OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL & GAS RESOURCES MANAGEMENT
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WASHINGTON COUNTY PRODUCED WATER INVESTIGATION

EXECUTIVE SUMMARY

In late 2019, three owners of production wells in Washington County reported to the Ohio Department of Natural Resources, Division of Oil and Gas Resources Management (Division) an increased flow of salt water, known as brine, during their extraction process in 28 production wells located in the Berea Sandstone formation. While some amount of brine is expected to be produced along with crude oil and natural gas, these owners reported seeing a higher volume than normal. The owners believed that the brine came from a nearby Class II Saltwater Injection Well, Redbird #4, in the Ohio Shale formation, which sits below the Berea Sandstone formation as shown in Figure A. The Division has received no reports of adverse effects to human health or safety associated with any of the wells at issue.

The Division began investigating the matter, and scientists in the Division's Underground Injection Control program requested and procured available data, including samples from the 15 production wells where brine samples could be obtained. The Division contracted with a third-party, Resource Services International, to analyze the data and determine if brine was travelling from Redbird #4 to the production wells.

The Division also discussed the allegations of brine travelling out of its injection zone with the owner of the Redbird #4 injection well in March of 2020. As of May 22, 2020, the owner voluntarily completed modifications to the Redbird #4 well to seal off the Ohio Shale formation. The Redbird #4 had not actively injected since November of 2019 because of an unrelated pump problem.

Key Report Conclusions

- Wastewater injected into the Ohio Shale Formation from the Redbird #4 well is the source of brine that has appeared in several production wells drilled into the adjacent Berea formation. The conclusion is based on data and water samples obtained from both the injection well and the production wells.
- Naturally occurring fissures exist between the Ohio Shale formation and the Berea Sandstone formation, allowing wastewater to migrate between the formations and into the production wells.
- Since Redbird #4 is no longer injecting brine into the Ohio Shale formation, brine volumes in the impacted production wells are expected to decrease and natural gas production will return to expected rates.
- It is unlikely that wastewater will migrate farther – including into underground sources of drinking water due to the composition of the rock layers and other factors.

Actions by the Division of Oil and Gas Resources Management

Based on these conclusions and the unique geologic makeup of the area around the Redbird #4, there is currently no reason to believe that this issue is occurring in other wells outside of

this area. However, as a result of the initial complaint and in advance of the of the report's findings, the Division did the following:

- Collected samples from two other Class II Saltwater Injection operations injecting into the Ohio Shale within a ten-mile radius of the Redbird #4 well to allow for testing to determine if any wastewater is migrating out of the injection formation.
- Added conditions to all newly permitted Class II Saltwater Injection Wells after August 11, 2020. These conditions allow the Division to stop operations if fluids injected into the well do not remain in the zone in which they were injected and will require operators to perform additional testing.
- Contracted to plug an idle and orphan well located near Redbird #4 that contained wastewater, removing water from the Berea Formation.
- Compiled a list of 11 nearby wells that are being examined for determination if they qualify as idle and orphaned wells to be plugged by the Division's Orphan Well Program.

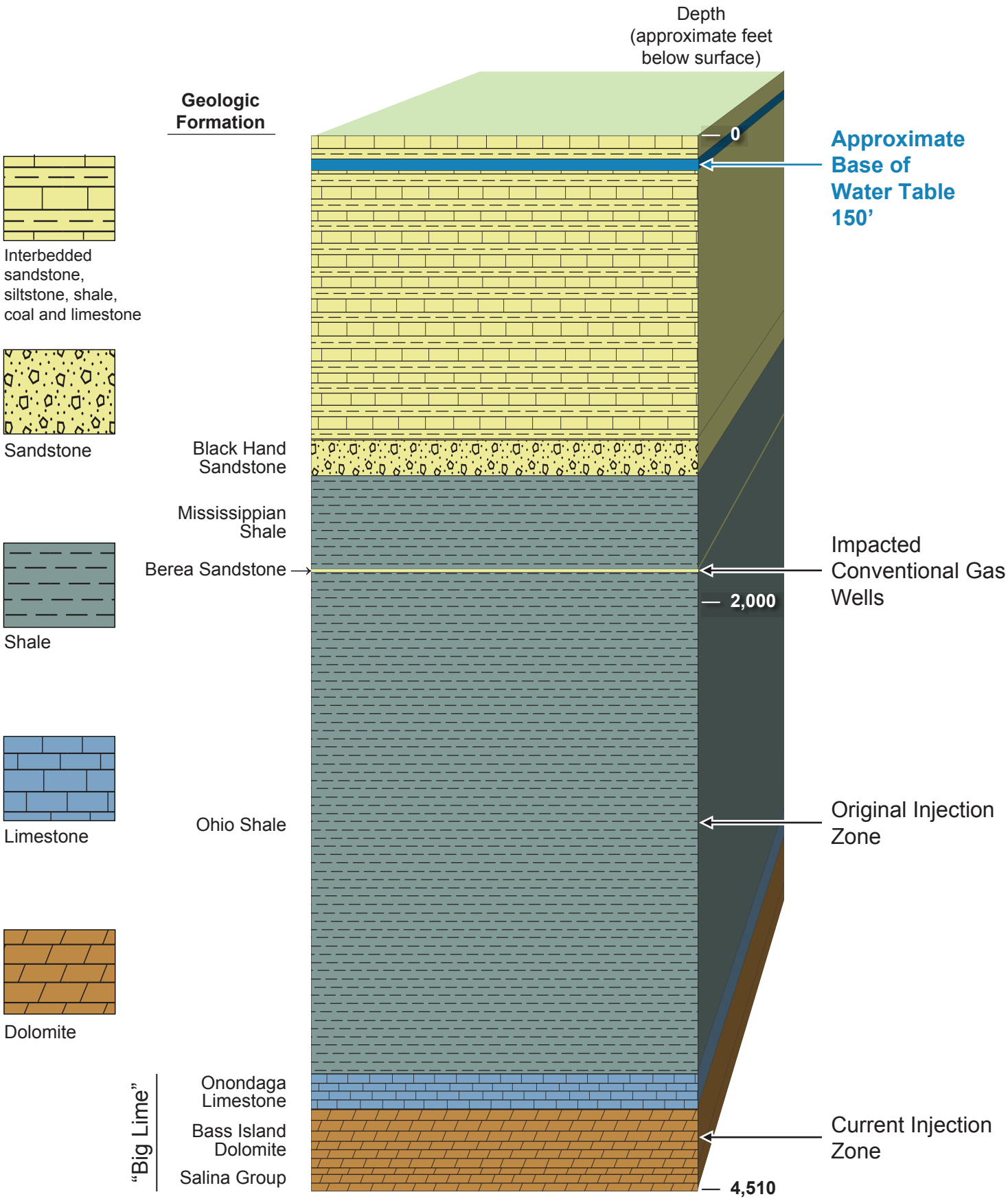
Moving forward, the Division will

- Engage an expert to provide further findings to determine if additional regulatory action is necessary.
- Prohibit the issuance of new Class II Saltwater Injection Well permits into the Ohio Shale formation within a ten-mile radius of the Redbird #4 until further studies of nearby injection wells are completed.
- Prepare a Scope of Work to contract a third-party consultant to conduct a groundwater study to corroborate the conclusions of the report.

The Division strives to protect human health, safety, and the environment and will take all necessary action to investigate any complaints it receives and will respond accordingly. While no surface environmental impacts have occurred, and the Division has not received any reports of contamination to groundwater in the geographical area, any residents who have questions should contact the Ohio Department of Natural Resources, Division of Oil and Gas Resources Management, at (614) 265-6608 or oilandgas@dnr.state.oh.us.

Figure A

Generalized Geology Near the Redbird #4 Injection Well



August 25, 2020

RESOURCE
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Ladies and Gentlemen,

RE: Brine Intrusion in Several Washington County Producing Gas Wells, Potentially from Brine Disposal Operations at the Redbird #4 location

CONCLUSIONS

1. Brine injected in the Redbird #4 well into the Ohio Shale through perforations at 3676 to 4040 feet is the source of the water which has appeared in a number of shallow Berea producing gas wells north east of the Redbird well.

2. The bottom of the Berea in the Redbird well is recorded to be 1860 feet, 1816 feet above the top Ohio Shale perforation. Injection pressures are sufficiently high that both the hydrostatic head to the Berea and the frictional pressure loss to producing gas wells is possible in a fracture.

3. Water analyses for anions, cations, and Total Dissolved Solids ("TDS") from the producing wells indicate the water source is the brine injected at the Redbird #4 and no other reservoirs. Water quality is additionally altered by the transit through the fractures and contact with the marine deposited Ohio Shale.

4. The brine is transported through existing natural fractures, which provide a linear flow path and low-pressure resistance to water injected during the Redbird #4 disposal operations. The orientation of the fractures is approximately N79E from the Redbird well.

5. The natural fractures have low water storage capacity and demonstrate low backpressure to injection. Thus, once brine injection ceased at the Redbird #4 Well into the Ohio shale and stopped recharging the fractures, water production at the producing gas wells is expected to decrease and gas production will return to historic rates.

6. Further, due to the low volume of injected brine, the production of water at the gas wells, and the high porosity of the Berea Sand, it is unlikely that brine intrusion will occur in aquifers shallower than the Berea. Also, the over-lying strata is constraining upwards migration.

HISTORY

During the latter half of 2019, significant water production from producing Berea gas wells, which had historically produced little or minimal water, was reported to Ohio Department of Natural Resources ("ODNR"). Further it was posited by the gas well operators that the source of the new produced water may have been the Redbird #4 injection water. This observation was based on the absence of water production until shortly after injection began at the Redbird #4 well. The wells were producing from the Berea sandstone at approximately 2000 feet above the top perforations in the Redbird #4 and are located one to more than five miles from the Redbird well.

Water samples were collected from some of the gas producing wells and certain fresh water source wells IN Washington County and analyzed for common cations and anions. This data is presented in Appendix B. Water analyses for each well including, the injection sites at the Redbird #4 and the Flowers, were provided by the Ohio Department of Natural Resources ("ODNR").

Figure 1 and 2 in Appendix A are maps presenting the location of the Redbird #4 and the surrounding wells lying to the east of the well. Figure 1 includes the distance from the Redbird #4 to each well and values of concentrations of TDS and chlorides. Figure 2 is a heat map of the same data plotted with iso-concentration contours. The lighter colored areas indicate high TDS and chloride concentration, the darker areas indicate low concentrations.

The significance of the heat map is that a strong grouping of wells lying approximately N79E of the Redbird well all show both high TDS and chloride very similar to the reported injection water at the Redbird well. Further, several wells not on the N79E trend, show significantly lower TDS and chloride, the darker areas of the heat map Figure 2, than the Redbird and the on-trend wells. This is a strong indication of a direct connection between the Redbird and the indicated producing wells.

A second indication of the direct connection between the on-trend wells and the Redbird #4 is the observation provided by the gas producers that little water in their wells was produced until the injection operation started.

Data regarding the potential water to be sourced from the Big Injun Sandstone largely indicates the water is not sourced from this reservoir. The reservoir is a high porosity and permeability reservoir which in certain areas produces brine. The casing and tubing design used in the Redbird #4 well indicate the water cannot sourced from the Big Injun. Further, if the Big Injun is the water source at the gas wells, more water would be produced than has been reported.

The conclusion reached from this data and analysis is the source of the water is the Redbird #4 and moved from the well to the producing wells in a linear feature, likely an in-situ fracture, with a N79E trend.

SOURCE OF PRODUCED BRINE

Brine injection in the Redbird #4 well, SW/SW section 24, Washington County Ohio, was started November 10, 2018 through perforations into a thick interval of the Ohio shale between 3676 feet to 4070 feet. The first day injection volume was 10,052 barrels at an average rate of 418 barrels brine per hour. Injection operations into the Ohio Shale at the Redbird #4 ceased December 5, 2019 after approximately 4.2 million cumulative barrels of brine were injected. The source of the injected brine was wastewater from various well site operations in Ohio and adjacent states.

"The primary dissolved components of oilfield brines, sodium and chloride, are present in virtually all groundwater to some extent, due to the interaction of the water with the soil and rock matrices through which it flows. Contact with geologic materials such as evaporite minerals can result in groundwater with naturally high concentrations of total dissolved solids ("TDS"), including chloride among other ions, especially in arid and semi-arid regions." (Lee et.al. ref. 2).

Once the brine is injected and forced to flow along the fractures, the brine reacts with the rock material and is altered by the minerals within the rock. When water is injected into a marine environment deposited rock, as is the Ohio Shale, the water typically becomes more saline than static water in the same formation. Due to the movement along the fracture, the brine will further pick up additional TDS from erosion of the fracture face.

These processes have been extensively studied and reported, especially for oil field brines. Hem (ref 1) has extensive discussion on liquid-solid interfaces and geologic effects with references to the processes of ionic exchange and erosional effects. Lee (ref 2) presented similar information except his studies related to changes in rocks caused by exposure to oilfield brines, the reverse direction of changes, but both processes and conclusions are the same. It is fully expected that the brine injected at the Redbird #4 will increase in TDS from erosion and increase both calcium and sodium concentrations from ionic exchange processes. Water produced from the fracture will thus consistently demonstrate higher concentrations of the dissolved components as observed in the producing well water samples.

Although the brine was collected from different sites and different dates, the water tests of the brine sampled from the Redbird facility and the producing on-trend gas wells show consistently higher Total Dissolved Solids ("TDS"), Calcium ("Ca"), and Sodium ("Na") concentrations than nearby wells not affected by the brine injection. This can be easily seen in Figures 3 and 4b, the Schoeller and Stiff diagrams respectively.

It was necessary to develop a method of presenting tabular data as easily observable graphics to allow plotting and mapping water quality changes. This need was addressed by three primary techniques, Stiff diagrams (ref 6), Schoeller diagrams (ref 5) and Piper diagrams (ref 4). Each of these techniques, and many variations of each, allow relatively easy visualization of water quality properties and differences between different water sources.

"Stiff diagrams graphically illustrate the relative abundance of major ions, creating polygons with distinctive shapes. Cation and anion concentration are first converted from mg/l to milliequivalents per liter (meg/L) to account for differences in the concentrations of different ions and are then plotted on horizontal axis, with cations to the left of the zero point, anions to the right ***. This arrangement reflects potential or expected mineralogical source of each of these dissolved ions in groundwater. The points are then connected to form a polygon, the size and shape of which visually indicates the total ionic concentrations and relative importance of the individual ionic species." (Lee et al, ref 2)

Additional discussion of these diagrams can be found in Hem (ref 1) and Ohio (ref 3).

The Stiff diagrams for the Redbird #4 (colored red), the off-trend producing wells (colored green), and the on-trend producing wells (colored blue) are presented in Figures 4a and 4b. Note the shape of the polygons for the Redbird and on-trend wells are similar and distinctly different than the off-trend wells. This observation strongly indicates the water at the on-trend wells and the injection well are from the same source, while the off-trend wells indicate a different source, likely in-situ water.

Schoeller (ref 5) created a different visual presentation which allows a more quantitative comparison of waters from different sources. His method has been extensively modified for various purposes, but all modifications allow quick examination of several waters Hem (ref 1) and Ohio (ref 3). Figure 3 presents two versions of the Schoeller diagrams for the water samples studied. The upper diagram has a separate line for each producing well and the Redbird #4. The waters for the on-trend wells all lie above the injected water of the Redbird #4 indicating these waters have higher salinity than the Redbird #4. Review of the water tests included in Appendix B also shows TDS in their producing wells is consistently higher than at the Redbird #4. This is consistent with the ionic and geologic exposure of the injected water to the Ohio shale. Further, the water samples for the off-trend wells is consistently lower indicating a different source water.

The bottom Schoeller diagram in Figure 3 presents the average values of cations and ions for the Redbird #4 and on-trend wells with the average for the off-trend wells.

Closer analyses of the Schoeller plots presented in Figure 3 show that calcium and sodium concentrations in the brine and the producing on-trend wells are approximately twice the concentrations of off-trend wells near the Redbird #4. Similarly, TDS is higher in both the injected water and the on-trend wells. Both the similarity between the injection water and the on-trend wells as well as the dissimilarity between the injection water and the off-trend wells indicate the water source is the Redbird #4 well.

One last observation, supported by little directly-measured data but strongly suggested by the ionic and erosional factors of water moving in a fracture, is water would require a certain amount of transient time from day of injection to appearance at the producing wells. The date of first appearance of water and related volume of water is insufficient to identify this time precisely. However, the Hall plot, to be presented later provides certainty that the first produced water appeared in April to May 2019, after approximately 1.6 million barrels of brine had been injected into the Redbird.

FRACTURE DYNAMICS AND VOLUMETRICS

A fracture, as used in this study is a vertical crack, or a series of parallel cracks known as a swarm. A fracture, and in the extreme case a fault with movement alone the fracture plane, can be caused by both natural causes and manmade hydraulic fracturing technology. The fractures in this study are likely naturally occurring as the Redbird #4 well was not hydraulically fractured. Fracture shapes are very thin widths, often less than 0.05 inch, and typically great height and length measured in feet. (Carey et al, ref 17). Fractures deeper than approximately 500 feet will be vertical or near vertical and can extend for several miles. The width of at fracture can vary along the length of the fracture from 0.001 inch to 0.1 inches. Effective permeability of fractures ranges from .05 milliDarcies to several Darcies (National Research Council, ref 18).

A notable feature of a fracture is that the volume of the fracture is typically small due to the fracture width. If the fracture is in a non-permeable reservoir and fluid is injected into the fracture and no fluid flows from the fracture into the reservoir, the fluid can travel considerable distances, often miles, along the length of the fracture relatively quickly. Assuming the reservoir has permeability, the fluid injected into a fracture will enter the reservoir and travel much shorter distances along the fracture length. The Ohio Shale is an extremely low permeability reservoir and water will enter the matrix of the reservoir only under high pressures (Abel, ref 8, Knutson et al ref 9, Knuuskraa et al, ref 10).

Reported permeability of the Ohio Shale ranges from 1.0 microDarcy to 0.1 milliDarcy (Soeder, ref 11). Using these permeabilities, an estimate of fracture height and length, and the maximum reported 900 psi well head pressure, approximately 1500 psi at the fracture face, some of the injected volume of water will enter the matrix, the remaining volume moving along the fracture.

When a fluid is pumped into a fracture, the pressure may force the width of the fracture to increase slightly and reduce the resistance to flow down the fracture. In extreme cases, both the height and length of the fracture increase as a result. Although the faces of the fracture are rough, the width and height of the fracture creates little resistance to water flowing along the fracture face. (Bybee ref 13, and Carlsson et al ref 14). Thus, little pressure is lost along the length of a fracture and the pressure at any point is near the pressure at the injection point.

No data is available to calculate the pressure at the tip of the fracture near the producing gas wells. However making an arbitrary assumption that the frictional pressure lost along the fracture is 1000 psi, two-thirds of the maximum injection pressure and much higher than realistic, sufficient pressure remains to support a hydrostatic head and allow water to enter the Berea Formation.

An additional consideration is the plastic nature of the rock material in which the rock will weaken with exposure to repetitive cycles of high and low pressure. During this process other rock properties permanently change. As the rock weakens, it is more prone to break along the fracture axis. Should this occur, fluids travelling down the fracture may encounter lower friction losses and travel further.

MEASURING RESERVOIR RESPONSE

Well head injection pressures were recorded at the Redbird #4, often at 15 second intervals. Daily injection volumes were also provided. The pressure data is quite accurate and consistently recorded. This provides a solid view of the injection well pressure performance. Figures 5 through 9 present portions of the pressure data with daily injection volumes. Attempts to convert daily injection volumes to injection rates using the pressure data and time were unsuccessful. Absent the production rate, much of the technology to evaluate the reservoir and fracture performance cannot be used.

However, the pressure data shows that the initial injection pressure was generally about 450 psi. Beginning May 2019, the pressure increased to periods of 850 psi, typically in response to higher injection rates.

The gradual pressure increases in both the low-pressure time prior to May and the higher pressures post May are likely indications that the fractures and matrix are filling and presents higher resistance to additional injection. This is often observed in similar situations. It is noted that there are four periods of high injection rates, indicated by the yellow ovals around the pressure trace, Figure 5. These periods were determined to have a significant correlation with changes in reservoir performance.

Figures 6 to 9 present detailed and short time slices for each of these periods. The upper graph on Figure 7, August 1 to August 11, 2019 shows typical performance of well head pressure increases at higher injection volume, and lower at lower volumes. However, the rapid pressure fluctuations between 600 psi and 800 psi have no apparent explanation but appear consistently.

In 1963, a working engineer, posted a one-page article in World Oil with a simplified method to monitor water injectivity in a water flood reservoir. These are now known as Hall Plots. He was confronted with the need to optimize water flood performance in the absence of data. No theory was included. The original article gathered attention as often sophisticated data is not available. Since that time his method has evolved to allow evaluation of many reservoirs that have injection, production,

and cross-flow from other reservoirs (Fekete, (ref 19), Advantek, (ref 20), Hall (ref 21), and Mihcakan, ref 22). It uses deflections from an initial straight line to indicate changes in reservoir behavior.

No modification to the original method was required to adapt the method to the Redbird #4 and its fracture reservoir. The primary use of a Hall plot is to allow reservoir analysis when there is a lack of both accurate injection rate at the injection site and absence of water production volumes, rates, and pressures at the producing wells.

The Hall plot, Figure 5, presents the relationship between cumulative water injection volume and a simple function of injection pressure. Both the injection volume and injection pressure are available and accurate. In the Ohio Shale fracture reservoir, volume is approximately equal to the volume of the fractures. This characteristic is useful in examining the relationship between fluid injected and the reservoir volume into which the fluid is being injected.

A reservoir with unchanging volume and no fluid withdrawal will present as a straight line once the reservoir attains some stability. This is represented by dotted black line in Figure 5. Note at 1.6 million barrels of fluid, May 2019, the data deviates from the initial trend, indicating either the reservoir is increasing in size or, fluid is being withdrawn, effectively increasing the size of the reservoir. This reoccurs at 2.4 million barrels, August 2019, 2.8 million barrels, September 2019, and finally 3.8 million barrels, November 2018. Each of these inflection points indicate a change in reservoir producing dynamics. The downward deflection followed by a straight line of the same slope as the initial data indicates either, or both, that the reservoir is increasing in size or fluid is being withdrawn from the system.

The fracture size could increase due to extension of the fracture length, height, or width. Since the Hall plot deflections occur at periods of high pressure, the fracture could be increasing in size. However, water production at the producing wells was originally observed shortly after the first deflection and high-pressure period.

The pressure and rate plot shown in Figure 5 provides some insight to the operations at the Redbird well. At each inflection point in the Hall plot there are measured peaks in both pressure and injection rate. This is not likely a coincidence that the Hall plot deflections occur at these time periods. Further, close examination of the pressure data shows the highest pressure is increasing with each time period. Figure 5 presents the correlation between high pressure periods and Hall plot deflections.

These four time-slice Figures present an interesting glimpse of operations just prior to the Redbird #4 injection stopped into the Ohio Shale. During each time period the pressures are fluctuating between

500 and approximately 800 psi at essentially constant rates. This surging is potentially damaging to the fracture strength as discussed earlier.

However, a more interesting observation is the typical maximum pressure increases from less than 800 psi in May to greater than 850 psi in November. This is an indication that the volume of fluid injected is greater than the fracture volume plus water being withdrawn at the producing wells.

Our conclusions based on the data and water analyses is the water injected at Redbird #4 moved down a small fracture system and encountered a group of producing gas wells. The appearance of the water at the producing wells is merely the indication that injected water in the fracture encountered the wells.

PROJECTED FUTURE FAULT-RESERVOIR PERFORMANCE

Injection has ceased at the Redbird #4 well and no additional water influx is observed in the Hall plot. Thus, the water in the fault-reservoir will essentially deplete as the wells produce and water volume will decrease. This should be a relatively quick process as only the 800 psi injection pressure was moving water through the system. A rough maximum estimate is there will be no water production once approximately 2 million barrels of water is produced from the Ohio Shale fracture system, the difference between the cumulative injection volume and the volume at first appearance of water in May 2019.

This can be easily monitored by obtaining monthly water estimates for the on-trend wells, static fluid levels in affected wells, and quarterly water tests of TDS and chlorides. Each of these should decrease as the brine stops movement.

One additional suggestion from the ODNR office is to produce a Berea well located near the Redbird #4 which has shown a recent well head pressure and water at the surface. As mentioned earlier, the injection pressures at the Redbird well were insufficient to overcome the static water column at the well.

Production of water at this site should rapidly decrease water production at the producing gas wells. High TDS and chlorides in water tests will confirm the water source is the Redbird injection fluid and plotting on the Schoeller and Stiff plots.

Once water movement is arrested and the amount of water storage in the porosity of the Berea is produced. It is expected that gas production rates will return to those prior to the appearance of the water.

POSSIBILITY THAT BRINE CAN ENTER ADDITIONAL RESERVOIRS

The potential that the brine could move into additional reservoirs, particularly reservoirs above the Berea is highly unlikely. The water injection has ceased into the Ohio Shale and the relationship between fracture reservoir volume, including Berea porosity and producing wells, has been stabilized.

If assuming the fracture extended vertically through the Berea into a shallower interval, the pressure and porosity of the Berea would prevent brine moving higher.

Sincerely,

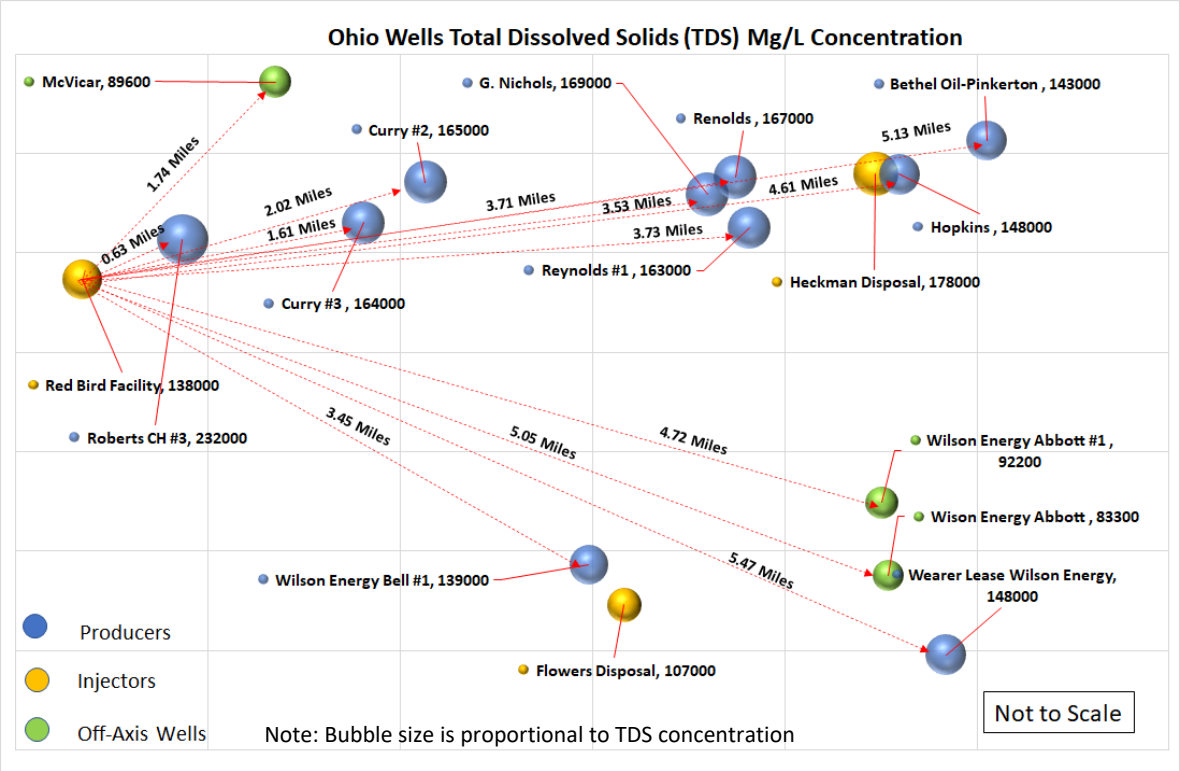
Resource Services International, Inc.

Resource Services International
Roland Blauer
Petroleum Engineer

Naing Aye
Petroleum Engineer

APPENDIX A

Ohio Impacted Wells Total Dissolved Solids (TDS) mg/L Concentration



Ohio Impacted Wells Chloride mg/L Concentration

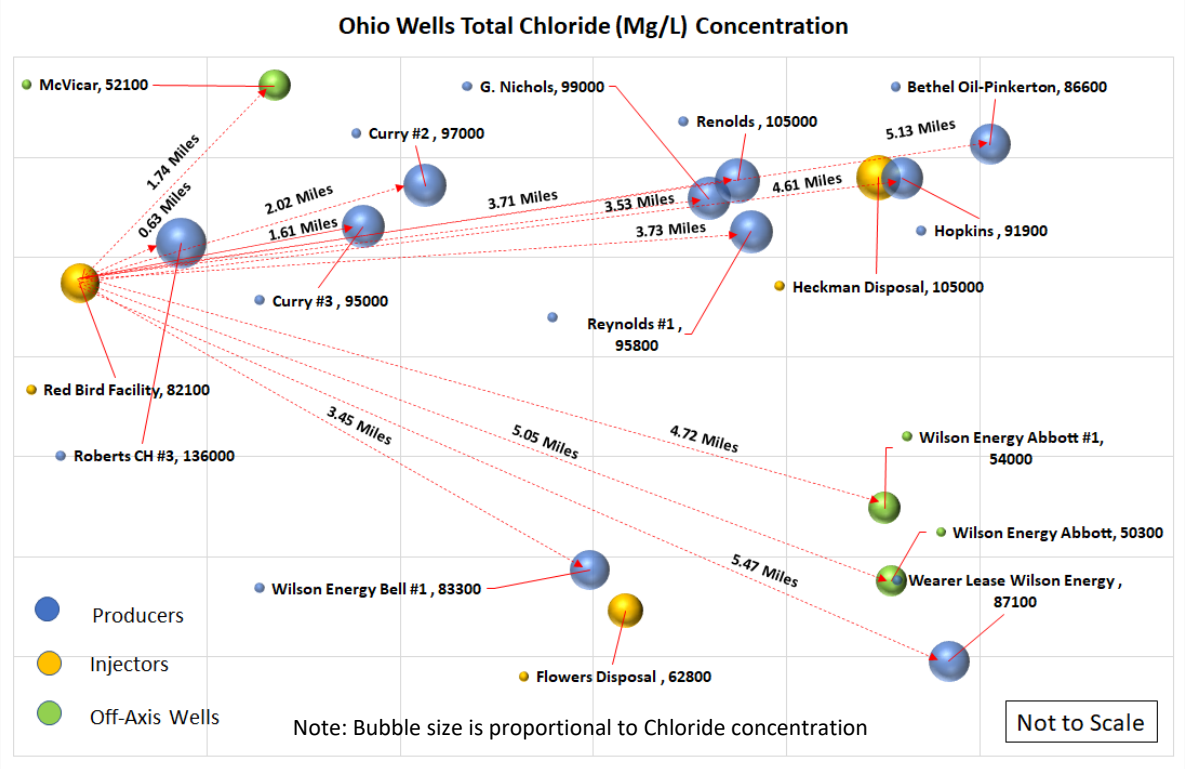


Figure 1

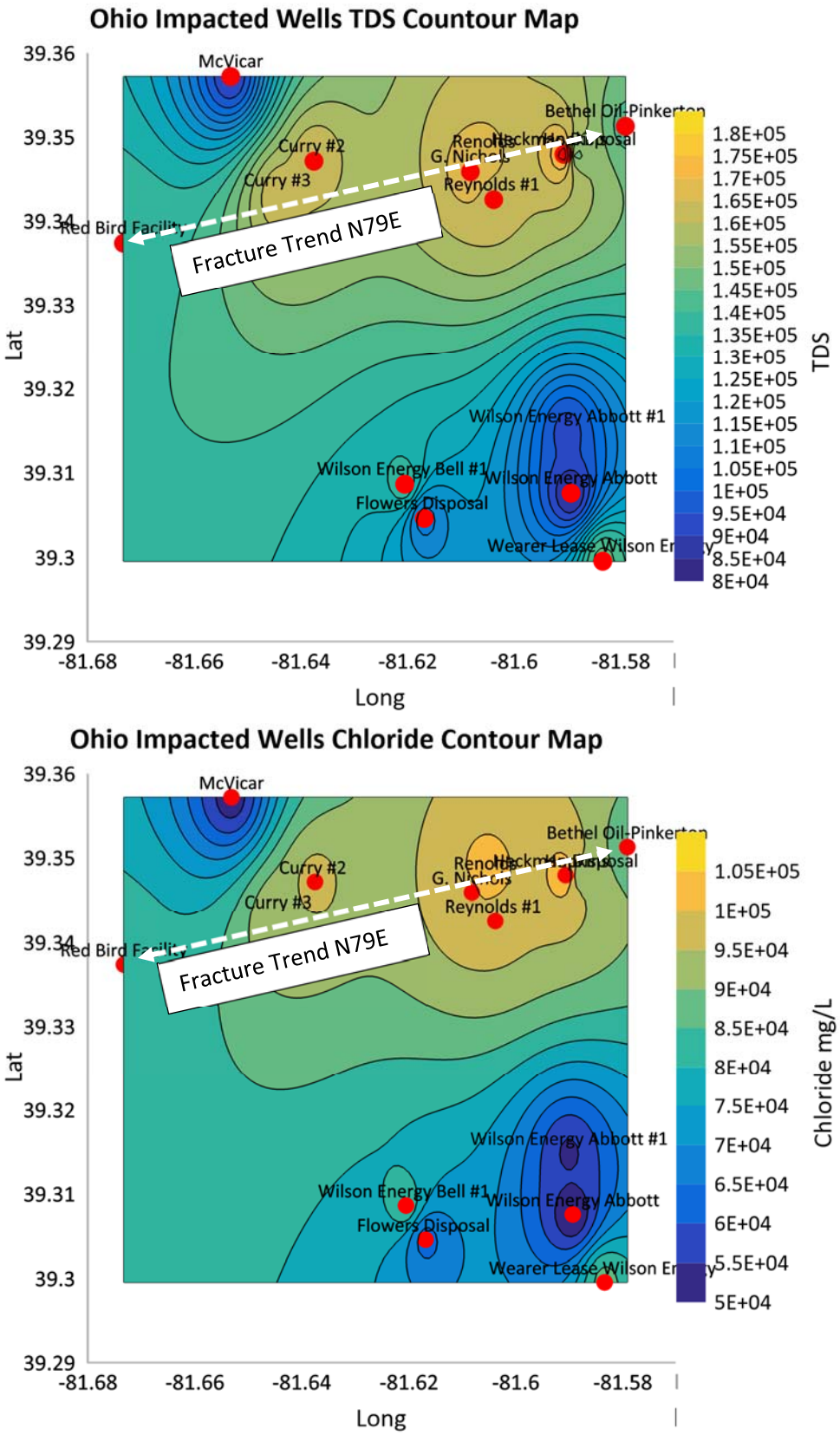
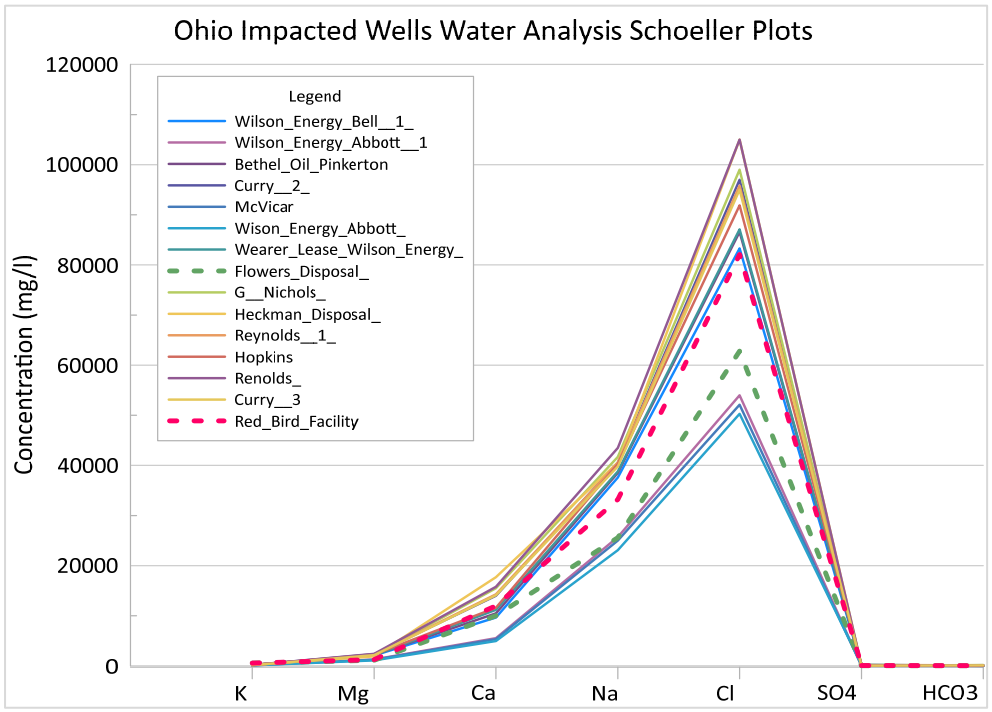

Ohio Impacted Wells TDS Countour Map
McVicar
Bethel Oil-Pinkerton
Curry #2
Curry #3
G. Nichols
Reynolds #1
Red Bird Facility
Fracture Trend N79E
Wilson Energy Abbott #1
Wilson Energy Bell #1
Wilson Energy Abbott
Flowers Disposal
Wearer Lease Wilson Energy
39.36
39.35
39.34
39.33
39.32
39.31
39.3
39.29
Lat
-81.68
-81.66
-81.64
-81.62
-81.6
-81.58
Long
1.8E+05
1.75E+05
1.7E+05
1.65E+05
1.6E+05
1.55E+05
1.5E+05
1.45E+05
1.4E+05
1.35E+05
1.3E+05
1.25E+05
1.2E+05
1.15E+05
1.1E+05
1.05E+05
1E+05
9.5E+04
9E+04
8.5E+04
8E+04
TDS
Ohio Impacted Wells Chloride Contour Map
McVicar
Bethel Oil-Pinkerton
Curry #2
Curry #3
Reynolds #1
Red Bird Facility
Fracture Trend N79E
Wilson Energy Abbott #1
Wilson Energy Bell #1
Wilson Energy Abbott
Flowers Disposal
Wearer Lease Wilson Energy
39.36
39.35
39.34
39.33
39.32
39.31
39.3
39.29
Lat
-81.68
-81.66
-81.64
-81.62
-81.6
-81.58
Long
1.05E+05
1E+05
9.5E+04
9E+04
8.5E+04
8E+04
7.5E+04
7E+04
6.5E+04
6E+04
5.5E+04
5E+04
Chloride mg/L

Figure 2

Ohio Impacted Wells Water Analysis Schoeller Plot



Ohio Impacted Wells On-Axis and Off-Axis Average Value

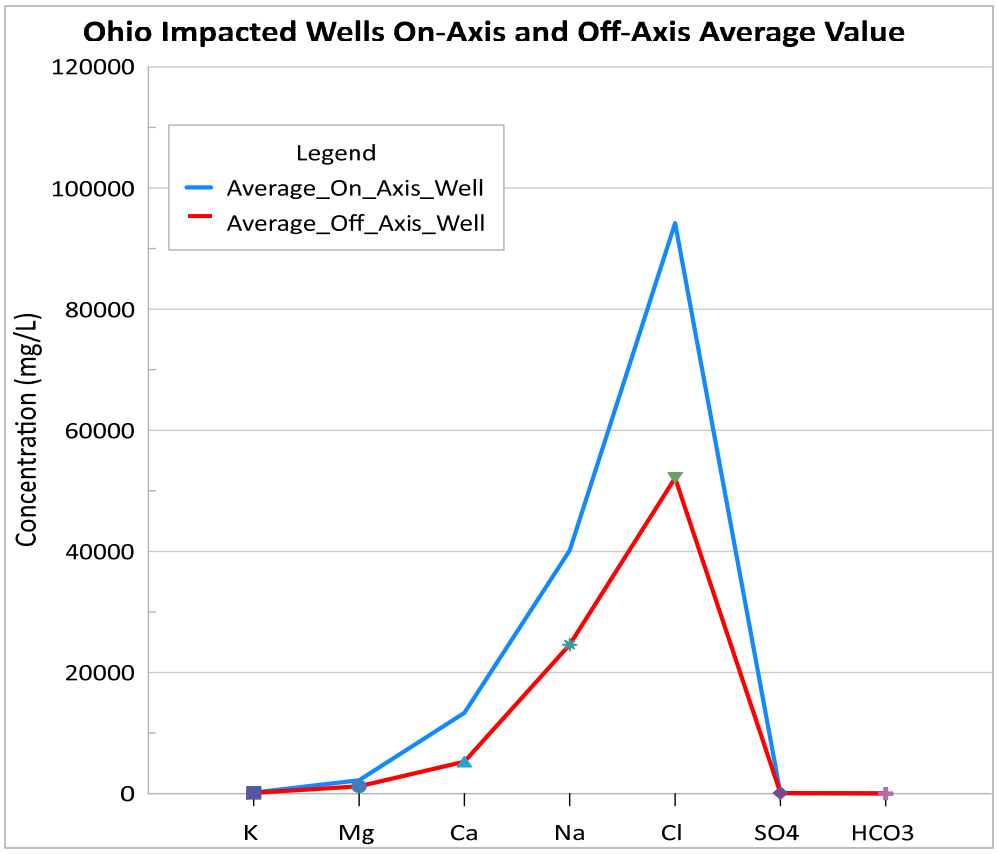


Figure 3

Ohio Impacted On-Axis Wells High Stiff Diagram

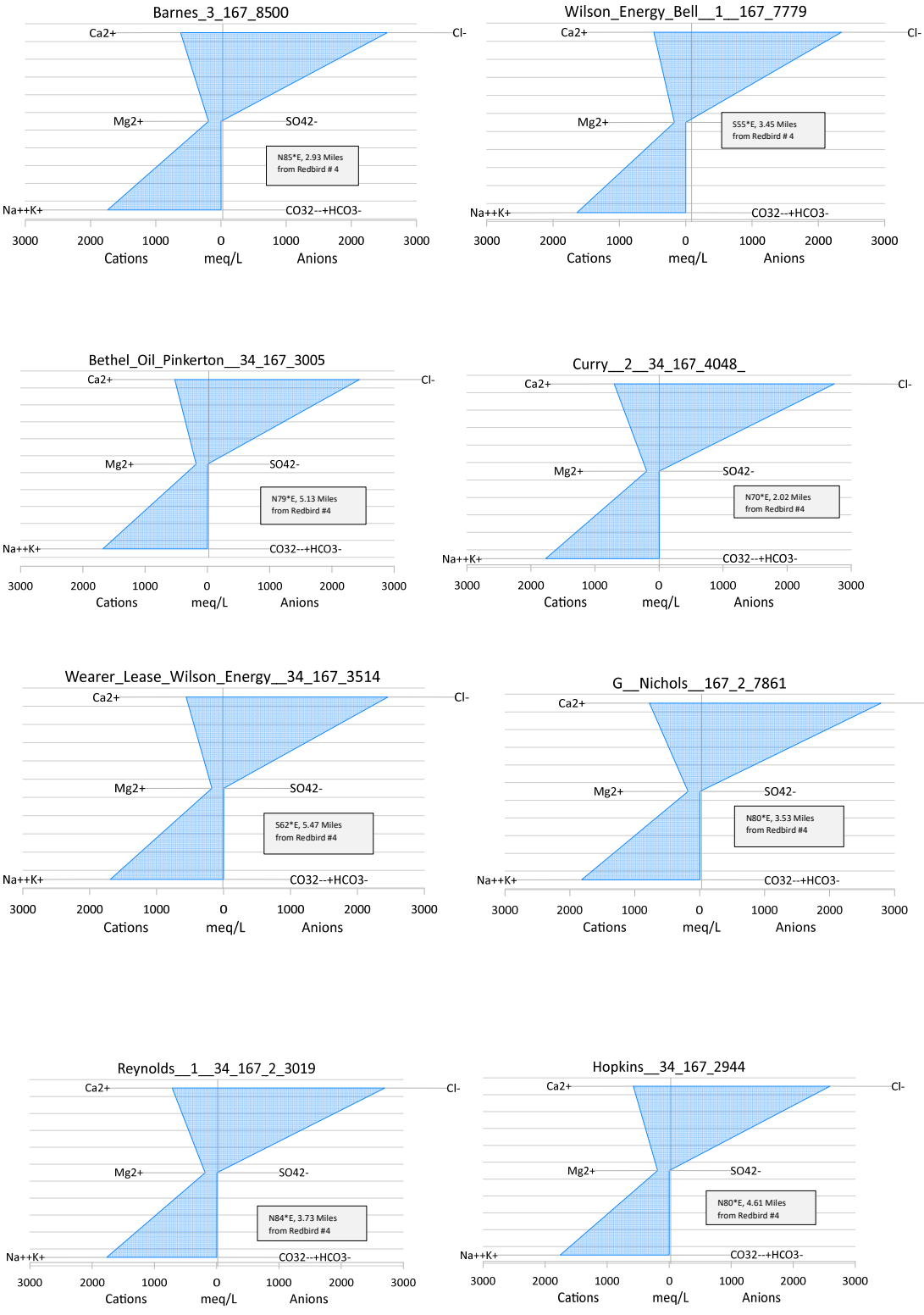
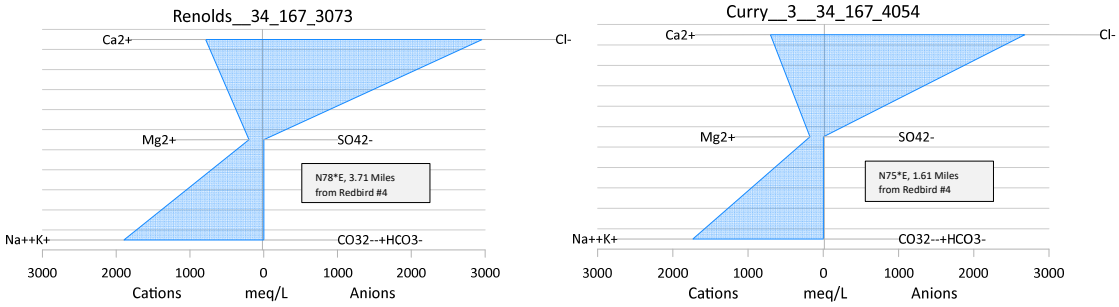
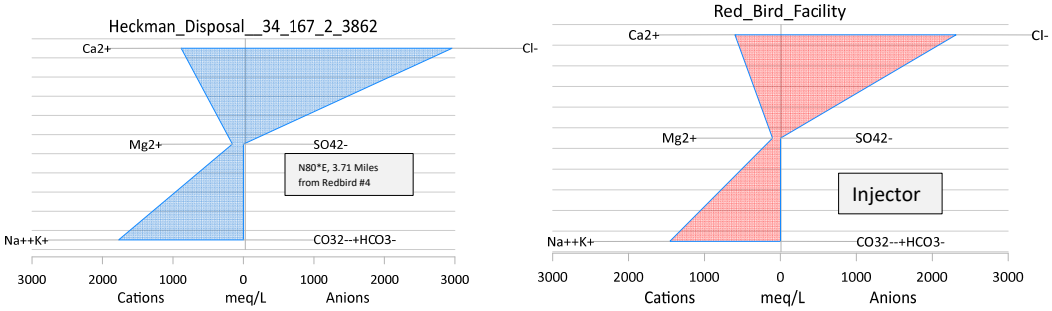
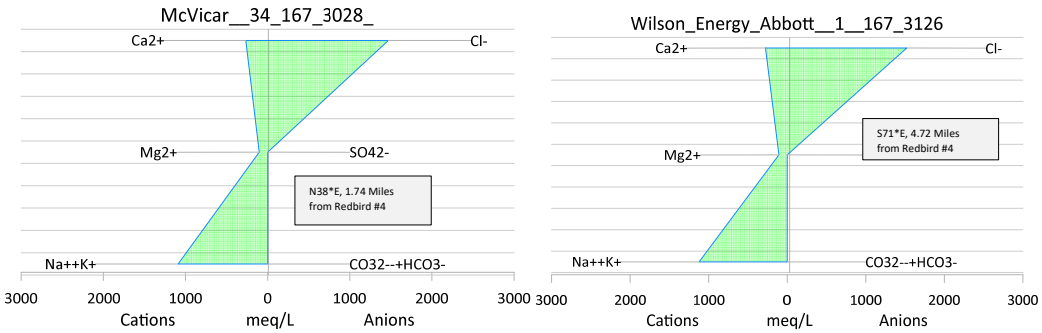


Figure 4a





Ohio Impacted Off-Axis Wells Stiff Diagram



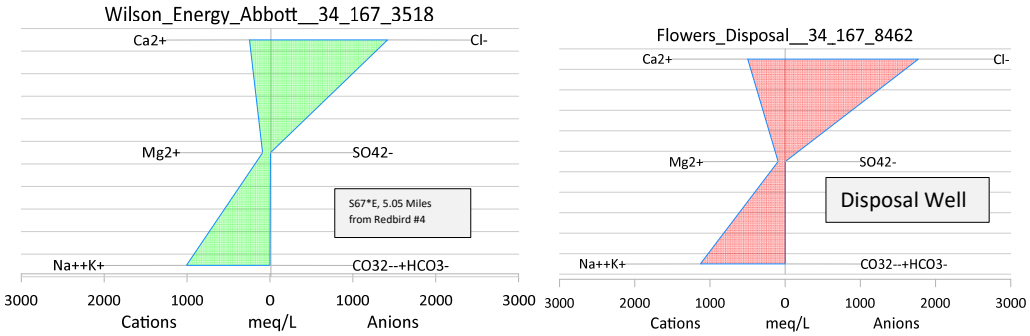
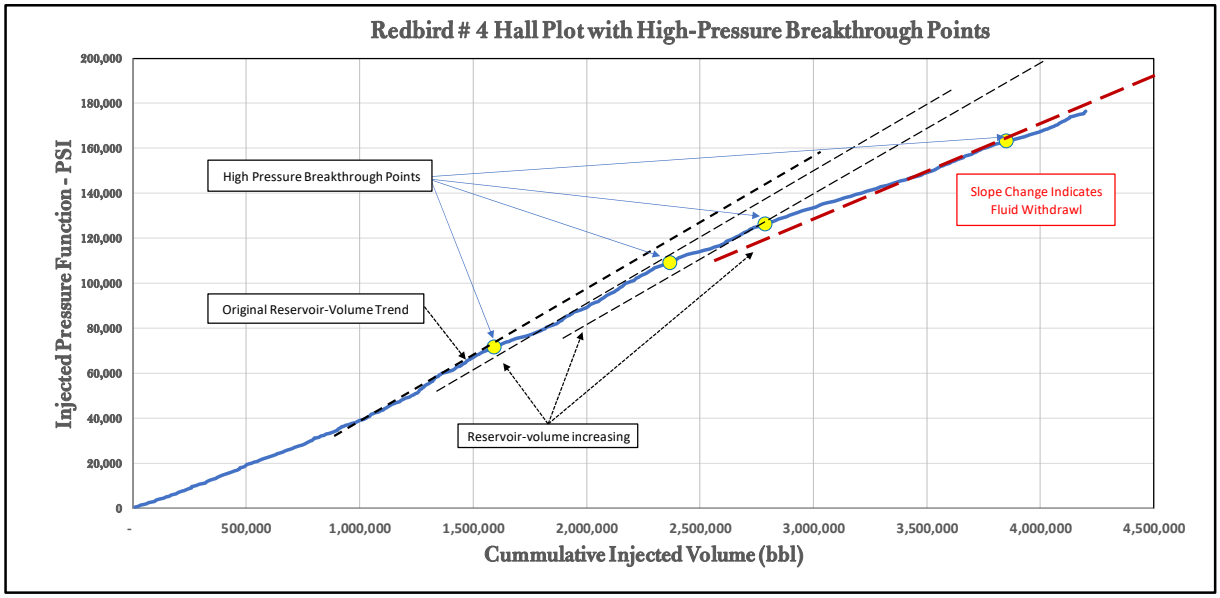


Figure 4b


Redbird # 4 Hall Plot with High-Pressure Breakthrough Points
Injected Pressure Function - PSI
Cummulative Injected Volume (bbl)
High Pressure Breakthrough Points
Original Reservoir-Volume Trend
Reservoir-volume increasing
Slope Change Indicates Fluid Withdrawl
200,000
180,000
160,000
140,000
120,000
100,000
80,000
60,000
40,000
20,000
0
-
500,000
1,000,000
1,500,000
2,000,000
2,500,000
3,000,000
3,500,000
4,000,000
4,500,000

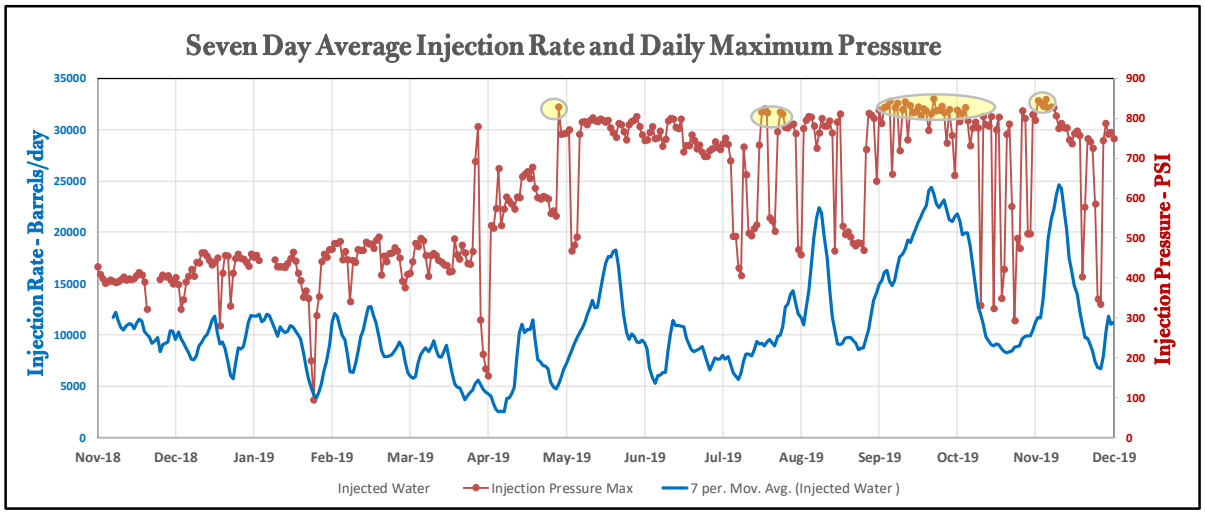
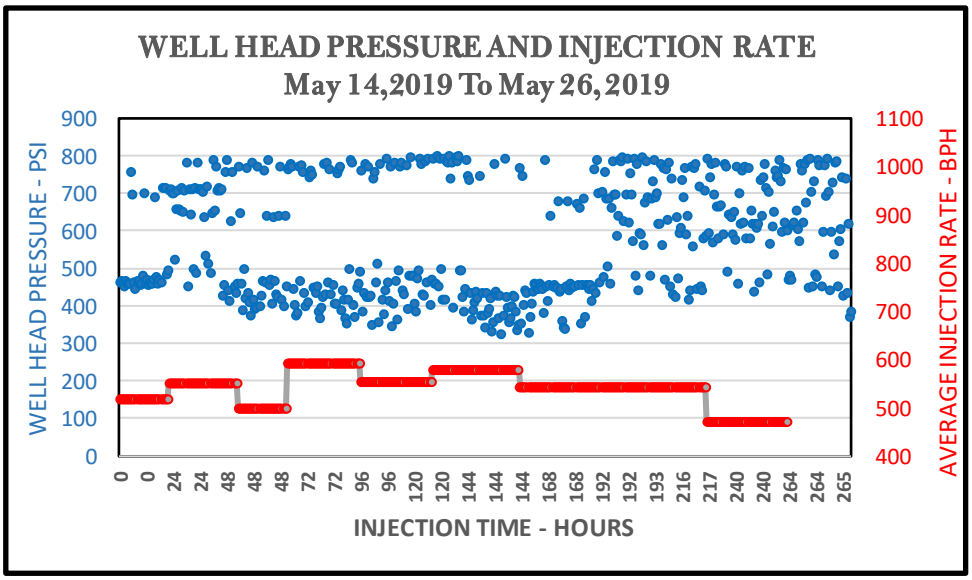

Seven Day Average Injection Rate and Daily Maximum Pressure
Injection Rate - Barrels/day
Injection Pressure - PSI
35000
30000
25000
20000
15000
10000
5000
0
900
800
700
600
500
400
300
200
100
0
Nov-18
Dec-18
Jan-19
Feb-19
Mar-19
Apr-19
May-19
Jun-19
Jul-19
Aug-19
Sep-19
Oct-19
Nov-19
Dec-19
Injected Water
Injection Pressure Max
7 per. Mov. Avg. (Injected Water)

Figure 5


WELL HEAD PRESSURE AND INJECTION RATE
May 14,2019 To May 26,2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

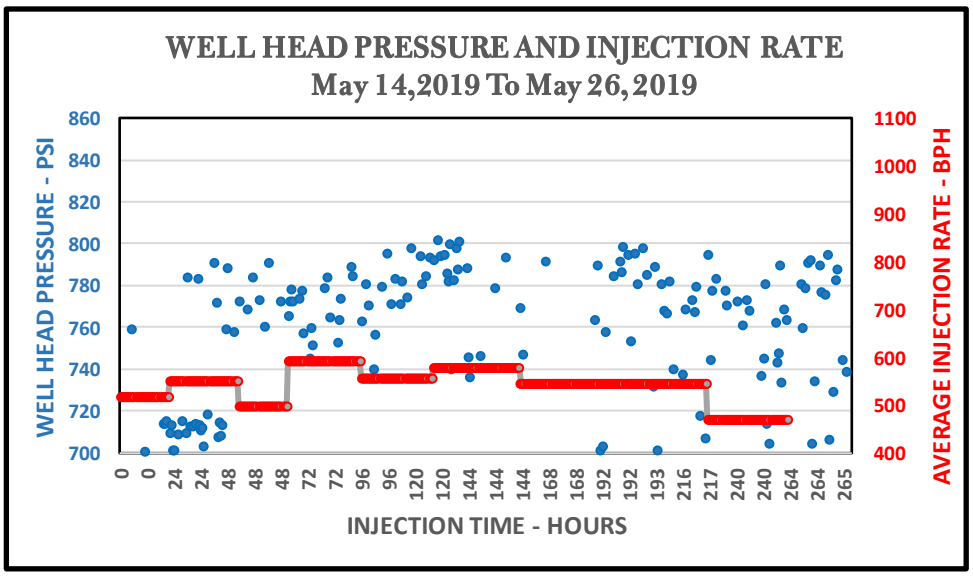
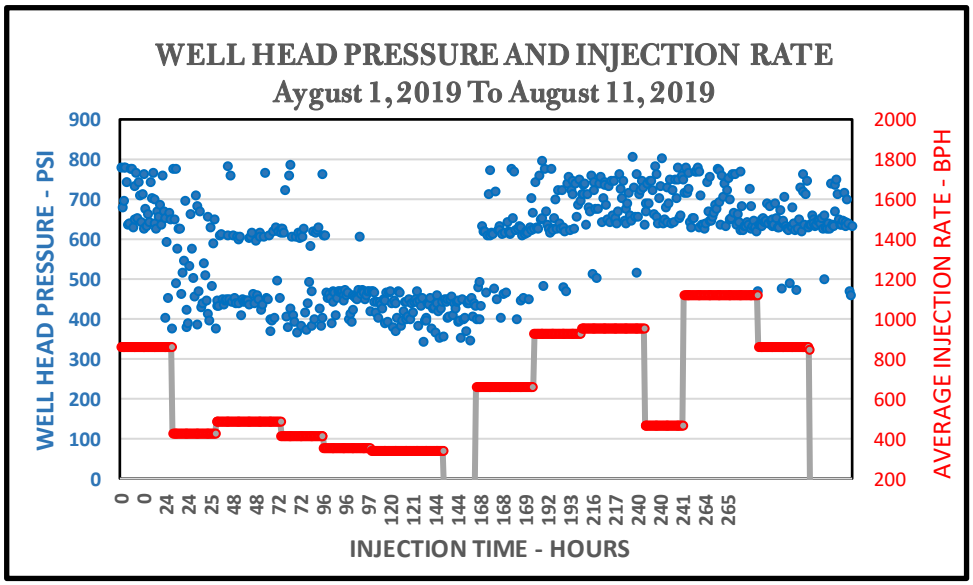

WELL HEAD PRESSURE AND INJECTION RATE
May 14,2019 To May 26,2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

Figure 6


WELL HEAD PRESSURE AND INJECTION RATE
Aygust 1, 2019 To August 11, 2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

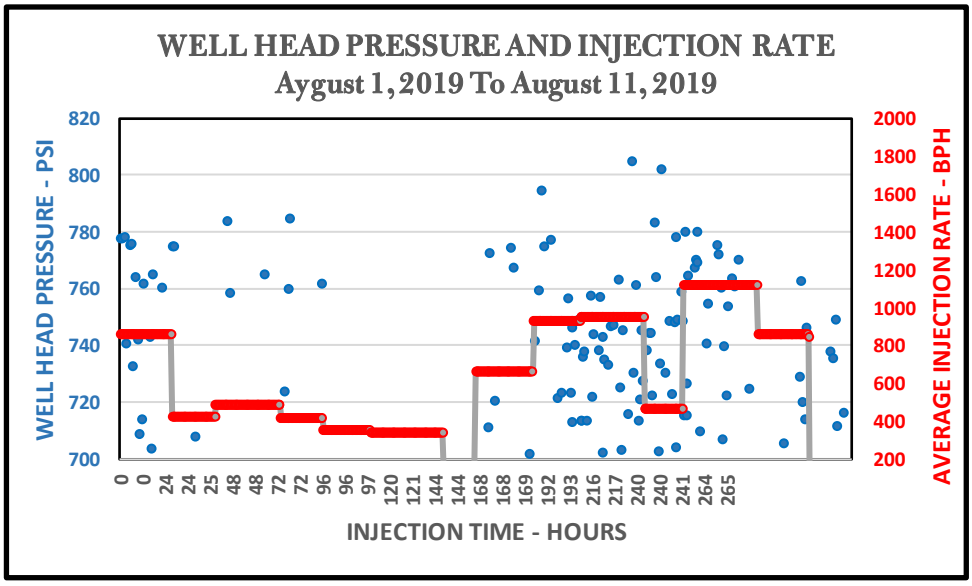
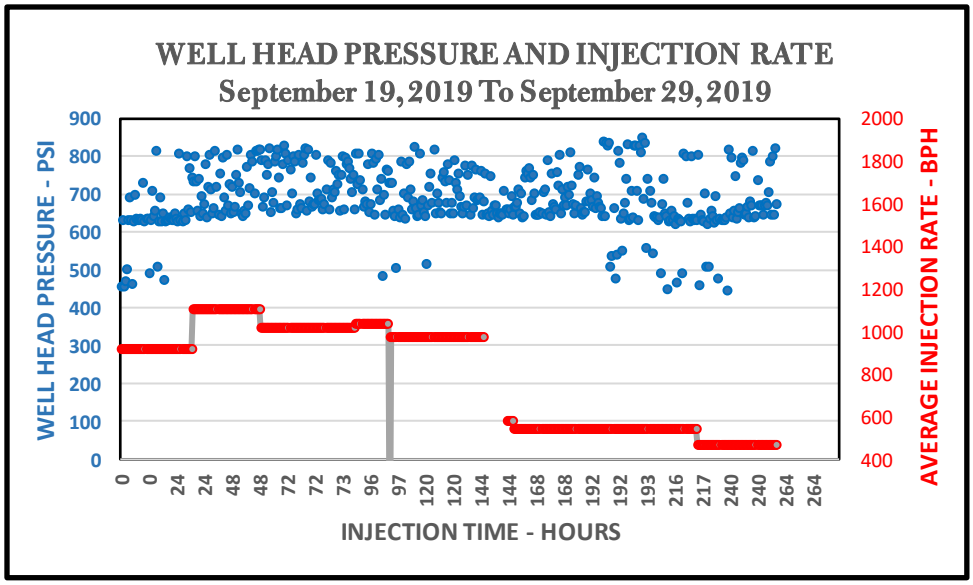

WELL HEAD PRESSURE AND INJECTION RATE
Aygust 1, 2019 To August 11, 2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

Figure 7


WELL HEAD PRESSURE AND INJECTION RATE
September 19, 2019 To September 29, 2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

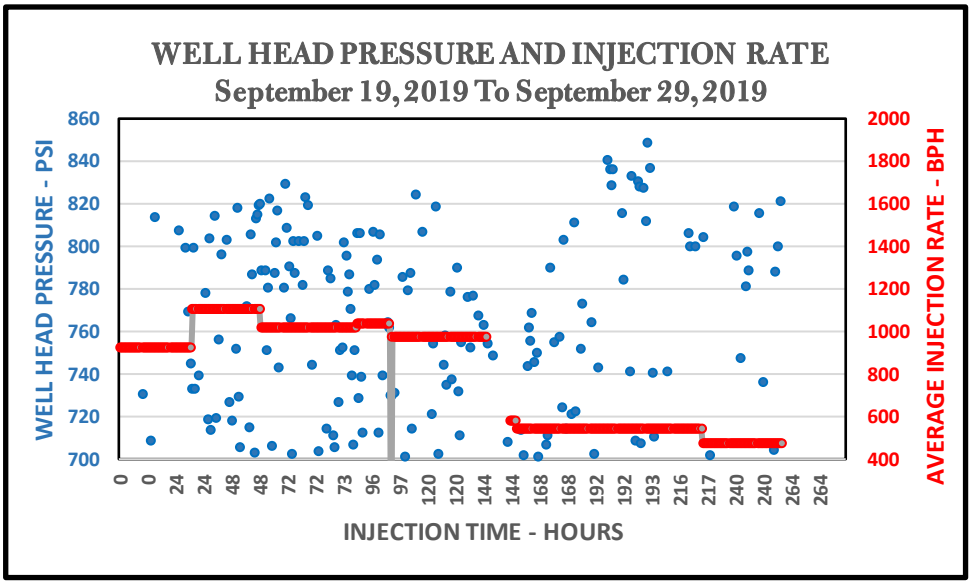
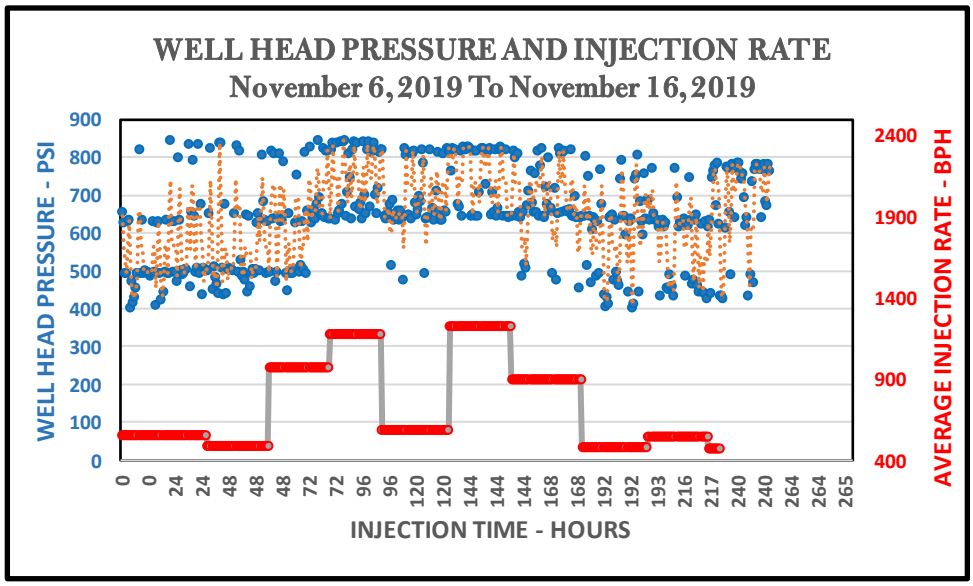

WELL HEAD PRESSURE AND INJECTION RATE
September 19, 2019 To September 29, 2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

Figure 8


WELL HEAD PRESSURE AND INJECTION RATE
November 6, 2019 To November 16, 2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

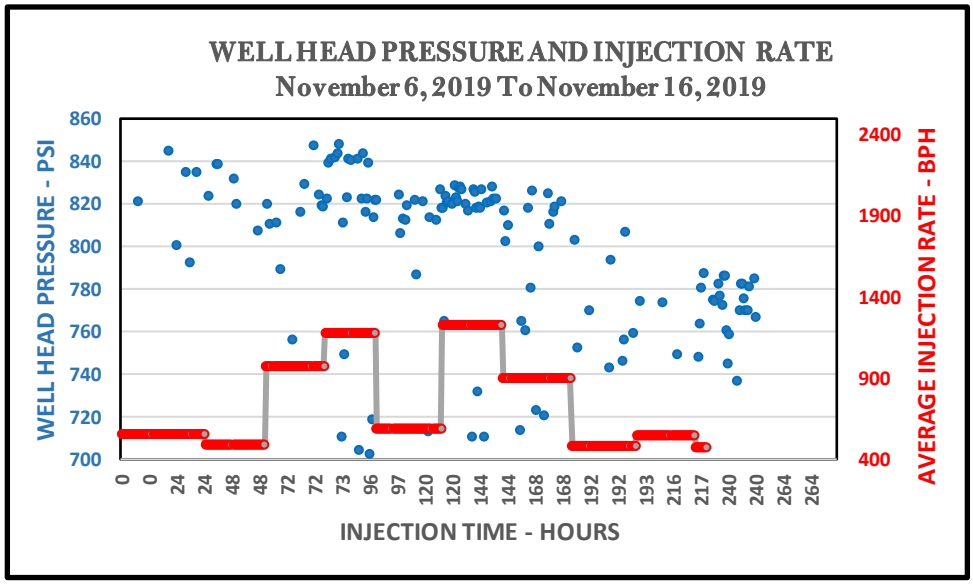

WELL HEAD PRESSURE AND INJECTION RATE
November 6, 2019 To November 16, 2019
WELL HEAD PRESSURE - PSI
AVERAGE INJECTION RATE - BPH
INJECTION TIME - HOURS

Figure 9

APPENDIX B

OHIO DEPARTMENT OF NATURAL RESOURCES - CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD
DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present (Y) N

Sample Temperature @ Lab:
DB017 16.1°C

Division: Oil & Gas
District Office: Zanesville
Sample Numbers: DB017 To
County/Township: Denham, Washington
Site: Barnes #3
Project Name (#)/Permit (#): 167-8500

FUNDING SOURCE:
- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

Sampled By: Dave Ball
Witnessed By: Jim Webb (Optional)

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas		SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB017	6-1-20	0900	2	P	NF	W	SW	NP			X		Well Head	39.34039 081.61853

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Ball	Date: 6-3-20	Time: (Military) 9:50	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Terrell	Date: 6-3-2020	Time: (Military) 950

LAB ID: 20060301
SAMPLE NUMBER: DB017
PROJECT NAME: Barnes #3 (167-8500)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Wellhead
GROUP: OIL & GAS
DATE SAMPLED: 6/1/2020
DATE RECEIVED: 6/3/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	5.64	SU		SM4500-H^+B	DET
Specific Conductivity	248,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	164	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	102	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	102	mg $CaCO_3$/L	1.67178	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	152,000	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	340	mg/L		SM2540D	DET
Total Solids (TS)	152,340	mg/L		CALCULATED	JMM
Sulfate, Total	32.9	mg/L	0.684978	SM4500-SO4D	DET
Chloride, Total	90,500	mg/L	2553.005	SM4500-CID	DET
Calcium, Total	12,400	mg/L	618.76	SM3120B	JMM
Magnesium, Total	2330	mg/L	191.7357	SM3120B	JMM
Sodium, Total	39,900	mg/L	1735.65	SM3120B	JMM
Potassium, Total	146	mg/L	3.73468	SM3120B	JMM
Iron, Total	65.4	mg/L	3.513288	SM3120B	JMM
Manganese, Total	13.4	mg/L	0.48776	SM3120B	JMM
Aluminum, Total	12.5	mg/L	1.39	SM3120B	JMM
Hardness, Total as CaCO3	40,600	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	215,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	29.2	mg/L	0.425152	SM3120B	DET
Strontium, Total	341	mg/L	7.78503	SM3120B	JMM
Bromide, Total	831	mg/L	10.40412	SM4110B	DET

Approved By: Joan McCann

Date: 6/9/2020

LAB ID: 20060301

Total Cations (EPM)	2563.48161	**Total Anions(EPM)**	2565.765878
% Ca	24.13748543	% HCO3 + CO3	0.065157153
% Mg	7.479503627	% SO4	0.026696824
% Na + K	67.85243449	% Cl	99.50264839
% Other	0.530576461	% Other	0.41
EPM Balance	0.044534174	% OH	0
		Water Type	NaCl

Measured TDS	152,000
Calculated TDS	145,000
Measured TDS/ Calculated TDS	1.05

	RATIO		**RATIO**
		H+ Conc.	2.29087E-06
measTDS/SC	0.612903226	calc TDS/SC	0.584677419
Ca/ HCO3	370.1204704	K/ HCO3	2.233954228
Mg/ SO4	279.9151214	Mn/ Fe	0.138832911
Fe/ SO4	5.12905232	Ca/ Mg	3.227150708
Al/ Ca	0.002246428	Na/ K	464.7386121
Al/ SO4	2.029262254	Ca/ Cl	0.242365369
Na/ Cl	0.679845907	Ca/ SO4	903.3282821
Na/ SO4	2533.877	Fe/ Cl	0.001376138
K/ SO4	5.4522627	Mg/ Cl	0.075101968
Al/ Cl	0.000544456	K/ Cl	0.001462857
Mn/ Cl	0.000191053	Br/Cl	0.004075245
Mn/ SO4	0.712081264	Ba/Sr	0.054611479

SAR		RSC		ESP
Carbonate Hardness	102	Non-Carbonate Hardness		40498

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD
DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB015 11.9°C

Division: Oil + Gas

District Office: Zanesville

Sample Numbers: DB 015 To

County/Township: Dunham Washington

Site: Wilson Energy Ball #1

Project Name (#)/Permit (#): 167-7779

FUNDING SOURCE:
- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

Sampled By: Dan Ball

Witnessed By: Bob Wilson (Optional)

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group 1	Group II	Group Oil & Gas		SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB 015	5-27-20	1400	2	P	NF	W	SW	HNO3			X		weekend	39.30853 081.62070

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dan Ball	Date: 5-29-20	Time: (Military) 9:30	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Lewis	Date: 5-29-2020	Time: (Military) 930

LAB ID: 20052901
SAMPLE NUMBER: DB015
PROJECT NAME: Wilson Energy Bell #1 (167-7779)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Wellhead
GROUP: OIL & GAS
DATE SAMPLED: 5/27/2020
DATE RECEIVED: 5/29/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	5.45	SU		SM4500-H^+B	DET
Specific Conductivity	239,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	283	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	29.6	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	29.6	mg $CaCO_3$/L	0.485144	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	139,000	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	994	mg/L		SM2540D	DET
Total Solids (TS)	139,994	mg/L		CALCULATED	JMM
Sulfate, Total	60.9	mg/L	1.267938	SM4500-SO4D	DET
Chloride, Total	83,300	mg/L	2349.893	SM4500-CID	DET
Calcium, Total	9660	mg/L	482.034	SM3120B	JMM
Magnesium, Total	2080	mg/L	171.1632	SM3120B	JMM
Sodium, Total	37,600	mg/L	1635.6	SM3120B	JMM
Potassium, Total	152	mg/L	3.88816	SM3120B	JMM
Iron, Total	279	mg/L	14.98788	SM3120B	JMM
Manganese, Total	15.4	mg/L	0.56056	SM3120B	JMM
Aluminum, Total	20.7	mg/L	2.30184	SM3120B	JMM
Hardness, Total as CaCO3	32,700	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	197,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	38.0	mg/L	0.55328	SM3120B	DET
Strontium, Total	183	mg/L	4.17789	SM3120B	JMM
Bromide, Total	668	mg/L	8.36336	SM4110B	DET

Approved By: Jason McClaren

Date: 6/5/2020

LAB ID: 20052901

Total Cations (EPM)	2315.26681	**Total Anions(EPM)**	2360.009442
% Ca	20.81980349	% HCO3 + CO3	0.020556867
% Mg	7.392806706	% SO4	0.053725971
% Na + K	70.81206161	% Cl	99.57133892
% Other	0.975328196	% Other	0.35
EPM Balance	0.957005096	% OH	0
		Water Type	NaCl

Measured TDS	139,000
Calculated TDS	133,000
Measured TDS/ Calculated TDS	1.05

	RATIO		**RATIO**
		H+ Conc.	3.54813E-06
measTDS/SC	0.581589958	calc TDS/SC	0.556485356
Ca/ HCO3	993.5895322	K/ HCO3	8.014445196
Mg/ SO4	134.9933514	Mn/ Fe	0.037400887
Fe/ SO4	11.82067262	Ca/ Mg	2.816224516
Al/ Ca	0.004775265	Na/ K	420.6617012
Al/ SO4	1.815419997	Ca/ Cl	0.205130191
Na/ Cl	0.696031692	Ca/ SO4	380.1715857
Na/ SO4	1289.968437	Fe/ Cl	0.006378112
K/ SO4	3.06652218	Mg/ Cl	0.072838721
Al/ Cl	0.000979551	K/ Cl	0.001654612
Mn/ Cl	0.000238547	Br/Cl	0.003559039
Mn/ SO4	0.442103636	Ba/Sr	0.132430485

SAR		RSC		ESP
Carbonate Hardness	29.6	Non-Carbonate Hardness		32670.4

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD
DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB016 12.0°C

Division: Oil + Gas

District Office: Zanesville

Sample Numbers: DB016 To

County/Township: Dunham / Washington

Site: Abbott #1 Wilson Energy

Project Name (#)/Permit (#): 167-3126

FUNDING SOURCE:
- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

Sampled By: Dan Ball

Witnessed By: Bob Wilson (Optional)

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas		SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB016	5-27-20	14:30	2	P	NF	W	SW	#30			X		well head	39.33488 081.58987

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dan Ball	Date: 5-29-20	Time: (Military) 8:30	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Tonell	Date: 5-29-2020	Time: (Military) 830

LAB ID: 20052902
SAMPLE NUMBER: DB016
PROJECT NAME: Wilson Energy Abbott #1 (167-3126)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Wellhead
GROUP: OIL & GAS
DATE SAMPLED: 5/27/2020
DATE RECEIVED: 5/29/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	5.47	SU		SM4500-H^+B	DET
Specific Conductivity	176,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	126	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	4.26	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	4.26	mg $CaCO_3$/L	0.0698214	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	92,200	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	660	mg/L		SM2540D	DET
Total Solids (TS)	92,860	mg/L		CALCULATED	JMM
Sulfate, Total	37.9	mg/L	0.789078	SM4500-SO4D	DET
Chloride, Total	54,000	mg/L	1523.34	SM4500-CID	DET
Calcium, Total	5540	mg/L	276.446	SM3120B	JMM
Magnesium, Total	1280	mg/L	105.3312	SM3120B	JMM
Sodium, Total	25,700	mg/L	1117.95	SM3120B	JMM
Potassium, Total	114	mg/L	2.91612	SM3120B	JMM
Iron, Total	69.7	mg/L	3.744284	SM3120B	JMM
Manganese, Total	4.56	mg/L	0.165984	SM3120B	JMM
Aluminum, Total	13.3	mg/L	1.47896	SM3120B	JMM
Hardness, Total as CaCO3	19,100	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	131,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	88.2	mg/L	1.284192	SM3120B	DET
Strontium, Total	214.00	mg/L	4.88562	SM3120B	JMM
Bromide, Total	363.00	mg/L	4.54476	SM4110B	DET

Approved By: Jason McCarver

Date: 6/5/2020

LAB ID: 20052902

Total Cations (EPM)	1514.20236	**Total Anions(EPM)**	1528.743659
% Ca	18.25687288	% HCO3 + CO3	0.004567241
% Mg	6.956216869	% SO4	0.051616109
% Na + K	74.0235354	% Cl	99.6465294
% Other	0.76337485	% Other	0.30
EPM Balance	0.477869121	% OH	0
		Water Type	NaCl

Measured TDS	92,200
Calculated TDS	86,700
Measured TDS/ Calculated TDS	1.06

	RATIO		**RATIO**
		H+ Conc.	3.38844E-06
measTDS/SC	0.523863636	calc TDS/SC	0.492613636
Ca/ HCO3	3959.33052	K/ HCO3	41.76541863
Mg/ SO4	133.4864234	Mn/ Fe	0.044329971
Fe/ SO4	4.745137996	Ca/ Mg	2.624540497
Al/ Ca	0.005349906	Na/ K	383.3689972
Al/ SO4	1.874288727	Ca/ Cl	0.181473604
Na/ Cl	0.733880815	Ca/ SO4	350.340524
Na/ SO4	1416.78009	Fe/ Cl	0.002457944
K/ SO4	3.695604237	Mg/ Cl	0.069144905
Al/ Cl	0.000970867	K/ Cl	0.001914294
Mn/ Cl	0.000108961	Br/Cl	0.002983418
Mn/ SO4	0.210351828	Ba/Sr	0.262851388

SAR		RSC		ESP
Carbonate Hardness	4.26	Non-Carbonate Hardness		19095.74

Dave,

Attached are preliminary results for the Curry #2 (34-167-4048) water sample that you submitted to the lab on 5/11/2020. The sample was taken at the Wellhead (39.34713; -81.63739)

Once my LIMS is back on line, I will be able to generate a final report of analysis.

pH	5.23 SU
Specific Conductivity	208,000 uS/cm
Alkalinity, Total	171 mg $CaCO_3$/L
Acidity, Total	195 mg $CaCO_3$/L
Chloride, Total	97,000 mg/L
Total Dissolved Solids	165,000 mg/L
Total Suspended Solids	190 mg/L
Sulfate, Total	65.0 mg/L
Hardness, Total	44,600 mg $CaCO_3$/L
Iron, Total	63.7 mg/L
Manganese, Total	16.8 mg/L
Aluminum, Total	16.2 mg/L
Calcium, Total	14,000 mg/L
Sodium, Total	40,600 mg/L
Potassium, Total	174 mg/L
Magnesium, Total	2330 mg/L
Barium, Total	47.0 mg/L
Strontium, Total	641 mg/L
Bromide, Total	1030 mg/L

If you need anything else, let me know.

Jason McClarren
Environmental Laboratory Supervisor
Ohio Department of Natural Resources
Division of Oil and Gas Resources Management
325 North 7th Street
Cambridge, Ohio 43725
Phone: 740-439-5591
Cell: 614-205-5174
Fax: 740-439-3075
Jason.McClarren@dnr.state.oh.us

From: "Mcclarren, Jason" <Jason.McClarren@dnr.state.oh.us>
Date: May 28, 2020 at 1:57:13 PM EDT
To: "Ball, David" <david.ball@dnr.state.oh.us>
Subject: McVicar (34-167-3028)

Dave,

Attached are preliminary results for the McVicar (34-167-3028) water sample that you submitted to the lab on 5/11/2020. The sample was taken at the Wellhead (39.35720; -81.65301)

Once my LIMS is back on line, I will be able to generate a final report of analysis.

pH	5.36 SU
Specific Conductivity	155,000 uS/cm
Alkalinity, Total	20.8 mg $CaCO_3$/L
Acidity, Total	106 mg $CaCO_3$/L
Chloride, Total	52,100 mg/L
Total Dissolved Solids	89,600 mg/L
Total Suspended Solids	672 mg/L
Sulfate, Total	25.5 mg/L
Hardness, Total	18,400 mg $CaCO_3$/L
Iron, Total	60.3 mg/L
Manganese, Total	7.99 mg/L
Aluminum, Total	12.4 mg/L
Calcium, Total	5330 mg/L
Sodium, Total	25,000 mg/L
Potassium, Total	151 mg/L
Magnesium, Total	1240 mg/L
Barium, Total	146 mg/L
Strontium, Total	220 mg/L
Bromide, Total	349 mg/L

If you need anything else, let me know.

Jason McClarren
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Ohio Department of Natural Resources
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325 North 7th Street
Cambridge, Ohio 43725
Phone: 740-439-5591
Cell: 614-205-5174
Fax: 740-439-3075
Jason.McClarren@dnr.state.oh.us

From: "Mcclarren, Jason" <Jason.McClarren@dnr.state.oh.us>
Date: May 28, 2020 at 2:01:58 PM EDT
To: "Ball, David" <david.ball@dnr.state.oh.us>
Subject: Wilson Energy Abbott (34-167-3518)

Dave,

Attached are preliminary results for the Wilson Energy Abbott (34-167-3518) water sample that you submitted to the lab on 5/11/2020. The sample was taken at the Wellhead (39.30757; -81.58919)

Once my LIMS is back on line, I will be able to generate a final report of analysis.

pH	5.35 SU
Specific Conductivity	125,000 uS/cm
Alkalinity, Total	3.36 mg $CaCO_3$/L
Acidity, Total	207 mg $CaCO_3$/L
Chloride, Total	50,300 mg/L
Total Dissolved Solids	83,300 mg/L
Total Suspended Solids	383 mg/L
Sulfate, Total	228 mg/L
Hardness, Total	16,900 mg $CaCO_3$/L
Iron, Total	121 mg/L
Manganese, Total	4.32 mg/L
Aluminum, Total	13.3 mg/L
Calcium, Total	4970 mg/L
Sodium, Total	23,100 mg/L
Potassium, Total	124 mg/L
Magnesium, Total	1090 mg/L
Barium, Total	3.08 mg/L
Strontium, Total	152 mg/L
Bromide, Total	306 mg/L

If you need anything else, let me know.

Jason McClarren
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Ohio Department of Natural Resources
Division of Oil and Gas Resources Management
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Cambridge, Ohio 43725
Phone: 740-439-5591
Cell: 614-205-5174
Fax: 740-439-3075
Jason.McClarren@dnr.state.oh.us

From: "Mcclarren, Jason" <Jason.McClarren@dnr.state.oh.us>
Date: May 28, 2020 at 2:06:57 PM EDT
To: "Ball, David" <david.ball@dnr.state.oh.us>
Subject: Weaver Lease Wilson Energy (34-167-3514)

Dave,

Attached are preliminary results for the Weaver Lease Wilson Energy (34-167-3514) water sample that you submitted to the lab on 5/11/2020. The sample was taken at the Wellhead (39.29956; -81.58324)

Once my LIMS is back on line, I will be able to generate a final report of analysis.

pH	5.50 SU
Specific Conductivity	209,000 uS/cm
Alkalinity, Total	11.1 mg $CaCO_3$/L
Acidity, Total	157 mg $CaCO_3$/L
Chloride, Total	87,100 mg/L
Total Dissolved Solids	148,000 mg/L
Total Suspended Solids	419 mg/L
Sulfate, Total	99.6 mg/L
Hardness, Total	36,700 mg $CaCO_3$/L
Iron, Total	57.3 mg/L
Manganese, Total	13.2 mg/L
Aluminum, Total	25.3 mg/L
Calcium, Total	11,200 mg/L
Sodium, Total	38,800 mg/L
Potassium, Total	172 mg/L
Magnesium, Total	2120 mg/L
Barium, Total	18.5 mg/L
Strontium, Total	148 mg/L
Bromide, Total	753 mg/L

If you need anything else, let me know.

Jason McClarren
Environmental Laboratory Supervisor
Ohio Department of Natural Resources
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Jason.McClarren@dnr.state.oh.us

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD
DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB005 18.6°C

Division: Oil + Gas

District Office: Zanesville

Sample Numbers: DB005 To —

County/Township: Belpre, Washington

Site: Flowers Disposal

Project Name (#)/Permit (#): 34-167-8462

FUNDING SOURCE:
- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

Sampled By: Dave Ball

Witnessed By: _____ (Optional)

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: (HNO3), HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas	9 # brine specific gravity to 1.20	SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB005	4-27-20	0700	2	P	NF	W	GW	HNO3			X		storage tanks	39.30449 081.41686

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Ball	Date: 4-27-20	Time: (Military) 15.05	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Terrell	Date: 4-27-2020	Time: (Military) 1505

LAB ID: 20042702
SAMPLE NUMBER: DB005
PROJECT NAME: Flowers Disposal (34-167-8462)
LOCATION: Washington/Belpre
SAMPLE LOCATION: Storage Tanks
GROUP: OIL & GAS
DATE SAMPLED: 4/27/2020
DATE RECEIVED: 4/27/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	6.04	SU		SM4500-H^+B	DET
Specific Conductivity	189,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	1170	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	59.5	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	59.5	mg $CaCO_3$/L	0.975205	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	107,000	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	290	mg/L		SM2540D	DET
Total Solids (TS)	107,290	mg/L		CALCULATED	DET
Sulfate, Total	41.2	mg/L	0.857784	SM4500-SO4D	DET
Chloride, Total	62,800	mg/L	1771.588	SM4500-ClD	DET
Calcium, Total	10,000	mg/L	499	SM3120B	JMM
Magnesium, Total	1140	mg/L	93.8106	SM3120B	JMM
Sodium, Total	25,600	mg/L	1113.6	SM3120B	JMM
Potassium, Total	567	mg/L	14.50386	SM3120B	JMM
Iron, Total	66.1	mg/L	3.550892	SM3120B	JMM
Manganese, Total	5.14	mg/L	0.187096	SM3120B	JMM
Aluminum, Total	6.45	mg/L	0.71724	SM3120B	JMM
Hardness, Total as CaCO3	29,700	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	143,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	360	mg/L	5.2416	SM3120B	DET
Strontium, Total	2000	mg/L	45.66	SM3120B	JMM
Bromide, Total	704	mg/L	8.81408	SM4110B	DET

Approved By: Jean M McGowan

Date: 4/30/2020

LAB ID: 20042702

Total Cations (EPM)	1776.271288	**Total Anions(EPM)**	1782.235069
% Ca	28.09255565	% HCO3 + CO3	0.054718091
% Mg	5.281321645	% SO4	0.048129678
% Na + K	63.50966024	% Cl	99.40260019
% Other	3.116462467	% Other	0.49
EPM Balance	0.167592254	% OH	0
		Water Type	NaCl

Measured TDS	107,000
Calculated TDS	100,000
Measured TDS/ Calculated TDS	1.07

			RATIO
	RATIO	H+ Conc.	9.12011E-07
measTDS/SC	0.566137566	calc TDS/SC	0.529100529
Ca/ HCO3	511.6872863	K/ HCO3	14.87262678
Mg/ SO4	109.3638958	Mn/ Fe	0.052689859
Fe/ SO4	4.139610904	Ca/ Mg	5.319228317
Al/ Ca	0.001437355	Na/ K	76.77956075
Al/ SO4	0.836154556	Ca/ Cl	0.281668198
Na/ Cl	0.628588588	Ca/ SO4	581.7315315
Na/ SO4	1298.228925	Fe/ Cl	0.002004355
K/ SO4	16.90852243	Mg/ Cl	0.052952831
Al/ Cl	0.000404857	K/ Cl	0.008186926
Mn/ Cl	0.000105609	Br/Cl	0.004975243
Mn/ SO4	0.218115516	Ba/Sr	0.114796321

SAR		RSC		ESP
Carbonate Hardness	59.5	Non-Carbonate Hardness		29640.5

OHIO DEPARTMENT OF NATURAL RESOURCES - CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD

DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB 002 17.6°C

Sampled By: Dave Ball

Witnessed By: _____
(Optional)

Division: Oil + Gas

District Office: Zanesville

Sample Numbers: DB 002 To _____

County/Township: Durham

Site: G. Nichols

Project Name (#)/Permit (#): 167-2-7861

FUNDING SOURCE:

- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas	Aquifer Study	SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB 002	4-23-20	1100	2	P	NF	W	GW	None			X		G. Nichols Producing well	39.34569 081.66797

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Ball	Date: 4-23-20	Time: (Military) 1420	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Lenhart	Date: 4-23-2020	Time: (Military) 1420

LAB ID: 20042302
SAMPLE NUMBER: DB002
PROJECT NAME: G. Nichols (167-2-7861)
LOCATION: Washington/Dunham
SAMPLE LOCATION: G. Nichols Producing Well
GROUP: OIL & GAS
DATE SAMPLED: 4/23/2020
DATE RECEIVED: 4/23/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	5.66	SU		SM4500-H^+B	DET
Specific Conductivity	176,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	368	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	205	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	205	mg $CaCO_3$/L	3.35995	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	169,000	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	274	mg/L		SM2540D	DET
Total Solids (TS)	169,274	mg/L		CALCULATED	DET
Sulfate, Total	60.1	mg/L	1.251282	SM4500-SO4D	DET
Chloride, Total	99,000	mg/L	2792.79	SM4500-CID	DET
Calcium, Total	15,500	mg/L	773.45	SM3120B	JMM
Magnesium, Total	2170	mg/L	178.5693	SM3120B	JMM
Sodium, Total	41,700	mg/L	1813.95	SM3120B	JMM
Potassium, Total	186	mg/L	4.75788	SM3120B	JMM
Iron, Total	156	mg/L	8.38032	SM3120B	JMM
Manganese, Total	18.6	mg/L	0.67704	SM3120B	JMM
Aluminum, Total	17.9	mg/L	1.99048	SM3120B	JMM
Hardness, Total as CaCO3	47,600	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	230,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	122	mg/L	1.77632	SM3120B	DET
Strontium, Total	1330	mg/L	30.3639	SM3120B	JMM
Bromide, Total	1060	mg/L	13.2712	SM4110B	DET

Approved By: James M. McGuire

Date: 4/30/2020

LAB ID: 20042302

Total Cations (EPM)	2813.91524	**Total Anions(EPM)**	2810.672432
% Ca	27.48661328	% HCO3 + CO3	0.119542568
% Mg	6.345937414	% SO4	0.044518955
% Na + K	64.63264615	% Cl	99.36376677
% Other	1.534803159	% Other	0.47
EPM Balance	0.057654146	% OH	0
		Water Type	NaCl

Measured TDS	169,000
Calculated TDS	159,000
Measured TDS/ Calculated TDS	1.06

			RATIO
	RATIO	H+ Conc.	2.18776E-06
measTDS/SC	0.960227273	calc TDS/SC	0.903409091
Ca/ HCO3	230.1968779	K/ HCO3	1.416056787
Mg/ SO4	142.7090776	Mn/ Fe	0.080789278
Fe/ SO4	6.69738716	Ca/ Mg	4.33137163
Al/ Ca	0.002573508	Na/ K	381.251734
Al/ SO4	1.590752524	Ca/ Cl	0.276945277
Na/ Cl	0.649511779	Ca/ SO4	618.1260499
Na/ SO4	1449.673215	Fe/ Cl	0.003000698
K/ SO4	3.802404254	Mg/ Cl	0.063939394
Al/ Cl	0.000712721	K/ Cl	0.00170363
Mn/ Cl	0.000242424	Br/Cl	0.004751951
Mn/ SO4	0.541077071	Ba/Sr	0.058501049

	SAR		RSC	ESP
Carbonate Hardness	205	Non-Carbonate Hardness		47395

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD
DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB003 17.3°C

Division: Oil + Gas
District Office: Zanesville
Sample Numbers: DB003 To
County/Township: Dunham
Site: Heckman Disposal
Project Name (#)/Permit (#): 34-167-2-3862

FUNDING SOURCE:
- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☑

Sampled By: Dave Ball

Witnessed By: (Optional)

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: (HNO3), HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas	specific gravity	SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB003	4-23-20	1130	2	P	NF	W	GW	HNO3			X		Heckman Disposal	39.34786 081.59068

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Ball	Date: 4-23-20	Time: (Military) 1420	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Lovell	Date: 4-23-2020	Time: (Military) 1420

LAB ID: 20042303
SAMPLE NUMBER: DB003
PROJECT NAME: Heckman Disposal (34-167-2-3862)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Heckman Disposal
GROUP: OIL & GAS
DATE SAMPLED: 4/23/2020
DATE RECEIVED: 4/23/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	5.18	SU		SM4500-H^+B	DET
Specific Conductivity	188,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	456	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	37.9	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	37.9	mg $CaCO_3$/L	0.621181	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	178,000	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	556	mg/L		SM2540D	DET
Total Solids (TS)	178,556	mg/L		CALCULATED	DET
Sulfate, Total	113	mg/L	2.35266	SM4500-SO4D	DET
Chloride, Total	105,000	mg/L	2962.05	SM4500-CID	DET
Calcium, Total	17,700	mg/L	883.23	SM3120B	JMM
Magnesium, Total	1910	mg/L	157.1739	SM3120B	JMM
Sodium, Total	40,600	mg/L	1766.1	SM3120B	JMM
Potassium, Total	212	mg/L	5.42296	SM3120B	JMM
Iron, Total	182	mg/L	9.77704	SM3120B	JMM
Manganese, Total	15.5	mg/L	0.5642	SM3120B	JMM
Aluminum, Total	9.17	mg/L	1.019704	SM3120B	JMM
Hardness, Total as CaCO3	52,100	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	230,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	27.9	mg/L	0.406224	SM3120B	DET
Strontium, Total	1750	mg/L	39.9525	SM3120B	JMM
Bromide, Total	1220	mg/L	15.2744	SM4110B	DET

Approved By: James M. McCleaven

Date: 4/30/2020

LAB ID: 20042303

Total Cations (EPM)	2863.646528	**Total Anions(EPM)**	2980.298241
% Ca	30.84284291	% HCO3 + CO3	0.020842914
% Mg	5.488592899	% SO4	0.078940422
% Na + K	61.86248696	% Cl	99.3877042
% Other	1.806077234	% Other	0.51
EPM Balance	1.996112517	% OH	0
		Water Type	NaCl

Measured TDS	178,000
Calculated TDS	166,000
Measured TDS/ Calculated TDS	1.07

	RATIO		**RATIO**
		H+ Conc.	6.60693E-06
measTDS/SC	0.946808511	calc TDS/SC	0.882978723
Ca/ HCO3	1421.85611	K/ HCO3	8.730080283
Mg/ SO4	66.80689092	Mn/ Fe	0.057706627
Fe/ SO4	4.155738611	Ca/ Mg	5.61944445
Al/ Ca	0.001154517	Na/ K	325.6708513
Al/ SO4	0.433425994	Ca/ Cl	0.298182002
Na/ Cl	0.596242467	Ca/ SO4	375.4176124
Na/ SO4	750.6822065	Fe/ Cl	0.003300768
K/ SO4	2.305033451	Mg/ Cl	0.053062541
Al/ Cl	0.000344256	K/ Cl	0.001830813
Mn/ Cl	0.000190476	Br/Cl	0.005156699
Mn/ SO4	0.239813658	Ba/Sr	0.010167674

SAR		RSC		ESP
Carbonate Hardness	37.9	Non-Carbonate Hardness		52062.1

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD

DNR 734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB004 17.5°C

Division: Oil + Gas

District Office: Zanesville

Sample Numbers: DB004 To

County/Township: Dunham

Site: Reynolds 1

Project Name (#)/Permit (#): 34-167-2-3019

Sampled By: Dave Ball

Witnessed By: (Optional)

FUNDING SOURCE:

- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: (HNO3), HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas	Specific Analysis	SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB004	4-23-20	1145	2	P	NF	W	GW	HNO3			X		Reynolds #1 Producing well	39.34248 081.60383

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Ball	Date: 4-23-20	Time: (Military) 14:20	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Tamulonis	Date: 4-23-2020	Time: (Military) 1430

LAB ID: 20042304
SAMPLE NUMBER: DB004
PROJECT NAME: Reynolds #1 (34-167-2-3019)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Reynolds #1 Producing Well
GROUP: OIL & GAS
DATE SAMPLED: 4/23/2020
DATE RECEIVED: 4/23/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	6.33	SU		SM4500-H*B	DET
Specific Conductivity	221,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	195	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	128	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	128	mg $CaCO_3$/L	2.09792	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	163,000	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	972	mg/L		SM2540D	DET
Total Solids (TS)	163,972	mg/L		CALCULATED	DET
Sulfate, Total	204	mg/L	4.24728	SM4500-SO4D	DET
Chloride, Total	95,800	mg/L	2702.518	SM4500-CID	DET
Calcium, Total	14,300	mg/L	713.57	SM3120B	JMM
Magnesium, Total	2240	mg/L	184.3296	SM3120B	JMM
Sodium, Total	40,500	mg/L	1761.75	SM3120B	JMM
Potassium, Total	179	mg/L	4.57882	SM3120B	JMM
Iron, Total	71.7	mg/L	3.851724	SM3120B	JMM
Manganese, Total	17.5	mg/L	0.637	SM3120B	JMM
Aluminum, Total	13.1	mg/L	1.45672	SM3120B	JMM
Hardness, Total as CaCO3	44,900	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	222,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	16.2	mg/L	0.235872	SM3120B	DET
Strontium, Total	684	mg/L	15.61572	SM3120B	JMM
Bromide, Total	1030	mg/L	12.8956	SM4110B	DET

Approved By: Jan McClaren

Date: 4/30/2020

LAB ID: 20042304

Total Cations (EPM)	2686.025456	**Total Anions(EPM)**	2721.7588
% Ca	26.56601777	% HCO3 + CO3	0.077079571
% Mg	6.862541067	% SO4	0.156049096
% Na + K	65.75994342	% Cl	99.29307476
% Other	0.811497745	% Other	0.47
EPM Balance	0.660776065	% OH	0
		Water Type	NaCl

Measured TDS	163,000
Calculated TDS	153,000
Measured TDS/ Calculated TDS	1.07

	RATIO		**RATIO**
		H+ Conc.	4.67735E-07
measTDS/SC	0.737556561	calc TDS/SC	0.692307692
Ca/ HCO3	340.1321309	K/ HCO3	2.182552242
Mg/ SO4	43.39944623	Mn/ Fe	0.165380489
Fe/ SO4	0.906868396	Ca/ Mg	3.871163394
Al/ Ca	0.002041454	Na/ K	384.7607025
Al/ SO4	0.342977152	Ca/ Cl	0.264038944
Na/ Cl	0.65189205	Ca/ SO4	168.0063476
Na/ SO4	414.7948805	Fe/ Cl	0.001425235
K/ SO4	1.07805937	Mg/ Cl	0.068206613
Al/ Cl	0.000539023	K/ Cl	0.001694279
Mn/ Cl	0.000235706	Br/Cl	0.004771698
Mn/ SO4	0.149978339	Ba/Sr	0.015104779

SAR		RSC		ESP
Carbonate Hardness	128	Non-Carbonate Hardness		44772

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD

DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB 006 13.2°C

Division: Oil + Gas

District Office: Zanesville

Sample Numbers: DB 006 To

County/Township: Dunham, Washington

Site: Hopkins

Project Name (#)/Permit (#): 34-167-2944

FUNDING SOURCE:

- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

Sampled By: Dave Ball

Witnessed By Bob Wilson - well owner (Optional)

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas		SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB006	5-3-20	13:06	2	P	NF	W	GW	HNO3			X		well head	39.34785 081.58828

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Ball	Date: 5-4-20	Time: (Military) 1200	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Lenell	Date: 5.4.2020	Time: (Military) 12[illegible]

LAB ID: 20050401
SAMPLE NUMBER: DB006
PROJECT NAME: Hopkins (34-167-2944)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Wellhead
GROUP: OIL & GAS
DATE SAMPLED: 5/3/2020
DATE RECEIVED: 5/4/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	4.37	SU		SM4500-H^+B	DET
Specific Conductivity	242,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	131	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	0.00	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	148,000	mg/L		SM2540C	JMM
Total Suspended Solids (TSS)	1080	mg/L		SM2540D	JMM
Total Solids (TS)	149,080	mg/L		CALCULATED	JMM
Sulfate, Total	44.5	mg/L	0.92649	SM4500-SO4D	DET
Chloride, Total	91,900	mg/L	2592.499	SM4500-CID	DET
Calcium, Total	11,600	mg/L	578.84	SM3120B	JMM
Magnesium, Total	2280	mg/L	187.6212	SM3120B	JMM
Sodium, Total	40,300	mg/L	1753.05	SM3120B	JMM
Potassium, Total	153	mg/L	3.91374	SM3120B	JMM
Iron, Total	76.8	mg/L	4.125696	SM3120B	JMM
Manganese, Total	15.2	mg/L	0.55328	SM3120B	JMM
Aluminum, Total	4.15	mg/L	0.46148	SM3120B	JMM
Hardness, Total as CaCO3	38,400	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	214,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	30.8	mg/L	0.448448	SM3120B	DET
Strontium, Total	208	mg/L	4.74864	SM3120B	JMM
Bromide, Total	771	mg/L	9.65292	SM4110B	DET

Approved By: Jan M McCann

Date: 5/7/2020

LAB ID: 20050401

Total Cations (EPM)	2533.762484	**Total Anions(EPM)**	2603.07841
% Ca	22.84507738	% HCO3 + CO3	0
% Mg	7.404845607	% SO4	0.03559209
% Na + K	69.34208518	% Cl	99.59358082
% Other	0.407991833	% Other	0.37
EPM Balance	1.349388222	% OH	0
		Water Type	NaCl

Measured TDS	148000
Calculated TDS	146277.5
Measured TDS/ Calculated TDS	1.011775564

	RATIO		**RATIO**
		H+ Conc.	4.2658E-05
measTDS/SC	0.611570248	calc TDS/SC	0.604452479
Ca/ HCO3	NA	K/ HCO3	NA
Mg/ SO4	202.5075284	Mn/ Fe	0.134105858
Fe/ SO4	4.453038889	Ca/ Mg	3.085152424
Al/ Ca	0.00079725	Na/ K	447.9219366
Al/ SO4	0.498094961	Ca/ Cl	0.223274917
Na/ Cl	0.676200839	Ca/ SO4	624.7665922
Na/ SO4	1892.141308	Fe/ Cl	0.001591397
K/ SO4	4.224265777	Mg/ Cl	0.07237079
Al/ Cl	0.000178006	K/ Cl	0.00150964
Mn/ Cl	0.000213416	Br/Cl	0.003723404
Mn/ SO4	0.597178599	Ba/Sr	0.094437144

SAR		RSC		ESP
Carbonate Hardness	0	Non-Carbonate Hardness		38400

OHIO DEPARTMENT OF NATURAL RESOURCES - CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD

DNR-734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB 007 13.6°C

Division: Oil + Gas

District Office: Zanesville

Sample Numbers: DB 007 To

County/Township: Durham, Washington

Site: Ronalds

Project Name (#)/Permit (#): 34-167-3073

FUNDING SOURCE:

- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

Sampled By: Dave Bell

Witnessed By: Bob Wilson - well owner (Optional)

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas		SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB 007	5-3-20	13:58	2	P	NF	W	GW	HNO3			X		well head	39.34751 081.60527

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Bell	Date: 5-4-20	Time: (Military) 12:00	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Terrell	Date: 5-4-2020	Time: (Military) 1200

LAB ID: 20050402
SAMPLE NUMBER: DB007
PROJECT NAME: Renolds (34-167-3073)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Wellhead
GROUP: OIL & GAS
DATE SAMPLED: 5/3/2020
DATE RECEIVED: 5/4/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	5.32	SU		SM4500-H^+B	DET
Specific Conductivity	261,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	250	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	190	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	190	mg $CaCO_3$/L	3.1141	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	167,000	mg/L		SM2540C	JMM
Total Suspended Solids (TSS)	290	mg/L		SM2540D	JMM
Total Solids (TS)	167,290	mg/L		CALCULATED	JMM
Sulfate, Total	49.4	mg/L	1.028508	SM4500-SO4D	DET
Chloride, Total	105,000	mg/L	2962.05	SM4500-CID	DET
Calcium, Total	15,800	mg/L	788.42	SM3120B	JMM
Magnesium, Total	2420	mg/L	199.1418	SM3120B	JMM
Sodium, Total	43,500	mg/L	1892.25	SM3120B	JMM
Potassium, Total	172	mg/L	4.39976	SM3120B	JMM
Iron, Total	108	mg/L	5.80176	SM3120B	JMM
Manganese, Total	18.4	mg/L	0.66976	SM3120B	JMM
Aluminum, Total	13.5	mg/L	1.5012	SM3120B	JMM
Hardness, Total as CaCO3	49,400	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	239,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	57.2	mg/L	0.832832	SM3120B	DET
Strontium, Total	964	mg/L	22.00812	SM3120B	JMM
Bromide, Total	1020	mg/L	12.7704	SM4110B	DET

Approved By: Joan M McClimen

Date: 5/7/2020

LAB ID: 20050402

Total Cations (EPM)	2915.025232	**Total Anions(EPM)**	2978.963008
% Ca	27.04676417	% HCO3 + CO3	0.104536377
% Mg	6.831563508	% SO4	0.034525706
% Na + K	65.06460868	% Cl	99.43225183
% Other	1.057063646	% Other	0.43
EPM Balance	1.084796464	% OH	0
		Water Type	NaCl

Measured TDS	167,000
Calculated TDS	167,000
Measured TDS/ Calculated TDS	1.00

	RATIO		**RATIO**
		H+ Conc.	4.7863E-06
measTDS/SC	0.639846743	calc TDS/SC	0.639846743
Ca/ HCO3	253.1774831	K/ HCO3	1.412851225
Mg/ SO4	193.6220234	Mn/ Fe	0.115440832
Fe/ SO4	5.640947858	Ca/ Mg	3.959088449
Al/ Ca	0.001904061	Na/ K	430.0802771
Al/ SO4	1.459590008	Ca/ Cl	0.266173765
Na/ Cl	0.638831215	Ca/ SO4	766.5667161
Na/ SO4	1839.800954	Fe/ Cl	0.001958698
K/ SO4	4.277808243	Mg/ Cl	0.067231073
Al/ Cl	0.000506811	K/ Cl	0.001485377
Mn/ Cl	0.000226114	Br/Cl	0.004311338
Mn/ SO4	0.651195713	Ba/Sr	0.037842033

SAR		RSC		ESP
Carbonate Hardness	190	Non-Carbonate Hardness		49210

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD

DNR 734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB 008 13.0°C

Division: Oil & Gas

District Office: Zanesville, OH

Sample Numbers: DB008 To

County/Township: Dunham, Washington

Site: Curry #3

Project Name (#)/Permit (#): 167-4054

FUNDING SOURCE:

- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

Sampled By: Dave Bell

Witnessed By (Optional): Bob Wilson - well owner

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas		SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB008	5-3-20	14:01	2	P	NF	W	GW	None			X		well Head	39.39304 081.64384

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Bell	Date: 5-4-20	Time: (Military) 12:00	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Lowell	Date: 5-4-2020	Time: (Military) 12:00

LAB ID: 20050403
SAMPLE NUMBER: DB008
PROJECT NAME: Curry #3 (34-167-4054)
LOCATION: Washington/Dunham
SAMPLE LOCATION: Wellhead
GROUP: OIL & GAS
DATE SAMPLED: 5/3/2020
DATE RECEIVED: 5/4/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	4.94	SU		SM4500-H^+B	DET
Specific Conductivity	255,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	293	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	131	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	131	mg $CaCO_3$/L	2.14709	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	164,000	mg/L		SM2540C	JMM
Total Suspended Solids (TSS)	286	mg/L		SM2540D	JMM
Total Solids (TS)	164,286	mg/L		CALCULATED	JMM
Sulfate, Total	58.5	mg/L	1.21797	SM4500-SO4D	DET
Chloride, Total	95,000	mg/L	2679.95	SM4500-CID	DET
Calcium, Total	14,100	mg/L	703.59	SM3120B	JMM
Magnesium, Total	2160	mg/L	177.7464	SM3120B	JMM
Sodium, Total	39,800	mg/L	1731.3	SM3120B	JMM
Potassium, Total	158	mg/L	4.04164	SM3120B	JMM
Iron, Total	142	mg/L	7.62824	SM3120B	JMM
Manganese, Total	16.9	mg/L	0.61516	SM3120B	JMM
Aluminum, Total	7.25	mg/L	0.8062	SM3120B	JMM
Hardness, Total as CaCO3	44,100	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	218,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	106	mg/L	1.54336	SM3120B	DET
Strontium, Total	970	mg/L	22.1451	SM3120B	JMM
Bromide, Total	972	mg/L	12.16944	SM4110B	DET

Approved By: Jan McClaren

Date: 5/7/2020

LAB ID: 20050403

Total Cations (EPM)	2649.4161	**Total Anions(EPM)**	2695.4845
% Ca	26.55641747	% HCO3 + CO3	0.079655068
% Mg	6.708889555	% SO4	0.045185569
% Na + K	65.49902222	% Cl	99.42368431
% Other	1.235670758	% Other	0.45
EPM Balance	0.861913129	% OH	0
		Water Type	NaCl

Measured TDS	164,000
Calculated TDS	151,000
Measured TDS/ Calculated TDS	1.09

			RATIO
	RATIO	H+ Conc.	1.14815E-05
measTDS/SC	0.643137255	calc TDS/SC	0.592156863
Ca/ HCO3	327.6946937	K/ HCO3	1.882380338
Mg/ SO4	145.9365994	Mn/ Fe	0.080642455
Fe/ SO4	6.263077087	Ca/ Mg	3.958392406
Al/ Ca	0.001145838	Na/ K	428.3657129
Al/ SO4	0.661921065	Ca/ Cl	0.26253848
Na/ Cl	0.646019515	Ca/ SO4	577.674327
Na/ SO4	1421.463583	Fe/ Cl	0.002846411
K/ SO4	3.318341174	Mg/ Cl	0.066324521
Al/ Cl	0.000300827	K/ Cl	0.001508103
Mn/ Cl	0.000229542	Br/Cl	0.004540921
Mn/ SO4	0.505069911	Ba/Sr	0.06969307

SAR		RSC		ESP
Carbonate Hardness	131	Non-Carbonate Hardness		43969

OHIO DEPARTMENT OF NATURAL RESOURCES – CAMBRIDGE ENVIRONMENTAL LABORATORY

CHAIN OF CUSTODY RECORD

DNR 734-3002A Revised 12/14

325 North 7th Street
Cambridge, Ohio 43725

Telephone: (740) 439-5591
Fax No.: (740) 439-3075

SAMPLE RECEIVING:
(For Lab Use Only)

Ice Present Y (N)

Sample Temperature @ Lab:
DB014 19.5°C

Division: Oil & Gas

District Office: Zanesville

Sample Numbers: DB014 To

County/Township: Washington Denham

Site: Red Bird Facility

Project Name (#)/Permit (#):

Sampled By: Dave Ball

Witnessed By: Daniel (Optional)

FUNDING SOURCE:

- AML ☐
- AML Set-Aside ☐
- Coal Regulatory ☐
- Industrial Minerals ☐
- Oil & Gas ☒

SAMPLE NUMBERS	DATE	TIME (Military)	Sample Information: Number of Containers	Bottle Type: Glass (G) or Plastic (P)	Filtered (F) or Non-Filtered (NF)	Matrix: Air (A) Soil (S) Water (W)	Water Code: SW, GW, WW, DW	Preservative: HNO_3, HCl, Other	Analysis Requested: Group I	Group II	Group Oil & Gas		SAMPLE LOCATION	LATITUDE/LONGITUDE COORDINATES/COMMENTS
DB014	5-14-20	0830	2	P	NF	WS	W	HNO			X		Downhole tanks	39.33764 081.67383

Water Codes: Surface Water (SW), Ground Water (GW), Waste Water (WW), Drinking Water (DW)

Turned In By: Dave Ball	Date: 5-14-20	Time: (Military) 1040	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By:	Date:	Time: (Military)
Transferred By:	Date:	Time: (Military)	Received By Lab: Daniel Lewallen	Date: 5-14-2020	Time: (Military) 1040

LAB ID: 20051401
SAMPLE NUMBER: DB014
PROJECT NAME: Red Bird Facility
LOCATION: Washington/Dunham
SAMPLE LOCATION: Downhole Tanks
GROUP: OIL & GAS
DATE SAMPLED: 5/14/2020
DATE RECEIVED: 5/14/2020

OHIO DEPARTMENT OF NATURAL RESOURCES
CAMBRIDGE ENVIRONMENTAL LABORATORY
325 NORTH SEVENTH STREET
CAMBRIDGE, OH 43725

PARAMETER	RESULT	UNITS	EPM	METHOD	ANALYST
pH	5.84	SU		SM4500-H^+B	DET
Specific Conductivity	228,000	uS/cm		SM2510B	DET
Total Acidity as CaCO3	348	mg $CaCO_3$/L		SM2310B	DET
Total Alkalinity as CaCO3 (m-alk)	74.6	mg $CaCO_3$/L		SM2320B	DET
Phenolphthalein Alkalinity as CaCO3	0.00	mg $CaCO_3$/L		SM2320B	DET
Carbonate (CO3) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
BiCarbonate (HCO3) Alkalinity as CaCO3	74.6	mg $CaCO_3$/L	1.222694	SM2320B	DET
Hydroxide (OH) Alkalinity as CaCO3	0.00	mg $CaCO_3$/L	0	SM2320B	DET
Total Dissolved Solids (TDS)	138,000	mg/L		SM2540C	DET
Total Suspended Solids (TSS)	326	mg/L		SM2540D	DET
Total Solids (TS)	138,326	mg/L		CALCULATED	JMM
Sulfate, Total	68.3	mg/L	1.422006	SM4500-SO4D	DET
Chloride, Total	82,100	mg/L	2316.041	SM4500-CID	DET
Calcium, Total	12,000	mg/L	598.8	SM3120B	JMM
Magnesium, Total	1270	mg/L	104.5083	SM3120B	JMM
Sodium, Total	33,200	mg/L	1444.2	SM3120B	JMM
Potassium, Total	552	mg/L	14.12016	SM3120B	JMM
Iron, Total	97.1	mg/L	5.216212	SM3120B	JMM
Manganese, Total	8.18	mg/L	0.297752	SM3120B	JMM
Aluminum, Total	14.6	mg/L	1.62352	SM3120B	JMM
Hardness, Total as CaCO3	35,200	mg $CaCO_3$/L		SM2340B	JMM
Hardness, Total S elements analyzed as CaCO3	181,000	mg $CaCO_3$/L		CALCULATED	JMM
Barium, Total	1010	mg/L	14.7056	SM3120B	DET
Strontium, Total	2560	mg/L	58.4448	SM3120B	JMM
Bromide, Total	908	mg/L	11.36816	SM4110B	DET

Approved By: Jason McClaren

Date: 6/4/2020

LAB ID: 20051401

Total Cations (EPM)	2241.916344	**Total Anions(EPM)**	2330.05386
% Ca	26.70929277	% HCO3 + CO3	0.052474924
% Mg	4.661561092	% SO4	0.06102889
% Na + K	65.04792937	% Cl	99.3986036
% Other	3.581216766	% Other	0.49
EPM Balance	1.927779755	% OH	0
		Water Type	NaCl

Measured TDS	138,000
Calculated TDS	129,000
Measured TDS/ Calculated TDS	1.07

	RATIO		**RATIO**
		H+ Conc.	1.44544E-06
measTDS/SC	0.605263158	calc TDS/SC	0.565789474
Ca/ HCO3	489.7382338	K/ HCO3	11.5484005
Mg/ SO4	73.49357176	Mn/ Fe	0.057082036
Fe/ SO4	3.668206745	Ca/ Mg	5.729688455
Al/ Ca	0.002711289	Na/ K	102.2792943
Al/ SO4	1.141711076	Ca/ Cl	0.258544646
Na/ Cl	0.623564091	Ca/ SO4	421.0952696
Na/ SO4	1015.607529	Fe/ Cl	0.002252211
K/ SO4	9.929747132	Mg/ Cl	0.045123683
Al/ Cl	0.000700989	K/ Cl	0.00609668
Mn/ Cl	0.000128561	Br/Cl	0.004908445
Mn/ SO4	0.209388709	Ba/Sr	0.251615199

SAR		RSC		ESP
Carbonate Hardness	74.6	Non-Carbonate Hardness		35125.4

GENERAL REFERENCE

Includes Stiff, Schoeller, and Piper Diagrams, water-solid interfaces, and Geologic effects

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