125’	Unknown
Smith Pump & Supply	9-14N-5E SESESW	175’	105’
Kevin Garrett	16-14N-5E	70’	Unknown
Greg Piper	17-14N-5E SENENE	160’	85’
Greg Piper	17-14N-5E	160’	85’

In Section 9, Township 14 North, Range 5 East, the lowermost Underground Source of Drinking Water (USDW) is determined by the Oklahoma Corporation Commission (OCC) to be at a depth of 200 feet. The Hydrologic Atlas – 4 of the Oklahoma Geological Survey classifies this area as a minor aquifer with fair to poor quality water.

At the injection well site, six monitoring wells have been drilled and completed. Five of these wells are completed in the uppermost groundwater aquifer at a depth of 90 to 125 feet and in the Pennsylvanian sandstone, part of the Vanoss Group. The sixth well is the Deep Monitor Well which was drilled to a depth of approximately 260 feet to determine the lowermost Underground Source of Drinking Water (USDW). The monitoring well locations are shown in **Figure 2**.

OIL AND GAS WELLS

Oil and gas well data obtained from the OCC are tabulated in Table 2 for wells located within a one-mile radius of MES #1 and are also shown in **Figure 2**.

There is only one (1) well located within the ¼-mile radius AOR of MES #1, which has been drilled and plugged; eight (8) wells are located within a ½-mile radius; and forty-three (43) wells

within a one-mile radius. Most wells within a one-mile radius of MES #1 have been plugged and abandoned, however eleven wells remain active and unplugged. Out of the eleven unplugged and active wells, one of them (Tipton #3) is oil producer; nine of them (Midas #1-8H, Nectar #1-4H, Corinth #1-9H, Argus #1-5, Underwood #1, Underwood #2, Kalka #1-Hercules, Johnson #1-16 and Icarus #1-16H) are gas producers, and the remaining one (Twin Cities #1) are oil field saltwater disposal wells.

Tipton #3 and Johnson #1-16 produce from the Pennsylvanian Prue Sandstone at an approximate depth of 3,000 to 3,500 feet. The other gas wells produce from the Hunton Limestone at a depth of approximately 4,500 to 4,700 feet. Twin Cities #1 is completed in the Arbuckle Group and is used to dispose saltwater in this formation.

Curry #9 is listed in the OCC records; however, the records do not show any detail or information regarding the well. Due to its apparent proximity to MES #1, MES contacted the lease owner, Mr. William Tipton, regarding the well. Mr. Tipton stated that Curry #9 was spudded but was never drilled. Additionally, a field reconnaissance was conducted at the recorded location of Curry #9 and no indications of a well were observed.

Tipton #1 (in SE/4 of SW/4 of NE/4 of Section 8, Township 14 North, Range 5 East), Tipton #1 (in NW/4 of SW/4 of NE/4 of Section 8 Township 14 North, Range 5 East), Tipton #1 (in NE/4 of SE/4 of NW/4 of Section 9, Township 14 North, Range 5 East), and Tipton #5 (in NE/4 of SW/4 of SE/4 of Section 5, Township 14 North, Range 5 East) have some records in the OCC files, however there are no plugging records. A field reconnaissance was performed at the recorded locations of these wells and no indications of wells were observed at any of these locations. MES interviewed Mr. Tipton regarding these wells, and he stated that all these wells were drilled into the Prue Sandstone at a depth of approximately 3,500 feet, tested, determined to be dry and therefore plugged.

Review of the well logs indicates that all the oil and gas production in the vicinity of the injection well has been from the lenticular sandstone strata (Prue, Red Fork, and Taneha) in the

Pennsylvanian System and Hunton Limestone. Several exploration wells were drilled into deeper strata (Wilcox) within a one-mile radius, but were all recorded as dry holes. The deepest penetration within a one-mile radius of MES #1 is to a depth of 6,600 feet into the Arbuckle Group by Twin Cities #1 saltwater disposal well. There are no unplugged wells within a one-mile radius of MES #1 except for the seven active production wells and the two saltwater disposal wells.

TABLE 2: List of Oil and Gas Wells Within 1 -Mile Radius of MES #1

Well Name	Location	Total Depth	Date	Type	Status
WELLS WITHIN 1/4 MILE RADIUS					
1. Norman	9-SW/NW/SW	4676	6/3/1975	Dry	Plugged
WELLS WITHIN 1/2 MILE RADIUS					
2. Curry #9	9-NW/SE/NW	*Spudded but never drilled by owner.			
3. Tipton #1	9-NE/SE/NW	3528	8/3/1948	Dry	Plugged
4. William #1	8-SW/SE/NE	4720	12/4/1954	Dry	Plugged
5. Kalka #8-1	8-C/SE/SE	4716	2/1/1970	Dry	Plugged
6. Midas #1-8H	8-NE/NE/NE/NE		8/15/2007	H Gas	Active
Lateral #1	8-NE/SW/NW	4519		H Gas	Active
Lateral #2	8-SE/SW/NE	4527		H Gas	Active
7. Nectar #1-4H	8-NE/NE/NE		8/27/2008	H Gas	Active
Lateral #1	4-SW/NE/SE	4545		H Gas	Active
Lateral #2	4-SW/NW/NE	4511		H Gas	Active
8. Corinth #1-9H	8-NE/NE/NE		10/23/2008	H Gas	Active
Lateral #1A	9-SE/NW/NW	4544		H Gas	Active
Lateral #1B	9-SW/NE/SW	4549		H Gas	Active
Lateral #2	9-SE/SW/NE	4584		H Gas	Active
9. Tipton #1	8-SE/SW/NE	3528	8/25/1945	Dry	Plugged
WELLS WITHIN 1 MILE RADIUS					
10. E. Hallock #1	4-SW/SW/SE	3492	1/19/1948	Dry	Plugged
11. Sporleder #1	4-SW/SW/SW	3850	8/15/1982	Oil	Plugged
12. D.S. Strough #2	4-SE/SE/SE	3472	6/22/1926	Oil	Plugged
13. Argus #1-5	5-NW/NW/SE		3/25/2002	H-Gas	Active
Lateral #1	5-SE/SW/SE	4467		H-Gas	Active
14. WM.T. Tipton #1	5-CSW/SE/SE	3528	11/2/1945	Oil	Plugged
15. WM.T. Tipton #2	5-NW/SE/SE	3519	6/6/1949	SWD	Active
16. Underwood #1	5-NE/SE/SE/SE	3750	2/4/2022	Gas	Active
17. Underwood #2	5-E2/NE/NE/SE	3752	5/31/2022	Gas	Active
18. Tipton #3	5-SW/NE/SE	3610	5/27/1958	Oil	Active
19. R. Rounsavell #2	5-SE/SE/SW	3512	7/19/1960	Oil	Plugged
20. Tipton #2	5-SW/SW/SE	3500	11/21/1945	Oil	Plugged
21. R. Rounsavell #3	5-NW/SE/SW	3521	3/24/1946	Oil	Plugged
22. Tipton #3	5-SE/SW/SE	3513	12/5/1945	SWD	Plugged

Well Name	Location	Total Depth	Date	Type	Status
23. Tipton #4	5-NW/SW/SE	3496	1/1/1946	Oil	Plugged
24. Tipton #5	5-NE/SW/SE	3518	10/30/1948	Dry	Plugged
25. Bradshaw #1	8-NW/NW/SE	3485	7/12/1947	Oil	Plugged
26. E. Slack #1	8-SE/SW/NW	3489	7/28/1932	Oil	Plugged
27. Jason #1	8-NW/NE/SW	4775	9/4/1987	Oil	Plugged
28. Kalka #1 (Hercules)	8-NE/SW/SE	4645	10/17/01 (Re. Comp.)	Gas (4408')	Active
29. Martin #1	8-NE/NE/SW	3484	1/15/1948	Oil	Plugged
30. Mears #1	8-NE/NE/NW	3491	9/27/1945	Oil	Plugged
31. R.P. Martin #1	8-SW/SE/SW	4433	6/1/1926	Dry	Plugged
32. Willa #1	8-NW/SW/SE	4653	2/2/1979	Oil	Plugged
33. Jason #2	8-SE/NW/SW	4722	12/22/1997	Oil	Plugged
34. Martin #2	8-SE/NE/SW	3477	4/16/1968	Oil	Plugged
35. Mears #2	8-SE/NW/NW	3515	3/26/1953	Dry	Plugged
36. Tipton #1	8-NW/NE/NE	3523	5/28/1946	Dry	Plugged
37. Tipton #2	8-NE/NW/NE	3499	8/14/1945	Oil (SWD)	Plugged
38. Mears #3	8-SE/SE/NW	3483	2/1/1948	Oil	Plugged
39. Tipton #3	8-NW/NW/NE	3503	11/1/1945	Oil	Plugged
40. Mears #4	8-NE/SE/NW	3495	4/16/1968	Oil	Plugged
41. Tipton #4	8-SW/SW/NE	3494	11/13/1947	Oil	Plugged
42. Tipton #5	8-NW/SW/NE	3490	8/15/1948	Oil	Plugged
43. R.P. Martin #1	8-NE/NW/SW	2890	11/24/25	Dry	Plugged
44. L.R. Martin #1	8-NE/NW/SW	3492	2/25/26	Oil	Plugged
45. E. Igenthrone #1	9-NW/SE/SE	4750	8/24/1957	Dry	Plugged
46. W.G. Richie #1	9-NE/NE/NE	4545	8/31/1926	Dry	Plugged
47. McCracken #1	10-SW/SW/SW	3916	9/14/1947	Dry	Plugged
48. Sch. Land #6	16-NE/NE/NW	4457	11/3/1925	Dry	Plugged
49. Johnson #1-16	16-NE/NW/NW	4753	2/21/1982	Gas (3495')	Active
50. Icarus #1-16H	16-SW/SW/SW		7/18/2008	H Gas	Active
Lateral #2	16-SE/NE/NW	4540		H Gas	Active
51. Taylor #1A	17-SE/NE/NW	3531	7/6/1951	Dry	Plugged
52. Twin Cities #1	5-SW/SW/SE	6600	4/23/2001	SWD	Active

EFFECTIVENESS OF PAST ABANDONED WELL PLUGGING

A review of OCC Rules and Regulations available online (http://www.occ.state.ok.us/) show that regulations regarding the proper plugging and abandonment of oil and gas wells in Oklahoma have undergone modifications over the years since the first regulation Order No. 937; Case No. 2325 was promulgated with an effective date 6/16/1915. Major modifications to the regulations occurred in 1945 and 1971.

The earliest regulations required wells to be filled with mud-laden fluid of maximum density under the supervision of the Oklahoma Corporation Commission or its conservation agent. Subsequent changes in regulations required that the open hole below the shoe be filled with

cement or mud-laden fluid to a point 25 feet above the shoe of the casing (1945). In 1971 the mud-laden fluid was required to have a minimum density of 9.0 pounds per gallon (ppg). The wellbore was required to be filled with cement at least 50 feet above the casing or liner shoe. Any productive formation (oil, gas or water) must be sealed from at least 50 feet above the top of the formation, and at least 50 feet below the base of the formation.

Plugging Procedures

Dr. Evren Ozbayoglu, a University of Tulsa (McDougal School of Petroleum Engineering) Professor was contracted in 2013 (during the original permitting process of MES #1) to review plugging records of nearby oil and gas wells, to quantify the plugging efficiency, and to determine whether the wells had been plugged properly. Plugging reports were reviewed for three of the deeper penetrating wells which were either in relatively close proximity to the MES #1 or plugged at a time prior to more modern or current practices. Two of the wells were plugged and abandoned in 1926 (regulations of 1915 and 1917 in effect), and the third well was plugged and abandoned in 1956 (regulations of 1945 in effect). All wells were plugged in accordance with the State regulations in effect at the time of plugging. It is assumed that well plugging activities took place under the supervision of an Oklahoma Corporation Commission conservation agent, as required by regulation. The following presents a summary of Dr. Ozbayoglu's review and evaluation. A copy of Dr. Ozbayoglu's report and analysis entitled *"Analysis on Plugging Efficiency of the Nearby Wells and Hydraulic Interference Possibility"* is included in **Appendix C**.

The Magnolia "Richie" #1, approximately 0.92-mile northeast of the MES injection well (NE NE NE Section 9), was drilled slightly through the Hunton Formation to a total depth of 4,545'. The well was completed as a dry hole on 12/13/26. The well was plugged and abandoned on 12/21/26.

Applicable regulations required the well to be filled with mud-laden fluid, having a maximum density of 25% greater than water density. According to the plugging report, a mud-hog pump was used for the plugging activities. The use of a mud-hog pump implies that a high solids

concentration of fluid was pumped into the wellbore; thus satisfying the regulations in effect at that time. No casing was reported to have been removed from the well during the plugging and abandonment process.

The Prairie Oil & Gas Company "Martin #1, approximately 0.92 mile southwest of the MES injection well (SW SE SW Section 8), was drilled into the Wilcox Sand at a depth of 4,433'. The well was completed as a dry hole on 6/12/26. The well was plugged and abandoned on 8/5/26.

The wellbore was reportedly filled with mud-laden fluid with a fluid weight that was at least 25% heavier than water. For purposes of evaluation, Dr. Ozbayoglu assumed that a 10.41 pound per gallon (ppg) fluid was used for plugging the well satisfying the regulations. No casing was reported to have been removed from the well during the plugging and abandonment process. No cement or mechanical plugs were reportedly used.

The Mealy-Wolfe Drilling Company "Bradshaw" #1, approximately 0.58 mile west of the MES injection well (NW NW SE Section 8), was drilled to a depth of 3,485' and completed as an oil well in the Prue Sand on 7/21/47. The well was plugged and abandoned on 10/18/56.

According to the plugging report, cement slurry comprised from 10 sacks of cement was placed at the bottom of the pipe; while keeping the hole filled with mud, the 7" production casing was pulled to a depth of 2,871'. The mud-laden fluid was left to settle, refilled with mud periodically, and finally capped with 5 sacks of cement. This well was plugged in accordance with the 1945 regulations in effect at the time.

All of the wells plugged and abandoned conformed strictly to the oil and gas regulations in place at the time of abandonment.

Evaluation of Plugging Efficiency

Considering the depth of the Magnolia "Richie" #1 well (4,545') and using conservative formation parameters for the area, the maximum formation pressure for this well is expected to be 2,308 psi (4,545' x 0.508 psi/ft); with a minimum formation fracture pressure expected to be 2,756 psi (4,454' x 0.6064 psi/ft). Considering the well was plugged in accordance with the regulations, the calculated bottom-hole pressure is 2,445 psi and is within the upper and lower pressure margins. Calculations provided in Dr. Ozbayoglu's report indicates that the waterfront associated with a continuous injection rate of 20 barrels per minute (bbl/min) for a period of 50 years will extend approximately 4,621' (0.875 mile) from the injection well. Under these conditions, the waterfront will not reach the vertical projection of the Magnolia "Richie" #1 well. Additionally, approximately 470 feet of strata (Simpson Group) a one of the identified confining units for the MES injection well (Sylvan Shale) lies between the bottom of the Magnolia "Richie" #1 well and the MES injection zone.

A bottomhole pressure of 2,400 psi has been calculated for the Prairie Oil & Gas Company "Martin #1 well. Since maximum formation and minimum fracture pressures for this well are 2,266 psi and 2,706 psi, respectively, the existing bottomhole pressures within the well are within a safe margin. As with the Magnolia "Richie" #1 well, the Prairie Oil & Gas Company "Martin #1 well is beyond the calculated injectate waterfront and over a period of 50 years the front will not reach the vertical projection of the Prairie Oil & Gas Company "Martin #1 well. Approximately 470 feet of strata (Simpson Group) separate the bottom of the Prairie Oil & Gas Company "Martin #1 well and the MES injection zone within the Arbuckle Group.

The Mealy-Wolfe Drilling Company "Bradshaw" #1 well is a much shallower well that was completed as an oil well in the Prue Sand and operated for a period of about 9 years. A bottomhole pressure of 1,887 psi has been calculated for this well and the maximum formation and minimum fracture pressures are 1,781 psi and 2,127 psi, respectively. The bottomhole pressures are calculated to be within a safe margin.

The Mealy-Wolfe Drilling Company "Bradshaw" #1 well is located approximately 0.58 miles from the Mid-Way injection well. After a period of 10 to 25 years of operation at a maximum and continuous injection rate of 20 bbls/min, the calculated waterfront will extend past the vertical projection of the Bradshaw #1. However, the vertical distance between the top of the Arbuckle Formation and the bottom of the Bradshaw #1 is in excess of 1,500'. The strata separating the two formations include both upper confining layers (the Woodford Shale and the Sylvan Shale) for the Arbuckle injection zone. No hydraulic interference is expected between the injection zone and these wells.

DEFICIENCY NO 6

In accordance with 40 C.F.R. § 146.14(a)(4), the applicant is required to provide maps and cross sections of USDWs within the AOR. No such maps were provided.

RESPONSE:

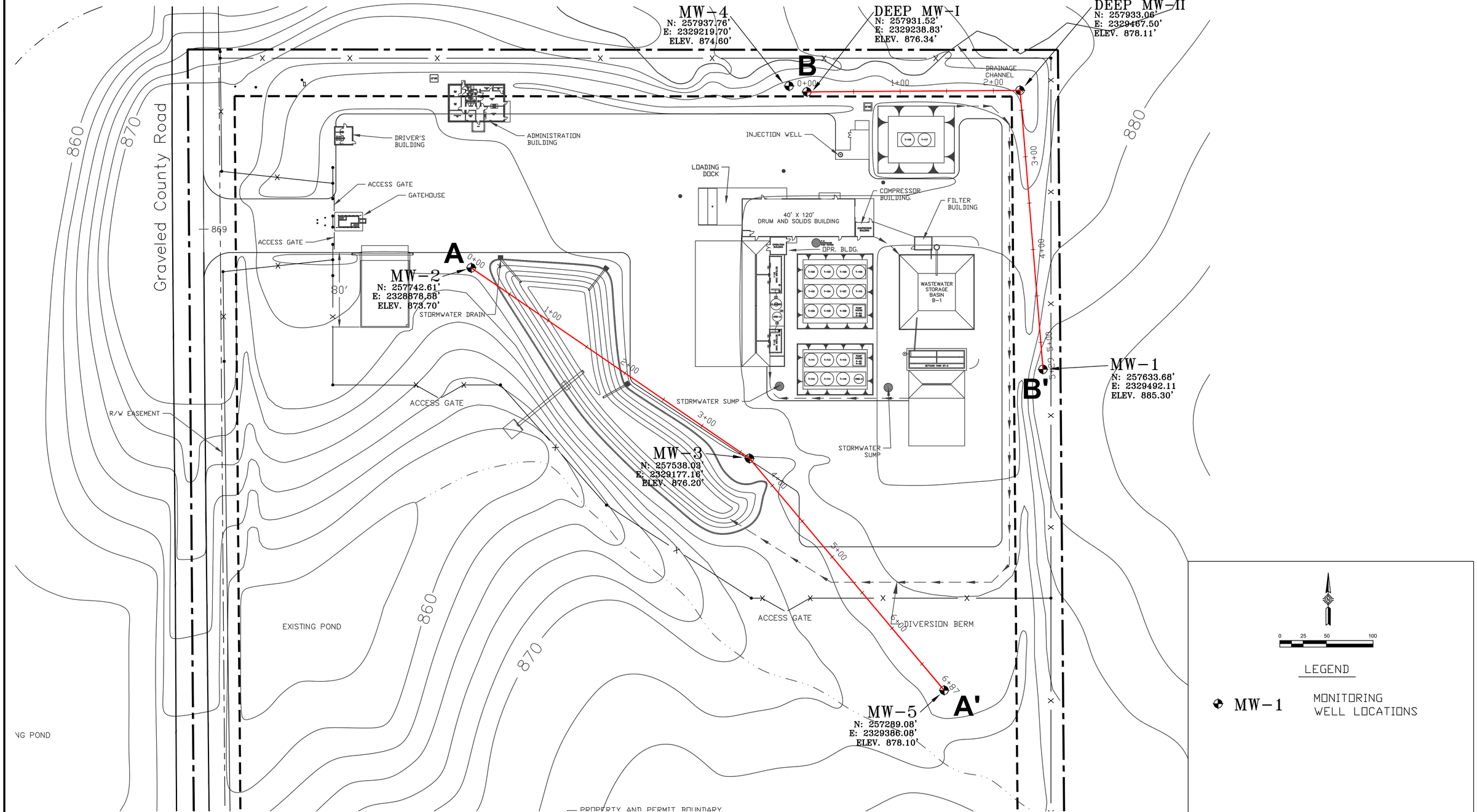
The surface geology in the vicinity of the injection well is comprised of sediments from the Vanoss Group. The Vanoss Group is composed of red-brown to gray shale and orange-brown fine-grained cross-bedded sandstone which grades southward into arkosic sandstone and conglomerate. Total thickness of the group ranges from 250 feet in the south to 490 feet in the north (USGS Hydrologic Atlas 4).

Laboratory analytical results of groundwater samples collected from DMW-2 on February 19, 2016 showed a Specific Conductance of 21,200 µmhos/cm and Total Dissolved Solids concentration of 20,100 mg/L. The results obtained from sampling DMW-2 are believed to represent the natural quality of the groundwater in the sand unit of the Vanoss Formation at both DMW-1 and DMW-2. The Vanoss is not known as a major source of drinking water due to its poor yield and water quality (USGS Hydrologic Atlas-4). Residual brines can remain in sandstones and shales of the Vanoss that have not been diluted by freshwater circulation. Sandstones overlain by or encased in thick clay and shale sequences are likely to be somewhat isolated from the flow system and retain some of the residual brine (USGS Water Resources Investigation Report 96-4173). This appears to be the case in DMW-1 and DMW-2 where the sandstone aquifer is overlain by approximately 40 feet of shale and underlain by approximately 110 feet of red shale (per the DMW-1 log).

It is also interesting to note that OCC's Base of Treatable Water contours show the depth to the base of the treatable water to be about 200 feet in the area of the Injection well. Our current monitoring system for the Solid Waste Management Permit has five (5) monitoring wells completed in a shallower sandstone unit which range in depth from about 102 feet bgs to 125 feet bgs. It is believed that this sand unit is the lowermost source of drinking water in the area. Based on the drilling logs from DMW-1 and DMW-2, there does not appear to be any other

major water bearing zones between the sand of the shallow monitoring wells and DMW-1 and DMW-2.

Cross Sections A-A' and B-B' show increasing development of sandstone thickness with depth, although only two monitoring wells, DMW-1 and DMW-2, are deep enough to penetrate the Base of Treatable water. Historical oil and gas production in the area comes from two separate reservoirs – the Prue Sandstone (±3,600' bgs) and the Hunton Limestone (±4,500' bgs). Given the shallow nature of the USDW, there is a separation of several thousand feet between the USDW and the producing horizons with numerous interbedded confining shale layers.



PATH: C:\Midway\NOD 12-28-2024\
FILE: MONITOR WELLS WITH CROSS SECTIONS - ALB.dwg
DATE: Jan 29, 2025 - 2:08PM

GENERAL NOTES

1. VERTICAL DATUM, NAVD 88. HORIZONTAL DATUM NAD83 OKLAHOMA STATE PLAN NORTH ZONE.

REVISIONS

NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE

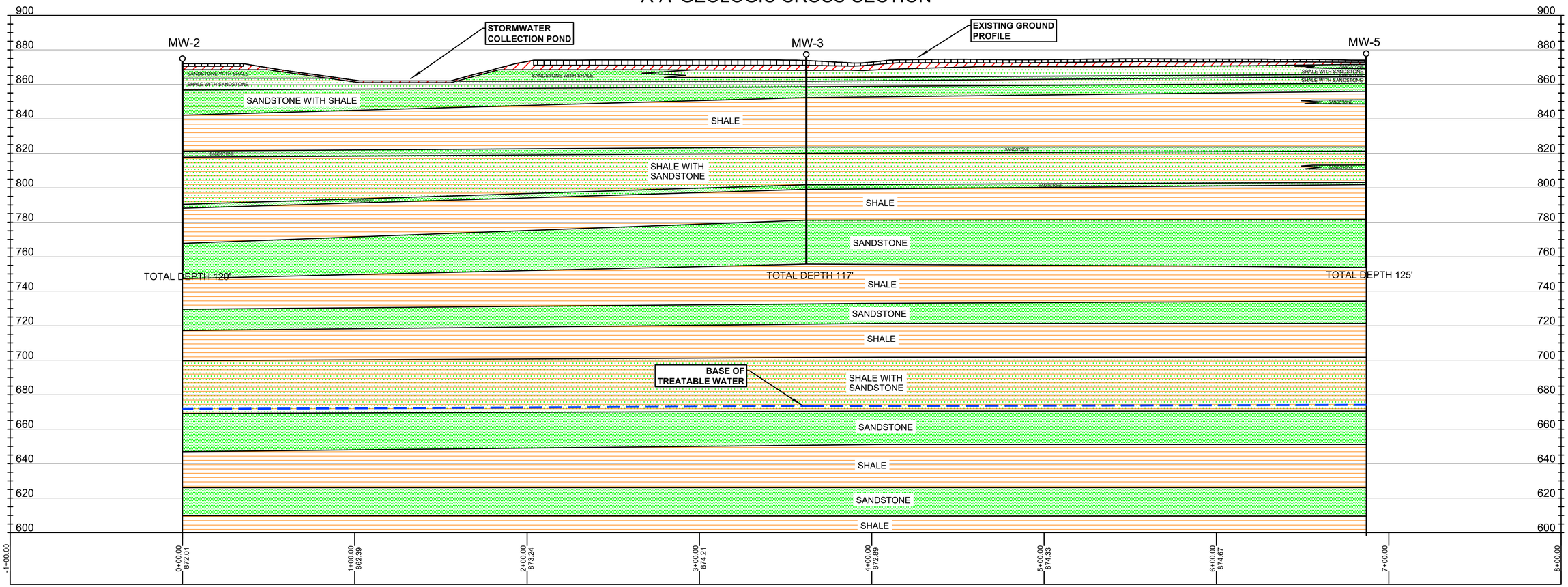
A & M Engineering and Environmental Services, Inc.
Consulting - Design - Construction - Remediation

DRAWN:	CHECKED BY:	MATERIALS BY:	ENGINEER:
ALB			
DATE: 1/20/2025	DATE:	DATE:	DATE:

GEOLOGIC CROSS-SECTION LOCATION MAP
MID-WAY ENVIRONMENTAL, INC.
DAVENPORT, OKLAHOMA

APPROVED BY:	SCALE:	PROJECT NUMBER:	DRAWING NUMBER:	REV.:
OM	GRAPHIC	1706-0046-012	FIGURE NO. 3	
DATE: 1/20/2025				

A-A' GEOLOGIC CROSS-SECTION



LEGEND

- TOPSOIL/FILL
- CLAY
- SHALE
- SANDSTONE
- SHALE WITH SANDSTONE
- SANDSTONE WITH SHALE
- SAND
- SAND WITH SHALE

0 15 30 60

GENERAL NOTES

REVISIONS

NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE

A & M Engineering and Environmental Services, Inc.
Consulting - Design - Construction - Remediation

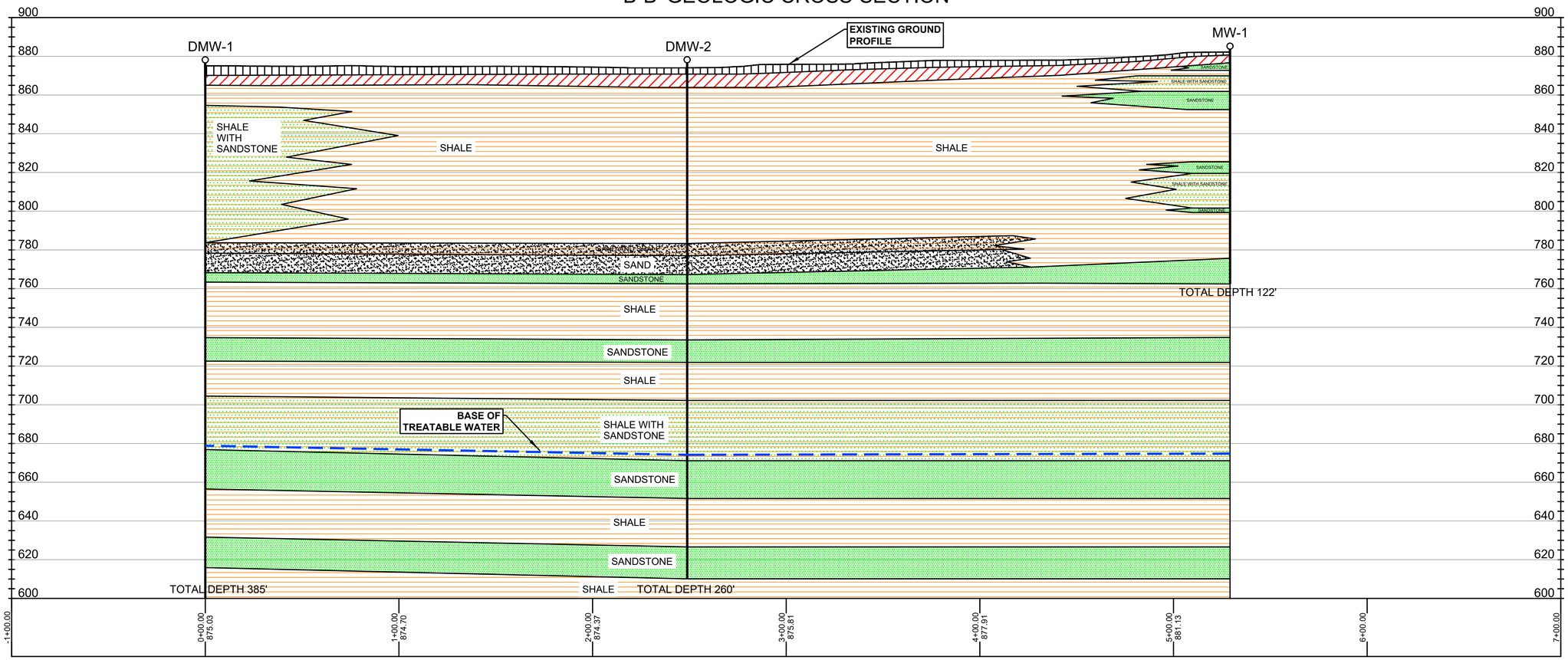
DRAWN:	CHECKED BY:	MATERIALS BY:	ENGINEER:	APPROVED BY:	SCALE:	PROJECT NUMBER:	DRAWING NUMBER:	REV.:
ALB				OM	GRAPHIC	1706-0046-012	FIGURE NO. 4A	
DATE: 1/20/2025	DATE:	DATE:	DATE:	DATE: 1/20/2025				

GEOLOGIC CROSS-SECTION A-A'

MID-WAY ENVIRONMENTAL, INC.
DAVENPORT, OKLAHOMA

PATH: C:\Midway\NOD 12-28-2024\
FILE: MONITOR WELLS WITH CROSS SECTIONS - ALB.dwg
DATE: Jan 29, 2025 - 2:09PM

B-B' GEOLOGIC CROSS-SECTION



LEGEND

- TOPSOIL/FILL
- CLAY
- SHALE
- SANDSTONE
- SHALE WITH SANDSTONE
- SANDSTONE WITH SHALE
- SAND
- SAND WITH SHALE

0 15 30 60

PATH: C:\Midway\NOD 12-28-2024\
FILE: MONITOR WELLS WITH CROSS SECTIONS - ALB.dwg
DATE: Jan 29, 2025 - 2:09PM

GENERAL NOTES

REVISIONS

NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE

A & M Engineering and Environmental Services, Inc.
Consulting - Design - Construction - Remediation

GEOLOGIC CROSS-SECTION B-B'

MID-WAY ENVIRONMENTAL, INC.
DAVENPORT, OKLAHOMA

DRAWN:	CHECKED BY:	MATERIALS BY:	ENGINEER:	APPROVED BY:	SCALE:	PROJECT NUMBER:	DRAWING NUMBER:	REV.:
ALB				OM	GRAPHIC	1706-0046-012	FIGURE NO. 4B	
DATE: 1/20/2025	DATE:	DATE:	DATE:	DATE: 1/20/2025				

DEFICIENCY NO 7

Please provide a discussion on the injection and confining zones in accordance with OAC 252:652-5-1(3).

RESPONSE:

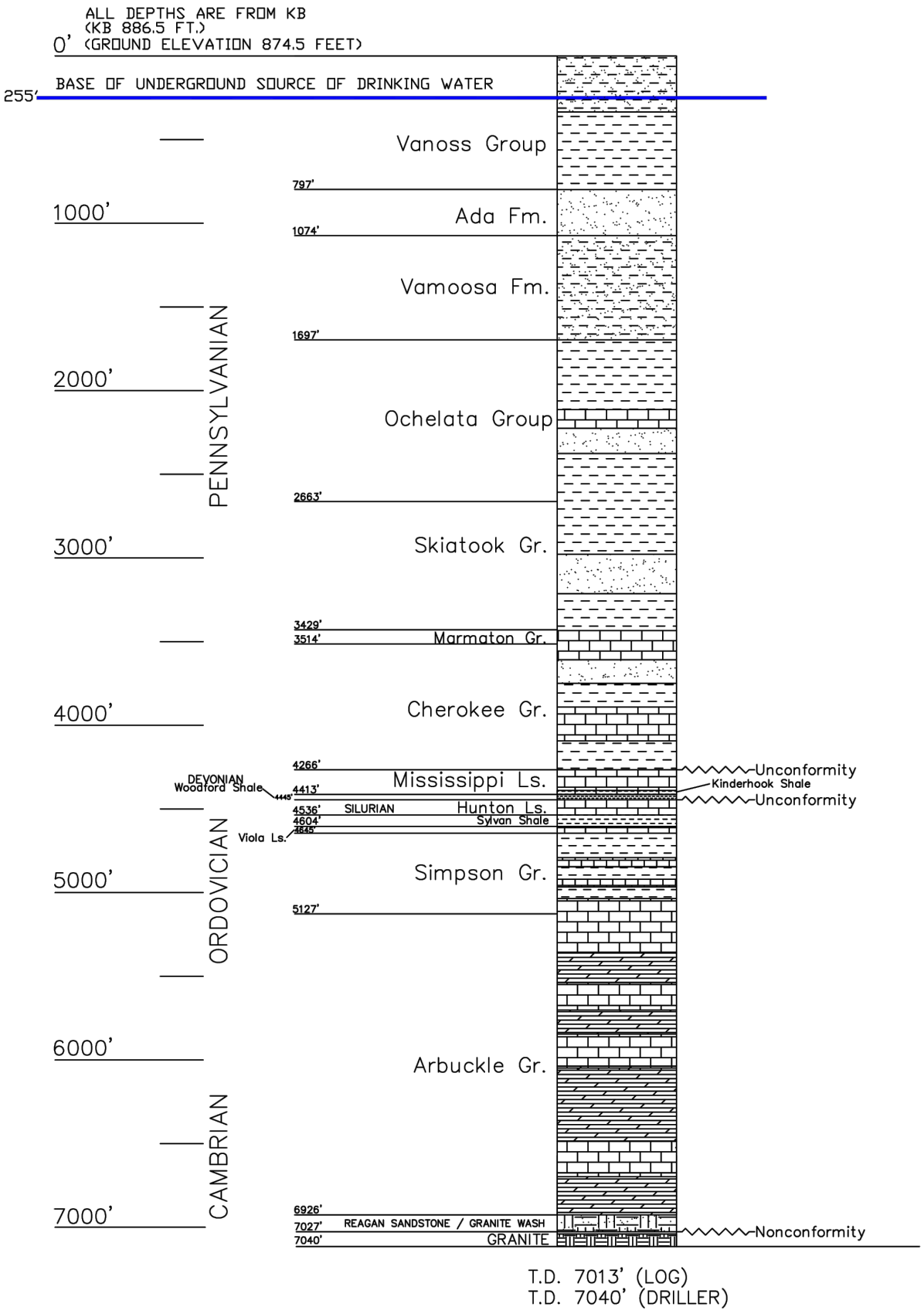
Characteristics of the Injection Zone

(Arbuckle Group, Regan Sandstone, and Granite Wash)

The injection zone in MES #1 is the Cambro-Ordovician Arbuckle Group, the Reagan Sandstone and the Granite Wash, shown in **Figure 5**.

The Arbuckle Group is predominantly composed of dolomite with thin layers of chert, shale and interbedded sandstone and limestone in upper part and sandstone in lower part. The dolomite is white, buff-cream to light gray, very fine to fine crystalline, sucrosoic, stylolitic and occasionally pyritic. The porosity of the dolomite ranges from none to good and is of intracrystalline and vuggy types. Fracture porosity is also common throughout the section. The sandstone sections of the Arbuckle Group are mainly encountered at the lower part. The sandstone is generally white to light gray, fine to medium-grained, rounded, moderately to good sorted, cemented with dolomite and with fair to good porosity. The lowest unit of the Arbuckle Group is the Reagan Sandstone (i.e., Lamotte Formation), which is comprised of sandstone. The Reagan Sandstone is white to light gray, fine-grained, rounded, moderately sorted, cemented and with poor to fair porosity. The thickness of the Reagan Sandstone is approximately 60 feet in MES #1.

The Granite Wash is composed of sandstone and conglomerate. The sandstone is gray, red to light orange, fine to medium-grained, sub-angular to round, poor to fairly sorted, quartz, feldspar, and glauconite grains, fair to good porosity. It is approximately 40 feet thick.



A & M Engineering and Environmental Services, Inc.
Consulting - Design - Construction - Remediation

STRATIGRAPHIC COLUMN OF
MID-WAY ENVIRONMENTAL SERVICES, INC.
INJECTION WELL MES #1

SCALE:	DATE:	FIGURE NO.
AS SHOWN	1/29/2025	5
APPROVED BY:	DRAWN BY:	PROJECT NO.
OM	ALB	1706-0046-012

Injection Zone – Depths

The top of the injection zone (i.e., top of the Arbuckle Group) is at a depth of 5,127 feet and the bottom is at a depth of 7,027 feet. The Reagan Sandstone and Granite Wash comprise the lower portion of the injection zone at a depth of 6,926 to 7,027 feet. During injection testing and temperature surveying it was discovered that the Arbuckle Group and lower part of the overlying Simpson Group are hydraulically connected. Therefore, a portion of the injectate may infiltrate up to 47 feet into the lower portion of the Simpson Group from a depth of 5,080 feet to 5,127 feet.

DEQ through correspondence dated April 22, 2016, directed Mid-Way to conduct plug-back activities in its' injection well. Plug-back activities took place from February 21, 2017, through February 24, 2017. A cement plug was set at a depth of 6,775' which was 35' above the minimum required depth of 6,810' bgs. This would change the total thickness of the injection zone to 1,648 feet (6,775' - 5,127').

Injection Zone – Thickness

The total thickness of the injection section is 1,648 feet. The Arbuckle Group is 1,799 feet thick as shown in **Figure 5**. The thickness of the Reagan Sandstone and Granite Wash above the granite basement is 101 feet.

Injection Zone – Porosity and Permeability

The porosity amount and type vary throughout the injection zone. The data presented below is collected from electric logs, sidewall cores and well testing.

The porous dolomite units of the Arbuckle Group have an 8 to 20 percent porosity range. Sidewall cores showed a range of 2 to 8.4% and logs showed 5 to 20%. Additionally, these units have a permeability of 10 to 1,000 millidarcies (md). Sidewall cores showed a permeability of 0.2 to 1.9 md while well testing showed an average of 537 md. The vuggy and fractured zones may have higher porosity and permeability values.

The sandstone units of the Arbuckle Group, except for the basal Reagan Sandstone, have a porosity range of 2.5 to 14 percent. Sidewall cores showed a porosity of 11.1% while logs showed 2.5 to 14%. The permeability for the same units was 0.92 to 1.05 millidarcies based on sidewall cores.

The measured porosity and permeability for the Reagan Sandstone are low; 3 to 10 percent porosity based on logs, 11.1% porosity based on sidewall cores and permeabilities less than 32.1 millidarcies based on sidewall cores.

The Granite Wash conglomerate and sandstone units have good porosities, 10 to 20% from logs and 18.4 to 19.5% from sidewall cores. Permeability ranged from 275 to 661 md in sidewall cores.

Injection Zone – Temperature

The temperature of the injection zone is measured every year after the Pressure Fall of Test. In 2024 the temperature was measured on November 18, 2024. The data is provided in **Table 3**.

Injection Zone – Pressure

The static pressure of the injection zone is measured every year after the Pressure Fall of Test. In 2024 the static pressure was measured on November 18, 2024. The data is provided in **Table 3**.

Table 3: MES #1 Injection Well Static Pressure and Temperature Measurements

	November 18, 2024, Measurements		
Depth	**Pressure (psi)**	**Gradient (psi/ft)**	**Temperature (°F)**
0	147.27	-	65.36
100	195.58	0.483	67.08
500	372.23	0.442	69.38
1,000	592.47	0.440	72.40
1,500	812.33	0.440	75.87
2,000	1032.58	0.440	79.68
2,500	1252.63	0.440	84.40
3,000	1472.81	0.440	88.99
3,500	1692.95	0.440	95.75
4,000	1912.91	0.440	101.61
4,500	2132.76	0.440	108.09
5,000	2352.28	0.439	113.17
5,340	2507.59	0.457	87.57

Injection Zone – Testing and Original Formation Water

After drilling and electrical logging of MES #1 was completed, the drilling mud was displaced out of the well by reverse circulation on May 5, 2010. After mud displacement, water from the well began flowing to the surface (i.e., an artesian condition), and for a few minutes the flowing water was observed to be mixed with mud. As the flow continued, the formation water cleared and the flow resembled typical brine (i.e., grayish salty water). The well was left to flow for approximately two hours until only formation water was flowing from the well. The water was then measured to weigh 8.9 lbs/gallon, confirming that the flowing water was formation water. Formation water was then collected into four previously prepared clean 55-gallon drums for

future use and sampling. The drums were filled directly from the flow line. After the formation water samples were collected in drums, the well was shut in. Pressure at the well head was then observed to be approximately 200-250 pounds per square inch gauge (psig). The drums were transported and stored at MES's Stroud facility for future use. Formation water samples were collected from the drums on September 29, 2010, and delivered to a laboratory for analysis.

The formation water samples taken from the injection zone were analyzed for the following parameters: Volatile Organic Compounds (Method 8260), pH, Specific Conductance, Viscosity, Specific Gravity, Total Dissolved Solids, Cations, Anions and Metals. The analytical results are tabulated in **Table 4**. Analytical results show that the Arbuckle formation water has 76,900 ppm Total Dissolved Solids (TDS), 44,000 ppm chloride, 25,000 ppm sodium, and minor concentrations of inorganic metals. No major organics were detected.

Confining Units (Seals)

The injection intervals (i.e., the Arbuckle Group and Granite Wash) are overlain by the Woodford Formation and Sylvan Shale. The Woodford Formation consists of an organically rich black shale with a thickness of 38 feet in MES #1 as shown in **Figure 5**. The Sylvan Shale is a green shale with a thickness of 68 feet as shown in **Figure 5**. The upper part of the Simpson Group also has a thick shale section that will serve as a seal or confining unit.

The Woodford Shale is overlain by a 40-feet to 70-feet thick shale unit (i.e., Kinderhook Shale) of the Mississippian section as determined from electrical logging. Further up the stratigraphic column, there are several thick shale sections in the Pennsylvanian formations. The shale units in general have very low effective porosity and permeability. The vertical permeability in shale is usually lower than the horizontal permeability due to compaction and clay mineralogy.

The Woodford Shale was cored from a depth of 4,426 to 4,451.5 feet. The Woodford Shale is dark gray, black, brownish black, very fine texture, medium soft, some splitting, some blocky, and pyritic. The core was sent to Core Laboratories to be tested for porosity and permeability (air and brine).

Table 4: Detected Parameters in Arbuckle Formation Water from MES #1 Injection Well

Parameter	Result	Unit
pH	6.72	s.u.
Specific Conductance	130,000	µmhos/cm
Specific Gravity	1.05	g/cc at 4° C
Viscosity	1.86 at 60° F	centipoise
	0.78 at 130 F	centipoise
Bicarbonate	439	mg/L
Carbonate	< 1.2	mg/L
Chloride	44,000	mg/L
Nitrogen as Nitrate	< 0.4	mg/L
Sulfate	33.7	mg/L
TDS	76,900	mg/L
Antimony	< 0.01	mg/L
Arsenic	< 0.005	mg/L
Beryllium	< 0.01	mg/L
Cadmium	< 0.001	mg/L
Calcium	5,190	mg/L
Chromium	< 0.01	mg/L
Copper	<0.01	mg/L
Iron	23.1	mg/L
Lead	< 0.005	mg/L
Magnesium	979	mg/L
Mercury	< 0.00001	mg/L
Nickel	< 0.01	mg/L
Potassium	468	mg/L
Selenium	< 0.0005	mg/L
Silver	< 0.002	mg/L

Parameter	Result	Unit
Sodium	25,600	mg/L
Thallium	< 0.01	mg/L
Zinc	0.122	mg/L
2-Butanone (MEK)	0.0755	mg/L
Chloromethane	0.0115	mg/L

The core laboratory tests were conducted on three separate formation plugs: one from 4,426 feet; a second one from 4,436 feet; and a third from 4,450 feet in depth. The laboratory results were as follows:

Porosity:	0.1% to 4.2%
Permeability:	
Air:	0.0000137 to 0.5795 md.
Brine:	0.003 to 0.0000034 md.

The tests were conducted under confining pressures between 800 and 1,700 psi. One of the samples (i.e., FD2 sample) was fractured, thus it showed the higher permeability of 0.5795 md. The fracture in the FD2 sample plug either developed during cutting of the plug or it could have been present locally. The Woodford Shale is fissile along bedding planes but is not fractured throughout the section and will serve as an adequate confining layer.

The porosity and permeability of the confining (i.e., seal) layers over the injection zone show very low values indicating that they will serve as confining units and will prevent the upward movement of non-hazardous wastewater.

DEFICIENCY NO 8

Please provide information on all facility monitoring wells including location, construction, and maintenance in accordance with OAC 252:652-7-1(4).

RESPONSE:

The current groundwater monitoring system for the Solid Waste Management Permit has five (5) monitoring wells (MW 1 to MW 5) completed in a shallower sandstone unit and range in depth from about 91 feet bgs to 116 feet bgs to monitor the uppermost aquifer and a deep monitoring well (DMW-2) completed to a depth of 260 feet bgs to monitor the lowermost aquifer.

It is believed that this sand unit is the lowermost source of drinking water in the area. Based on the drilling logs from the deep monitoring well, there does not appear to be any other major water bearing zones between the sand of the shallow monitoring wells and the deep monitoring well.

UPPERMOST USDW

The uppermost freshwater aquifer is a sandstone unit of Vanoss Group and is at an approximate depth of 90-120 feet below the site. Five shallow groundwater monitoring wells, labeled MW-1 through MW-5, are completed in this uppermost aquifer. MW-4 is the up-gradient well, MW-1 is side-gradient and MW-2, MW-3 and MW-5 are down-gradient wells for the facility. The monitor wells were drilled by the air-rotary drilling method, and each was completed with 2-inch diameter screens and casings. The well locations are shown in **Figure 6**, the completion data for each of the monitor wells is provided in **Table 5** and well completion logs are included in **Appendix B**.

LOWERMOST USDW

The lowermost USDW is a sandstone aquifer at an approximate depth of 240 to 255 feet. This sandstone unit is also part of the Vanoss Group. The Vanoss formation in this area of Oklahoma is reported to only produce fair to poor quality water. One monitor well, the deep monitor well,

was completed in this aquifer. The well screen and casing in this well is 4-inch diameter PVC. The screen depth is at 238 to 253 feet and the sand pack is at 234 to 253 feet. The top of casing elevation of this deep monitor well is 878.10 feet MSL. The location of the deep monitor well is shown in **Figure 6**, the completion data for the monitor well is provided in **Table 5** and the well completion log is included in **Appendix B**.

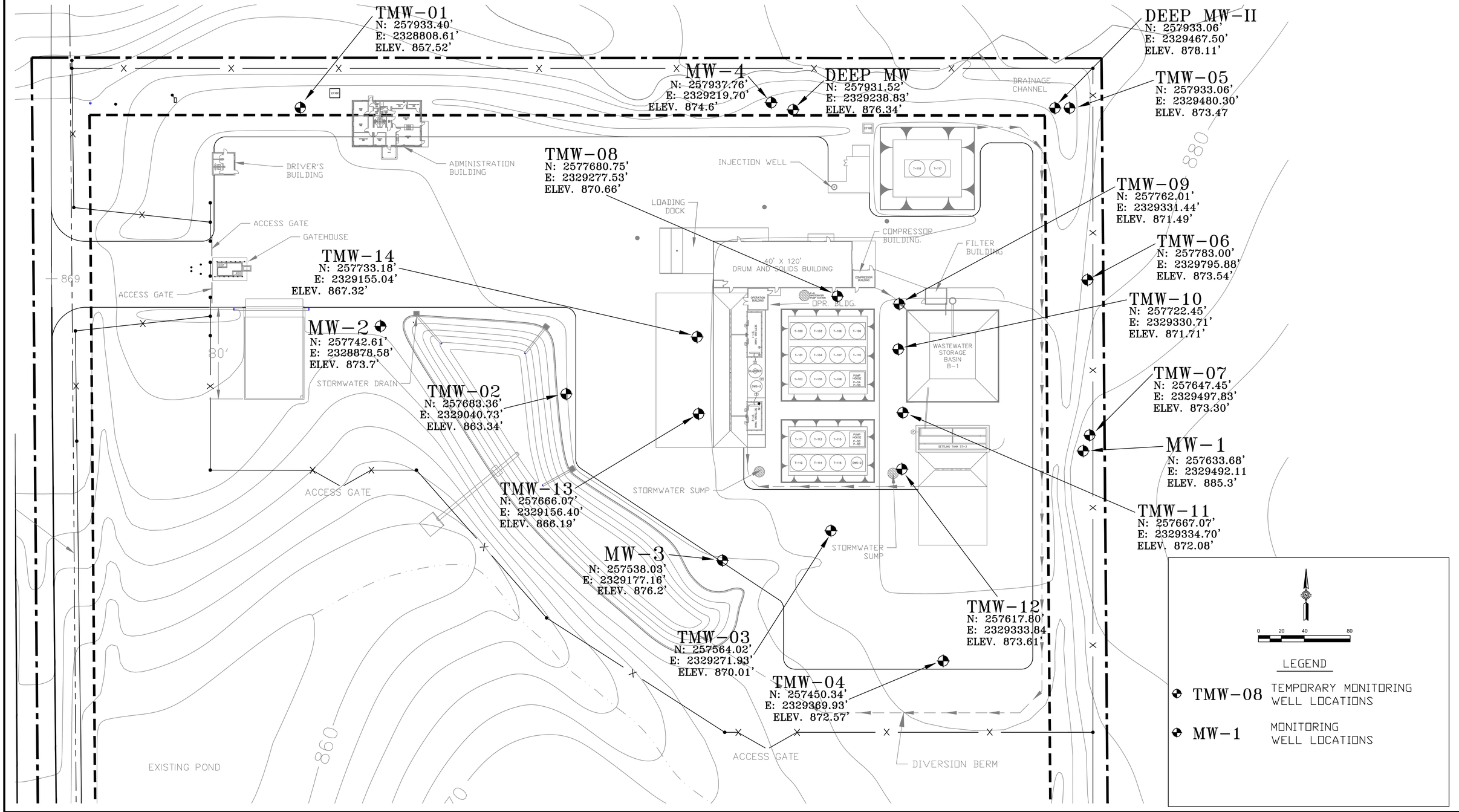
TABLE 5: MONITOR WELL COMPLETION DATA

Well No.	TOC Elevation* (ft.)	Total Depth (ft.)	Screen Depth (ft.)	Casing (ft.)	Sand Pack (ft.)	Bentonite (ft.)	Cement (ft.)
MW-1	885.30	122	105-118	+2 - 105	95-122	10-95	0-10
MW-2	873.70	102	91-101	+2 - 91	89-102	10-89	0-10
MW-3	876.20	117	99-109	+2 - 99	97-117	10-97	0-10
MW-4	874.60	112	102-112	+2 - 102	98-112	10-98	0-10
MW-5	878.10	125	90-125	+2 - 90	86-125	2-86	0-2
DMW-2	878.10	260	238-253	+2 - 238	234-253	228-234	0-228

* All elevation data based on North American Vertical Datum of 1988 (NAVD 88).

TEMPORARY MONITORING WELLS

MES also has nine (9) temporary monitoring wells (TMW-9 to TMW-14). These temporary wells were drilled according to the direction of DEQ for the purpose of assessment monitoring. These are shallow monitoring wells and the information about these temporary wells will be furnished with DEQ's discretion.



PATH: C:\Mitre\NOD 12-28-2024\
FILE: FACILITY MONITORING WELL LOCATION MAP.dwg
DATE: Jan 29, 2025 - 2:03PM

GENERAL NOTES

1. VERTICAL DATUM, NAVD 88. HORIZONTAL DATUM NAD83 OKLAHOMA STATE PLAN NORTH ZONE.

REVISIONS

NO.	DESCRIPTION	BY	CHECKED	DATE	NO.	DESCRIPTION	BY	CHECKED	DATE

A & M Engineering and Environmental Services, Inc.
Consulting - Design - Construction - Remediation

FACILITY MONITORING WELL LOCATION MAP
MID-WAY ENVIRONMENTAL, INC.
DAVENPORT, OKLAHOMA

DRAWN:	CHECKED BY:	MATERIALS BY:	ENGINEER:	APPROVED BY:	SCALE:	PROJECT NUMBER:	DRAWING NUMBER:	REV.:
ALB				OM	GRAPHIC	1706-0046-012	FIGURE NO. 6	
DATE: 1/29/2025	DATE:	DATE:	DATE:	DATE: 1/29/2025				

DEFICIENCY NO 9

Please provide information on the types of continuous monitoring devices used to monitor injection pressure, flow rate, specific gravity, volume and annulus pressure in accordance with 40 C.F.R. § 146.13(b)(2).

RESPONSE:

MES continuously monitor flow rate, injection pressure, annulus pressure, specific gravity, pH and temperature. Monitoring parameters are recorded on circular charts at or near the wellhead. A flow meter is installed on the injection well to measure cumulative volumes. The specific gravity monitoring device has a resolution of 0.01 and measures specific gravity at a corrected temperature of 60 degrees Fahrenheit. Automatic alarm systems are designed to sound and shut-off the well when pressures or flow rates exceed permitted operating conditions. All monitoring equipments are calibrated at least annually.

APPENDIX A

ADJACENT WELL LOG

White—Water Resources Board
Canary—Driller's Copy
Pink—Customer's Copy

STATE OF OKLAHOMA

MULTI-PURPOSE WATER WELL REPORT

OKLAHOMA WATER RESOURCES BOARD
1000 N.E. 10th St., P.O. Box 53585
Oklahoma City, Oklahoma 73152

#11594

1. WELL OWNER Mr. Kevin Garrett PHONE 918-968-2188

2. LEGAL DESCRIPTION NW ¼ of NW ¼ of NW ¼ of sec. 16 ; TWP. 14N N; RGE 5E EIM (Circle One) WIM ECM COUNTY Lincoln

FINDING LOCATION 99 & Deepfork 1st. section N. 9/10 W. South Side
Blocks or distance(s) from given point(s).

3. TYPE OF WORK	4. USE	NON-DOMESTIC	5. DRILLING METHOD
☒ New Well ☐ Plugging	☒ Domestic	☐ Irrigation	☐ Fluid Rotary ☐ Rev. Rotary
☐ Reconditioning Work	☐ Stock	☐ Municipal	☐ Cable ☐ Other
☐ Test/Monitoring	☐ Test/Monitoring	☐ Industrial	☒ Air Rotary
☐ G.W. Heat Pump	☐ G.W. Heat Pump	☐ Commercial	☐ H.S. Auger
☐ Other	☐ Other	☐ Other	

6. LITHOLOGIC LOG

Material	From	To	Saturated
Subsoil	0	2	
Clay	2	4	
Blow Sand	4	16	
Clay	16	40	
Quicksand	40	55	
Clay	55	70	

RECEIVED
OCT 19 1987
Oklahoma Water Resources Board

7. LOCATION PERMIT

If this well is Non-Domestic, has the location been permitted?

☐ Yes ☐ No Permit No. _____

8. NEW WELL CONSTRUCTION DATA

DATES: Started 9/29/87 Completed 9/29/87
Contractor Don Loman's Drilling Service, Inc.
Driller Greg Loman
Diameter Hole 8 in. Total Depth 70 ft.

CASING RECORD

	Diameter	From	To
Surface Pipe	in.	ft.	ft.
Well Casing	5 in.	0 ft.	70 ft.

Cement Grout Surface Seal? ☒ Yes ☐ No
Type of Surface Seal: Cement Depth of Seal: 20' ft.
GRAVEL PACK:
Gravel Packed From 20' ft. to 70' ft.
Amount Used: _____

PERFORATION RECORD

Type/Size		
PVC/.025	From 50 ft. To 70 ft.	
	From ft. To ft.	
	From ft. To ft.	

9. WELL TEST DATA

Static Water Level Below Land Surface Airlift ft.
Approximate Yield 20 gpm.
If Artesian: Flows gpm.

10. PUMP INFORMATION

Pump Type _____
Power Source _____
Rated Capacity _____ gpm.
Depth of Bowls or Cylinder _____ ft.

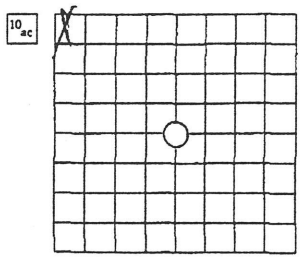
11. PLUGGING DATA

Date Plugged _____
Backfilled With _____ Material To _____ ft.
Grouted or Cemented From _____ Ft. To _____ ft.

12. RECONDITIONING WORK

Date Completed _____
Replaced Casing From _____ ft. To _____ ft.
Replaced Screen From _____ ft. To _____ ft.
Deepened Well From _____ ft. To _____ ft.
Redeveloped Well By _____

13. PLAT



14. CERTIFICATION

The work described above was done under my supervision, and this report is true and correct to the best of my knowledge.

Name Don Loman License # WD66
Address Rt #2 Box 87 Shawnee, Ok Phone #273-4398
Signed Don Loman Date 9/29/87

Form 424-0887

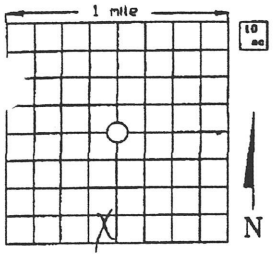
USE ADDITIONAL SHEETS IF NECESSARY

#28066

MULTI-PURPOSE COMPLETION REPORT

OKLAHOMA WATER RESOURCES BOARD
600 N. HARVEY AVE.
P.O. BOX 150
OKLAHOMA CITY, OK 73101-0150

Please plot well location



Legal Description

SE 1/4 SE 1/4 SW 1/4 of Sec. 9 Twp. 14N Rge. 5E

County Lincoln Well No:

Well Owner Smith Pump & Supply Phone 258.0834

Address 709 Manvel Chandler, Okla. 74834

Finding location 1 Miles South 1/2 West of Davenport

Type of work

- ☐ Geotechnical Boring
- ☐ G.W. Heat Pump Well
- ☐ Monitor Well
- ☐ Observation Well
- ☐ Piezometer
- ☐ Plugging
- ☐ Pump Inst.*
- ☐ Reconditioning
- ☐ W.W. Test Hole
- ☐ De-watering
- ☐ Other
- ☐ Water Well

G.W. Use

- ☒ Domestic
- ☐ Non-Domestic:

Specify Purpose

Drilling Method

- ☐ Hand Auger
- ☐ Cable Tool
- ☒ Air Rotary
- ☐ Fluid Rotary
- ☐ H.S. Auger
- ☐ S.S. Auger
- ☐ Rev. Rotary
- ☐ D.W. Rev. Rotary
- ☐ Other

Lithologic Log

Material	From	To	Saturated
Subsoil	0	2	
Shale	2	7	
Clay	7	95	
Sandrock	95	105	
Shale & Sandrock	105	115	
Sandrock	115	125	
Shale	125	157	
Sandrock	157	172	
Shale	172	175	

RECEIVED
JUL 13 1992
Oklahoma Water Resources Board

*See Pump Installers Form On Back

Non-Domestic Permitting

If this well is for other than domestic use (use of water for household purposes, for farm and domestic animals up to the normal grazing capacity of the land & for the irrigation of land not to excede 3 acres.)

Permit No:

New Boring or Well Construction Data

Date: Started 6/30/92 Completed 6/30/92

Firm Don Loman's Drilling Service, Inc.

Operator Greg Loman

Type of Construction ☐ Open Hole ☒ Cased Hole

Hole Diameter 8 inches total depth 175 feet

Hole Diameter inches total depth feet

CASING RECORD

	diameter		from		to	
Surface pipe		inches	0	feet	~~175~~	feet
Well casing	5	inches		feet	~~175~~	feet
Well casing		inches		feet		feet
Well casing		inches		feet		feet

SCREEN or PERFORATION RECORD

Type and Slot Size	from		to	
PVC/025	105	feet	125	feet
	~~160~~	feet	~~175~~	feet
		feet		feet

GRAVEL PACK

Type and Size	from		to	
Sand Springs--Bird's eye	15	feet	175	feet
		feet		feet
		feet		feet

SEAL

Cement Grout Surface Seal Installed ☒ Yes ☐ No

	from		to	
Type of Surface Seal Cement	0	feet	15	feet
Aquifer Seal Type		feet		feet
		feet		feet

HYDROLOGIC DATA

First Water Zone Encountered ft.

Approximate Yield 10 GPM Artesian ☐ Yes ☐ No

Plugging Data

Date Plugged

Backfilled From feet feet Type

Cement Grouted From feet feet

Reconditioning Work

Replaced Casing/Screen From feet feet

Deepened Well From feet feet

Redeveloped Well By

Certification

The work described above was done under my supervision.
This report is correct to the best of my knowledge.

Name Greg Loman DPC-0127 Lic. No.

Address 15602 Rock Creek Rd. Shawnee Phone 273-4398

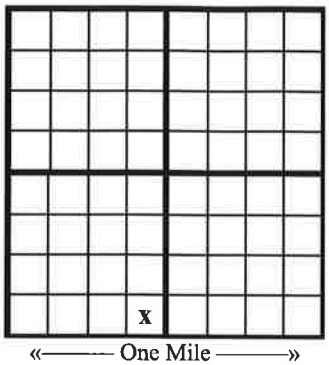
Signed Greg Loman Date 6/30/92

MULTI-PURPOSE WELL COMPLETION & PLUGGING REPORT

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location

North



Each square is 10-acres

WELL ID NUMBER: 109165

Quarters SE-SE-SW **Section** 05 **Township** 14N **Range** 05EI

Latitude 35.71072 Longitude -96.797169

Date collected(latitude and longitude), if different from date the well was drilled: 05/08/2007

Method latitude and longitude was collected: Mathematical conversion program

County Lincoln Variance Request No. (if applicable) n/a

WELL OWNER - NAME AND ADDRESS

Well Owner Charlie Ezell Phone (405) 258-0594

Address/City/State PO Box 425 Davenport OK Zip 74026

Finding Location 2.5 miles east of Chandler on Hwy 66, house on north side #4762

Well Name ___ Water Rights #: ___

TYPE OF WORK: Groundwater Well **USE OF WELL:** Domestic

NEW WELL CONSTRUCTION DATA

Date Well or Boring Was Completed 03/26/2007

Number of wells or borings represented by this log 1

* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter 8 inches to a depth of 360 ft.

CASING INFORMATION ***Note:** If surface casing is used please indicate that on the appropriate well casing information line.

Surface Pipe Material: __ Surface Pipe Diameter ___ inches Surface Pipe From ___ ft to ___ ft

SCREEN OR PERFORATION INFORMATION

FILTER PACK INFORMATION

Filter Pack Material: __

WELL SEAL INFORMATION

Type of Surface Seal n/a

Surface Seal Interval: From n/a ft to n/a ft

Type of Annular Seal n/a

Annular Seal Interval: From n/a ft to n/a ft

Filter Pack Seal Material n/a

Filter Pack Seal Interval: From n/a ft to n/a ft

TYPE OF COMPLETION: __

HYDROLOGIC INFORMATION

Depth to water at time of drilling __ ft

Estimated yield of well __ gpm

First water zone __ft

LITHOLOGY DESCRIPTION

MATERIAL	ENCOUNTERED		SATURATED
	FROM (ft.)	TO (ft.)	
Subsoil	0	4	N
Clay	4	50	N
Sandrock	50	55	N
Clay	55	95	N
Sandrock	95	100	N
Clay	100	135	N
Sandrock	135	145	N
Clay	145	265	N
Sandrock	265	320	N
Shale	320	360	N

WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION

Has this well been disinfected after completion of work? n/a

Are than any potential sources of pollution or wastewater lagoons within 300 ft. of the well? n/a

Distance of Well is n/a from possible source. Type of possible source: n/a

PLUGGING INFORMATION

Date Well or Boring Was Plugged 03/26/2007

Total Depth of well being plugged 360 ft.

Was the well contaminated or was it plugged as though it was contaminated? No

If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? No

Was the grout tremied? No

Backfilled with Drill Cuttings

Backfilled from 20 ft. to 360 ft.

Grouted with Cement Grout

Grouted from 0 ft. to 20 ft.

Grouted with Cement

Grouted from __ ft. to __ ft.

Firm Name Loman Drilling, Inc.

D/PC No. DPC-0127

Operator Name TYLER LOMAN

OP No. OP-0201

Date 05/08/2007

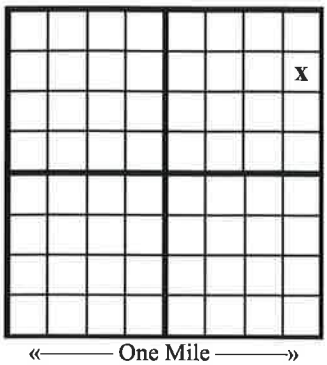
Comments: n/a

MULTI-PURPOSE WELL COMPLETION & PLUGGING REPORT

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location

North



Each square is 10-acres

WELL ID NUMBER: 176861

Quarters SE-NE-NE **Section** 17 **Township** 14N **Range** 05EI

Latitude 35.69324 Longitude -96.78801

Date collected(latitude and longitude), if different from date the well was drilled: 10/05/2016

Method latitude and longitude was collected: GPS - uncorrected data

County Lincoln

Variance Request No. (if applicable) n/a

WELL OWNER - NAME AND ADDRESS

Well Owner Greg Piper Phone _____

Address/City/State 1715 S. Lowery Ave Okc OK Zip 73129

Finding Location ___

Well Name ___ Water Rights #: ___

TYPE OF WORK: Groundwater Well **USE OF WELL:** Irrigation

NEW WELL CONSTRUCTION DATA

Date Well or Boring Was Completed 10/05/2016

Number of wells or borings represented by this log 1

* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter 8 inches to a depth of 160 ft.

CASING INFORMATION ***Note:** If surface casing is used please indicate that on the appropriate well casing information line.

Surface Pipe Material: PVC / Plastic Surface Pipe Diameter 6 inches Surface Pipe From 1 ft to 10 ft

1) Well Casing Material PVC Casing Diameter 4.5 inches Casing From -3 ft to 160 ft

SCREEN OR PERFORATION INFORMATION

Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 20 slot (0.020 inch) From 85 ft to 95 ft.

Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 20 slot (0.020 inch) From 140 ft to 160 ft.

Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 20 slot (0.020 inch) From 110 ft to 120 ft.

FILTER PACK INFORMATION

Filter Pack Material: Gravel 1/8 inch (pea gravel)

Filter Pack Interval: From 22 ft to 160

WELL SEAL INFORMATION

Type of Surface Seal Cement Grout

Type of Annular Seal Bentonite/Cement Grout

Filter Pack Seal Material n/a

Surface Seal Interval: From 2 ft to 10 ft

Annular Seal Interval: From 10 ft to 22 ft

Filter Pack Seal Interval: From n/a ft to n/a ft

TYPE OF COMPLETION: Pitless Adapter

HYDROLOGIC INFORMATION

Depth to water at time of drilling 85 ft Estimated yield of well 10 gpm First water zone 85 ft

LITHOLOGY DESCRIPTION

MATERIAL	ENCOUNTERED		SATURATED
	FROM (ft.)	TO (ft.)	
Sand Rock	0	5	N
Shale	5	67	N
Sand Rock	67	95	Y
Shale	95	107	N
Sand Rock	107	119	Y
Shale	119	139	N
Sand Rock	139	160	Y

WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION

Has this well been disinfected after completion of work? Yes

Are than any potential sources of pollution or wastewater lagoons within 300 ft. of the well? Y

Distance of Well is 51 - 75 feet from possible source. Type of possible source: Barn

PLUGGING INFORMATION

Date Well or Boring Was Plugged n/a Total Depth of well being plugged __ ft.

Was the well contaminated or was it plugged as though it was contaminated? n/a

If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? n/a

Was the grout tremied? n/a

Backfilled with n/a Backfilled from ___ ft. to ___ ft.

Grouted with n/a Grouted from ___ ft. to ___ ft.

Grouted with Cement Grouted from ___ ft. to ___ ft.

Firm Name VANNOY & SON DRILLING D/PC No. DPC-0213

Operator Name ANTHONY SANTIAGO OP No. OP-1476

Date 10/20/2016

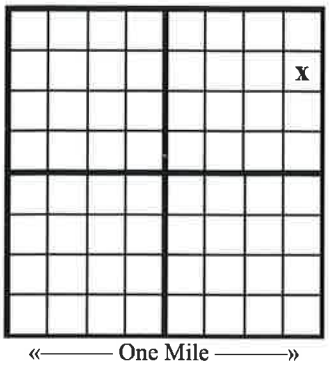
Comments: n/a

MULTI-PURPOSE WELL COMPLETION & PLUGGING REPORT

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location

North



Each square is 10-acres

WELL ID NUMBER: 176862

Quarters SE-NE-NE **Section** 17 **Township** 14N **Range** 05EI

Latitude 35.69325 Longitude -96.78837

Date collected(latitude and longitude), if different from date the well was drilled: 10/06/2016

Method latitude and longitude was collected: GPS - uncorrected data

County Lincoln

Variance Request No. (if applicable) n/a

WELL OWNER - NAME AND ADDRESS

Well Owner Greg Piper Phone ____

Address/City/State 1715 S. Lowery Ave Okc OK Zip 73129

Finding Location ___

Well Name ___ Water Rights #: ___

TYPE OF WORK: Groundwater Well **USE OF WELL:** Irrigation

NEW WELL CONSTRUCTION DATA

Date Well or Boring Was Completed 10/06/2016

Number of wells or borings represented by this log 1

* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter 8 inches to a depth of 160 ft.

CASING INFORMATION ***Note:** If surface casing is used please indicate that on the appropriate well casing information line.

Surface Pipe Material: PVC / Plastic Surface Pipe Diameter 6 inches Surface Pipe From 1 ft to 10 ft

1) Well Casing Material PVC Casing Diameter 4.5 inches Casing From -3 ft to 160 ft

SCREEN OR PERFORATION INFORMATION

Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 20 slot (0.020 inch) From 85 ft to 95 ft.

Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 20 slot (0.020 inch) From 140 ft to 160 ft.

FILTER PACK INFORMATION

Filter Pack Material: Gravel 1/8 inch (pea gravel)

Filter Pack Interval: From 22 ft to 160

WELL SEAL INFORMATION

Type of Surface Seal Cement Grout

Type of Annular Seal Bentonite/Cement Grout

Filter Pack Seal Material n/a

Surface Seal Interval: From 2 ft to 10 ft

Annular Seal Interval: From 10 ft to 22 ft

Filter Pack Seal Interval: From n/a ft to n/a ft

TYPE OF COMPLETION: Pitless Adapter

HYDROLOGIC INFORMATION

Depth to water at time of drilling 85 ft Estimated yield of well 8 gpm First water zone 85 ft

LITHOLOGY DESCRIPTION

MATERIAL	ENCOUNTERED		SATURATED
	FROM (ft.)	TO (ft.)	
Sand Rock	0	10	N
Shlae	10	77	N
Sand Rock	77	93	Y
Shale	93	138	N
Sand Rock	138	160	Y

WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION

Has this well been disinfected after completion of work? Yes

Are than any potential sources of pollution or wastewater lagoons within 300 ft. of the well? Y

Distance of Well is 51 - 75 feet from possible source. Type of possible source: Barn

PLUGGING INFORMATION

Date Well or Boring Was Plugged n/a Total Depth of well being plugged __ ft.

Was the well contaminated or was it plugged as though it was contaminated? n/a

If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? n/a

Was the grout tremied? n/a

Backfilled with n/a Backfilled from ___ ft. to ___ ft.

Grouted with n/a Grouted from __ ft. to __ ft.

Grouted with Cement Grouted from __ ft. to __ ft.

Firm Name VANNOY & SON DRILLING D/PC No. DPC-0213

Operator Name ANTHONY SANTIAGO OP No. OP-1476

Date 10/20/2016

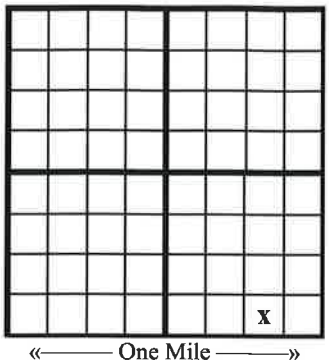
Comments: n/a

MULTI-PURPOSE WELL COMPLETION & PLUGGING REPORT

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location

North



Each square is 10-acres

WELL ID NUMBER: 45065

Quarters SW-SE-SE **Section** 05 **Township** 14N **Range** 05EI

Latitude 35.71072 Longitude -96.790492

Date collected(latitude and longitude), if different from date the well was drilled: 08/30/1999

Method latitude and longitude was collected: Interpolation from PLSS

County Lincoln

Variance Request No. (if applicable) n/a

WELL OWNER - NAME AND ADDRESS

Well Owner Melissa Stambaugh

Phone (918) 377-2522

Address/City/State Box 157 Davenport OK

Zip 74026

Finding Location ___

Well Name ___

Water Rights #: ___

TYPE OF WORK: Groundwater Well

USE OF WELL: Domestic

NEW WELL CONSTRUCTION DATA

Date Well or Boring Was Completed 12/15/1998

Number of wells or borings represented by this log 1

* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)

Hole Diameter 8 inches to a depth of 125 ft.

CASING INFORMATION ***Note:** If surface casing is used please indicate that on the appropriate well casing information line.

Surface Pipe Material: __ Surface Pipe Diameter ___ inches Surface Pipe From ___ ft to ___ ft

1) Well Casing Material PVC Casing Diameter 5 inches Casing From 0 ft to 125 ft

SCREEN OR PERFORATION INFORMATION

FILTER PACK INFORMATION

Filter Pack Material: __

WELL SEAL INFORMATION

Type of Surface Seal _Cement Grout_ Surface Seal Interval: From _0_ ft to _15_ ft

Type of Annular Seal _n/a_ Annular Seal Interval: From _n/a_ ft to _n/a_ ft

Filter Pack Seal Material _n/a_ Filter Pack Seal Interval: From _n/a_ ft to _n/a_ ft

TYPE OF COMPLETION: __

HYDROLOGIC INFORMATION

Depth to water at time of drilling __ ft Estimated yield of well _8_ gpm First water zone __ft

LITHOLOGY DESCRIPTION

MATERIAL	ENCOUNTERED FROM (ft.)	ENCOUNTERED TO (ft.)	SATURATED
subsoil	0	3	N
shale	3	10	N
sandrock	10	13	N
shale	13	20	N
crystalized sandrock	20	30	N
clay	30	35	N
crystalized sandrock	35	40	N
clay	40	110	N
sandrock	110	125	N

WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION

Has this well been disinfected after completion of work? _n/a_

Are than any potential sources of pollution or wastewater lagoons within 300 ft. of the well? _n/a_

Distance of Well is _n/a_ from possible source. Type of possible source: _n/a_

PLUGGING INFORMATION

Date Well or Boring Was Plugged _n/a_ Total Depth of well being plugged __ ft.

Was the well contaminated or was it plugged as though it was contaminated? _n/a_

If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? _n/a_

Was the grout tremied? _n/a_

Backfilled with _n/a_ Backfilled from ___ ft. to ___ ft.

Grouted with _n/a_ Grouted from __ ft. to __ ft.

Grouted with _Cement_ Grouted from __ ft. to __ ft.

Firm Name __ D/PC No. _DPC-0127_

Operator Name __ OP No. __

Date _01/12/1999_

Comments: n/a

APPENDIX B

MONITORING WELL LOG

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	DRILLING METHOD: AIR ROTARY DOWNHOLE AIR HAMMER		MONITORING WELL: MW-1
SITE NAME AND LOCATION MID-WAY ENVIRONMENTAL SERVICES, INC. DAVENPORT, LINCOLN COUNTY, OKLAHOMA NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E	SAMPLING METHOD: CUTTINGS		SHEET 1 OF 2
			DRILLING START / FINISH
	WATER LEVEL		TIME 8:30 / TIME 12:30
WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F	TIME		
G.L. ELEV. 1004.755'	DATE		DATE 11-17-04 / DATE 11-17-04
DATUM MSL TOC ELEV. 1007.55'	CASING DEPTH		
DRILL RIG B-61	TYPE GRAVEL: 10/20 SAND	CASING DIA:	SCREEN DIA: 2.0"
ANGLE BEARING	TYPE BENTONITE: CHIPS	SURFACE CASING	SLOT SIZE: 0.010
SAMPLE HAMMER TORQUE FT.-LBS			

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOWHAWK DRILLING

LOGGED BY GAVIN JAMES

DATE NOVEMBER 15, 2004 CHK'D BY IT

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	WELL NOTES	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
0			CEMENT GROUT 0-10'		TOPSOIL, BROWN, CLAYEY, MOIST	
					CLAY, GRAYISH RED, MOIST, PLASTIC, SOFT	
10					SANDSTONE, ORANGE, FINE GRAIN, MEDIUM HARD, MOIST	
					SHALE, RED, SILTY, SOFT, DRY	
20					SHALE AND SANDSTONE INTERBEDS, ORANGE, EACH NO MORE THAN 1' THICK, MEDIUM HARD, DRY	
					SANDSTONE, GRAY, DRY, MEDIUM FINE, MEDIUM HARD	
					SANDSTONE, ORANGE, DRY, FINE, MEDIUM HARD RED SHALE STREAKS	
30					SANDSTONE, GRAY, DRY, FINE, MEDIUM HARD, MOIST	
					SHALE, ORANGE RED, SILTY, MEDIUM HARD, WITH SANDSTONE STREAKS, DRY	
40			BENTONITE CHIPS 10-95'		SHALE, ORANGE, SILTY, MEDIUM HARD, WITH BROWN SANDSTONE STREAKS	
50					SAME AS ABOVE	
60					SANDSTONE, GRAY, DRY, MEDIUM HARD, FINE GRAIN	
					SHALE, ORANGE, MEDIUM HARD, DRY	

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	DRILLING METHOD: AIR ROTARY DOWNHOLE AIR HAMMER		MONITORING WELL: MW-1
SITE NAME AND LOCATION MID-WAY ENVIRONMENTAL SERVICES, INC. DAVENPORT, LINCOLN COUNTY, OKLAHOMA NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E	SAMPLING METHOD: CUTTINGS		SHEET 2 OF 2
			DRILLING START / FINISH
	WATER LEVEL		TIME 8:30 / TIME 12:30
WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F	TIME		
G.L. ELEV. 1004.755'	DATE		DATE 11-17-04 / DATE 11-17-04
DATUM MSL TOC ELEV. 1007.55'	CASING DEPTH		
DRILL RIG B-61	TYPE GRAVEL: 10/20 SAND	CASING DIA:	SCREEN DIA: 2.0"
ANGLE BEARING	TYPE BENTONITE: CHIPS	SURFACE CASING	SLOT SIZE: 0.010
SAMPLE HAMMER TORQUE FT.-LBS			

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
70				SHALE, ORANGE, MEDIUM HARD, WITH SANDSTONE STREAKS	
80				SANDSTONE, LIGHT GRAY, MEDIUM HARD, DRY	
90		BENTONITE CHIPS 10-95'		SHALE, RED, MEDIUM HARD, DRY	
100		SAND 95-118'		SHALE, RED, MEDIUM HARD, DRY, WITH BROWNISH GRAY SANDSTONE STREAKS	
110		SCREEN 105-118'		SANDSTONE, BROWNISH ORANGE, MEDIUM HARD, DRY SAME AS ABOVE BUT MOIST WET @ 109'	
120		BOTTOM CAP		SANDSTONE, ORANGE BROWN, MEDIUM HARD TO HARD, WET WITH RED SHALE STREAKS FLOWING WATER	
				T.D. = 122.0'	

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOHAWK DRILLING

LOGGED BY GAVIN JAMES

DATE NOVEMBER 15, 2004 CHK'D BY IT

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

SITE NAME AND LOCATION

MID-WAY ENVIRONMENTAL SERVICES, INC.
DAVENPORT, LINCOLN COUNTY, OKLAHOMA
NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E

WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F

G.L. ELEV. 993.06'

DATUM MSL TOC ELEV. 996.04'

DRILL RIG B-61

ANGLE BEARING

SAMPLE HAMMER TORQUE FT.-LBS

DRILLING METHOD: AIR ROTARY
DOWNHOLE AIR HAMMER

SAMPLING METHOD: CUTTINGS

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

TYPE GRAVEL: 10/20 SAND CASING DIA:

TYPE BENTONITE: CHIPS SURFACE CASING

MONITORING WELL: MW-2

SHEET 1 OF 2

DRILLING

START	FINISH
TIME 9:15	TIME 13:15
DATE 11-19-04	DATE 11-19-04

SCREEN DIA: 2.0"

SLOT SIZE: 0.010

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOWHAWK DRILLING

LOGGED BY GAVIN JAMES

DATE NOVEMBER 15, 2004 CHK'D BY IT

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	WELL NOTES	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
0			CEMENT GROUT 0-10'		TOPSOIL, BROWN, CLAYEY, MOIST	
					CLAY, REDDISH BROWN, MOIST, PLASTIC	
					SANDSTONE, ORANGE, FINE GRAIN, MEDIUM HARD, DRY, WITH SHALE STREAKS	
10					SHALE, RED, SILTY, SOFT, DRY, WITH GRAY SANDSTONE BED @ 11.0'	
20					SANDSTONE, WHITE, GRAY, DRY, MEDIUM FINE, WITH SHALE STREAKS	
					SANDSTONE, BROWNISH ORANGE, MOIST, MEDIUM HARD WITH SHALE STREAKS	
30					SHALE, BROWNISH ORANGE, SILTY, MEDIUM HARD, MOIST WITH SANDSTONE STREAKS	
40			BENTONITE CHIPS 10-89'		SAME AS ABOVE BUT DRY	
50					SANDSTONE, GRAY, DRY, MEDIUM HARD, FINE GRAIN	
60					SHALE, RED, MEDIUM HARD, DRY WITH SANDSTONE STREAKS	

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	DRILLING METHOD: AIR ROTARY DOWNHOLE AIR HAMMER		MONITORING WELL: MW-2
SITE NAME AND LOCATION MID-WAY ENVIRONMENTAL SERVICES, INC. DAVENPORT, LINCOLN COUNTY, OKLAHOMA NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E	SAMPLING METHOD: CUTTINGS		SHEET 2 OF 2
			DRILLING START / FINISH
	WATER LEVEL		TIME 9:15 / TIME 13:15
WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F	TIME		
G.L. ELEV. 993.06'	DATE		DATE 11-19-04 / DATE 11-19-04
DATUM MSL TOC ELEV. 996.04'	CASING DEPTH		
DRILL RIG B-61	TYPE GRAVEL: 10/20 SAND	CASING DIA:	SCREEN DIA: 2.0"
ANGLE BEARING	TYPE BENTONITE: CHIPS	SURFACE CASING	SLOT SIZE: 0.010
SAMPLE HAMMER TORQUE FT.-LBS			

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
70		BENTONITE CHIPS 10-89'		SHALE, REDDISH ORANGE, MEDIUM HARD, WITH SANDSTONE STREAKS	
				SANDSTONE, BROWNISH GRAY, MED. HARD, DRY	
				SHALE, RED, MEDIUM HARD, DRY	
				SANDSTONE, GRAY, MEDIUM HARD, DRY	
80				SHALE, RED, MEDIUM HARD, DRY	
				SANDSTONE, GRAY, MEDIUM HARD, DRY	
90				SHALE, RED, MEDIUM HARD, DRY	
		SAND 89-101'		SANDSTONE, ORANGE, MEDIUM HARD, DRY, FINE GRAIN, WITH RED SHALE STREAKS	
		SCREEN 91-101'		SAME AS ABOVE BUT WET @ 92.0' FLOWING WATER	
100				SANDSTONE, ORANGE BROWN, MEDIUM HARD TO HARD, WET WITH RED SHALE STREAKS	
		BOTTOM CAP		T.D. = 102.0'	
110					
120					

DRILLER ALLAN BRANTLEY DRILLING COMPANY MOWHAWK DRILLING

LOGGED BY GAVIN JAMES DATE NOVEMBER 15, 2004 CHK'D BY IT

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

DRILLING METHOD: AIR ROTARY / DOWNHOLE AIR HAMMER

MONITORING WELL: MW-3

SITE NAME AND LOCATION

MID-WAY ENVIRONMENTAL SERVICES, INC.
DAVENPORT, LINCOLN COUNTY, OKLAHOMA
NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E

SAMPLING METHOD: CUTTINGS

SHEET 1 OF 2

					DRILLING START	DRILLING FINISH
WATER LEVEL						
TIME					13:45	10:30
DATE					11-17-04	11-18-04
CASING DEPTH						

WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F

G.L. ELEV. 995.66'

DATUM MSL TOC ELEV. 998.56'

DRILL RIG B-61

ANGLE BEARING

SAMPLE HAMMER TORQUE FT.-LBS

TYPE GRAVEL: 10/20 SAND

TYPE BENTONITE: CHIPS

CASING DIA:

SURFACE CASING

SCREEN DIA: 2.0"

SLOT SIZE: 0.010

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOWHAWK DRILLING

LOGGED BY GAVIN JAMES

DATE NOVEMBER 15, 2004 CHK'D BY IT

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	WELL NOTES	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
0			CEMENT GROUT 0-10'		TOPSOIL, BROWN, CLAYEY, MOIST	
					CLAY, RED, MOIST, PLASTIC, STIFF	
					SANDSTONE, RED, FINE GRAIN, SOFT, DRY	
10					SHALE, RED, SILTY, MEDIUM TO SOFT, WITH SANDSTONE STREAKS	
					SANDSTONE, TAN, MOIST, MEDIUM FINE	
					SHALE, RED, SANDY, MEDIUM HARD, DRY, WITH SANDSTONE STREAKS	
20					SANDSTONE, TAN TO GRAYISH BROWN, MEDIUM HARD, MOIST WITH RED SHALE STREAKS	
					SHALE, RED, SILTY, SOFT, DRY	
30					SHALE, BROWNISH ORANGE, SILTY, MEDIUM HARD, DRY WITH TAN SANDSTONE STREAKS	
					SHALE, RED, MEDIUM HARD, DRY, WITH TAN SANDSTONE STREAKS	
40			BENTONITE CHIPS 10-97'		SAME AS ABOVE	
50					SANDSTONE, GRAY, DRY, MEDIUM HARD, FINE GRAIN	
					SHALE, RED, MEDIUM HARD, DRY, WITH TAN SANDSTONE STREAKS	
60					SAME AS ABOVE	

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	DRILLING METHOD: AIR ROTARY DOWNHOLE AIR HAMMER		MONITORING WELL: MW-3
SITE NAME AND LOCATION MID-WAY ENVIRONMENTAL SERVICES, INC. DAVENPORT, LINCOLN COUNTY, OKLAHOMA NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E	SAMPLING METHOD: CUTTINGS		SHEET 2 OF 2
			DRILLING START TIME 13:45 / FINISH TIME 10:30
WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F	WATER LEVEL / TIME		
G.L. ELEV. 995.66'	DATE		DATE 11-17-04 / DATE 11-18-04
DATUM MSL / TOC ELEV. 998.56'	CASING DEPTH		
DRILL RIG B-61	TYPE GRAVEL: 10/20 SAND	CASING DIA:	SCREEN DIA: 2.0'
ANGLE BEARING	TYPE BENTONITE: CHIPS	SURFACE CASING	SLOT SIZE: 0.010
SAMPLE HAMMER TORQUE FT.-LBS			

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOWHAWK DRILLING

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
70				SHALE, REDDISH ORANGE, MEDIUM HARD, DRY, WITH SANDSTONE STREAKS	
				SANDSTONE, TAN, SOFT, DRY, WITH RED SHALE STREAKS	
80		BENTONITE CHIPS 10-97'		SHALE, RED, MEDIUM HARD, DRY, WITH SANDSTONE STREAKS	
90				SAME AS ABOVE	
				SANDSTONE, BROWNISH TAN, MEDIUM HARD, FINE GRAIN, WITH RED SHALE STREAKS	
100		SAND 97-109'		MOIST @ 98.0'	
				SAME AS ABOVE BUT WET @ 100.0'	
		SCREEN 99-109'		FLOWING WATER	
				SANDSTONE, ORANGE TAN, MEDIUM HARD TO HARD, WET WITH RED SHALE STREAKS	
110		BOTTOM CAP			
120				T.D. = 117.0'	

LOGGED BY GAVIN JAMES

DATE NOVEMBER 15, 2004 CHK'D BY IT

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.

SITE NAME AND LOCATION

MID-WAY ENVIRONMENTAL SERVICES, INC.
DAVENPORT, LINCOLN COUNTY, OKLAHOMA
NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E

WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F

G.L. ELEV. 994.44'

DATUM MSL TOC ELEV. 997.44'

DRILL RIG B-61

ANGLE BEARING

SAMPLE HAMMER TORQUE FT.-LBS

DRILLING METHOD: AIR ROTARY
DOWNHOLE AIR HAMMER

SAMPLING METHOD: CUTTINGS

WATER LEVEL				
TIME				
DATE				
CASING DEPTH				

TYPE GRAVEL: 10/20 SAND CASING DIA:

TYPE BENTONITE: CHIPS SURFACE CASING

MONITORING WELL: MW-4

SHEET 1 OF 2

DRILLING START	DRILLING FINISH
TIME 12:05	TIME 15:30
DATE 11-15-04	DATE 11-16-04

SCREEN DIA: 2.0'

SLOT SIZE: 0.010

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOHAWK DRILLING

LOGGED BY GAVIN JAMES

DATE NOVEMBER 15, 2004 CHK'D BY IT

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	WELL NOTES	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
	1-2-4		CEMENT GROUT 0-10'		TOPSOIL, BROWN, CLAYEY, MOIST	
	5-10-23				CLAY, RED, MOIST, PLASTIC, STIFF	
	12-23-36				SANDSTONE, RED, DARK RED, FINE GRAIN, MEDIUM HARD, DRY	
10	13-27-41				SANDSTONE, RED W/ WHITE STREAKS, FINE GRAIN, MEDIUM TO SOFT, DRY	
					SANDSTONE, REDDISH ORANGE, FINE GRAIN, MEDIUM HARD, DRY W/ SHALE STREAKS	
	17-26-29				SHALE, RED, SILTY, MEDIUM HARD, WITH SANDSTONE STREAKS	
20						
					SANDSTONE, WHITE, GRAY, MOIST, MEDIUM FINE, SOFT	
30					SHALE, RED, SILTY, MEDIUM HARD, WITH SANDSTONE STREAKS, DRY	
			BENTONITE CHIPS 10-98'		SHALE, BROWNISH ORANGE, SILTY, MEDIUM HARD, WITH SANDSTONE STREAKS, DRY	
40					SAME AS ABOVE	
50					SAME AS ABOVE	
60					SANDSTONE, GRAY, DRY, MEDIUM HARD, FINE GRAIN	
					SHALE, REDDISH ORANGE, MEDIUM HARD, DRY	

WELL COMPLETION LOG

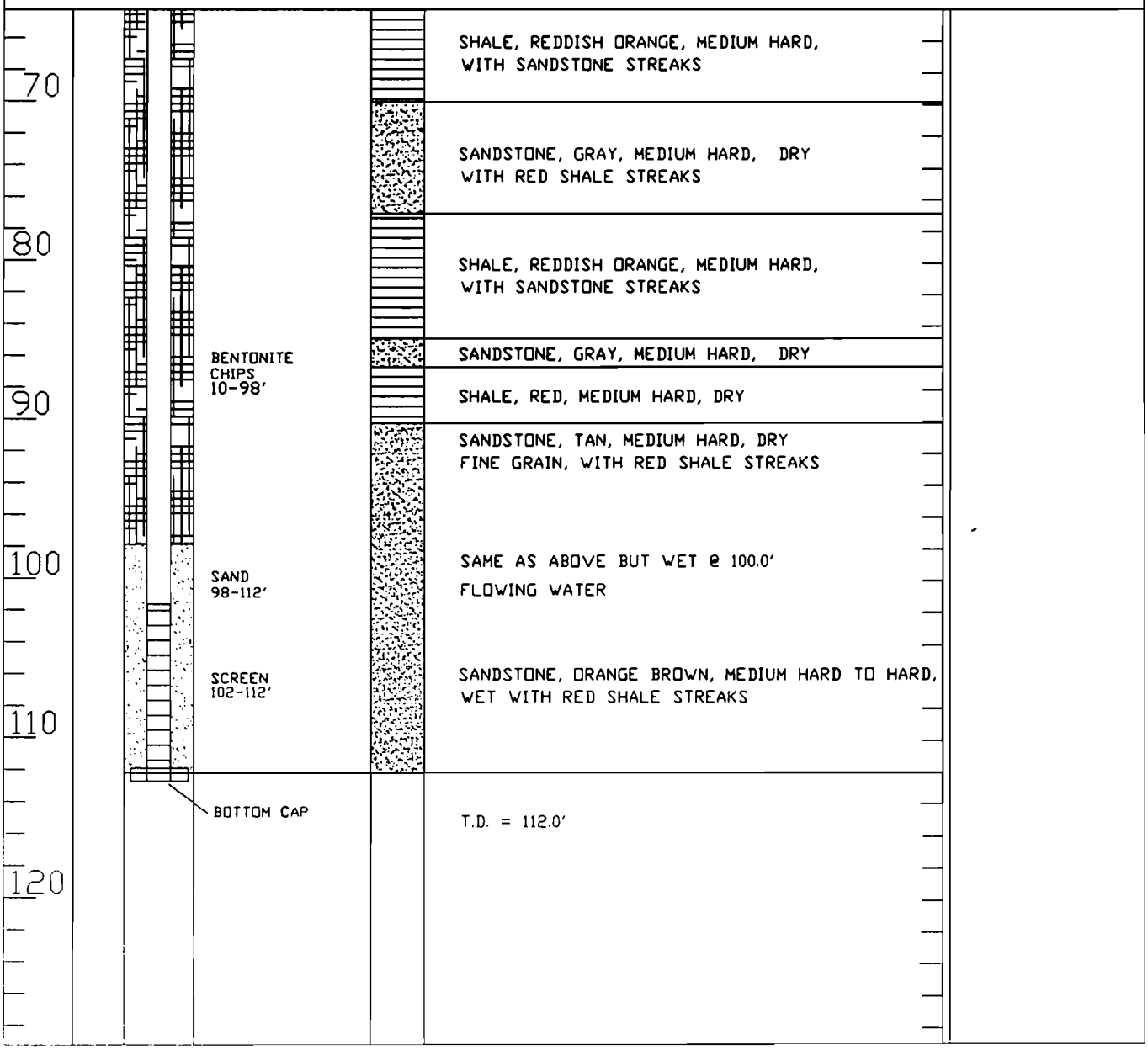
A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	DRILLING METHOD: AIR ROTARY DOWNHOLE AIR HAMMER	MONITORING WELL: MW-4
SITE NAME AND LOCATION MID-WAY ENVIRONMENTAL SERVICES, INC. DAVENPORT, LINCOLN COUNTY, OKLAHOMA NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E	SAMPLING METHOD: CUTTINGS	SHEET 2 OF 2
		DRILLING START / FINISH
WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F	WATER LEVEL / TIME	TIME 12:05 / TIME 15:30
G.L. ELEV.	DATE	DATE 11-15-04 / DATE 11-16-04
DATUM MSL / TOC ELEV.	CASING DEPTH	
DRILL RIG B-61	TYPE GRAVEL: 10/20 SAND / CASING DIA:	SCREEN DIA: 2.0"
ANGLE BEARING	TYPE BENTONITE: CHIPS / SURFACE CASING	SLOT SIZE: 0.010
SAMPLE HAMMER TORQUE FT.-LBS		

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOWHAWK DRILLING

LOGGED BY GAVIN JAMES

DATE NOVEMBER 15, 2004 CHK'D BY IT



WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	DRILLING METHOD: AIR ROTARY DOWNHOLE AIR HAMMER		MONITORING WELL: MW-5
SITE NAME AND LOCATION MID-WAY ENVIRONMENTAL SERVICES, INC. DAVENPORT, LINCOLN COUNTY, OKLAHOMA NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E	SAMPLING METHOD: CUTTINGS		SHEET 1 OF 2
			DRILLING
			START: TIME 11:15 / DATE 6-30-05
			FINISH: TIME 10:30 / DATE 6-30-05
WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F	WATER LEVEL / TIME / DATE / CASING DEPTH		
G.L. ELEV. 997.13			
DATUM MSL — TOC ELEV. 1000.30			
DRILL RIG B-61	TYPE GRAVEL: 10/20 SAND	CASING DIA:	SCREEN DIA: 2.0"
ANGLE BEARING	TYPE BENTONITE: CHIPS	SURFACE CASING	SLOT SIZE: 0.010
SAMPLE HAMMER TORQUE FT.-LBS			

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOWHAWK DRILLING

LOGGED BY GAVIN JAMES

DATE JULY 5, 2005 CHK'D BY IT

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	WELL NOTES	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
			CEMENT GROUT 0-2'		TOPSOIL, BROWN, CLAYEY, MOIST	
					CLAY, RED, MOIST, PLASTIC, STIFF	
					SANDSTONE, RED, FINE GRAIN, SOFT, DRY	
					SHALE, RED, SILTY, MEDIUM TO SOFT, WITH SANDSTONE STREAKS	
10					SANDSTONE, TAN, MOIST, MEDIUM FINE	
					SHALE, RED, SANDY, MEDIUM HARD, DRY, WITH SANDSTONE STREAKS	
					SANDSTONE, TAN TO GRAYISH BROWN, MEDIUM HARD, MOIST WITH RED SHALE STREAKS	
20					SHALE, RED, SILTY, SOFT, DRY	
					SANDSTONE, GRAY, MOIST, MEDIUM HARD	
30					SHALE, REDDISH ORANGE, SILTY, MEDIUM HARD, DRY WITH TAN SANDSTONE STREAKS	
			BENTONITE GROUT 2-79'		SHALE, RED, MEDIUM HARD, DRY, WITH TAN SANDSTONE STREAKS	
40					SAME AS ABOVE	
50					SANDSTONE, GRAY, DRY, MEDIUM HARD, FINE GRAIN	
					SHALE, RED, MEDIUM HARD, DRY, WITH TAN SANDSTONE STREAKS	
60					SANDSTONE, GRAY, DRY, MEDIUM HARD, FINE GRAIN	

WELL COMPLETION LOG

A & M ENGINEERING AND ENVIRONMENTAL SERVICES, INC.	DRILLING METHOD: AIR ROTARY DOWNHOLE AIR HAMMER		MONITORING WELL: MW-5
SITE NAME AND LOCATION MID-WAY ENVIRONMENTAL SERVICES, INC. DAVENPORT, LINCOLN COUNTY, OKLAHOMA NW/4 OF SW/4 OF SECTION 9, T-14-N, R-5-E	SAMPLING METHOD: CUTTINGS		SHEET 2 OF 2
			DRILLING START / FINISH
	WATER LEVEL		TIME 11:15 / TIME 19:30
WEATHER: CLOUDY, LIGHT RAIN TEMP: 50 F	TIME		
G.L. ELEV. 997.13	DATE		DATE 6-30-05 / DATE 6-30-05
DATUM MSL TOC ELEV. 1000.30	CASING DEPTH		
DRILL RIG B-61	TYPE GRAVEL: 10/20 SAND	CASING DIA:	SCREEN DIA: 2.0"
ANGLE BEARING	TYPE BENTONITE: CHIPS	SURFACE CASING	SLOT SIZE: 0.010
SAMPLE HAMMER TORQUE FT.-LBS			

DEPTH IN FEET	BLOW COUNT	WELL TYPICAL	SYMBOL	DESCRIPTION OF MATERIAL	NOTES
70		BENTONITE GROUT 2-79'		SHALE, REDDISH ORANGE, MEDIUM HARD, DRY, WITH SANDSTONE STREAKS	
				SANDSTONE, TAN, SOFT, DRY	
80		BENTONITE CHIPS 79-86'		SHALE, RED, MEDIUM HARD, DRY, WITH SANDSTONE STREAKS	
				SAME AS ABOVE	
90				SANDSTONE, ORANGE TAN, MEDIUM HARD, FINE GRAIN, WITH RED SHALE STREAKS	
		SAND 86-125'		MOIST @ 92.0'	
100				SAME AS ABOVE BUT WET @ 95'	
		SCREEN 90-125'			
110				SANDSTONE, ORANGE TAN, MEDIUM HARD TO HARD, WET WITH RED SHALE STREAKS	
120				SANDSTONE, ORANGE TAN, MEDIUM HARD TO HARD, WET	
		BOTTOM CAP		T.D. = 125.0'	

DRILLER ALLAN BRANTLEY

DRILLING COMPANY MOWHAWK DRILLING

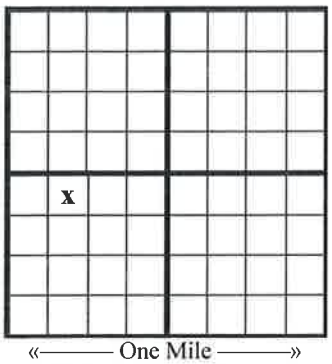
LOGGED BY GAVIN JAMES

DATE JULY 5, 2005 CHK'D BY IT

MULTI-PURPOSE WELL COMPLETION & PLUGGING REPORT

Oklahoma Water Resources Board
3800 North Classen Boulevard
Oklahoma City, OK 73118
Telephone (405) 530-8800

Legal Location
North



«——— One Mile ———»
Each square is 10-acres

WELL ID NUMBER: 172619

Quarters NE-NW-SW **Section** 09 **Township** 14N **Range** 05EI

Latitude 35.70236 Longitude -96.78434

Date collected(latitude and longitude), if different from date the well was drilled:
02/01/2016
Method latitude and longitude was collected: GPS - corrected data (WAAS)

County Lincoln Variance Request No. (if applicable) n/a

WELL OWNER - NAME AND ADDRESS
Well Owner Midway Environmental Services Phone _____
Address/City/State 900536 South 3490 Road Davenport OK Zip ____
Finding Location ___
Well Name Deep MW Water Rights #: ___
TYPE OF WORK: Monitoring Well **USE OF WELL:** Water Quality

NEW WELL CONSTRUCTION DATA
Date Well or Boring Was Completed 02/03/2016
Number of wells or borings represented by this log 1
* (Borings are within the same 10 acre-tract and with the same general depths and lithologies)
Hole Diameter 12 inches to a depth of 20 ft.
Hole Diameter 7.875 inches to a depth of 260 ft.

CASING INFORMATION ***Note:** If surface casing is used please indicate that on the appropriate well casing information line.
Surface Pipe Material: PVC / Plastic Surface Pipe Diameter 8 inches Surface Pipe From 0 ft to 20 ft
1) Well Casing Material PVC Casing Diameter 4 inches Casing From 0 ft to 238 ft

SCREEN OR PERFORATION INFORMATION
Type of Screen: PVC Type of Slots or Openings: Factory Slotted - 10 slot (0.010 inch) From 238 ft to 253 ft.

FILTER PACK INFORMATION

Filter Pack Material: Sand 10-20 (coarse)

Filter Pack Interval: From 234 ft to 253

WELL SEAL INFORMATION

Type of Surface Seal Cement Grout

Type of Annular Seal Cement Grout

Filter Pack Seal Material Bentonite Pellets

Surface Seal Interval: From 0 ft to 20 ft

Annular Seal Interval: From 0 ft to 228 ft

Filter Pack Seal Interval: From 228 ft to 234 ft

TYPE OF COMPLETION: Above Ground

HYDROLOGIC INFORMATION

Depth to water at time of drilling ___ ft Estimated yield of well ___ gpm First water zone ___ft

LITHOLOGY DESCRIPTION

MATERIAL	ENCOUNTERED FROM (ft.)	ENCOUNTERED TO (ft.)	SATURATED
Silty Clay	0	4	N
Shale and Sandstone, weathered	4	15	N
Shale and Sandstone, interbedded	15	260	N

WELL LOCATION TO POTENTIAL SOURCES OF POLLUTION

Has this well been disinfected after completion of work? No

Are than any potential sources of pollution or wastewater lagoons within 300 ft. of the well? Y

Distance of Well is 101 - 300 feet from possible source. Type of possible source: Above Ground Storage Tank

PLUGGING INFORMATION

Date Well or Boring Was Plugged n/a Total Depth of well being plugged ___ ft.

Was the well contaminated or was it plugged as though it was contaminated? n/a

If the well or boring was plugged as if it was contaminated, was the casing removed or perforated? n/a

Was the grout tremied? n/a

Backfilled with n/a Backfilled from ___ ft. to ___ ft.

Grouted with n/a Grouted from ___ ft. to ___ ft.

Grouted with Cement Grouted from ___ ft. to ___ ft.

Firm Name GILES ENVIRONMENTAL SERVICES, INC. D/PC No. DPC-0596

Operator Name CLARK GILES OP No. OP-1182

Date 02/29/2016

Comments: n/a

APPENDIX C

PLUGGING EFFICIENCY OF THE NEARBY WELLS, AND HYDRAULIC INTERFERENCE POSSIBILITY

PREPARED BY

EVREN M. OZBAYOGLU, PHD

- Report -

Mid-Way MES-#1

Analysis on

Plugging Efficiency of the Nearby Wells, and

Hydraulic Interference Possibility

Prepared by

Evren M. Ozbayoglu, PhD

April, 2013

Mid-Way MES-#1

Analysis on
Plugging Efficiency of the Nearby Wells, and
Hydraulic Interference Possibility

The Plugging and abandonment process refers to the process to prepare a well to be closed permanently: usually after geophysical logs determine there is insufficient hydrocarbon potential to complete the well, or after production operations have drained the reservoir. Different regulatory bodies have their own requirements for plugging operations. Most require that cement plugs be placed and tested across any open hydrocarbon-bearing formations, across all casing shoes, across freshwater aquifers, and perhaps several other areas near the surface, including the top 20 to 50 ft of the wellbore. The well designer may choose to set bridge plugs in conjunction with cement slurries to ensure that higher density cement does not fall in the wellbore. In that case, the bridge plug would be set and cement pumped on top of the plug through drillpipe, and the drillpipe withdrawn before the slurry thickened.

To seal selected intervals of a dry hole or a depleted well, operators can place a cement plug at the required depth to help prevent zonal communication and migration of any fluids that might infiltrate underground freshwater sources.

A plug must prevent fluid flow in a wellbore, either between formations or between a formation and the surface. A competent plug must provide both a hydraulic and mechanical seal. One of the major challenges during a plugging operation is placing a small volume of plugging material into a large volume of wellbore fluid. If plugging fluid is contaminated by the wellbore fluid, a weak, diluted, non-uniform or unset plug may result. Displacement efficiency, slurry stability, fluid compatibilities must also be considered for a plug job. And when the work string from a heavier balanced cement plug must be removed from its position above a lighter wellbore fluid, the plugging operations can be very difficult.

A typical abandonment plug is schematically presented in Figure-1.

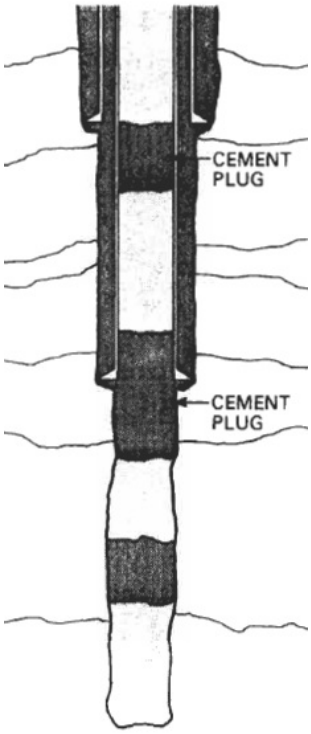


Figure – 1 Abandonment plug

1. Placement Techniques

Dump bailers are used for placing very small volumes of plugging material precisely and economically. These tools can be run on wireline, slickline, or sandline. Through tubing and through casing sizes are available. Sand, barite, plastics, cement slurries, etc. are all placed with this technique. The use of dump bailers for spotting materials that thermally depend on set times (such as resins and cement slurries) has historically been limited to shallow depths because of temperature concerns.

A limit plug, cement basket, permanent bridge plug, or sand pill is often placed below the desired plugging location to provide a solid bottom in the wellbore. The dump bailer, containing a measured quantity of plugging material, is lowered to the desired depth. The bailer is opened, and then raised to release the plugging material at this location.

One of the most technically effective ways to spot fluid in a wellbore is to lay it with a pipe, either the tubing, drillpipe, or most commonly, coiled tubing. The coiled tubing process consists of placing the end of the coiled tubing at the bottom of the planned plug depth, and while the plugging slurry exits, the nozzle at the end of the coiled tubing slowly extracts the pipe, so that the pull-out rate matches the fluid pump rate and keeps the end of the coiled tubing just below the top of the slurry. This placement method results in a volume of plugging fluid with little or no contamination in the wellbore.

Probably the most common technique in plugging and abandonment operations is the balanced-plug method. This method involves pumping the slurry through drillpipe or tubing until the level outside is equal to that inside the string. The volume and hydrostatics of wellbore fluids, preflushes, spacers, and plugging fluids must be carefully calculated to ensure that the system is being correctly balanced in the hole. The pipe or tubing is, then, pulled slowly from the plugging material before it sets, leaving the plug in place.

2. Summary of Oklahoma Regulations Related with Technical Issues

The following presents a discussion of the plugging and abandonment procedures historically required within the State of Oklahoma. The discussion includes the regulations and requirements in place during the identified period and provides a historic record of the changes in the plugging and abandonment process in Oklahoma.

1915 – Wells are required to be filled with mud-laden fluid of maximum density. Fresh water, whether above or below the surface must be protected from pollution.

1917 – Plugging must be achieved by the use of mud-laden fluid and in addition, cement and plugs may be used. All dry or abandoned wells must be thoroughly cleaned out, and before the casing is removed, the well must be filled with mud-laden fluid having a density 25 % heavier than water density (10.41 pounds per gallon (ppg)) unless other methods are directed by the inspector. Plugging of wells must be accomplished by pumping maximum density mud-laden fluid so that all oil, gas or water is confined to the strata in which they occur.

1945 – If no casing is to be pulled immediately, then a plug must be placed at the top and bottom of the casing to prevent any influx into the well. Plugging of wells must be accomplished with mud-laden fluid, cement or a mechanical plug so that all oil, gas or water is confined to the reservoir in which they occur. The plug must permanently prevent migration of oil, gas, water or other substance from the formation. While plugging any well, the open hole below the casing shoe must be filled with cement or mud-laden fluid to a point 25 ft above the shoe of the casing. If it is not possible to fill the entire open hole, a minimum of 25 ft of plug must be set, and the plug must extend at least 25 ft above the shoe of the casing. If the casing is to be removed from the hole, the hole must be filled with cement or mud-laden fluid to a point where it is proposed to sever the pipe. If this is unsuccessful, then the hole must be filled with cement or mud-laden fluid to the point where the actual severance occurs. As the pipe is pulled from the hole, the hole will be kept full of mud-laden fluid to the top of the casing at all times. If the string is planned to be removed, the fluid level must be kept at least 25 ft above the shoe of the succeeding string of casing. If chunk mud is used, it will be covered with a column of water at all times, and mud will never be placed into the hole in a manner that will allow it to bridge the hole. A plug or seal will be placed at the surface of the ground or the bottom of the cellar in the hole.

1961 – Similar to 1945

1971 – "Mud" is referred to fluids having a minimum density of 9.0 ppg, and API Marsh Funnel viscosity of a minimum of 36. Injection of cement into the well must be by the tubing and pump method or the pump and plug method. Before casing is removed, all salt water must be displaced, and the well must be filled with mud. The wellbore must be filled with cement at least 50 ft above the casing or liner shoe. Any productive formation (oil, gas or water) must be sealed from at least 50 ft above the top of the formation, to at least 50 ft below the base of the formation. If the strata have already been sealed off by a casing, the casing will not be removed. If the only conductivity is through perforations, a minimum 50 ft of cement from base and top of the formations and a bridge plug capped with 10 ft of cement set at the top of the producing formation is required. The top 30 ft of the wellbore below 3 ft of the surface of the ground must be filled with cement.

1987 – No significant change

2002 – No significant change

3. Nearby Wells, Plugging Efficiency and Discussions

An analysis is herein conducted to investigate and verify whether wells which are close to the Mid-Way Injection well have been plugged properly. Wells considered in this evaluation include three wells which have been plugged and abandoned under differing requirements. This is important so that any potential problems that may occur during operation of the Mid-Way injection well can be identified.

3.1 Well-1

Plugging operations for the Richie-1 well of the Magnolia Petroleum Company (1926), which had a total depth of 4545 ft was conducted by pumping sand. A casing was set at 4150 ft, and no casing was pulled out from the well. Sand packing was used as the plugging tool, by filling the well to the top.

This operation is bonded with the regulations of 1915 and 1917. Based on the regulations, the well should have been filled with mud-laden fluid, having a minimum density of 25 % greater than water density. If sand, having a specific gravity of 2.6 with a concentration of 15.6 % was used, the regulation was satisfied. According to the plugging report, a mud-hog pump was used for this operation. The use of a mud-hog indicates that high solid concentration fluids could be pumped without any difficulty. The regulation required that the well needed to be filled with mud-laden fluid. It appears the regulations were followed, and the plugging operation was conducted successfully. The plugging report indicates the well was plugged per the regulations.

Considering the depth of this well, the maximum formation pressure is expected to be 2308 psi, and the minimum fracture pressure is expected to be 2756 psi. If a mud, having a weight 25 % more than water was used for plugging, the pressure at the bottomhole is expected to be 2445 psi, which is within the upper and lower pressure margins. Calculations based on a continuous maximum injection rate of 20 barrels per minute (bbl/min), indicate that after 50 years, the front-end of the injection fluid will be 0.875 miles away from Mid-Way well. It is important to note that Mid-Way will not be injecting

continuously; therefore, the projected front-end distances are absolute worst case values. In reality, it will take much longer for the injection front to migrate as far as is calculated. Since the distance between the Mid-Way well and Richie-1 is close to 0.92 mile, the water front will not reach the vertical projection of the Richie-1 Well and there is no chance for hydraulic interference.

Additionally, the bottom of the Richie-1 well is above the confining Sylvan shale, providing a vertical barrier between this well and the Mid-Way injection well during the injection process.

3.2 Well-2

Martin-1 of Prairie Oil and Gas Company (1926) was drilled to 4433 ft. No casing had been removed from the well during the plugging and abandonment process. The well was filled with mud-laden fluid. According to the regulations of 1917, the fluid weight must be at least 25 % heavier than the water density. Therefore, a 10.41 ppg fluid must have been used during the plugging operation. No cement or mechanical plugs were used.

Assuming that a 10.41 ppg mud is used for plugging the well, the pressure at the bottomhole should be 2400 psi. Since maximum formation and minimum fracture pressures for this well is estimated to be 2266 psi and 2706 psi, respectively, the pressure within the well is in safe zone. The distance between Mid-Way and Martin-1 wells is approximately 0.92 mile. Therefore, even after 50 years, the front-end of the injection fluid will not able to reach to the vertical projection of Martin-1. Thus, no interference is expected.

3.3 Well-3

Plugging operation conducted at Bradshaw-1 of Wolfe Drilling Company (1956), were conducted under the 1945 regulations. The Bradshaw-1 had a total depth of 3485 feet. A slurry, which consisted of 10 sacks of cement, was placed at the bottom of the pipe, then the well was shut off. The 7 inch casing, which was landed to 3481 ft was pulled to 2871 ft, filling the well with mud at the same time. After settling the cement, the top of the surface casing (10.75 in outer diameter) was capped with 5 sacks of cement slurry.

Assuming that the inner diameter of the 7 inch casing is 6.25 in, the inner diameter of the 10.75 inch surface casing is 10 inches, and the cement used had a yield of 1.35 ft^3/ft, it can be determined that capacity of the 7 inch casing is 0.213 ft^3/ft, capacity of 10.75 inch casing is 0.575 ft^3/ft, and the annular volume between 10.75 inch casing and 7 inch casing is 0.278 ft^3/ft. Assuming that all the cement is left inside the 7 inch casing, the length of the cement column inside the casing is 63.4 ft. Length of the cement cap at the surface (in the annular space between 10.75 inch and 7 inch casings) is 18.0 ft.

The method of plugging is valid for this well. Major application described as the method of plugging in year 1945 is filling the well with mud-laden fluid that is used for plugging tool as much as possible (25 ft minimum above the shoe). Clearly, the well has been plugged successfully and safely, as described in the regulations.

Assuming that the maximum formation pressure and minimum fracture pressures for Bradshaw-1 are 1781 psi and 2127 psi, respectively, if the plugging process is conducted by a mud having a 25 % greater than water density, the bottomhole pressure will be 1887 psi. Therefore, the pressure is within the limits. Also, the cement used acts as an additional barrier beside the mud-laden fluid. Therefore, the plugging process was efficient.

Distance between Mid-Way and Bradshaw-1 is 0.58 mile. This means that after 25 years of injection at the Mid-Way injection well, the front-end of the injection fluid will be past the vertical projection of Bradshaw-1. However, the distance between the top of the Arbuckle formation and the bottom of Bradshaw-1 is more than 1500 ft. The two impermeable confining layers are above the Arbuckle formation and below the bottom of the Bradshaw-1. Therefore, no hydraulic interference is expected.

3.4 Well-4

There are 3 horizontal wells which belong to Altex Energy Corporation, and which can be considered as "close to" the Mid-Way Injection Well. All of these wells and their laterals have true vertical depths around 4550 ft, and are completed in the Hunton Formation. The Hunton Formation, is located above the confining Sylvan shale. The Closest well, Corinth-1-9H, which has an entry point at northeast corner of section-8, has a trajectory to east-southeast into section-9. The laterals of this particular well, 1B and 2, have true vertical depths of 4549 ft, and 4584 ft, respectively. Among the laterals, the closest one to Mid-Way Injection well appears to be 1B of Corinth-1-9H. At its closest point, this lateral is located 908 ft horizontally and 578 ft vertically away from the top of the injection zone of Mid-Way.

Considering the fact that if enough overburden exists, the horizontal permeability is much higher than the vertical permeability in a horizontally aligned sediment. Comparing the overburden stress and formation pressure (average pressure gradients for overburden is 1.0 psi/ft, and for formation pressure is 0.5 psi/ft), which are also similar to vertical and horizontal stresses, respectively; there exists a significant difference, more than two-fold. Therefore, the vertical permeability is expected to be much less than horizontal permeability, which makes the assumption of radial flow and no flow in θ and z direction reasonable. This will lead to the injected fluid moving within the horizontal plane, but not in the vertical direction. Since the top of the injection zone is measured to be approximately 5100 ft (from previously conducted injection tests) the distance between the base of Hunton formation and the top of injection zone is approximately 500 ft. The impermeable shale barrier (Sylvan shale) is within this 500 ft. Thus, a hydraulic interference is not expected between the closest lateral, 1B, and Mid-Way Injection well.

During the injection process, the amount of increase of pressure within the injected formation is estimated to be 400 psi after 50 years of injection at a 20 bbl/min injection rate. Average formation and minimum fracture pressures at Hunton formation are estimated to be 2275 psi and 2890 psi, respectively. Since the initial formation pressure at the injection zone is 2450 psi, it is expected to increase to 2850 psi after 50 years of injection. Therefore, even if this pressure is directly transferred to Hunton Formation, it will not fracture. Yet, pressure transfer to Hunton formation is not possible, either due to the impermeable layer below it, or due to the lower vertical permeability. It is expected that after

a year of injection, the front-end of the injected fluid will reach to the vertical projection of the lateral. However, it will not able to reach to the lateral, since the vertical flow of the injected fluid is expected to be minimal.

As a conclusion, no hydraulic interference is expected at the nearby plugged or horizontal wells due to the injection process at the Mid-Way Injection Well.