Point Pleasant Produced Water Characterization:
An Analysis of Past Production and Prediction of Future Production

by

Victoria R. Wilson

Submitted in Partial Fulfillment of the Requirements

for the Degree of

Master of Science

in the

Environmental Science

Program

YOUNGSTOWN STATE UNIVERSITY

May, 2019

Point Pleasant Produced Water Characterization:
An Analysis of Past Production and Prediction of Future Production

Victoria R. Wilson

I hereby release this thesis to the public. I understand that this thesis will be made available from the OhioLINK ETD Center and the Maag Library Circulation Desk for public access. I also authorize the University or other individuals to make copies of this thesis as needed for scholarly research.

Signature:

Victoria R. Wilson, Student | Date

Approvals:

Dr. Jeffrey C. Dick, Thesis Advisor | Date

Bill Dawson, Committee Member | Date

Dr. Peter Kimosop, Committee Member | Date

Dr. Tony Vercellino, Committee Member | Date

Dr. Salvatore A. Sanders, Dean of Graduate Studies | Date

ABSTRACT

Exploration and production activities beginning in 2011 have defined the Point Pleasant Formation of eastern Ohio and the Appalachian Basin as a major North American unconventional shale play. Unconventional wells are stimulated using high volume–high pressure hydraulic fracturing technology. The large volumes of water used in this process create large volumes of water production over the life of a well.

This research characterizes rates of produced water for the Point Pleasant Formation unconventional play of eastern Ohio and provides a means of predicting future produced water volumes through 2022. The research utilizes Ohio Department of Natural Resources Division of Oil and Gas Resources (ODNR DOGRM) unconventional production reports for 2011 through the first quarter of 2017. These periodic reports were used to select a representative sample of producing wells from across the Point Pleasant play.

The combination of individual water production characteristics for sixty selected wells combined with a spatial analysis of production from these wells provides a basis for distinguishing between a northern production region and a southern production region. These two regions closely correspond to an industry recognized normal pressured zone in the north and an over pressured zone in the south. Composite production decline plots for each region provide a basis for predicting future water production.

The findings show percent decline in the northern region of sixty-nine percent in the first four quarters as compared to sixty three-percent decline for the southern region over the first four quarters. After four years of production, the percent declines are essentially indistinguishable at ninety-five and ninety-three percent, northern and southern region respectively. The composite production decline curves provide a means of predicting water production for the first forty-eight quarters of production (10.5 years) of any given well within each respective region. The findings can also be used to plan for additional UIC wells and produced water treatment facilities.

ACKNOWLEDGEMENTS

There are many people to whom I owe much gratitude for supporting me on my journey while completing this work. The list is very long. I will address a few.

I would like to thank my committee members: Dr. Peter Kimosop, Dr. Tony Vercellino, and Bill Dawson. I humbly thank you for investing your time and expertise.

I would like to thank my thesis advisor and mentor, Dr. Jeffrey C. Dick. Throughout the years that we have known each other, you have gifted me with your dedication, support, guidance, and knowledge. You are an extraordinary example of what an educator should be. Thank you from the bottom of my heart.

I dedicate this work to my daughter, Brooke Wilson. You make me proud. May you continue to set yourself to a higher standard. Directly face the challenges life gives you with strength, confidence, and occasionally a little bit of fear. Never give up. I love you “larger than infinity.”

Table of Contents

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1

INTRODUCTION

1.1 History of Ohio Oil and Gas Production

Ohio has a lengthy and interesting history of oil and gas production. The earliest indications of oil and gas dates back to the early 1700s in southeastern Ohio when settlers found seeps and natural springs that had natural gas and crude oil flowing from them. As a surveyor, George Washington explored the Ohio River Valley in 1770. He happened to come across burning springs and recorded this discovery in his field notes. The first well in Ohio, and in the country, was “accidentally” drilled back in 1814. The well was drilled by Silas Thorla and Robert McKee in Noble County for the purpose of mining salt, but the well also produced oil and natural gas (Kell, 2011).

The first commercial production of oil and gas occurred in the 1850s near Steubenville where wells were drilled to provide natural gas for the thriving manufacturing industry and domestic uses along the Ohio River. In southeastern Ohio from the 1860s to the 1890s, commercial production took place as well owners developed Pennsylvanian age rocks. The Lima Oil field located in northwestern Ohio produced between 1888 and 1937, and put Ohio on the map as the world’s largest oil producer. Well owners tapped into the vast oil reserves of the Ordovician age Trenton Limestone. The play became known as the Lima-Findlay oil trend and produced more than twenty four million barrels of oil annually. By 1910, poor conservation practices caused production to drop drastically to around 8 million barrels per year (Kell, 2011).

1.2 Unconventional Oil and Gas Production

Organic-rich shale and limestone are common source rocks for oil and gas that is typically produced from conventional reservoir rocks such as sandstone and limestone.

Unconventional drilling technology was developed for the commercial production of petroleum from these otherwise tight and non-productive source rocks. Unconventional wells typically involve organic rich shale source rocks that are drilled horizontally to increase exposure of the formation to the well bore and are hydraulically fractured to improve formation permeability and production. Hydraulic fracturing is a technique developed in the 1950's to improve production of low permeable formations such as shale, chalk and tight sand. Hydraulic fracturing of shale through unconventional wells uses large quantities of water. As a rule of thumb, approximately one million gallons of water are used for each one thousand feet of lateral section (Dick, 2017).

Unconventional drilling and completion technologies have changed considerably since the first Point Pleasant wells were drilled in Ohio in 2011. Early Point Pleasant-wells had typical lateral lengths of five thousand feet with forty or fewer frac stages. These early wells often required spud to spud drill times of forty days or longer. As drilling and completion methods improved, lateral lengths of ten thousand feet or longer with eighty or more frac stages became common place while drill times were reduced by half. Eclipse Resources drilled the Purple Hayes well in twenty four days having a lateral of 18,500 feet and 124 frac stages in Guernsey County, Ohio in early 2016 (Marcellus Drilling News, 2016).

Hydraulic fracturing of unconventional wells requires large volumes of water pumped at high pressure along with proppant sand and a variety of chemical compounds such as friction reducers, biocides and corrosion inhibitors. The resulting hydraulic fracturing fluid, or frac solution, is pumped through well casing perforations with the purpose of creating fractures in the rock formation (Veil, 2015). The resulting fractures improve permeability in the vicinity of the well bore allowing greater volumes of oil and gas to be produced. After the water is injected and the fractures have been created, the pressure is lowered and the frac solution begins to flow back to the surface. After this initial flow back stage, remaining frac solution continues to produce in gradually decreasing volumes along with hydrocarbons. Frac solution produced in this manner is referred to as produced water (Veil, 2015).

The Point Pleasant Formation is an Ordovician Age organic-rich rock unit within a petroleum system, or play that consists of the Utica Shale rock unit and the underlying Point Pleasant Formation. Both rock units are considered prospects, however; the Point Pleasant Formation is the primary prospect and the one that has experienced the most exploration and development activity in the State of Ohio (Dick, 2017). Between 2011 and April, 2017 approximately 1,620 Point Pleasant unconventional wells produced more than sixty two million barrels of produced water (ODNR DOGR, 2017). Such large produced water volume not only requires adequate handling and disposal operations, but also possesses potential environmental issues. It is therefore important to develop a better understanding of rates and spatial variation of water production and to provide a means of predicting future water production.

1.3 Hydraulic Fracturing and Produced Water Disposal

Hydraulic fracturing slowly evolved as a safe and effective method of fracturing reservoir rock to improve production. By 1951, hydraulic fracturing had become a common stimulation procedure for many well operators in Ohio. Low-permeability reservoirs, such as the Clinton and Medina sands, were made commercially profitable by the use of hydraulic fracturing. Between 1951 and 2007 it is estimated that 78,000 oil and gas wells were completed using this method. With so many producing wells within the state of Ohio and the associated large volumes of produced water, regulations were enacted in 1985 requiring industry reporting of produced water. Produced water typically contains significant quantities of dissolved materials and residual hydraulic fracturing chemicals. It is therefore very important that it is properly handled, disposed and/or recycled (Kell, 2011).

The Ohio Department of Natural Resources Division of Oil and Gas Resources (ODNR DOGR) reports the volume of produced water from Point Pleasant producing wells. It is assumed these produced water reports typically do not include flowback volumes, since flowback is produced during well stimulation and prior to being classified by the ODNR as a producing well. During 2016, the Point Pleasant produced approximately four million barrels of produced water each quarterly reporting period which equates to a daily rate of forty-four thousand barrels (ODNR DOGR, 2016).

A common method of disposing produced water is through underground injection control (UIC). UIC of oil and gas water is classified as Class II injection by the United States Environmental Protection Agency (USEPA) and is considered a best management practice (BMP) for disposal of produced water. The practice dates back to the 1930s (Clark, 2005) and by 1950 was becoming an accepted practice.

As of March 4, 2019, Ohio has two-hundred and twenty-one Class II injection wells in operation (Figure 1.0). These wells handle produced water from Ohio's conventional and unconventional wells and in addition, receive produced water from Pennsylvania and West Virginia oil and gas production operations.

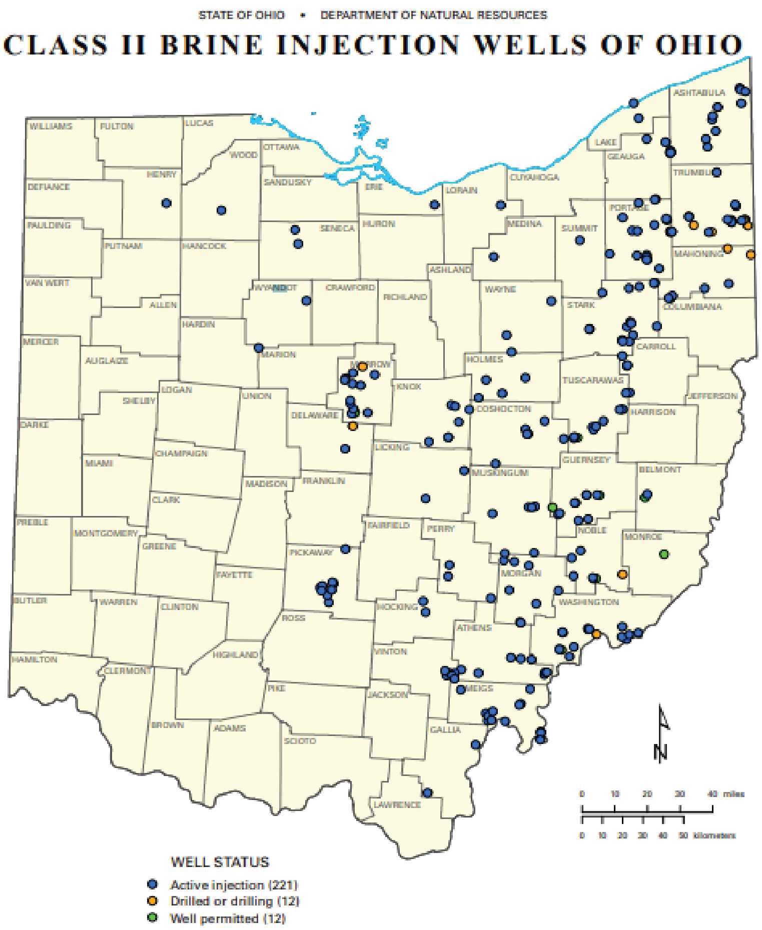

Figure 1.0. Class II brine injection wells of Ohio (ODNR DOGRM, 2019)

1.4 Water Resources Conservation

Conservation of water resources is important and as such, several methods of re-using and recycling produced water have been developed. Enhanced oil recovery (EOR) re-uses produced water to stimulate production in an existing well by injecting the water into the formation and hydraulically flushing remaining oil toward the well. Using the produced water for this purpose eliminates the use of groundwater or surface water.

Surface subsidence control is another way in which produced water is utilized. Surface subsidence can be controlled by injecting produced water into formations that have been depleted of resources to the extent that land subsidence has occurred. Surface subsidence wells that utilize injection of produced water to replace withdrawn groundwater are considered Class V injection wells by the USEPA, and 58 wells are identified in the United States, although the USEPA suspects there are more (NETL, 2017) (Veil, 2015).

Recycling produced water involves partial or complete treatment. Some methods include pad-to-pad recycling, evaporation, aquifer storage and recovery, agricultural use, reverse osmosis, and crystallization. Recycling produced water for reuse in hydraulic fracturing is a popular option as it requires minimal treatment and saves on transportation costs (Veil, 2015). Aquifer storage and recovery (ASR) requires purification to USEPA drinking water standards before it can be injected into a shallow formation and stored for future use. Agricultural use of produced water is yet another possible recycling option. The water is commonly used for irrigation and livestock watering, however; the costs of treatment for elevated salinity and toxicity can render the method cost prohibitive.

Reverse osmosis and crystallization methods of treating produced water are proven effective in removing high amounts of total dissolved solids (TDS). Reverse osmosis uses high pressure to pass the water through a semi-permeable membrane. One end product is pure water that can be used for a variety of purposes including drinking water. The other end product is a solution of concentrated minerals. Minerals with no economic value must be properly disposed. Crystallization utilizes advanced evaporation technologies that separate high levels of TDS from the produced water. Reverse osmosis and crystallization methods are very costly because large amounts of energy are used in the process (Gregory, Vidic, and Dzombak; 2011).

CHAPTER TWO

LITERATURE REVIEW

Limited research has been done in the area of quantifying volumes of produced water and predicting future quantities based on that data. Lutz (2013) carried out research and published results in the American Geophysical Union journal "Water Resources Research." Lutz focused his research on the Marcellus shale play in Pennsylvania and utilized data for gas and wastewater production from January 2000 to December 2011. He obtained this data from the Pennsylvania Department of Environmental Protection Bureau of Oil and Gas Management. Lutz accounted for both conventional and Marcellus shale data in his research, and evaluated data from 2,189 active wells. His objectives were to quantify drilling, flowback, and brine wastewater volumes produced by Marcellus and conventional wells, assess changes in the cumulative wastewater volume resulting from the rapid expansion of Marcellus wells and assess how wastewater disposal options and regulations are changing as the shale gas industry continues to develop.

Lutz used a few different approaches during his research. Since volumes of water and gas produced from Marcellus and conventional wells differ, the amount of gas recovered per unit of wastewater was considered. Also, cross-validation of reported data between the five largest oil and gas operators in the Marcellus region was utilized. Lastly, disposal facilities are required to report volumes of water received. Lutz analyzed transport and disposal methods of wastewater, and found that multiple disposal methods were reported. Lutz used the modal value from all disposal methods in an attempt to correct data entry inaccuracies on volumes reported. His research yielded results that demonstrate a correlation between produced water per unit of gas from both conventional and Marcellus shale wells. Marcellus wells produce more gas, and therefore produce more water. Conventional wells produce less gas, and therefore produce less water. However, Marcellus wells, in comparison to conventional wells, produced roughly 35% of wastewater per unit of gas. Lutz concluded that produced water volumes from the Marcellus shale will be almost ten times greater than volumes produced prior to Marcellus shale development and in conjunction with production from conventional wells dating back to 2003. (Lutz, 2013).

Veil (2015) conducted research for the Groundwater Protection Council with the purpose of updating a former comprehensive study published in 2009 on produced water volumes and management practices in the United States (Clark, 2009). Veil acquired data using a questionnaire distributed to oil and gas directors from all thirty-one oil and gas producing states and federal land agencies. Veil requested produced water and flow back data for the year 2012. If there was no data for 2012 available, Veil requested data from the most recent year reported. Two tables were for produced water volume information and produced water management practices. For states not providing water production data, Veil pursued alternative sources of information including the USEPA, federal land management agencies and state environmental protection agencies. His findings showed that during 2012 for combined onshore and offshore oil and gas production activities, 21.18 billion barrels (Bbl) of produced water, 2.26 billion Bbl of oil (including condensate), and 29,730,000 million cubic feet (mmcf) of gas were produced overall in the U.S. (Veil, 2015).

Kell's 2011 report "State Oil and Gas Agency Groundwater Investigations and Their Role in Advancing Regulatory Reforms, a Two-State Review: Ohio and Texas" was developed for the Groundwater Protection Council. The purpose of this work was to evaluate drilling and production activities, groundwater contamination investigations as a result of these activities and the subsequent regulations put forth by each state as a result of those contamination investigations. In addition, the report evaluated the potential for groundwater contamination reduction over time due to regulatory enhancements.

A synopsis of Kell's work follows: In the 1960's, Morrow County became the center of an oil production boom in Ohio. There were so many wells being drilled that emergency rules had to be set forth in 1964 by the General Assembly. These rules were necessary to establish well spacing standards and bonding. Thus, the Division of Oil and Gas within the ODNR was created with the passage of House Bill (HB) 234 by the General Assembly in 1965. Chapter 1509 of the Ohio Revised Code (ORC) was established to provide the Division of Oil and Gas with the authority to: (1) assure the protection of public health, safety, and the environment, (2) allow the orderly and efficient development of oil and gas reserves, and (3) to assure conservation of other natural resources (more specifically, groundwater). The injection of brine and other production fluids was authorized in 1965, but not many Class II wells were in operation. Open, earthen pits (unlined) were still being widely used as a method of storage, and in 1974 the state enacted time frames that would limit these pits to be in operation for only five months. In 1980, the state began to focus on the improvement of waste management practices, most importantly looking at Class II injection as the BMP. By 1983, earthen pit storage was banned in the state. This is the same year that the State of Ohio received primacy over underground injection control (UIC) from the USEPA. In 1985, comprehensive produced water legislation (Am. Sub. HB 501) was enacted. The Division of Mineral Resource Management (DMRM) within the ODNR was born with the merger of Division of Mines and Division of Oil and Gas in 2000. Ohio is known nationwide to have some of the best management practices and regulations over Class II injection. Regulations for various aspects of the injection process, such as run-off collection vaults, storage tanks, well pads, unloading pads, and distribution lines, including permitting for these various activities, has put the state at the forefront of UIC programs (Kell, 2011).

CHAPTER 3

RESEARCH OBJECTIVES, METHODS, AND PROCEDURES

3.1 Objectives

The purpose of this research is to characterize water production between 2011 and 2017 and to provide a means for predicting future water production from the Point Pleasant Formation of eastern Ohio.

3.2 Methods Overview

An understanding of water production decline is critical to understanding past production and predicting future production. ODNR DOGRM production reports show active producing wells in twenty-one counties. Ninety-eight percent of this production (based on May 6, 2017 ODNR DOGRM Cumulative Permitting Activity report) is concentrated in these eight counties: Belmont, Carroll, Columbiana, Guernsey, Harrison, Jefferson, Monroe, and Noble. The first step required the tabulation of produced water volumes reported by the ODNR DOGRM. Point Pleasant production has been provided quarterly through “Horizontal Shale Production” reports since 2013 and annually for the years 2011 and 2012. These periodic reports have been combined into a comprehensive oil, gas and produced water Excel database. Production reports through the first quarter of 2017 were used in this investigation. With more than 1620 producing Point Pleasant wells in eastern Ohio, it is beyond the scope of this research to analyze the production decline of every well. Therefore, a representative sample of sixty producing wells from across the Point Pleasant formation was used. These wells were used to construct produced water decline curves. The wells were selected based on three criteria. These three criteria are discussed in the next section (3.3).

It is important to note that at the conclusion of this research, it was discovered that one of the selected representative wells is actually a Marcellus Shale well. Well 49 on the well locator map (Figure 3.0) is Triad Hunter LLC Ormet Corp 1-9H located in Monroe County, Ohio Township. The characterisitcs of the Marcellus are similar to that of the Point Pleasant, and as a result this well was not withdrawn from the maps or composite decline curve.

It stands to reason that changes in production volumes with time could be useful in distinguishing areas of differing production characteristics. The water production data from the sixty representative sample wells was used to create annual and cumulative production maps. These maps, along with the individual production decline curves, were used to create composite type well decline curves for each distinguished production area. The type curves were used to estimate future production through the year 2022.

This research commenced in spring 2017 when available water production data were limited to 2011 through the first quarter of 2017. At the time of this study, water production data was available through the first quarter of 2018. These additional four quarters of production provide a means for validating future production estimates based on decline.

3.3 Data Selection and Preparation

Projections of future water production are based on a number of factors that include historic water production, water production decline rates for individual wells, historic and current drilling activity, possible future trends in drilling activity and technological advancements in drilling and production methods. The production data used in this research included approximately 1620 wells drilled between 2011 and the first quarter 2017.

The number of producing wells in the Point Pleasant shale play has steadily increased to approximately 1930 producing wells since 2011 (ODNR DOGRM 2018). With each additional well, the understanding of where the best production could be found and technology for the most effective drilling and completion evolved. During the first few years of exploration and production, lateral lengths were typically in the 5,000 foot (1,524m) range, whereas today the longest lateral lengths exceed 18,500 feet (5,639m). Concurrent with longer laterals, completion methods have been optimized with increased proppant and number of frac stages (Pickett, 2017). Improved technology and evolving completion methods have led to considerable improvements in well efficiency and production rates. The quality of individual well production data also varies considerably as a function of individual operator practices, production take away capacity restrictions and operations-related shut-in periods. Because of the disparity in well drilling, completions and quality of production data; certain data selection and preparation methods were used.

Water production in non-conventional Point Pleasant wells behaves much like oil and gas production in that water production declines over time (Dick 2017). Knowing that the production characteristics of the Point Pleasant likely vary with location, the proposed research examined water production and decline using representative wells from each of the eight major producing counties. Representative wells were selected using three criteria:

1. Completeness of record: selected wells were ideally in production at least eighty percent of the days in each reporting quarter (example; a 91 day quarter will require a minimum of 73 production days). Oil and gas production can be discontinuous as wells may be shut in for a variety of reasons. Shut in periods can adversely affect production decline.
2. Longevity of record: a minimum of seven quarters of production were used.
3. Location: spatial distribution by county and location within each county.

These three criteria were important to the investigation for analyzing production decline and predicting future volumes of produced water. Wells meeting the eighty percent production days criteria were identified using Excel. The wells meeting criterion #1 were then analyzed within Excel to identify wells meeting criterion #2. Finally, wells meeting criteria #1 and #2 were selected for production decline analysis based on spatial distribution (criteria #3). Figure 3.0. shows a map of sixty representative wells selected for decline analysis.

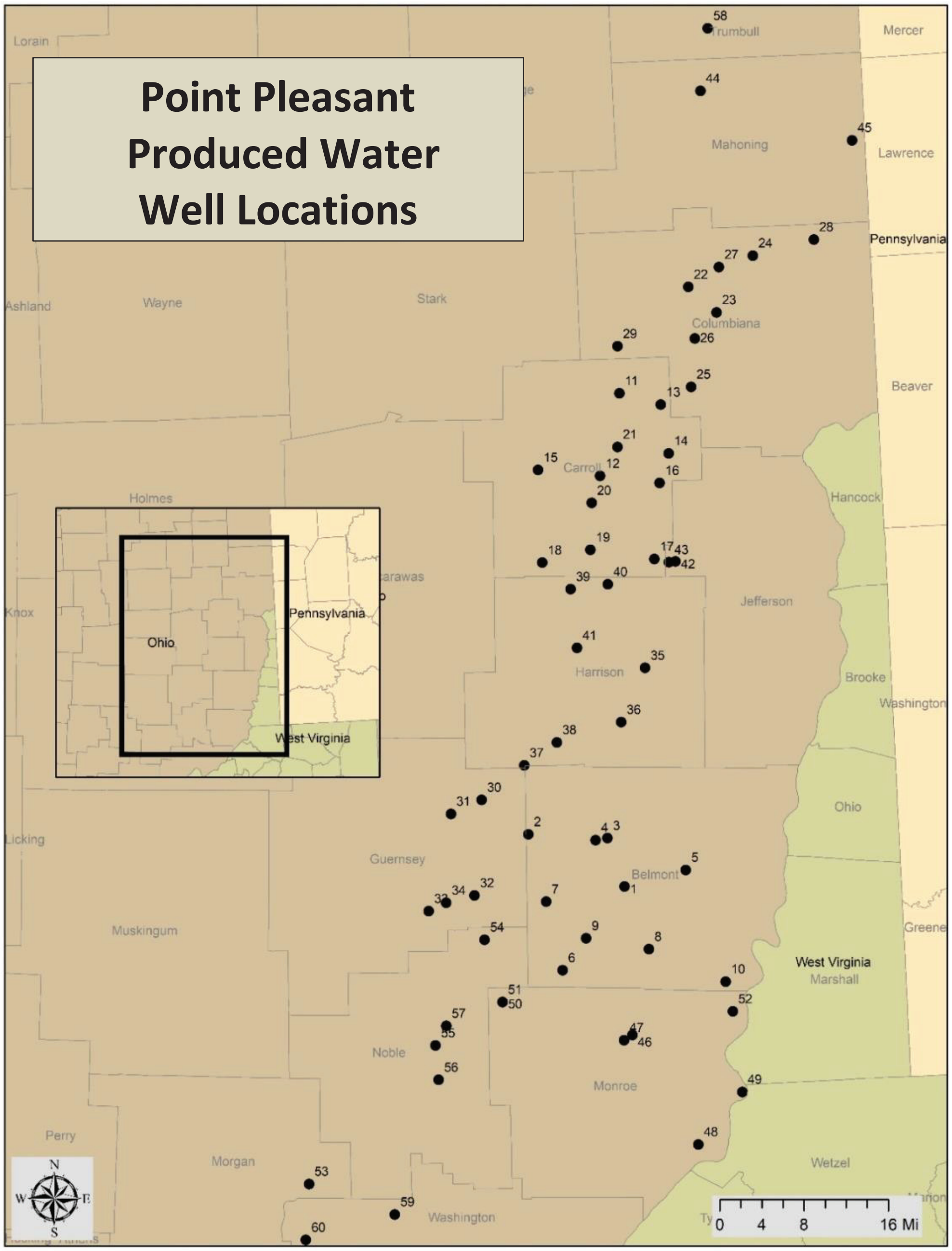

Figure 3.0. Locations of the sixty selected wells of the research, in numerical order by county and township.

Evolving drilling and completion methods creates a situation of wells having large differences in lateral lengths, completion methods, and corresponding differences in production. Wells having relatively short laterals were expected to have lower water production rates than wells with relatively long laterals. For example, a well with a twelve thousand foot lateral would be expected to have greater water production than a well with a five thousand foot lateral. In order to compensate for the influence of lateral length, quarterly production is expressed throughout this research as barrels per 1000 feet of lateral (Bbls/Mft). Lateral length was determined by obtaining perforation interval data from well stimulation and completion reports for the sixty representative individual wells as reported by ODNR DOGRM.

3.4 Unconventional Water Production Decline

Decline curves that express water production in Bbls/Mft were constructed for each of the sixty sample wells using Excel. These decline curves, in conjunction with the annual and cumulative production maps, were used to evaluate decline characteristics by region and to create composite percent decline curves. It was anticipated that produced water decline rates and characteristics would have some relationship to regions of differing production based on geographic location and operator production methods.

3.5 Annual and Cumulative Production Maps

In order to characterize water production across the Point Pleasant shale play, the sampled wells were used to create annual and cumulative water production maps. These maps provided meaningful images of spatial variation in water production. In addition, the maps were used to investigate water production characteristics as a function of spatial distribution. Annual production maps were created for the years 2012-2017. Cumulative production maps were created for the years 2012-2013, 2012-2014, 2012-2015, 2012-2016, and 2012-2017. All maps were created using ArcGIS 10.5. It is important to note that none of the sixty representative wells produced water in 2011. Wells 29 and 31 (Appendix A) produced water for 6% and 2% days production respectively, during the year 2012. That data was included in the maps, but not in the individual decline curves or composite decline curves.

3.6 Spatial Distribution of Decline Characteristics and Composite Decline Curves

Water production tends to decline as a function of natural gas production (Dick, 2017). Therefore, an understanding of natural gas production is essential to predicting future water production. It was anticipated that differing regions of the Point Pleasant shale play would have different natural gas production characteristics according to factors including: wet gas production, dry gas production, formation pressure, and controlled production. Composite decline curves were created from the individual decline curves for differing regions of production. The effect of formation pressure and production method is critically important; for example, the Rice Drilling Bigfoot 9H well in Belmont County (Figure 3.1) and the Antero Resources Gary 2H well in Monroe County (Figure 3.2) are both within the Point Pleasant overpressured region. However, as can be seen from the natural gas decline curves, the decline characteristics are very different. Both wells commensed production at comparable rates near 1,300,000 MCF Gas Equivalents per quarter, however the Bigfoot 9H well shows a much different style of decline and ultimately much greater overall production than the Gary 2H well due to what is known in the industry as “controlled production” (Dick 2017). Figure 3.3 shows natural gas production decline for the Antero Resources J Anderson 5H well. This is an example of traditional decline in the normal pressured portion of the Point Pleasant in Guernsey County.

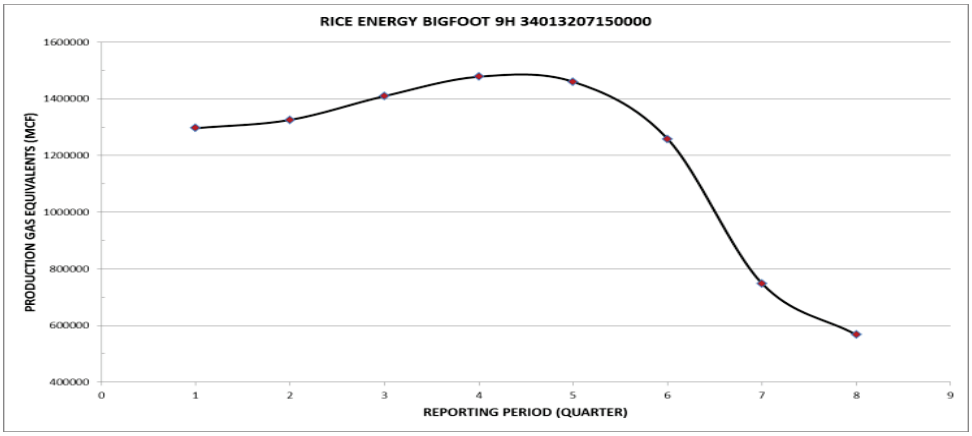

Figure 3.1. Natural gas decline curve for Rice Bigfoot 9H well with controlled production within overpressured region, Belmont Co. (Thomas et. al., 2017)

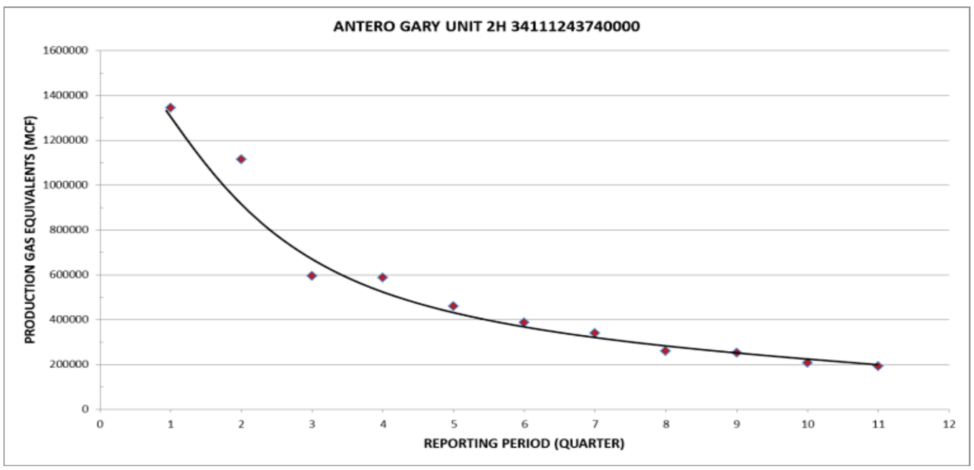

Figure 3.2. Natural gas decline curve for Antero Gary Unit 2H well without controlled production within overpressured region, Monroe Co. (Thomas et. al., 2017)

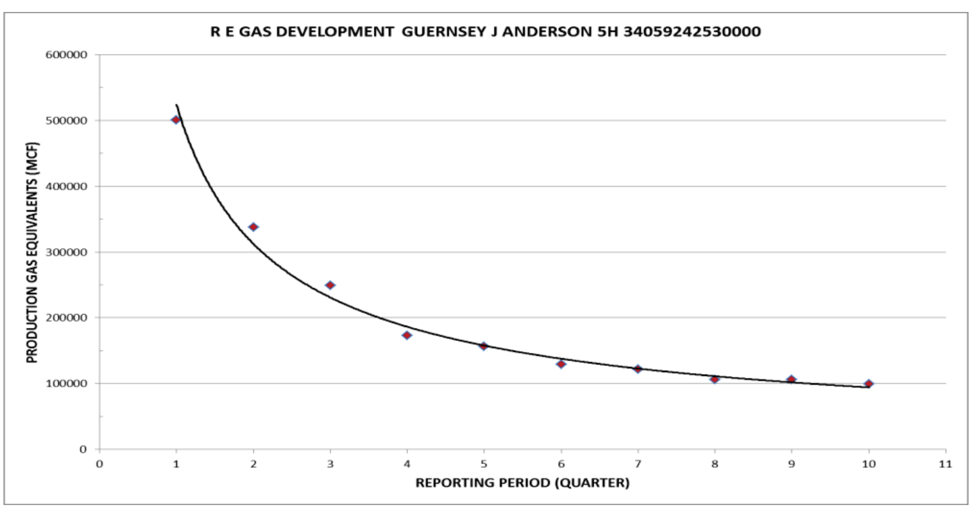

Figure 3.3. Natural gas decline curve for Antero Resources J Anderson 5H, normal pressured region, Guernsey Co. (Thomas et. al., 2017)

After carefully analyzing the maps, composite decline curves were constructed using water production characteristics of sixty representative wells by region. These composite decline curves express water production in terms of percent reduction as a function of time. Percent production decline is important as it provides a means of estimating future produced water volumes based on geographic location within the play and initial produced water volume.

3.7 Data Validation

This research utilized water production data from 2011 through the first quarter of 2017. At the conlcusion of this research, an additional four quarters of water production data were available. Water production data from the second quarter of 2017 through the first quarter of 2018 were plotted on the existing decline curves to compare and validate the trend lines.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 Decline Curves for the Sixty Selected Wells

A total of sixty wells were selected for the characterization phase of the research. Sorting methods in Excel were used to select wells that met the first two criteria: completeness of record and longevity of record. Wells with at least eighty percent days of production and seven or more quarters of production were the desired requirements for well selection before the final spatial criterion was met. On occasion, prior to the final wells being selected spatially, the volume of gas produced per quarter was also analyzed and compared to the volume of water reported for the correlating quarter. It is generally understood that gas expansion drives fluids such as produced water. Therefore, there is a general correlation between gas production and water production. Gas production was not a criterion for well selection, but was a useful tool when reported water volumes seemed erroneous. Oil and gas companies report volumes of oil and gas very carefully because of regulatory compliance responsibilities. However, through the course of this research, two types of suspected erroneous water reporting were discovered.

The first type is reported water volumes that did not correlate to reported oil and gas volumes. The second type was produced water and gas production data that were missing for one or more production quarters. It was vital to the research to select wells that had accurate reporting of data. Subsequently, wells that did not report matching decline for both water and gas were excluded, as were wells with missing data. The following figures are examples of wells that were not selected for the research, with an explanation justifying their exclusion.

Figure 4.0 shows NGO Development well Cosh Mill Creek A-1A located in Coshocton County, Millcreek Township. The well meets the criteria for minimum of eighty percent days production and minimum seven production quarters. However, the volume of gas produced per quarter is not consistent with the volume of water reported. This may indicate erroneous reporting for water volumes. For this reason, this well was not selected for the research.

PERIOD	GAS	WATER	WATER/1000'	%DAYS PROD
1	0	0	0	0
2	0	22159	5004	18
3	0	0	0	0
4	0	0	0	0
5	0	0	0	0
6	0	0	0	0
7	0	0	0	0
8	0	0	0	0
9	0	0	0	0
10	0	1267	286	100
11	4649	3069	693	100
12	19397	1369	309	100
13	12108	666	150	100
14	13903	840	190	100
15	13956	589	133	100
16	10119	454	103	100
17	9324	456	103	100
18	10587	265	60	100
19	9448	422	95	100

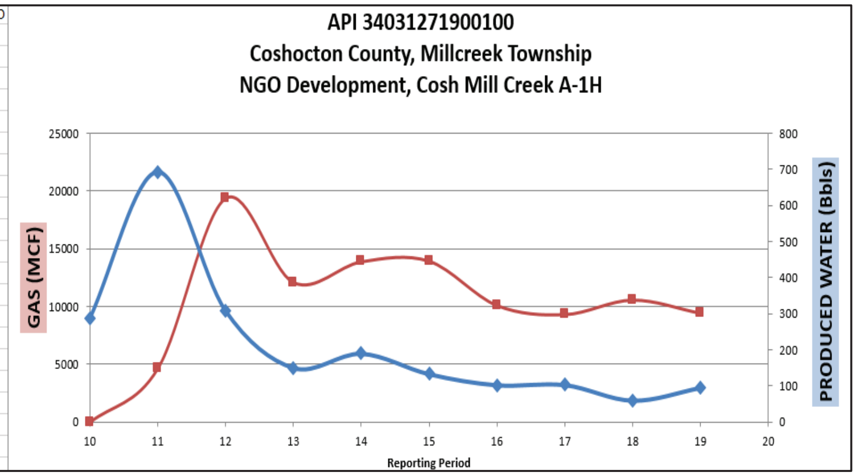

Figure 4.0. NGO Development well Cosh Mill Creek A-1H showing reported water volume that is inconsistent with reported gas volume.

Figure 4.1 shows Gulfport Energy well Lyon 3-27H located in Harrison County, Washington Township. This well has two missing reporting quarters for water and gas production. For this reason, this well was not selected for the research.

YEAR/QUARTER	PERIOD	GAS	WATER	WATER/1000'	% DAYS PROD
2011	1	0	0	0	0
2012	2	0	0	0	0
2013 Q1	3	0	0	0	0
2013 Q2	4	0	0	0	0
2013 Q3	5	42977	5444	1015	24
2013 Q4	6	71546	6012	1121	88
2014 Q1	7	52910	2100	392	100
2014 Q2	8	47115	1407	262	92
2014 Q3	9	46906	1357	253	97
2014 Q4	10	0	0	0	no data
2015 Q1	11	0	0	0	no data
2015 Q2	12	70559	997	186	85
2015 Q3	13	29697	1343	250	47
2015 Q4	14	37406	2577	481	98
2016 Q1	15	29253	763	142	92
2016 Q2	16	23682	703	131	89
2016 Q3	17	26460	711	133	97
2016 Q4	18	24113	601	112	98
2017 Q1	19	20450	429	80	94

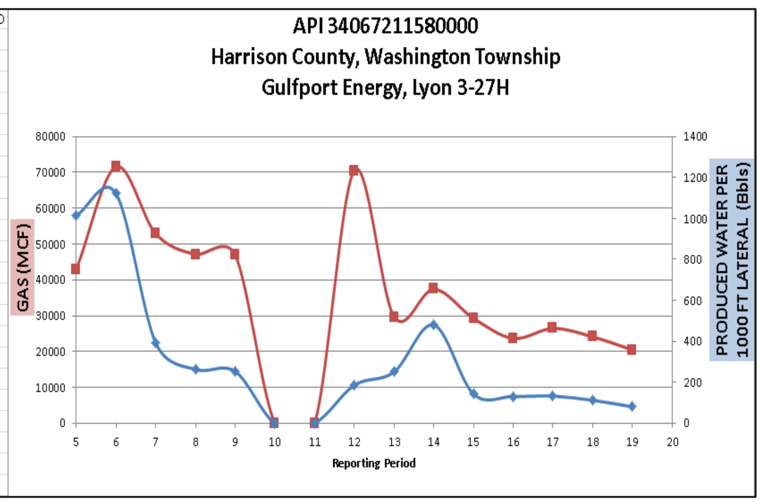

Figure 4.1. Gulfport Energy well Lyon 3-27H showing erroneous reported water and gas volumes.

The following figures are examples of wells that were selected for the research, with an explanation justifying their inclusion. Figures 4.2 and 4.3 show Gulfport Energy well Amanda 1-14 located in Belmont County, Somerset Township. This well is located in the over pressured region where controlled production methods are used by the well operator. Figure 4.2 shows evidence of controlled production for periods nine through twelve, and the resultant decline curve. Figure 4.3 shows a decline curve with periods nine through twelve eliminated. This well was included in the research with those quarters eliminated.

YEAR/QUARTER	PERIOD	GAS	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0	0
2012	2	0	0	0	0
2013 Q1	3	0	0	0	0
2013 Q2	4	0	0	0	0
2013 Q3	5	0	0	0	0
2013 Q4	6	0	0	0	0
2014 Q1	7	0	0	0	0
2014 Q2	8	0	0	0	0
2014 Q3	9	615820	4581	582	87
2014 Q4	10	625057	813	103	93
2015 Q1	11	807634	1963	249	97
2015 Q2	12	886571	3210	408	98
2015 Q3	13	1032326	4568	580	96
2015 Q4	14	787975	3462	440	99
2016 Q1	15	609307	2614	332	99
2016 Q2	16	516065	2337	297	100
2016 Q3	17	450342	1781	226	98
2016 Q4	18	398708	1561	198	99
2017 Q1	19	356026	1366	173	100

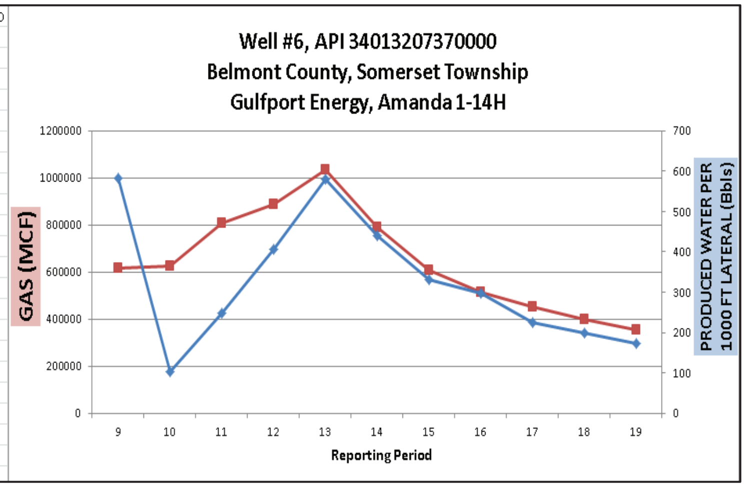

Figure 4.2. Gulfport Energy well Amanda 1-14H showing controlled production for production period nine through twelve.

YEAR/QUARTER	PERIOD	GAS	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0	0
2012	2	0	0	0	0
2013 Q1	3	0	0	0	0
2013 Q2	4	0	0	0	0
2013 Q3	5	0	0	0	0
2013 Q4	6	0	0	0	0
2014 Q1	7	0	0	0	0
2014 Q2	8	0	0	0	0
2014 Q3	9	615820	4581	582	87
2014 Q4	10	625057	813	103	93
2015 Q1	11	807634	1963	249	97
2015 Q2	12	886571	3210	408	98
2015 Q3	13	1032326	4568	580	96
2015 Q4	14	787975	3462	440	99
2016 Q1	15	609307	2614	332	99
2016 Q2	16	516065	2337	297	100
2016 Q3	17	450342	1781	226	98
2016 Q4	18	398708	1561	198	99
2017 Q1	19	356026	1366	173	100

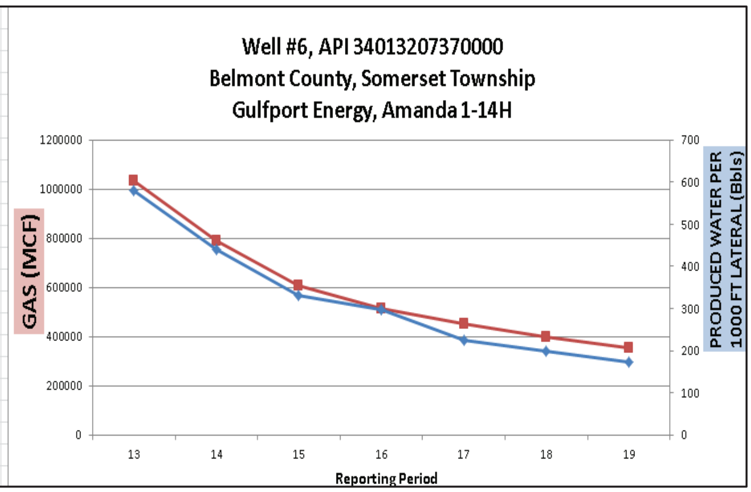

Figure 4.3. Gulfport Energy well Amanda 1-14H showing a decline curve with controlled production periods nine through twelve eliminated.

Figure 4.4 shows Eclipse Resources well Hayes Unit 6H located in Guernsey County, Millwood Township. This well is also located in the over pressured region where controlled production methods are used by well operators. The production characteristics of this well suggest the operator was restricting the well choke. During period six it appears the well was shut in. Water and gas production correspond closely for this well and thus it was selected for the research. Production of the Point Pleasant is “gas expansion,” or pressure driven. Since gas expansion pushes fluids to the surface, it is logical to use gas production history as a means of evaluating water production records.

YEAR/QUARTER	PERIOD	GAS	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0	0
2012	2	0	0	0	0
2013 Q1	3	0	0	0	0
2013 Q2	4	0	0	0	0
2013 Q3	5	0	0	0	0
2013 Q4	6	0	0	0	0
2014 Q1	7	0	0	0	0
2014 Q2	8	0	0	0	0
2014 Q3	9	0	0	0	0
2014 Q4	10	54118	4557	718	36
2015 Q1	11	188650	4484	707	100
2015 Q2	12	244211	7959	1254	99
2015 Q3	13	62904	2002	315	99
2015 Q4	14	131913	3783	596	99
2016 Q1	15	5121	151	24	99
2016 Q2	16	90451	751	118	99
2016 Q3	17	97728	2621	413	98
2016 Q4	18	86803	2247	354	98
2017 Q1	19	76484	1826	288	100

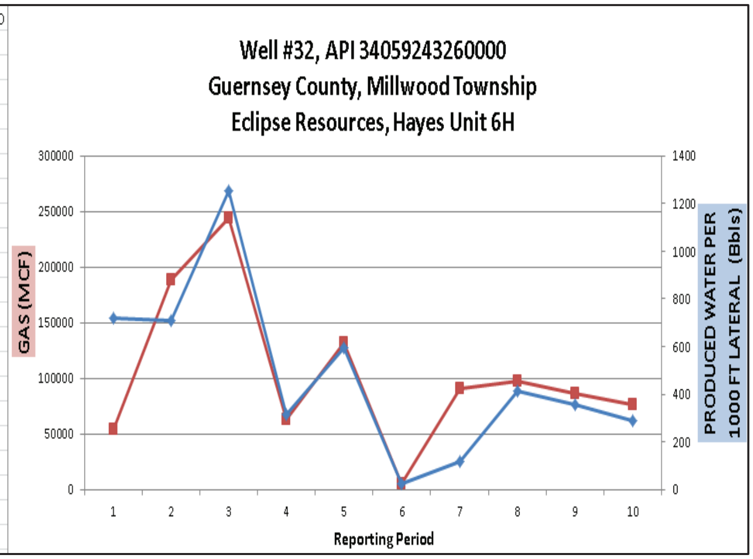

Figure 4.4. Eclipse Resources well Hayes Unit 6H showing evidence of a controlled choke procedure used in the over-pressured zone.

Production decline curves for the sixty representative wells were contructed using ODNR DOGRM production reports from 2011 through the first quarter of 2017. The decline curves express water production in Bbls/Mft. Using Excel, production data for each well were plotted as a function of time (periods). There are a total of nineteen periods of production for the duration of the research. Period one correlates to the year 2011. Period nineteen correlates to quarter one of 2017. A trend line was fit to the data for an additional twenty-three periods, which equates to quarter four of 2022. The initial production period varies for each representative well. The decline curves reflect those initial production periods. Production trend lines were created within Excel using the "power" function. This function within Excel is best utilized with data sets that compare measurements of a given entity over a certain amount of time. The data in this research compare measurements of produced water over time. The power function thus creates a trend line that best estimates the decline in produced water over the length of the research time period.

The following figures (Figure 4.5 and 4.6) demonstrate constructed decline curves and correlating trend lines for two of the sixty representative wells. The decline curves for the sixty selected wells used in the research can be found in Appendix A, and are identified as Appendices A.1 through A.60. Each decline curve is numbered (1-60) according to their location on the well locator map (Figure 3.0).

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	138	22	0
2014 Q3	9	1745	277	76
2014 Q4	10	318	50	100
2015 Q1	11	1991	316	100
2015 Q2	12	1520	241	98
2015 Q3	13	1120	178	100
2015 Q4	14	1100	175	100
2016 Q1	15	710	113	100
2016 Q2	16	880	140	99
2016 Q3	17	795	126	100
2016 Q4	18	581	92	100
2017 Q1	19	643	102	100

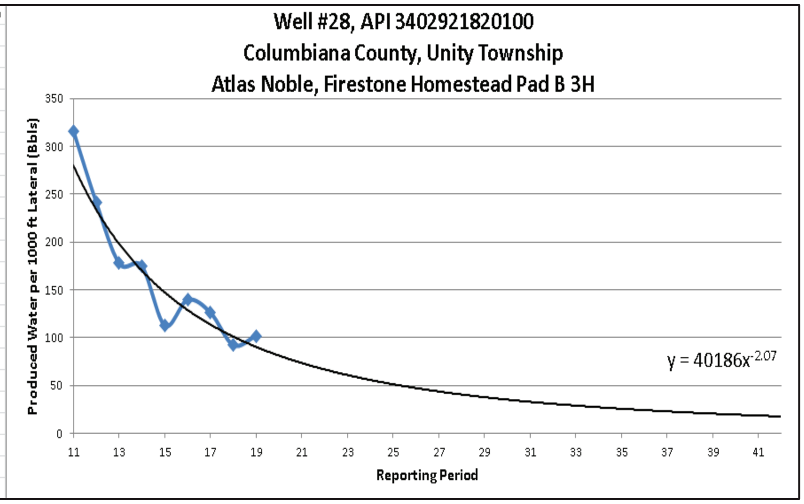

Figure 4.5 Well 28. Decline curve and correlating trend line, expressing water production in Bbls/Mft.

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	7198	1551	2
2013 Q1	3	0	0	0
2013 Q2	4	1044	225	14
2013 Q3	5	695	150	22
2013 Q4	6	2303	496	92
2014 Q1	7	1412	304	91
2014 Q2	8	989	213	97
2014 Q3	9	848	183	99
2014 Q4	10	1166	251	88
2015 Q1	11	647	139	87
2015 Q2	12	672	145	100
2015 Q3	13	618	133	91
2015 Q4	14	485	104	99
2016 Q1	15	431	93	96
2016 Q2	16	410	88	99
2016 Q3	17	375	81	99
2016 Q4	18	267	58	100
2017 Q1	19	335	72	99

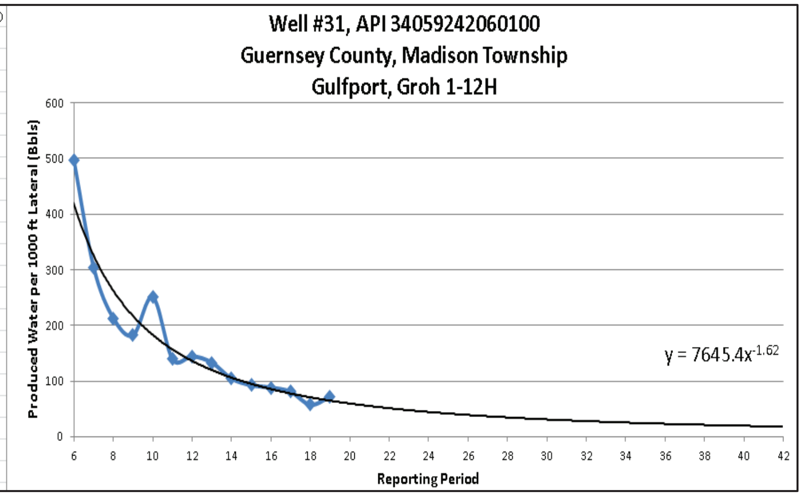

Figure 4.6. Well 31. Decline curve and correlating trend line, expressing water production in Bbls/Mft.

4.2 Annual and Cumulative Maps

Maps of annual and cumulative production of the sixty selected wells for the years 2012-2017 provided a visual representation of production characteristics as a function of spatial distribution. The maps were analyzed to locate similarities in water production volume by region, and ultimately two regions of production were identified; the northern and the southern region. The line of demarcation of the northern and southern zones passes through Harrison and Jefferson Counties (Figure 4.11) and corresponds to the line of demarcation of the normal and over pressured zones identified by Taylor McClain (McClain, 2013). On behalf of Range Resources, McClain presented research at the Pittsburgh Association of Petroleum Geologists May 2018 meeting. This research reveals the distinction between low initial production in the "Utica Source" (normal pressure) region and high initial production in the "Utica Seal" (over pressured) region (Fig 4.7). The line of demarcation in McClain's research is very close to the water production line of demarcation identified in Figure 4.11.

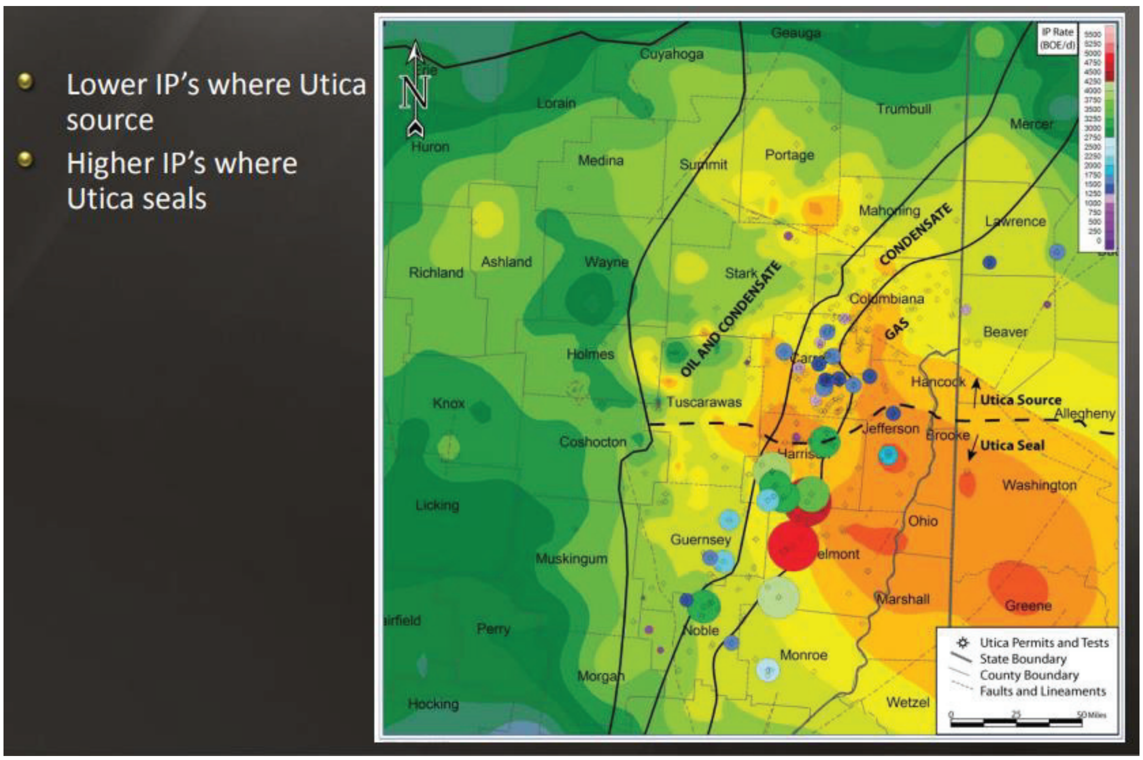

Figure 4.7. Taylor McClain, Range Resources; research showing line of demarcation (dashed black line) that distinguishes between the Utica source (normal pressure) and Utica seal (over pressured) regions.

4.3 Annual Maps

Figures 4.8 through 4.13 are maps of annual produced water for the sixty selected wells during the years 2012-2017. All maps were created using produced water data expressed as barrels per 1000 feet of lateral (Bbls/Mft) to compensate for the influence of varying lateral lengths.

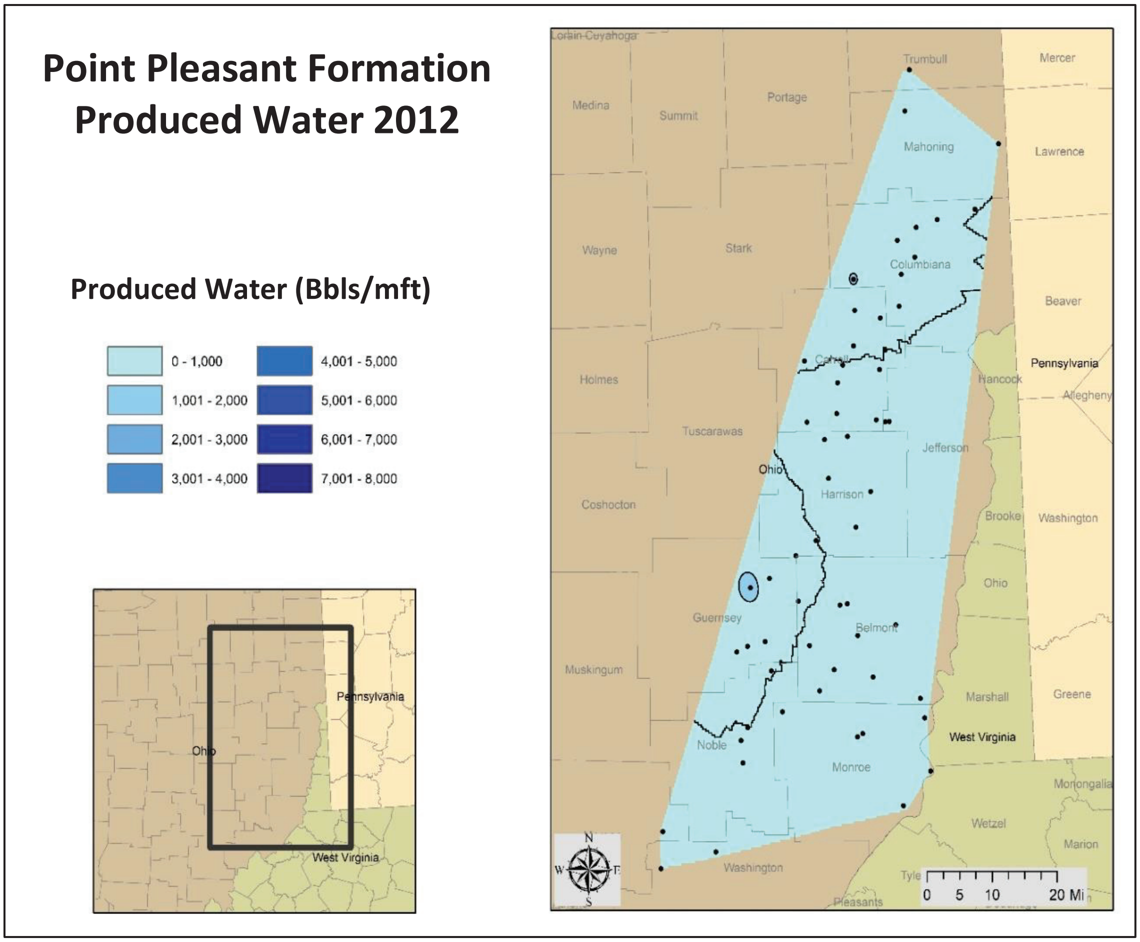

Figure 4.8. Annual produced water in barrels per 1000 feet of lateral for the sixty selected wells during the year 2012.

Figure 4.8 illustrates that produced water volumes for 2012 were generally within the same range from 0-1000 barrels. Only two wells used in this study produced water in 2012. Those two wells combined produced 2641 barrels per thousand feet of lateral.

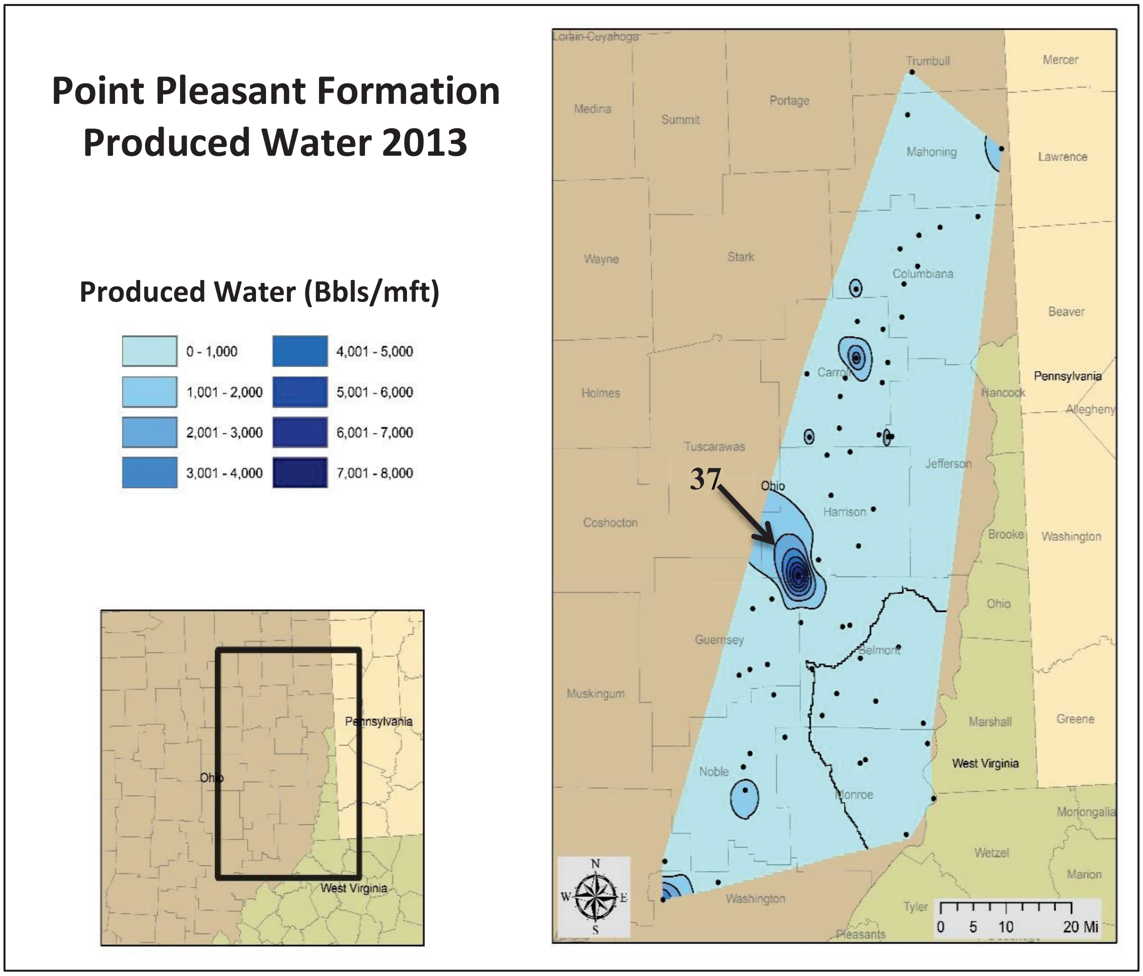

Figure 4.9. Annual produced water in barrels per 1000 feet of lateral for the sixty selected wells during the year 2013.

Figure 4.9 illustrates that most wells are still producing water in the 0-1000 barrels range. By the fourth quarter of 2013, twelve of the sixty selected wells for this study were producing. It is important to note well 37 in the southwest corner of Harrison County is located within the over-pressured zone. This well, Gulfport Energy Clay 4-4H, produced 7171 barrels of water per thousand feet of lateral length.

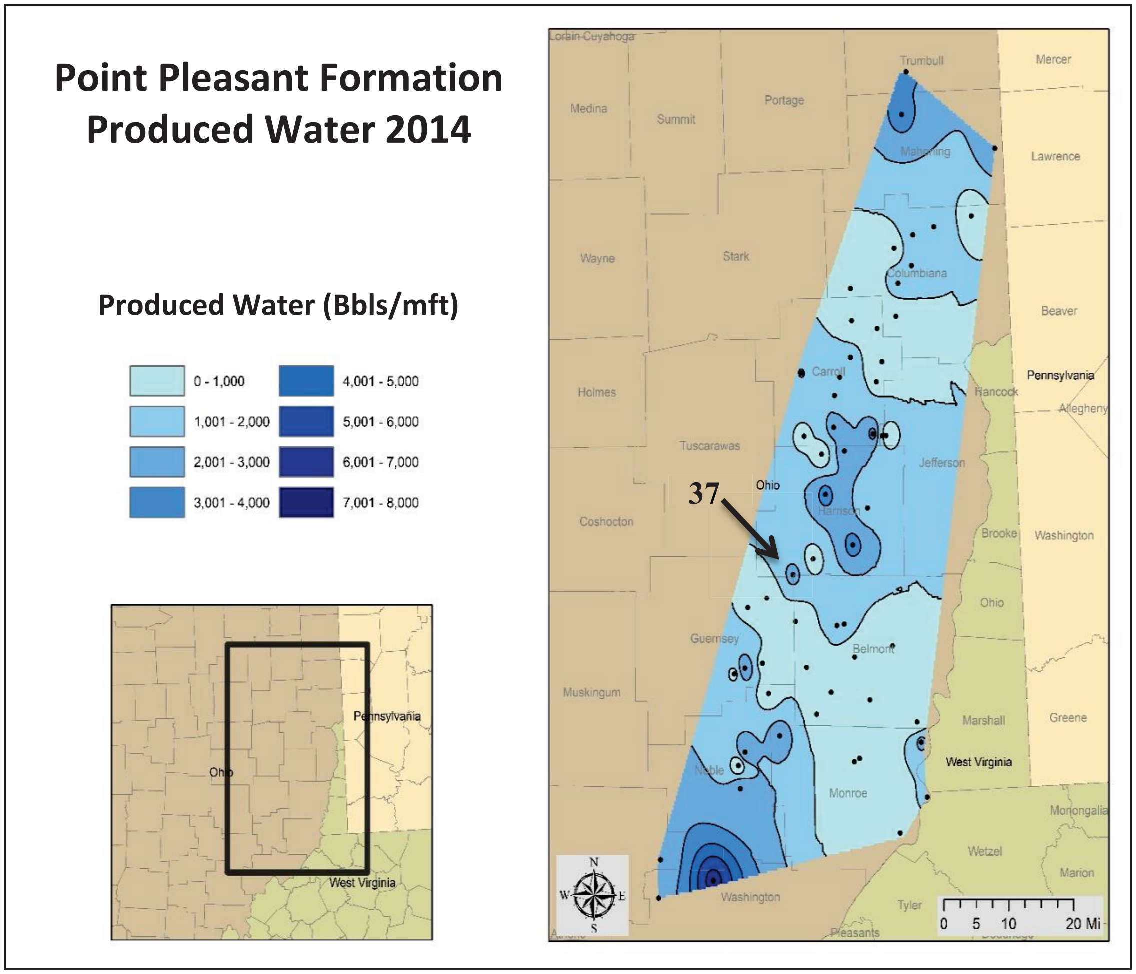

Figure 4.10. Annual produced water in barrels per 1000 feet of lateral for the sixty selected wells during the year 2014.

Figure 4.10 illustrates water production for nearly half of the wells used in this study. By the fourth quarter of 2014, thirty-four of the sixty selected wells were producing. Well 37 in the southwest corner of Harrison County had a slight decrease in produced water for the year 2014. The map shows a value of 2347 barrels of water per thousand feet of lateral length for this well. This well had fewer days of production for 2014 than the previous year. This may be due in part to well operations. Produced water volume for well 37 remains in the lower range throughout the remaining research time period.

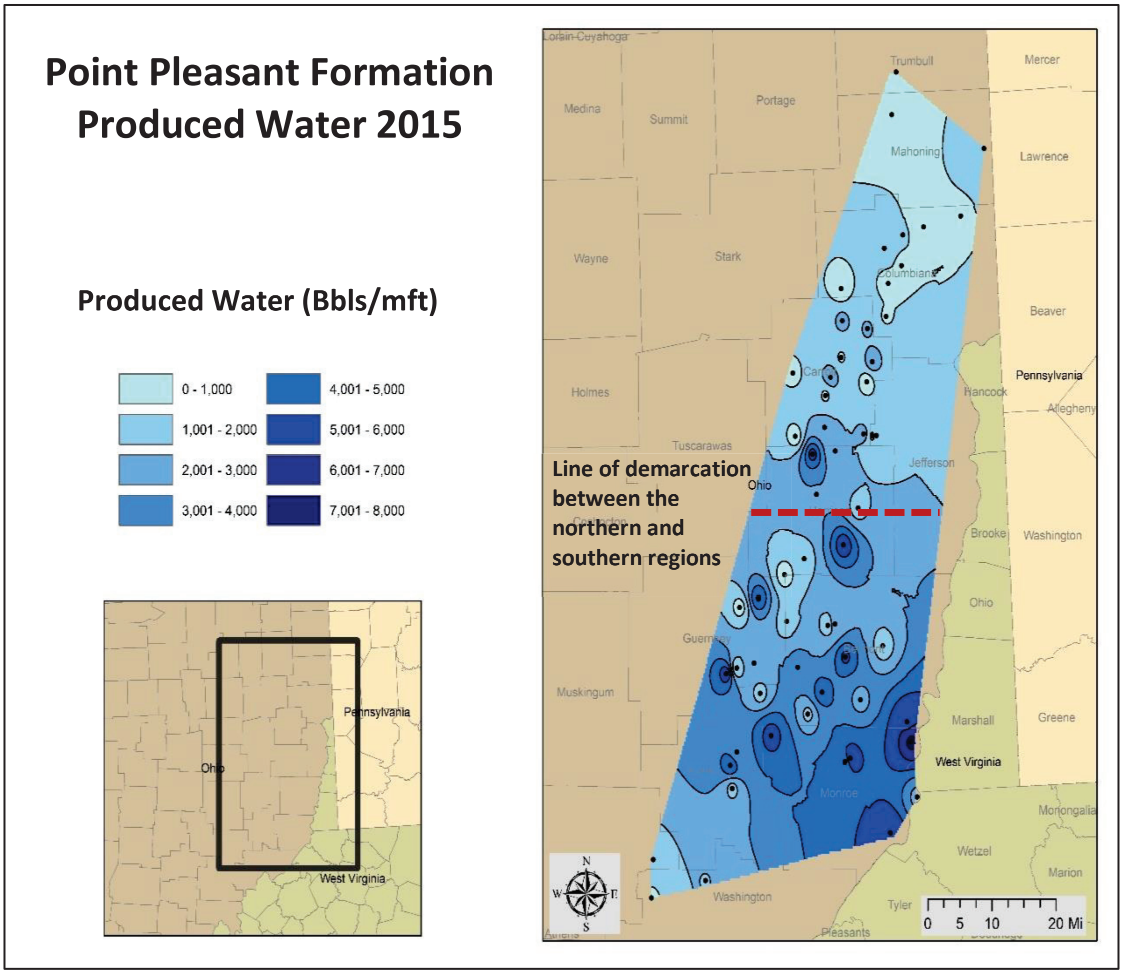

Figure 4.11. Annual produced water in barrels per 1000 feet of lateral for the sixty selected wells during the year 2015.

Figure 4.11 illustrates an overall increase in water production for most of the wells. By the second quarter of 2015, all wells were producing. This year of the research time period has the highest volume of produced water. A line of demarcation between the northern and southern regions is apparent during this year of production. This map provides a visual representation that the northern region produces less water than the southern region. These two regions correlate to the work of McClain (2013), in which he identified a similar line of demarcation that distinguishes between the Utica source (normal pressure) and Utica seal (over pressured) regions (Figure 13).

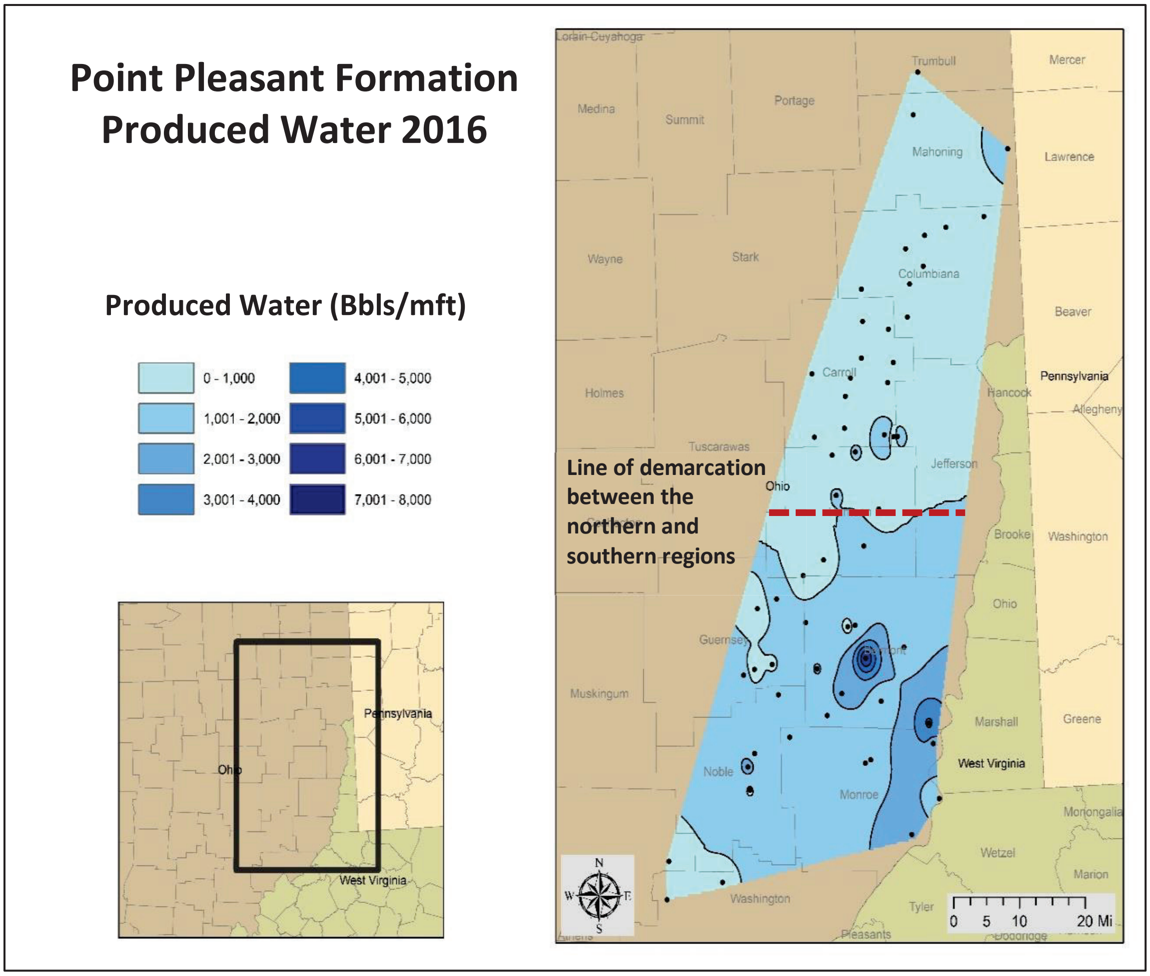

Figure 4.12. Annual produced water in barrels per 1000 feet of lateral for the sixty selected wells during the year 2016.

By 2016, the wells selected for this study are in late stages of production. Accordingly, Figure 4.12 illustrates a lower amount of produced water for the sixty selected wells. The year 2016 is the last full year of the research time period, and most of the wells (53) produced between zero to two-thousand barrels of water per thousand feet of lateral. During this year, thirty-three wells are in the 0-1000 barrel range, twenty are in the 1001-2000 range, five are in the 2001-3000 range, one is in the 4001-5000 range, and one is in the 5001-6000 range. The line of demarcation is still apparent.

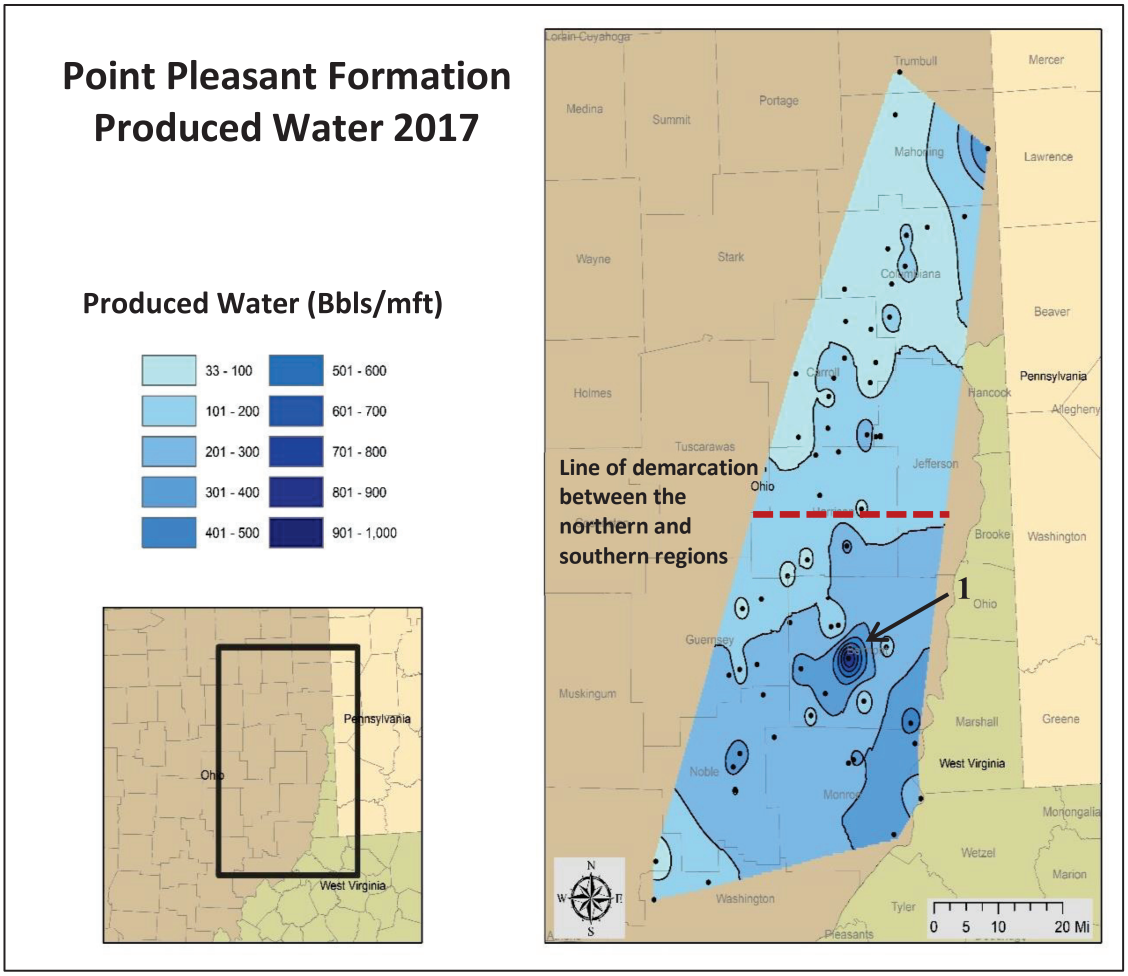

Figure 4.13. Annual produced water in barrels per 1000 feet of lateral for the sixty selected wells during the year 2017.

Figure 4.13 illustrates water production for only the first quarter of 2017. Note the produced water map key. The highest reported amount on this map is in the 801-900 barrel range. Rice Drilling well Krazy Train 4H, identified as #1 on the map, produced 807 barrels of water per thousand feet of lateral length during the first quarter of 2017. Of the sixty selected wells, it is the highest producing well for the length of the research time period. Based on analysis of ODNR DOGRM water production data, it produced 117,395 total barrels of water over a total of 563 production days. Its lateral length is 9829 feet, and it produced 11944 barrels of water per thousand feet of lateral. The line of demarcation is still apparent.

4.4 Cumulative Maps

Figures 4.14 through 4.18 are maps of cumulative produced water for the sixty selected wells for years 2012-2013, 2012-2014, 2012-2015, 2012-2016, and 2012-2017. All maps were created using produced water data expressed as barrels per 1000 feet of lateral (Bbls/Mft) to compensate for the influence of varying lateral lengths.

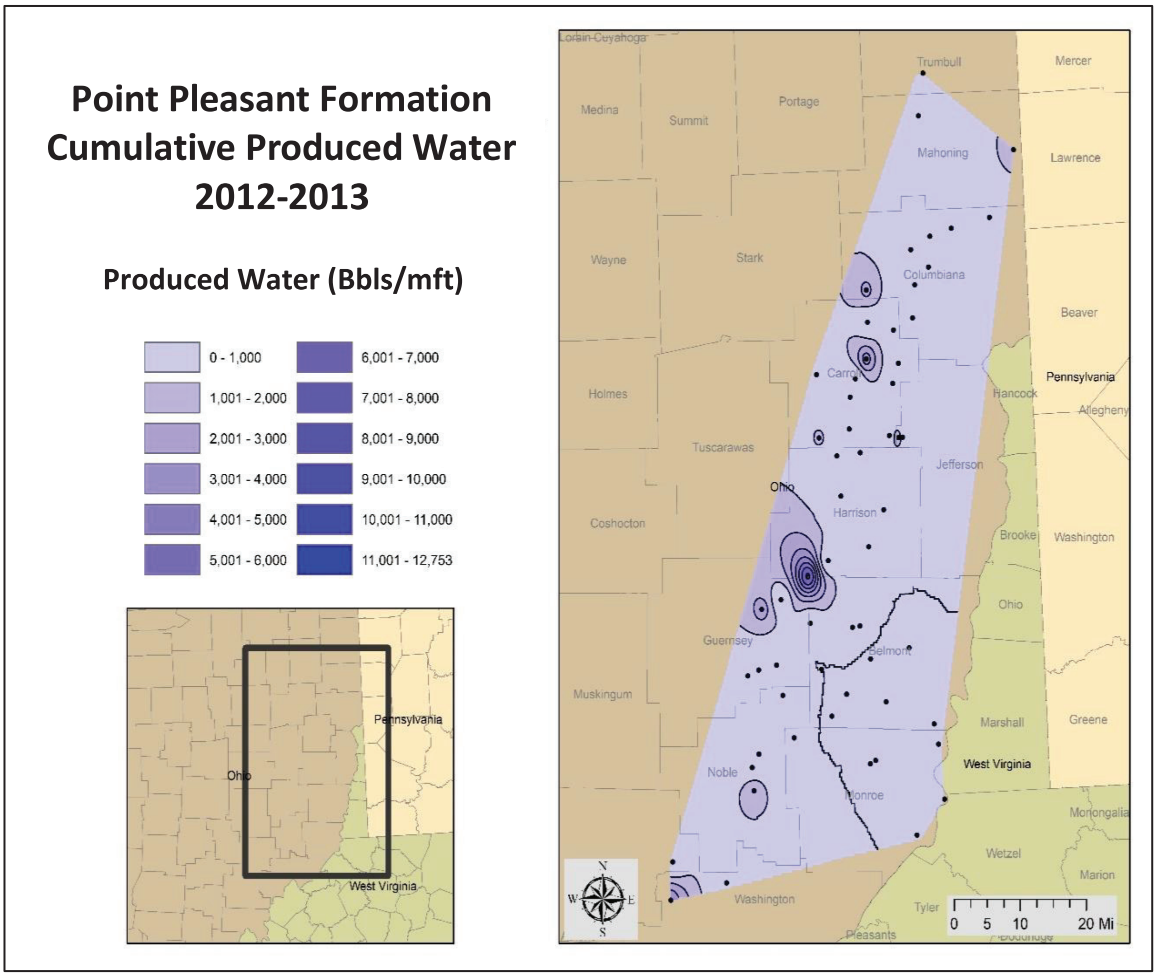

Figure 4.14. Cumulative produced water in barrels per 1000 feet of lateral for each of the sixty selected wells during years 2012-2013.

Figure 4.14 illustrates the cumulative produced water volume for the years 2012 and 2013 combined. By the fourth quarter of 2013, twelve of the sixty selected wells were producing. Based on analysis of ODNR DOGRM water production data, years 2012 through 2013 had a combined total of 26,517 barrels of produced water per thousand feet of lateral length.

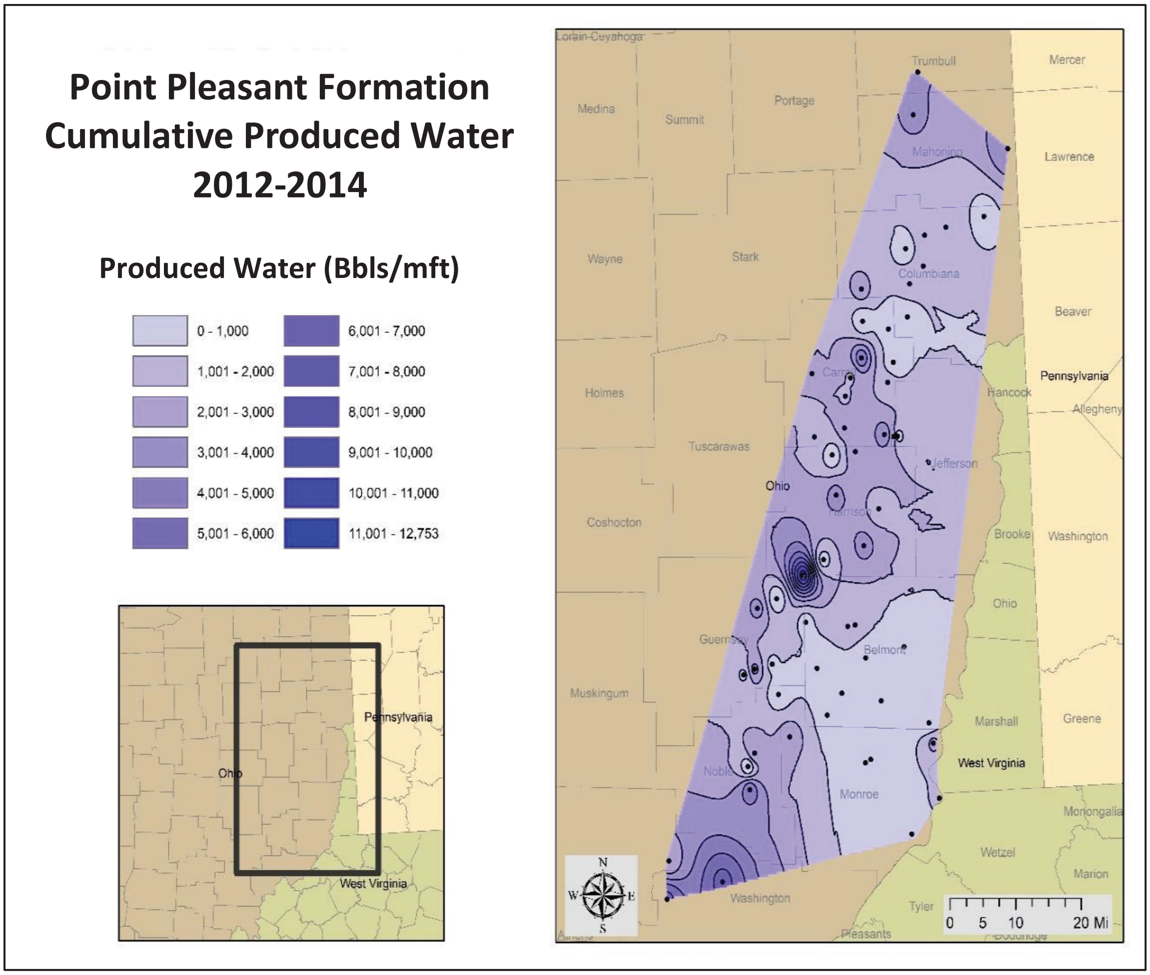

Figure 4.15. Cumulative produced water in barrels per 1000 feet of lateral for each of the sixty selected wells during years 2012-2014.

Figure 4.15 illustrates the cumulative produced water volume for years 2012 through 2014. This map shows more of an increase in water production than the previous map. By the fourth quarter of 2014, thirty-four of the sixty selected wells were producing. Based on analysis of ODNR DOGRM water production data, years 2012 through 2014 had a combined total of 108,180 barrels of produced water per thousand feet of lateral length.

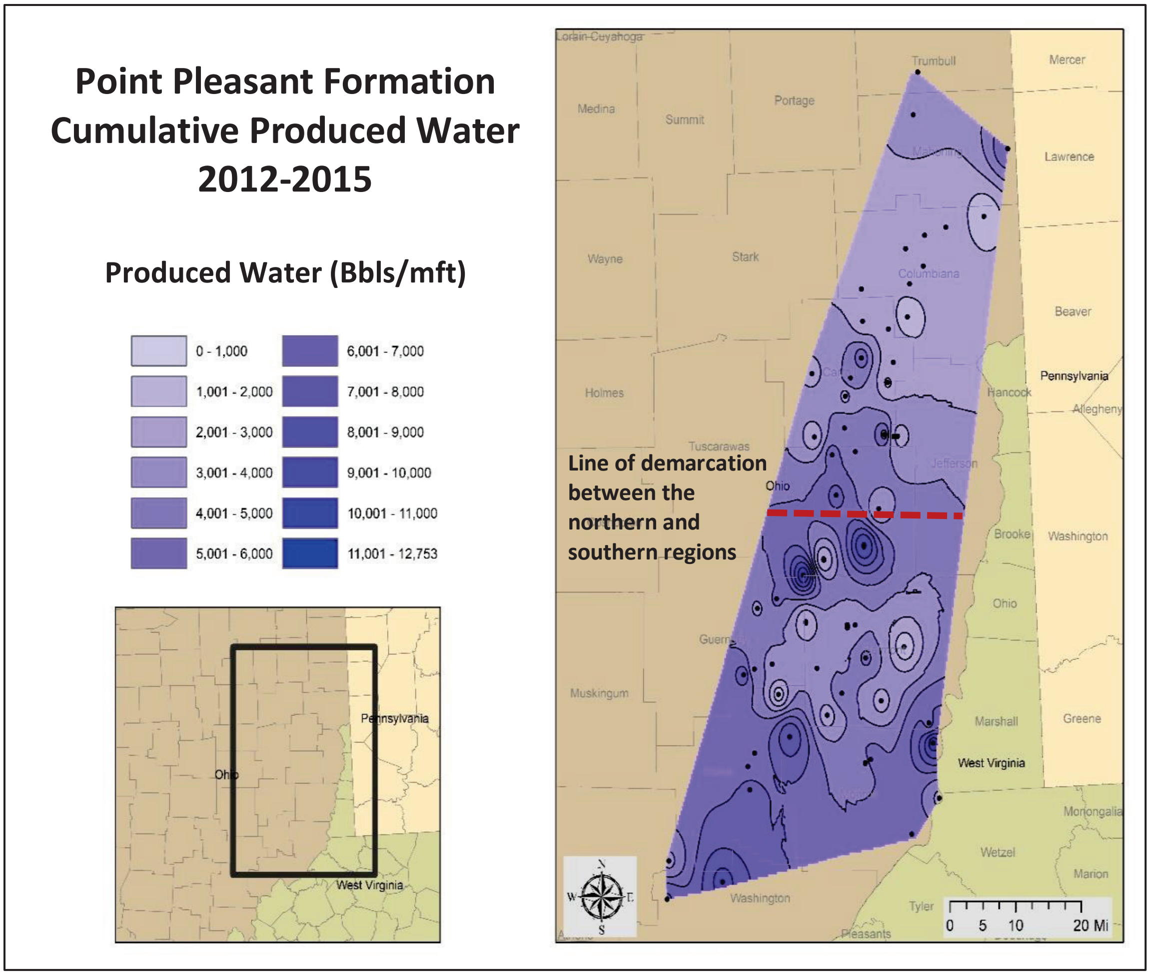

Figure 4.16. Cumulative produced water in barrels per 1000 feet lateral for each of the sixty selected wells during years 2012-2015.

Figure 4.16 illustrates the cumulative produced water volume for years 2012 through 2015. All wells were producing by the fourth quarter of 2015. Based on analysis of ODNR DOGRM water production data, years 2012 through 2015 had a combined total of 254,779 barrels of produced water per thousand feet of lateral length. As with the annual production map for 2015, this cumulative map also shows a line of demarcation between the northern and southern regions. This map provides a visual representation that the northern region produced less water than the southern region. The line becomes more apparent in the next two maps (Figures 4.17 and 4.18).

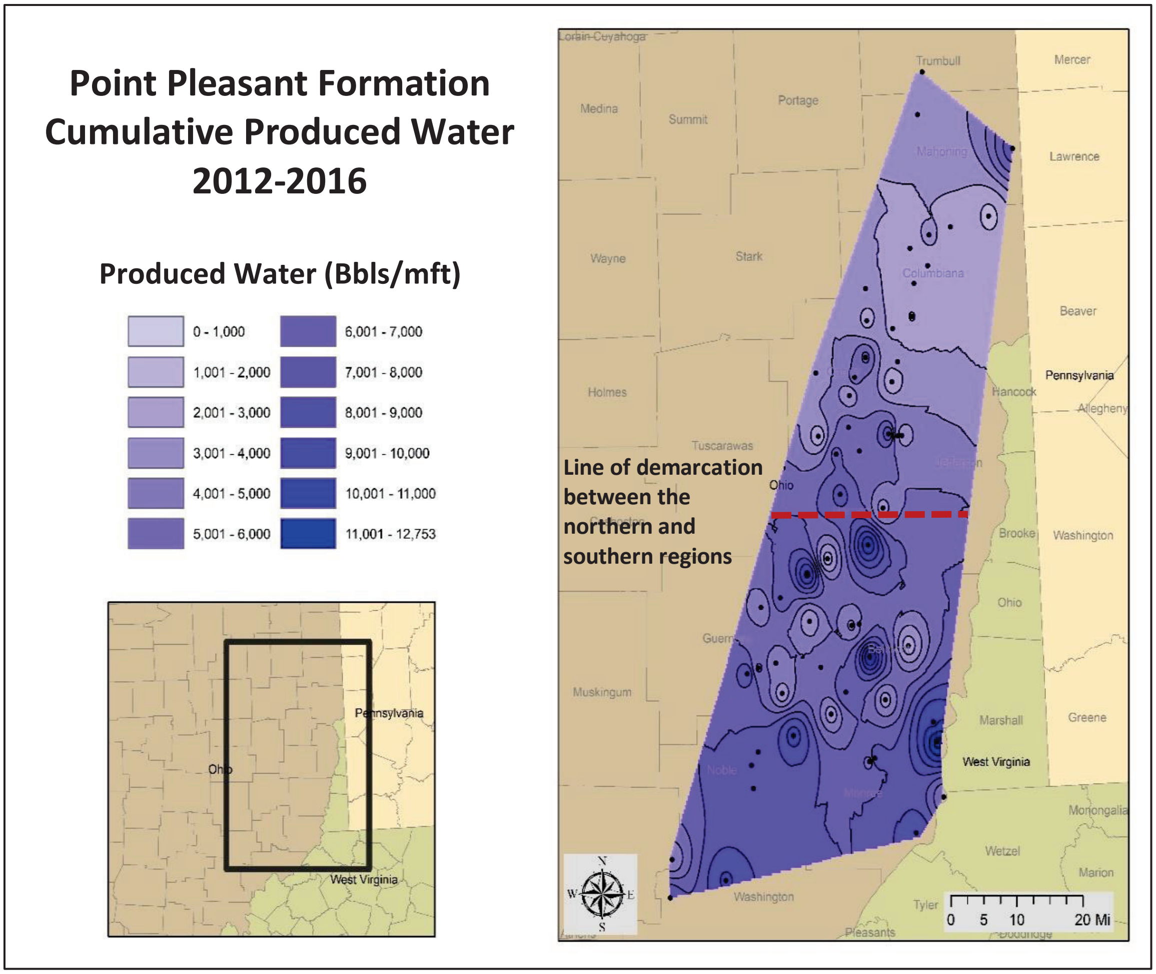

Figure 4.17. Cumulative produced water in barrels per 1000 feet lateral for each of the sixty selected wells during years 2012-2016.

Figure 4.17 illustrates the cumulative produced water volume for years 2012 through 2016. As expected, this map shows an increase water production throughout the entire research region, and the line of demarcation is more evident. Based on analysis of ODNR DOGRM water production data, years 2012 through 2016 had a combined total of 322,969 barrels of produced water per thousand feet of lateral length.

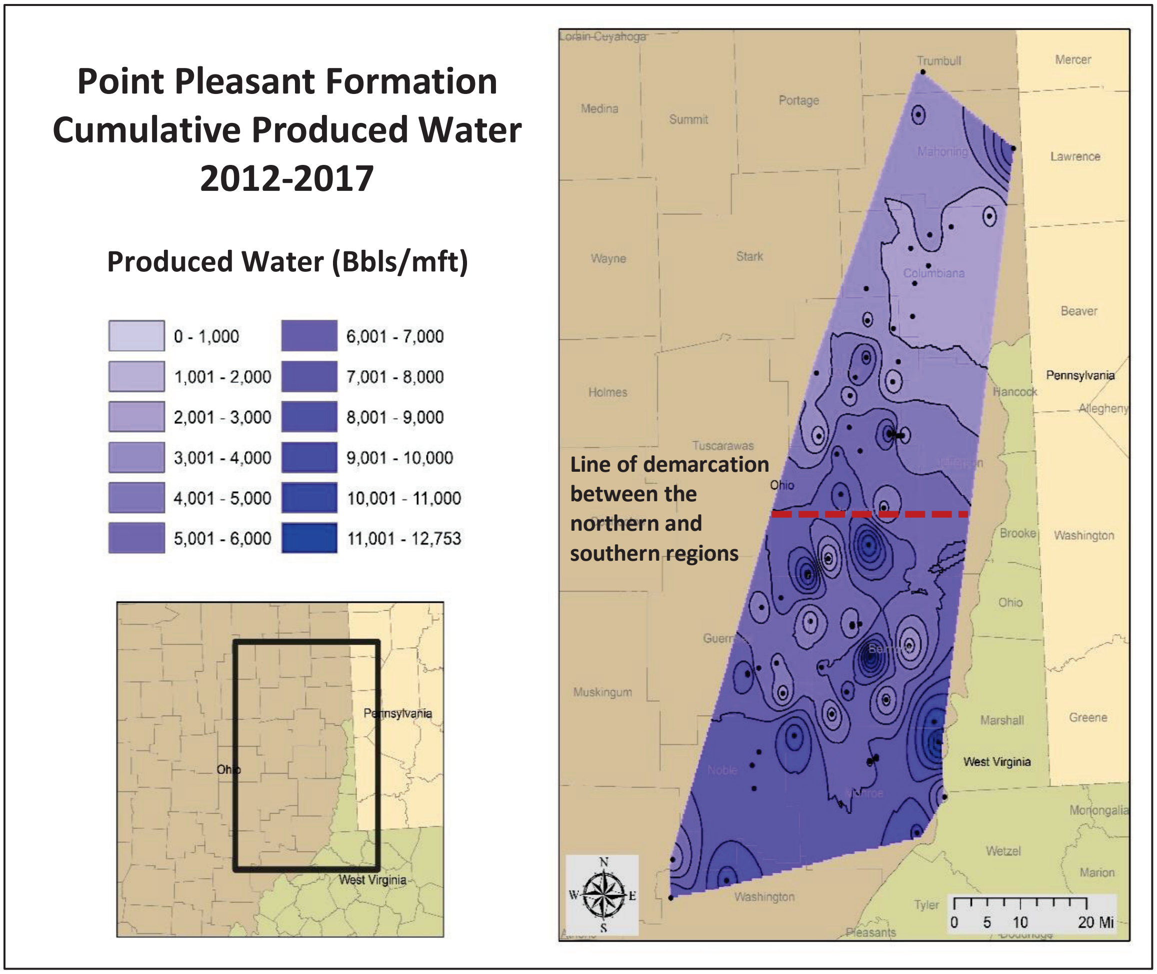

Figure 4.18. Cumulative produced water in barrels per 1000 feet lateral for each of the sixty selected wells during years 2012-2017.

Figure 4.18 illustrates the cumulative produced water volume for years 2012 through 2017. Based on analysis of ODNR DOGRM water production data, years 2012 through 2017 had a combined total of 333,867 barrels of produced water per thousand feet of lateral length. The line of demarcation between normal and overpressured regions is well distinguished. It is apparent that the total cumulative volume of produced water for the southern region is much higher than for the northern region. Based on analyzation of ODNR DOGRM water production data, the northern region has a cumulative total of 114,417 barrels of produced water per thousand feet of lateral. The southern region has a cumulative total of 219,450 barrels of produced water per thousand feet of lateral.

4.5 Composite Decline Curves

Composite decline curves were created for the two regions identified from the maps: north and south. A total of twenty-eight wells makes up the northern region. A produced water composite decline curve was created for the northern region by using the average periodic water production values to calculate the percent of decline per period (Tables 4.0 and 4.1). A trend line was constructed for the northern region to predict future volumes of produced water, expressed in percent decline (Figure 4.19). Period 4 represents year one. Period 20 represents year five. The northern region trend line suggests that future production for the first five years of any given well in the northern region will remain in the sixty-nine (69%) to ninety-five (95%) percent decline range (Table 4.4).

A total of 32 wells makes up the southern region. A produced water composite decline curve was created for the southern region by using the average periodic water values to calculate the percent of decline per period (Tables 4.2 and 4.3). A trend line was constructed for the southern region to predict future volumes of produced water, expressed in percent decline (Figure 4.20). Period 4 represents year one. Period 20 represents year five. The southern region trend line suggests that future production for the first five years of any given well in the southern region will remain in the sixty-three (63%) to ninety-five (95%) percent decline range (Table 4.4).

Table 4.0. Periodic production values for northern group of wells (Bbls/Mft).

	PRODUCTION PERIODS FOR NORTHERN GROUP OF WELLS (BARRELS PER 1000 FEET LATERAL)																
WELL #	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
11	817	256	98	127	112	99	97	87									
12	1503	1152	771	441	317	265	212	198	177	163							
13	759	292	360	331	174	147	80	59									
14	543	257	191	140	125	117	99	87									
15	959	697	206	103	209	173	168	123	134	105	99	46					
16	223	204	177	131	97	98	58	82	68	66	63	61	49				
17	1494	955	925	66	475	422	345	454	383	294							
18	269	188	135	120	71	89	93	44	51	49	47	39					
19	1110	408	474	429	212	287	227	140	123								
20	519	343	319	358	200	118	105	98	95	90	92	84					
21	1161	617	342	265	202	208	210	285	172	170	150	132	121	102			
22	718	596	303	224	223	141	87	90	70								
23	457	385	263	241	83	201	179	174	140	134	118						
24	390	167	193	135	126	109	79	68	59	52							
25	356	270	286	89	235	172	152	134	145	117							
26	538	325	253	219	187	64	142	149	128	119	93	78					
27	419	332	264	230	202	165	149	180	125	108							
28	316	241	178	175	113	140	126	92	102								
29	601	262	151	121	114	94	68	56	40	82	84	51	53	77	40	44	33
35	1089	608	448	286	205	153	146	153	128	86							
39	3286	1112	603	391	150	168	127	100									
40	923	523	293	656	632	477	474	267	188	125	109						
41	1800	1029	522	998	423	301	298	232	195	193							
42	479	413	380	312	288	234	210										
43	536	418	277	241	233	21	178	180	152	143	131	127					
44	1486	513	230	144	113	99	85	75	63	55	54	55					
45	943	651	534	502	493	473	434	393	467	410	399	424	392				
58	634	220	187	79	85	69	61	53	49	45	45	39					

Table 4.1. Average periodic production values and percent decline values per northern well (Bbls/Mft).

NORTHERN GROUP PRODUCTION PERIODS																
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
NUMBER OF WELLS IN PRODUCTION PER PERIOD																
28	28	28	28	28	28	28	27	23	20	13	11	4	2	1	1	1
TOTAL AVERAGE WATER PRODUCTION PER PERIOD PER 1000 FEET LATERAL																
869	480	334	270	218	182	167	150	141	130	114	103	154	89	40	44	33
PERCENT DECLINE PER PRODUCTION PERIOD																
100	45	62	69	75	79	81	83	84	85	87	88	82	90	95	95	96

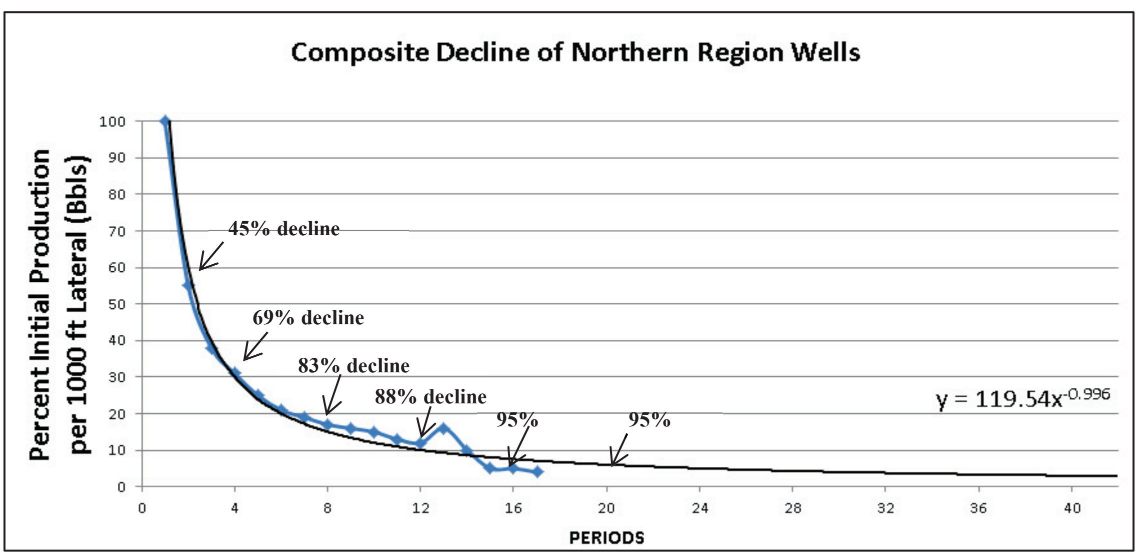

Figure 4.19. Composite decline curve of 28 northern region wells and resultant trendline.

Table 4.2. Periodic production values for southern group of wells (Bbls/Mft).

	PRODUCTION PERIODS FOR SOUTHERN GROUP OF WELLS (BARRELS PER 1000 FEET LATERAL)													
WELL #	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	2299	2629	2030	1095	1475	1254	807							
2	430	309	401	320	214	216	203							
3	1020	713	671	600	461	366	284	212	219	150				
4	649	440	404	367	363	275	230	211	175	168	144			
5	498	405	326	248	205	177								
6	580	440	332	297	226	198	173							
7	1202	784	650	544	448	403	334							
8	1058	861	589	328	247	311	186	147						
9	1845	1086	782	603	474	434	369							
10	3246	1768	1615	1211	834	459	434							
30	1341	1085	689	482	476	362	249	197						
31	496	304	213	183	251	139	145	133	104	93	88	81	58	72
32	707	1254	315	596	24	118	413	354	288					
33	2861	1553	856	585	411	329	280	243	229					
34	1554	758	369	361	266	225	206	185	172	154	146	164	151	
36	2519	1930	628	508	448	333	332	312						
37	2108	704	1000	550	93	62	73	94	117	100	94	79	65	75
38	456	314	237	165	138	109	86							
46	3226	1321	705	535	392	331	313							
47	2180	848	568	408	294	287	257							
48	1274	857	797	778	706	464	385							
49	1179	779	789	682	385	451	363	263	192	224				
50	3342	1400	566	780	645	614	272	276	239					
51	2413	1336	463	633	477	377	173	201	175					
52	1584	2060	1680	1995	1567	983	492	803	546	364				
53	1248	588	476	295	226	181	143	101	89	55				
54	468	264	689	665	486	374	282	251						
55	1741	1526	1240	859	515	489	409	324						
56	1495	773	562	417	349	279	239	210	212	270	196			
57	1172	907	681	501	434	417	357	327						
59	1805	1126	760	549	371	304	236	213	172	169	180			
60	774	357	270	210	220	206	194	181	164	164	141	138		

Table 4.3. Average periodic production values and percent decline values per southern well (Bbls/Mft).

SOUTHERN GROUP PRODUCTION PERIODS													
1	2	3	4	5	6	7	8	9	10	11	12	13	14
NUMBER OF WELLS IN PRODUCTION PER PERIOD													
32	32	32	32	32	32	31	21	15	11	7	4	3	2
TOTAL AVERAGE WATER PRODUCTION PER PERIOD PER 1000 FEET LATERAL													
1524	984	699	573	441	360	288	249	206	174	141	115	91	74
PERCENT DECLINE PER PRODUCTION PERIOD													
0	36	54	63	71	76	81	82	84	86	89	91	94	95

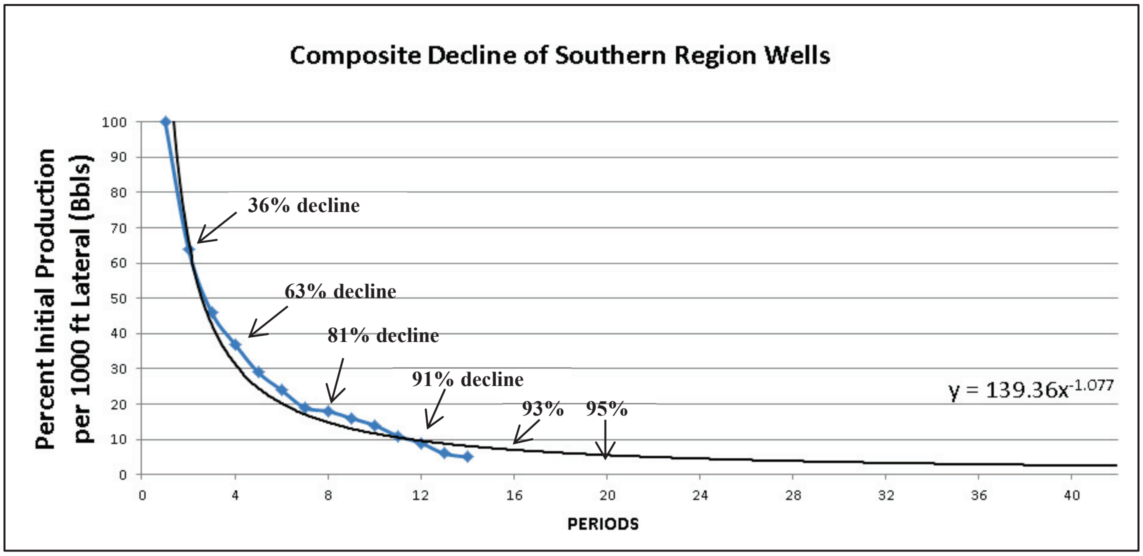

Figure 4.20. Composite decline curve of 32 southern region wells and resultant trendline.

The composite decline curves express a predicted percent decline for the first 10.5 years of any given well based on past water production. It is most useful to express water decline as percent reduction as well operators can readily apply percent production decline to initial production rates. These percent decline values provide well operators with an estimate of how much water will be produced in the future for each of the projected production years.

Table 4.4. Projected yearly percent decline production for the northern and southern regions.

Production Year	Northern Region Percent Decline	Southern Region Percent Decline
Year 1	69%	63%
Year 2	83%	81%
Year 3	88%	91%
Year 4	95%	93%
Year 5	95%	95%

4.6 Results Validation

The original sixty produced water decline curves and accompanying trend lines were created with water production data from 2011 through the first quarter of 2017. To validate the decline curves and trend lines, ODNR DOGRM quarterly production reports for the second quarter of 2017 through the first quarter of 2018 were accessed. These additional four quarters of water production data were plotted on each of the sixty production decline curves. These decline curves can be found in Appendix B and are identified as Appendices B1 through B60. Each decline curve is numbered (1-60) according to their location on the well locator map (Figure 2).

Roughly eighty-two percent of the selected wells show a steady decline corresponding to the predicted curve. The following two figures are example of such wells. Figure 4.21 shows water production for Chesapeake well Hartz 18-12-2 1H located in the northern production region of Columbiana County. The water production for the additional four quarters declines along the predicted path. Figure 4.22 shows water production for Gulfport Energy well Amanda 1-14H located in Belmont County. This well is located in the over pressured southern region. The water prodcution for the additional four quarters declines along the predicted path.

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	5359	1500	82
2014 Q4	10	1392	390	100
2015 Q1	11	598	167	90
2015 Q2	12	689	193	100
2015 Q3	13	484	135	100
2015 Q4	14	450	126	99
2016 Q1	15	390	109	98
2016 Q2	16	283	79	100
2016 Q3	17	242	68	99
2016 Q4	18	210	59	99
2017 Q1	19	187	52	99
2017 Q2	20	171	48	100
2017 Q3	21	154	43	100
2017 Q4	22	129	36	97
2018 Q1	23	105	29	99

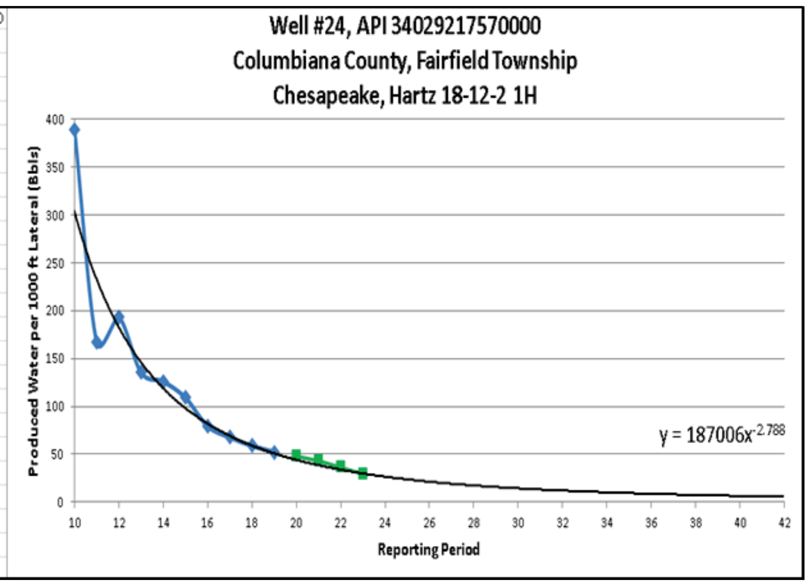

Figure 4.21. Chesapeake, Hartz 18-12-2 1H, additional water production data steadily decline.

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	4581	582	87
2014 Q4	10	813	103	93
2015 Q1	11	1963	249	97
2015 Q2	12	3210	408	98
2015 Q3	13	4568	580	96
2015 Q4	14	3462	440	99
2016 Q1	15	2614	332	99
2016 Q2	16	2337	297	100
2016 Q3	17	1781	226	98
2016 Q4	18	1561	198	99
2017 Q1	19	1366	173	100
2017 Q2	20	1264	160	100
2017 Q3	21	1170	149	100
2017 Q4	22	1009	128	97
2018 Q1	23	973	124	99

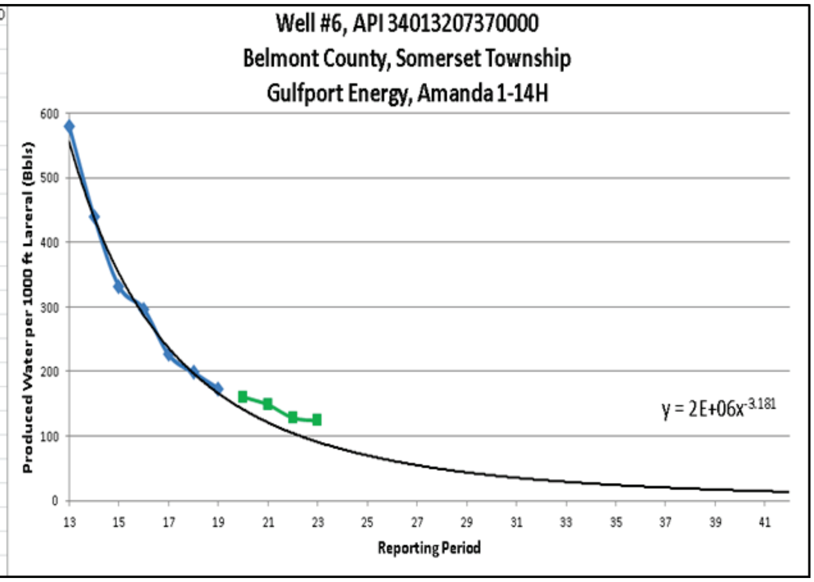

Figure 4.22. Gulfport Energy, Amanda 1-14H, additional water production data steadily decline.

The additional data for roughly eighteen percent of the selected wells did not show a steady decline. Figure 4.23 shows Gulfport Energy well Stronz 210 233 4B located in Belmont County. The water production data for the additional four quarters does not steadily decline.

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	11449	1747	81
2015 Q3	13	12091	1845	98
2015 Q4	14	7117	1086	97
2016 Q1	15	5125	782	99
2016 Q2	16	3954	603	100
2016 Q3	17	3104	474	92
2016 Q4	18	2844	434	99
2017 Q1	19	2418	369	100
2017 Q2	20	2454	374	99
2017 Q3	21	2382	363	95
2017 Q4	22	1382	211	93
2018 Q1	23	3555	542	100

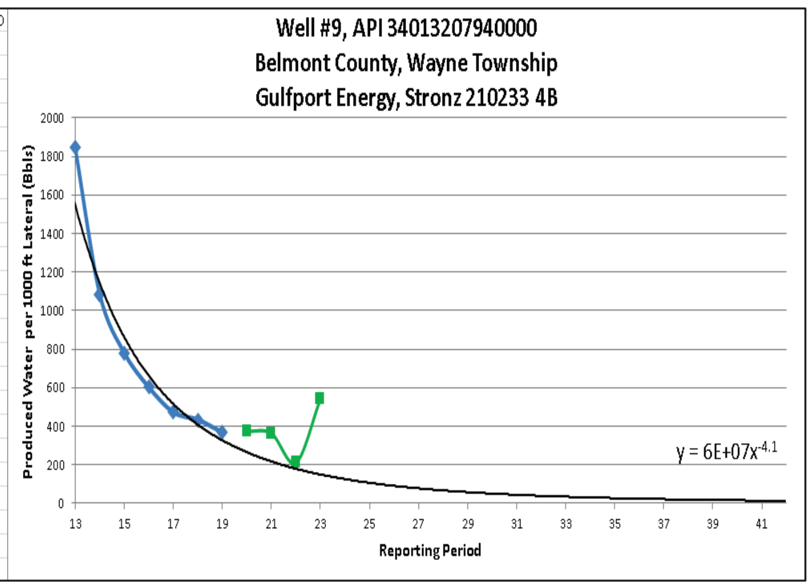

Figure 4.23. Gulfport Energy, Stronz 210233 4B, additional water production data does not steadily decline.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 Summary and Conclusions

This research was conducted with the intent of quantifying and characterizing water production rates in the Point Pleasant Formation and to provide a means of predicting future water production for existing and future wells. Data from ODNR DOGRM production reports were analyzed. Sixty representative wells were selected for the research by using the three criteria. Perforation interval data and lateral length values were obtained using completion reports published on the ODNR DOGRM website. Spatial analysis of production characteristics deliniated two distinct regions: a northern “normal pressured region” and a southern “over pressured region”. The delineation of these two regions correspondes to the findings of McClain (2013).

Water production data for the sixty wells were expressed as barrels per 1000 feet of lateral length (Bbls/Mft) and production decline curves were constructed for the northern and southern regions. The “power” function in Excel was used to extrapolate current production through the year 2022. The spatial variation of produced water expressed as Bbls/Mft was evaluated using annual water production maps and cumulative water production maps created using Arc GIS 10.5. Composite decline curves for each region were constructed and expressed as percent production reduction as a function of time.

This research provides important contributions to understanding past water production and predicting future water production. The findings clearly show that Point Pleasant Formation water production within the state of Ohio can be divided into a northern region and a southern region. These two regions closely correspond to a normal pressured region in the north where the overlying Utica Shale is considered a source rock and a southern over pressured region where the overlying Utica Shale acts as a seal (McClain 2013).

The spatial distinction of northern and southern and southern regions provides a means for distinguishing water production characteristics. Based on this spatial distinction, composite production decline curves were created. These composite production decline curves provide a means of predicting water production for the first forty-two quarters of production (10.5 years) of any given well within each respective region. The findings can also be used to plan for additional UIC wells and produced water treatment facilities.

5.2 Recommendations

Further analyzation of future ODNR DOGRM quarterly water production data reports is recommended. Different water production decline characteristics may become evident through continued analyses as more wells are drilled and produced. The methodology developed in this research can also be applied to other unconventional shale formations throughout the United States and the world.

REFERENCES

Clark, JE.; Bonura, D.E.; and Van Voorhees, R.F., 2005, "An Overview of Injection Well History in the United States of America." Underground Injection Science and Technology Developments in Water Science: 3-12. https://www.env.nm.gov/wqcc/Matters/14-15R/Item32/007B_RobertFVanVoorhees-OverviewPublication06-15-15.pdf

Clark, C.E., and J.A. Veil, 2009, Produced Water Volumes and Management Practices in the United States, ANL/EVS/R-09/1, prepared for the U.S. Department of Energy, National Energy Technology Laboratory, September 2009, 64 pp.

Dick, J.C., 2017, personal communication.

Geology.com, 2014, Hydraulic Fracturing Fluids - Composition and Additives. http://geology.com/energy/hydraulic-fracturing-fluids/

Gregory, Kevin B.; Vidic, Radisav D.; and Dzomback, David A., 2011, "Water Management Challenges Associated with the Production of Shale Gas by Hydraulic Fracturing." Elements 7.3, June 2011, 181-86. http://www.shale-gas-information-platform.org/categories/water-protection/expert-articles/vidic.html#c424

Kell, Scott, 2011, State Oil and Gas Agency Groundwater Investigations and Their Role in Advancing Regulatory Reforms; a Two-State Review: Ohio and Texas. http://www.gwpc.org/sites/default/files/State%20Oil%20%26%20Gas%20Agency%20Groundwater%20Investigations.pdf

Lutz, B. D., A. N. Lewis, and M. W. Doyle, 2013, Generation, transport, and disposal of wastewater associated with Marcellus Shale gas development, Water Resour. Res., 49, doi:10.1002/wrcr.20096. http://onlinelibrary.wiley.com/doi/10.1002/wrcr.20096/pdf

McClain, T., 2013 Sequence Stratigraphy and Petrophysics of the Late Ordovician Utica-Point Pleasant Interval in the Central Appalachian Basin, Eastern Ohio and Western Pennsylvania. West Virginia University unpublished master's thesis, Morgantown, West Virginia 96 pages.

NETL, National Energy Technology Laboratory, 2014, "Produced Water Management Technology Descriptions." http://www.netl.doe.gov/research/coal/crosscutting/pwmis/tech-desc

National Petroleum Council, 2011, “Management of produced water from oil and gas wells,” Working paper no. 2-17. http://www.npc.org/Prudent_Development-Topic_Papers/2-17_Management_of_Produced_Water_Paper.pdf

Ohio Department of Natural Resources, Division of Geological Survey, 2004, Oil and Gas Fields\ Map of Ohio, Map PG-1.

Ohio Department of Natural Resources Division of Oil and Gas Resources, 2017, First Quarter 2017 Horizontal Shale Production.

Office of Fossil Energy, 2014, Enhanced Oil Recovery. https://energy.gov/fe/science-innovation/oil-gas-research/enhanced-oil-recovery

Pickett, A., 2017, Extended Lateral Lengths, Optimized Completions Define Eclipse's Best Practices, The American Oil and Gas Reporter, March 2017, 4 pp.

Thomas, Andrew R.; Dick, Jefferey C.; Scully, Peter; Martis, Sydney A.; and Lim, Taekyoung, 2017, "Shale Investment Dashboard in Ohio," Urban Publications, 0 1 2 3 1464. http://engagedscholarship.csuohio.edu/urban_facpub/1464

Veil, John, 20015, U.S. Produced Water Volumes and Management Practices in 2012. http://www.gwpc.org/sites/default/files/Produced%20Water%20Report%202014-GWPC_0.pdf

Wolfe, Mark E., and Wickstrom, Lawrence H., 2014, "Analysis of Enhanced-Oil Recovery Potential in Ohio," ODNR Division of Geological Survey. http://geosurvey.ohiodnr.gov/energy-resources/enhanced-oil-recovery

APPENDIX A: PRODUCTION DECLINE PLOTS FOR THE SELECTED SIXTY POINT PLEASANT FORMATION WELLS

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	3494	355	9
2015 Q3	13	22593	2299	100
2015 Q4	14	25840	2629	100
2016 Q1	15	19955	2030	34
2016 Q2	16	10761	1095	73
2016 Q3	17	14494	1475	100
2016 Q4	18	12327	1254	100
2017 Q1	19	7931	807	100

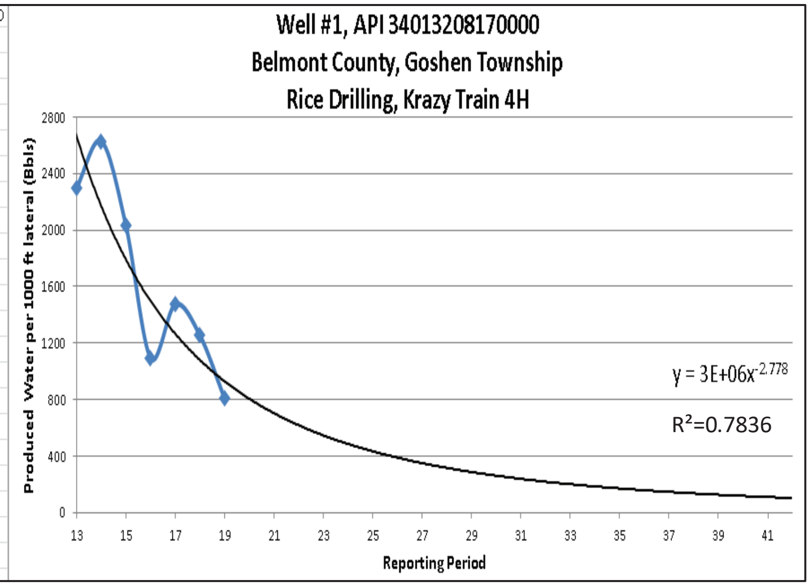

Figure A.1 Well 1 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	3513	503	43
2015 Q1	11	2415	346	81
2015 Q2	12	2410	345	93
2015 Q3	13	3003	430	100
2015 Q4	14	2157	309	100
2016 Q1	15	2803	401	98
2016 Q2	16	2234	320	99
2016 Q3	17	1496	214	99
2016 Q4	18	1508	216	99
2017 Q1	19	1416	203	99

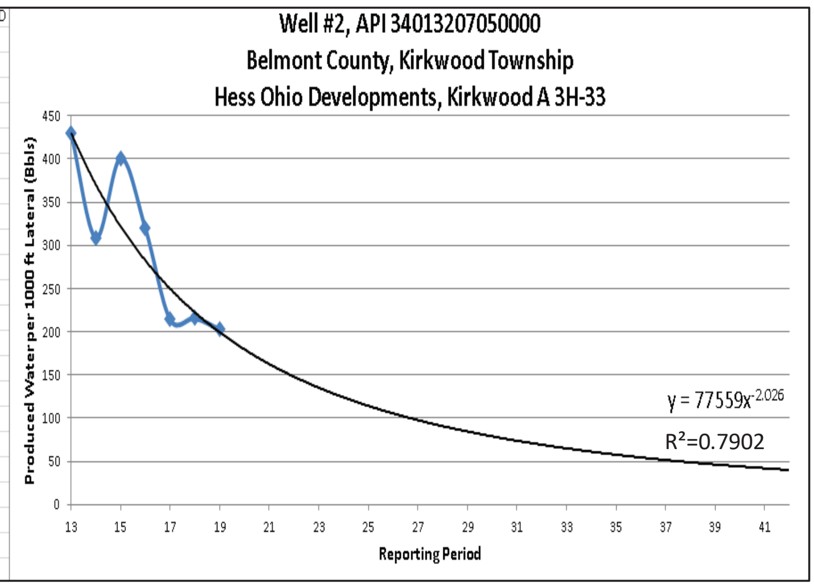

Figure A.2 Well 2 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	2219	489	21
2014 Q4	10	4625	1020	98
2015 Q1	11	3236	713	94
2015 Q2	12	3045	671	99
2015 Q3	13	2723	600	96
2015 Q4	14	2093	461	98
2016 Q1	15	1658	366	99
2016 Q2	16	1288	284	98
2016 Q3	17	961	212	99
2016 Q4	18	995	219	100
2017 Q1	19	681	150	100

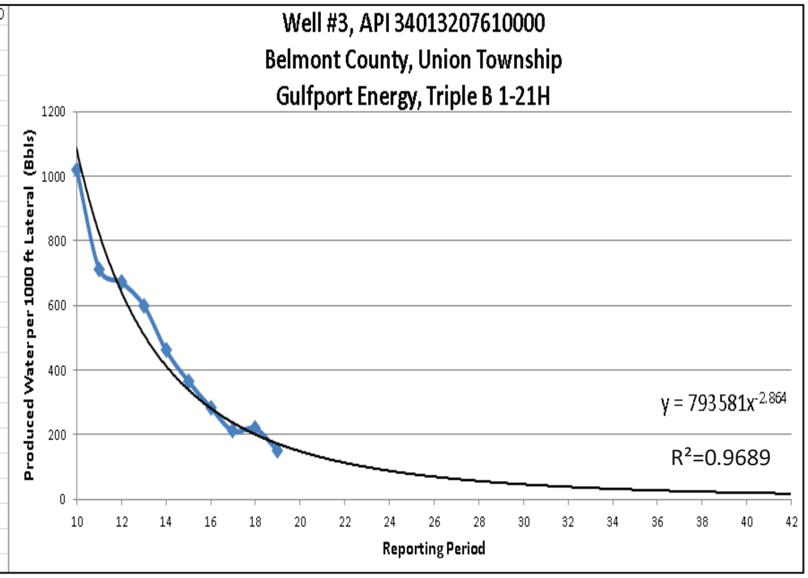

Figure A.3 Well 3 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	2886	373	20
2014 Q3	9	5019	649	96
2014 Q4	10	3401	440	97
2015 Q1	11	3126	404	94
2015 Q2	12	2836	367	99
2015 Q3	13	2811	363	97
2015 Q4	14	2129	275	99
2016 Q1	15	1782	230	99
2016 Q2	16	1635	211	98
2016 Q3	17	1353	175	99
2016 Q4	18	1300	168	99
2017 Q1	19	1113	144	100

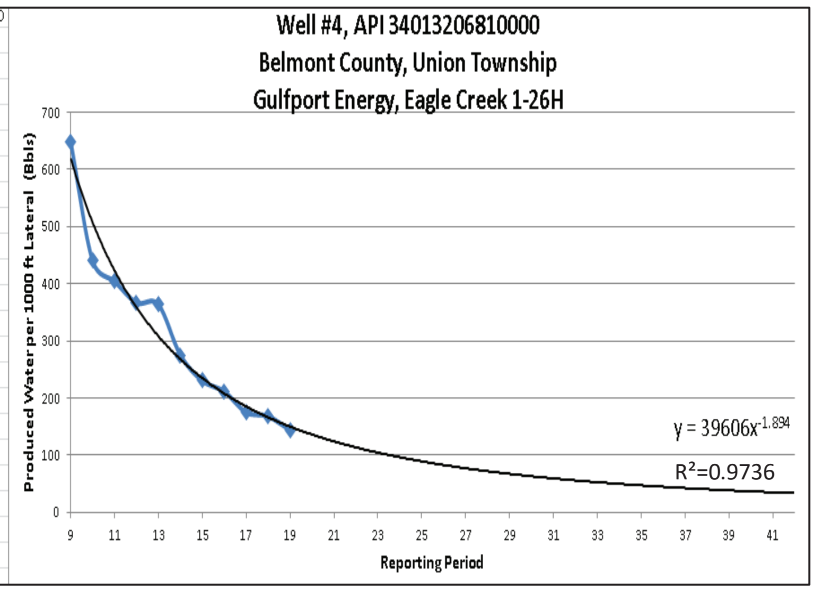

Figure A.4 Well 4 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	2830	367	86
2015 Q3	13	3240	420	100
2015 Q4	14	3848	498	100
2016 Q1	15	3128	405	99
2016 Q2	16	2514	326	100
2016 Q3	17	1918	248	100
2016 Q4	18	1584	205	100
2017 Q1	19	1369	177	100

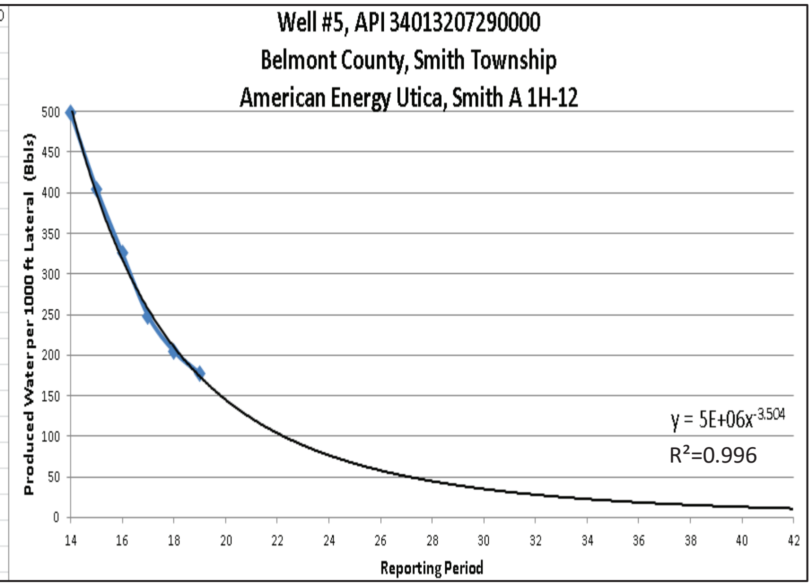

Figure A.5 Well 5 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	4581	582	87
2014 Q4	10	813	103	93
2015 Q1	11	1963	249	97
2015 Q2	12	3210	408	98
2015 Q3	13	4568	580	96
2015 Q4	14	3462	440	99
2016 Q1	15	2614	332	99
2016 Q2	16	2337	297	100
2016 Q3	17	1781	226	98
2016 Q4	18	1561	198	99
2017 Q1	19	1366	173	100

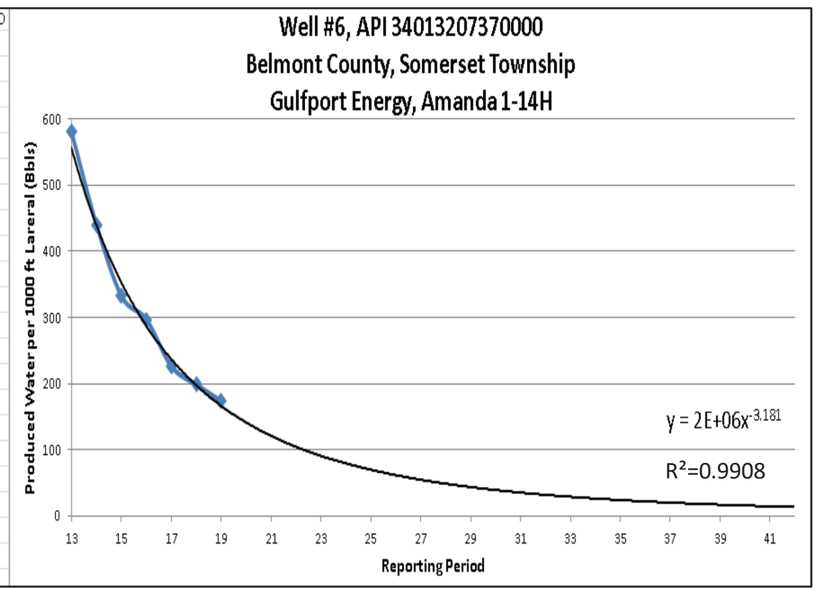

Figure A.6 Well 6 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	3266	363	7
2015 Q2	12	11948	1327	62
2015 Q3	13	10823	1202	98
2015 Q4	14	7056	784	100
2016 Q1	15	5851	650	99
2016 Q2	16	4902	544	95
2016 Q3	17	4031	448	99
2016 Q4	18	3631	403	100
2017 Q1	19	3009	334	100

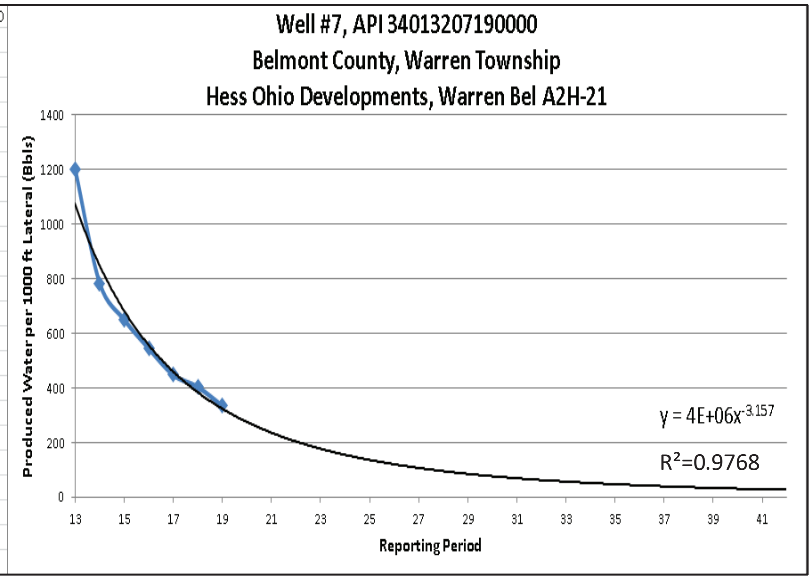

Figure A.7 Well 7 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	6366	1058	97
2015 Q3	13	5183	861	99
2015 Q4	14	3542	589	100
2016 Q1	15	1971	328	99
2016 Q2	16	1485	247	98
2016 Q3	17	1869	311	100
2016 Q4	18	1117	186	100
2017 Q1	19	886	147	100

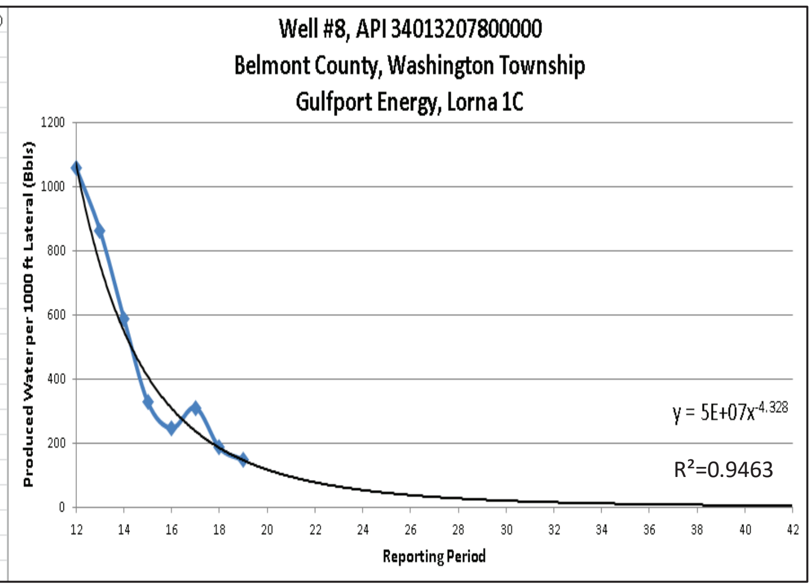

Figure A.8 Well 8 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	11449	1747	81
2015 Q3	13	12091	1845	98
2015 Q4	14	7117	1086	97
2016 Q1	15	5125	782	99
2016 Q2	16	3954	603	100
2016 Q3	17	3104	474	92
2016 Q4	18	2844	434	99
2017 Q1	19	2418	369	100

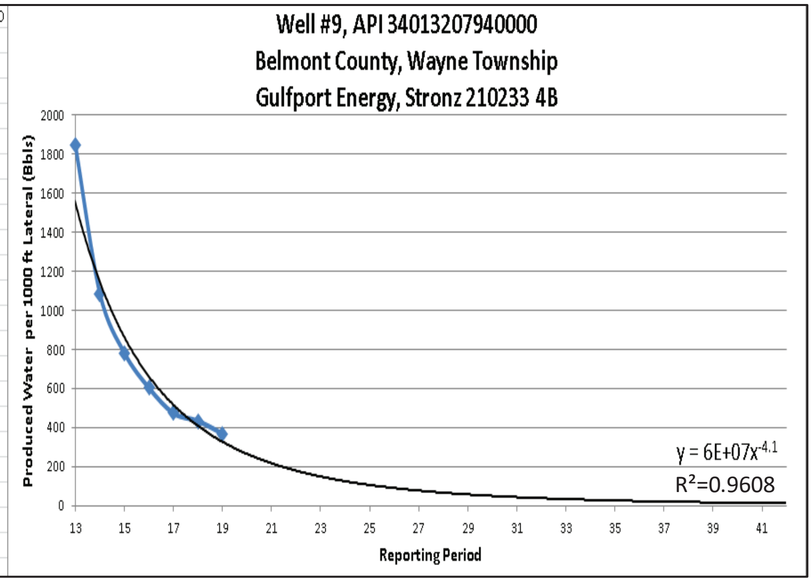

Figure A.9 Well 9 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	3557	750	9
2015 Q3	13	15386	3246	95
2015 Q4	14	8380	1768	100
2016 Q1	15	7653	1615	100
2016 Q2	16	5740	1211	100
2016 Q3	17	3955	834	100
2016 Q4	18	2177	459	100
2017 Q1	19	2055	434	74

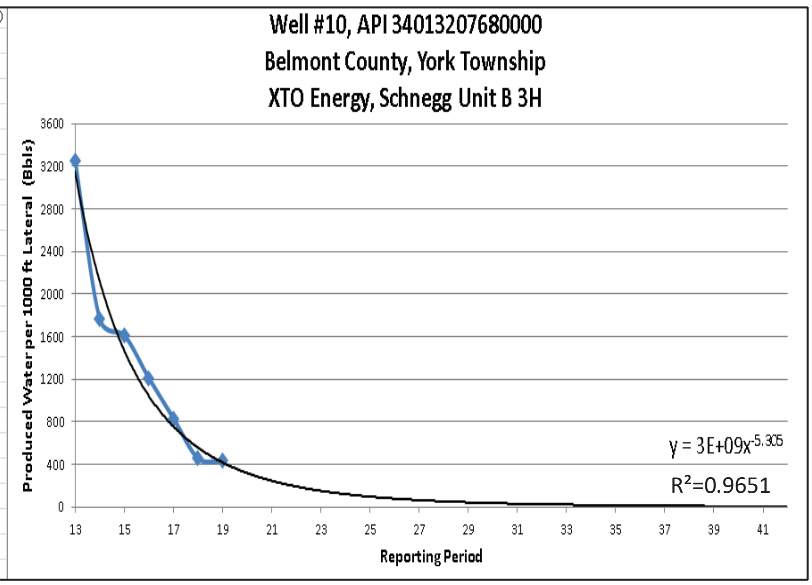

Figure A.10 Well 10 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	6521	1162	32
2015 Q2	12	4584	817	99
2015 Q3	13	1437	256	100
2015 Q4	14	551	98	100
2016 Q1	15	713	127	100
2016 Q2	16	628	112	100
2016 Q3	17	557	99	100
2016 Q4	18	546	97	100
2017 Q1	19	489	87	100

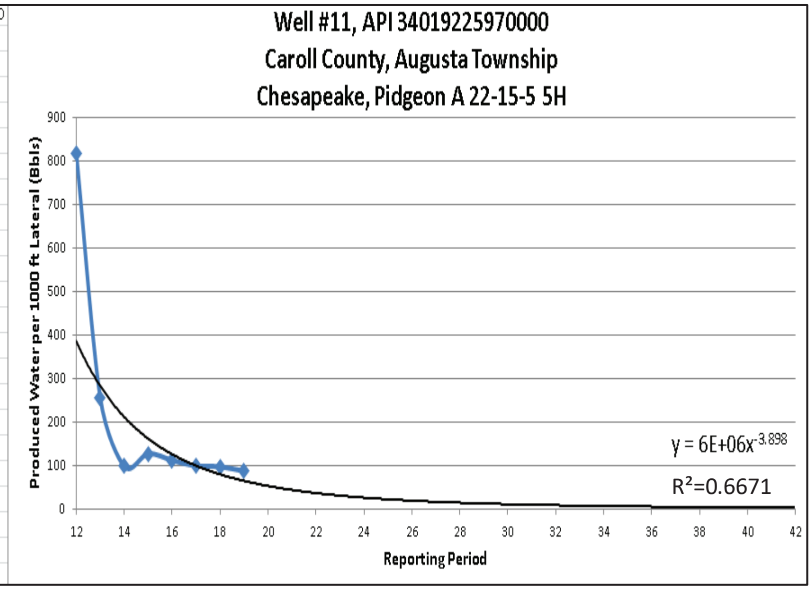

Figure A.11 Well 11 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	2999	382	11
2014 Q4	10	11802	1503	97
2015 Q1	11	9045	1152	100
2015 Q2	12	6052	771	100
2015 Q3	13	3460	441	100
2015 Q4	14	2491	317	100
2016 Q1	15	2082	265	100
2016 Q2	16	1662	212	100
2016 Q3	17	1556	198	100
2016 Q4	18	1391	177	100
2017 Q1	19	1284	163	100

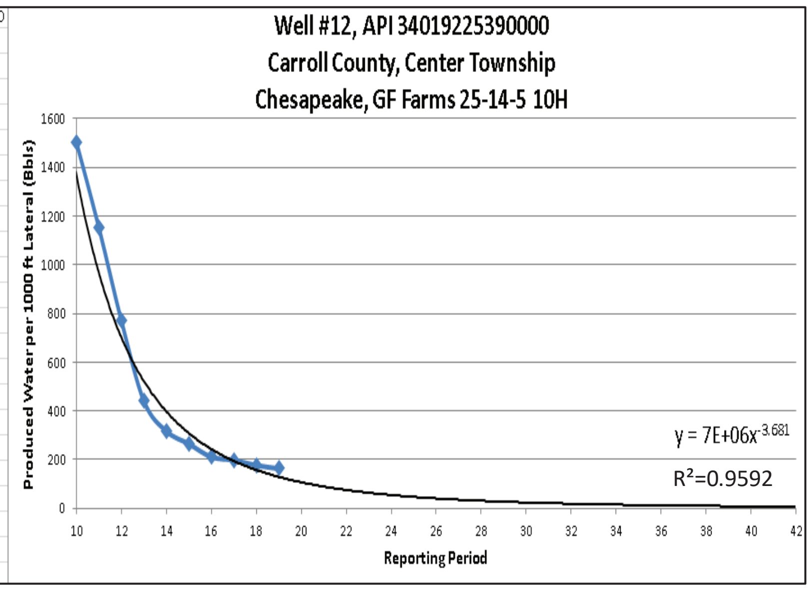

Figure A.12 Well 12 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	6386	753	41
2015 Q2	12	6439	759	99
2015 Q3	13	2481	292	100
2015 Q4	14	3050	360	100
2016 Q1	15	2805	331	100
2016 Q2	16	1473	174	100
2016 Q3	17	1243	147	100
2016 Q4	18	681	80	100
2017 Q1	19	503	59	100

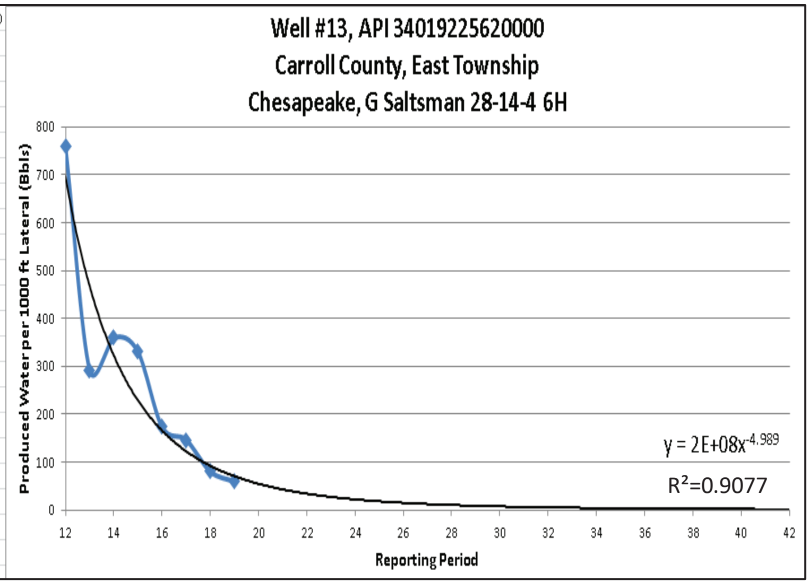

Figure A.13 Well 13 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	13054	1628	39
2015 Q2	12	4352	543	100
2015 Q3	13	2063	257	100
2015 Q4	14	1528	191	100
2016 Q1	15	1122	140	100
2016 Q2	16	1003	125	100
2016 Q3	17	935	117	100
2016 Q4	18	792	99	100
2017 Q1	19	698	87	100

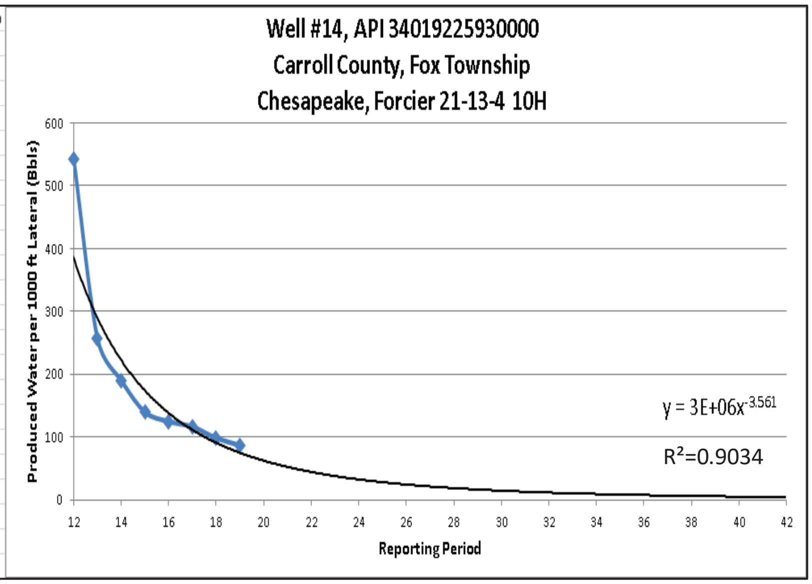

Figure A.14 Well 14 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	861	158	8
2014 Q2	8	5215	959	100
2014 Q3	9	3790	697	100
2014 Q4	10	1118	206	98
2015 Q1	11	561	103	34
2015 Q2	12	1139	209	100
2015 Q3	13	941	173	100
2015 Q4	14	913	168	95
2016 Q1	15	668	123	100
2016 Q2	16	728	134	100
2016 Q3	17	573	105	100
2016 Q4	18	537	99	100
2017 Q1	19	249	46	100

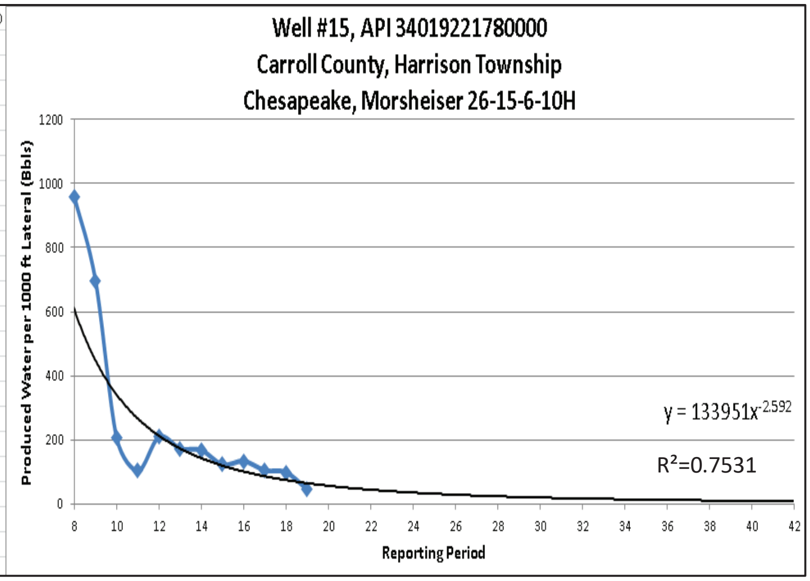

Figure A.15 Well 15 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	4165	775	71
2014 Q1	7	1202	223	99
2014 Q2	8	1097	204	100
2014 Q3	9	952	177	100
2014 Q4	10	703	131	100
2015 Q1	11	523	97	100
2015 Q2	12	528	98	100
2015 Q3	13	313	58	39
2015 Q4	14	442	82	100
2016 Q1	15	367	68	99
2016 Q2	16	356	66	100
2016 Q3	17	337	63	100
2016 Q4	18	328	61	100
2017 Q1	19	262	49	100

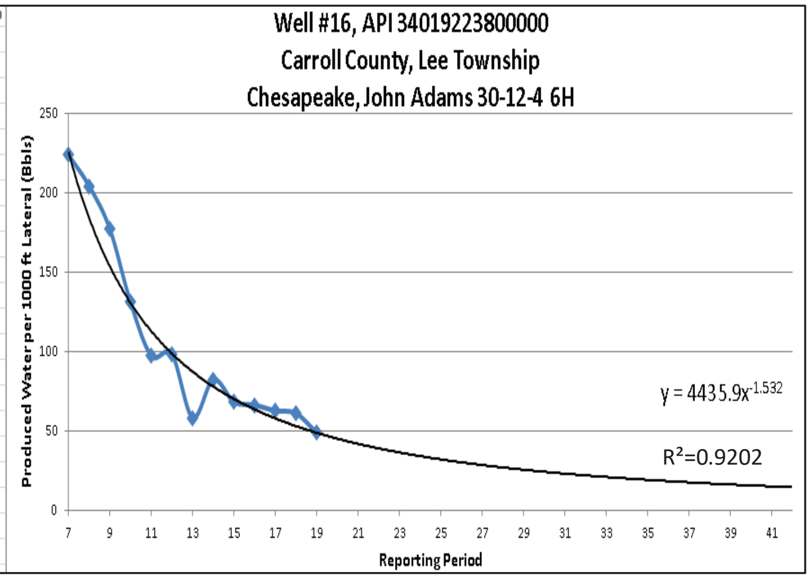

Figure A.16 Well 16 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	1219	299	8
2013 Q4	6	1146	281	37
2014 Q1	7	0	0	0
2014 Q2	8	1638	402	54
2014 Q3	9	6524	1602	40
2014 Q4	10	6085	1494	99
2015 Q1	11	3890	955	100
2015 Q2	12	3769	925	100
2015 Q3	13	269	66	10
2015 Q4	14	1933	475	100
2016 Q1	15	1717	422	78
2016 Q2	16	1407	345	100
2016 Q3	17	1849	454	100
2016 Q4	18	1561	383	100
2017 Q1	19	1196	294	100

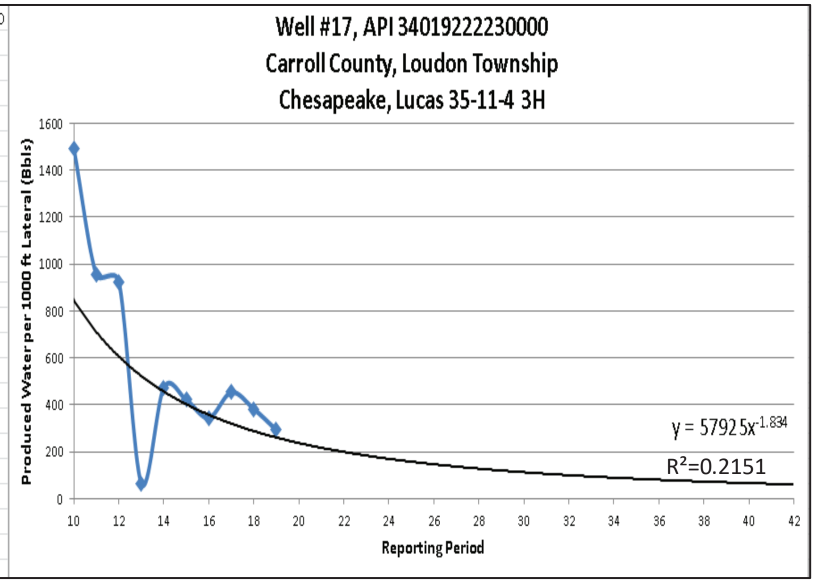

Figure A.17 Well 17 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	4974	927	80
2013 Q4	6	1092	203	57
2014 Q1	7	290	54	32
2014 Q2	8	1445	269	97
2014 Q3	9	1007	188	100
2014 Q4	10	723	135	93
2015 Q1	11	644	120	80
2015 Q2	12	383	71	100
2015 Q3	13	477	89	100
2015 Q4	14	500	93	97
2016 Q1	15	237	44	100
2016 Q2	16	272	51	100
2016 Q3	17	261	49	100
2016 Q4	18	252	47	100
2017 Q1	19	209	39	100

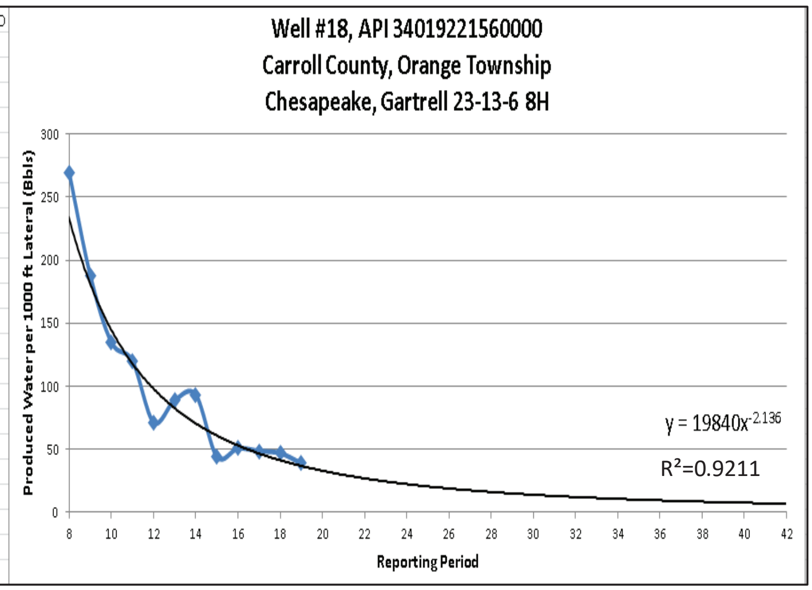

Figure A.18 Well 2 (see Figure 18 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	13700	2378	77
2015 Q1	11	6393	1110	100
2015 Q2	12	2348	408	100
2015 Q3	13	2728	474	100
2015 Q4	14	2470	429	88
2016 Q1	15	1220	212	100
2016 Q2	16	1656	287	100
2016 Q3	17	1308	227	100
2016 Q4	18	804	140	100
2017 Q1	19	711	123	100

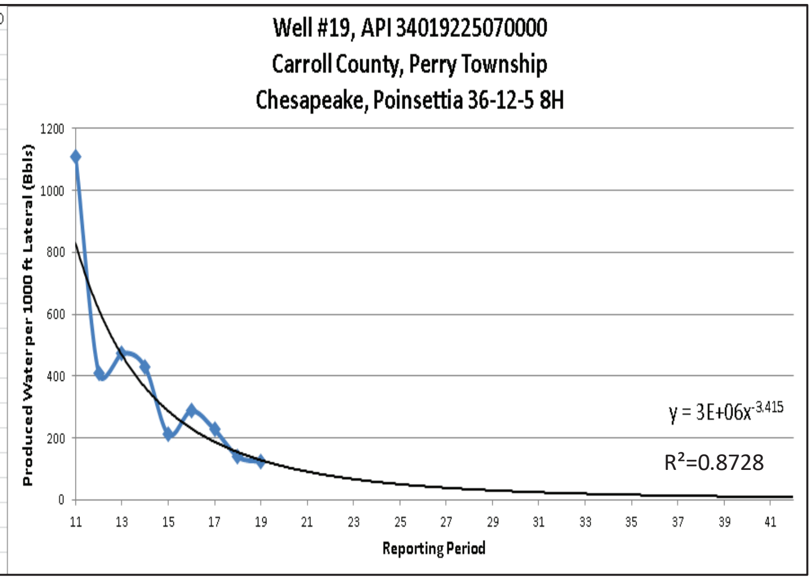

Figure A.19 Well 19 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	4780	728	69
2014 Q2	8	3408	519	100
2014 Q3	9	2253	343	98
2014 Q4	10	2090	319	98
2015 Q1	11	2350	358	93
2015 Q2	12	1313	200	100
2015 Q3	13	776	118	100
2015 Q4	14	687	105	100
2016 Q1	15	641	98	100
2016 Q2	16	625	95	100
2016 Q3	17	591	90	100
2016 Q4	18	603	92	100
2017 Q1	19	554	84	100

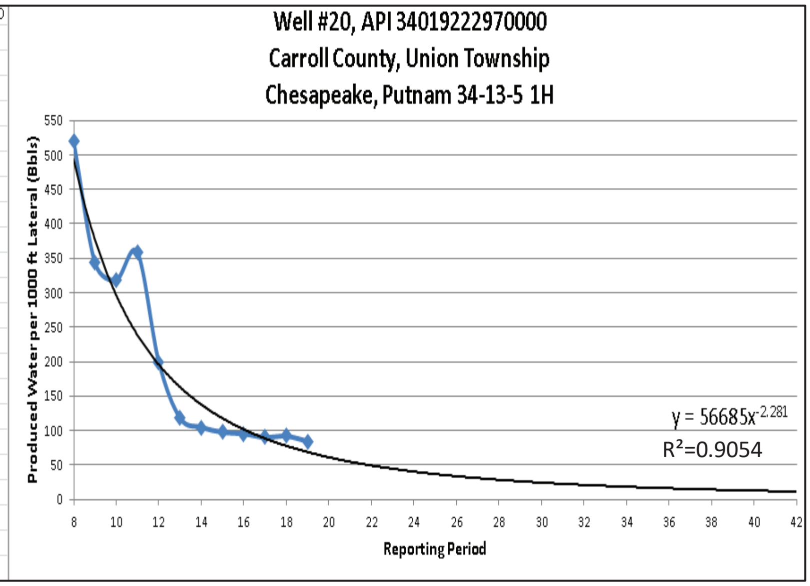

Figure A.20 Well 20 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	11528	2298	68
2013 Q4	6	5824	1161	93
2014 Q1	7	3096	617	96
2014 Q2	8	1714	342	96
2014 Q3	9	1328	265	97
2014 Q4	10	1012	202	100
2015 Q1	11	1044	208	100
2015 Q2	12	1053	210	100
2015 Q3	13	1429	285	100
2015 Q4	14	863	172	100
2016 Q1	15	855	170	100
2016 Q2	16	753	150	100
2016 Q3	17	664	132	100
2016 Q4	18	609	121	100
2017 Q1	19	510	102	100

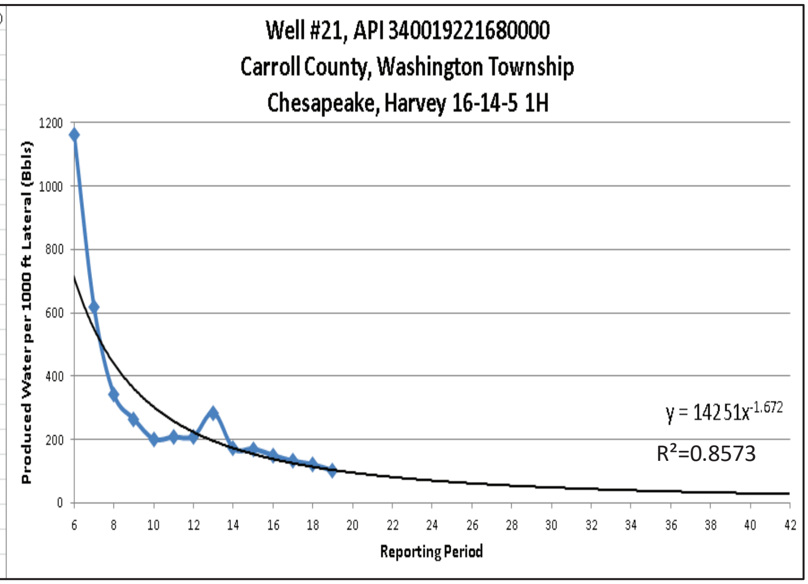

Figure A.21 Well 21 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4525	503	53
2015 Q1	11	6454	718	100
2015 Q2	12	5354	596	100
2015 Q3	13	2720	303	100
2015 Q4	14	2010	224	98
2016 Q1	15	2006	223	100
2016 Q2	16	1268	141	100
2016 Q3	17	786	87	100
2016 Q4	18	805	90	100
2017 Q1	19	628	70	100

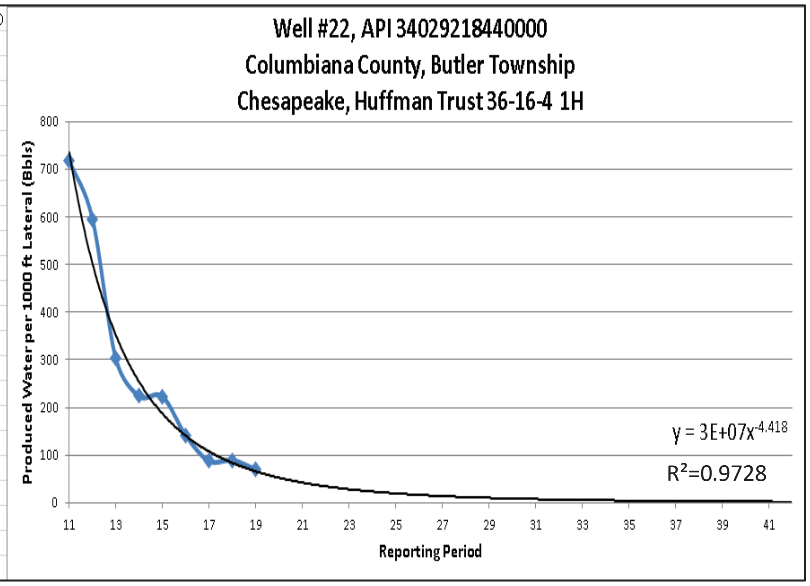

Figure A.22 Well 22 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	757	139	27
2014 Q2	8	2345	430	92
2014 Q3	9	2491	457	100
2014 Q4	10	2099	385	100
2015 Q1	11	1435	263	100
2015 Q2	12	1315	241	100
2015 Q3	13	454	83	39
2015 Q4	14	1098	201	100
2016 Q1	15	974	179	100
2016 Q2	16	947	174	100
2016 Q3	17	763	140	100
2016 Q4	18	730	134	100
2017 Q1	19	641	118	100

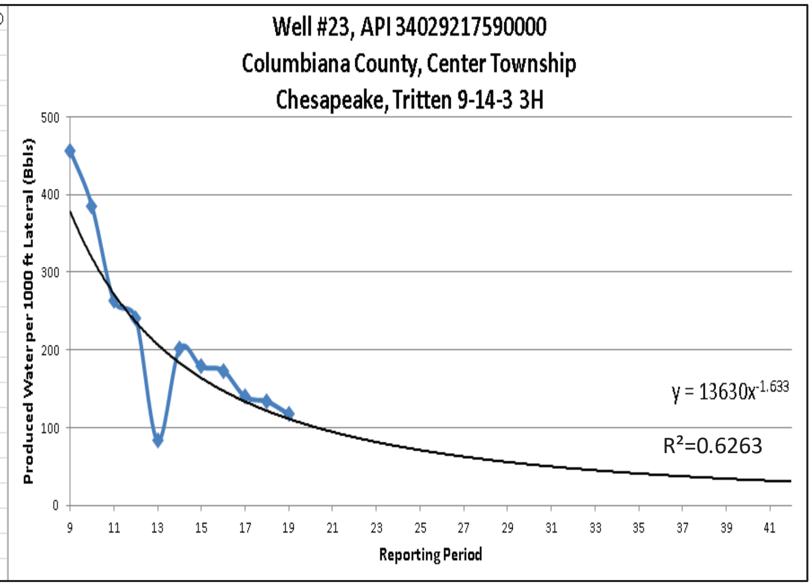

Figure A.23 Well 23 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	5359	1500	82
2014 Q4	10	1392	390	100
2015 Q1	11	598	167	90
2015 Q2	12	689	193	100
2015 Q3	13	484	135	100
2015 Q4	14	450	126	99
2016 Q1	15	390	109	98
2016 Q2	16	283	79	100
2016 Q3	17	242	68	99
2016 Q4	18	210	59	99
2017 Q1	19	187	52	99

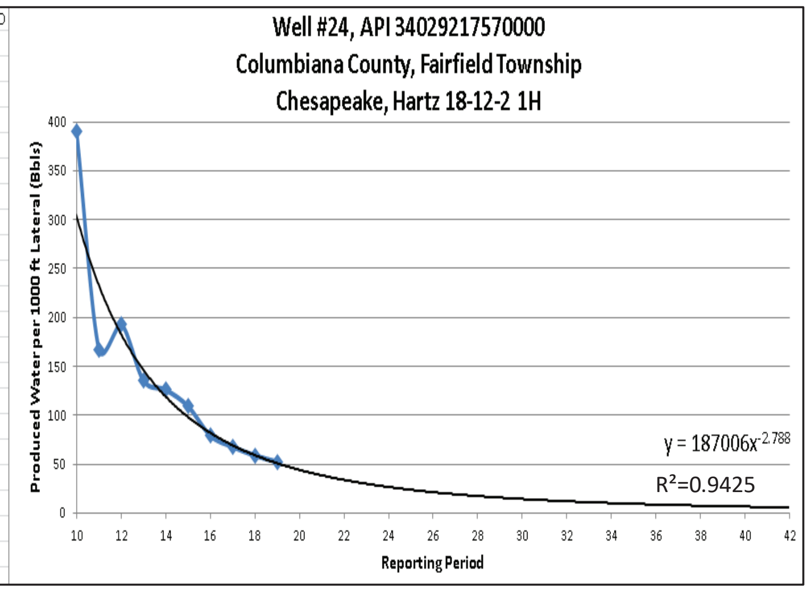

Figure A.24 Well 24 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	497	90	51
2014 Q4	10	1973	356	98
2015 Q1	11	1497	270	100
2015 Q2	12	1585	286	100
2015 Q3	13	493	89	39
2015 Q4	14	1305	235	100
2016 Q1	15	953	172	100
2016 Q2	16	843	152	100
2016 Q3	17	743	134	100
2016 Q4	18	802	145	100
2017 Q1	19	647	117	100

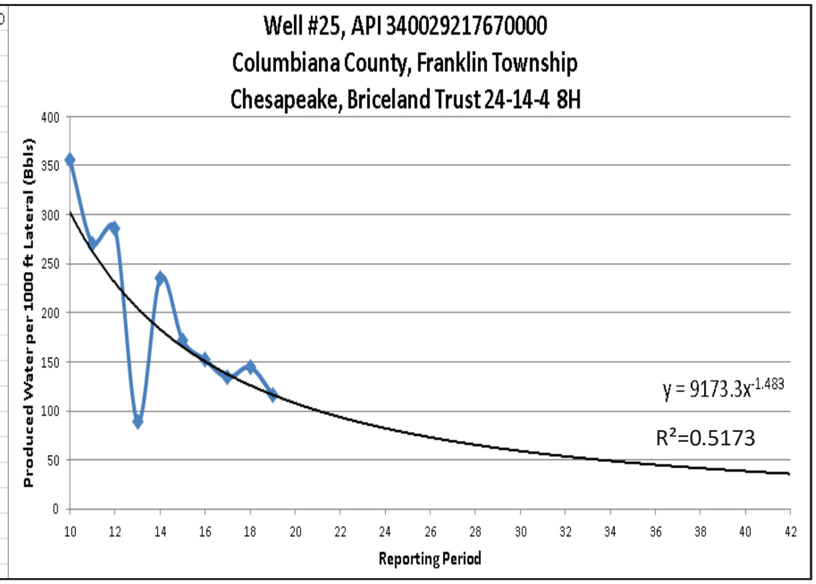

Figure A.25 Well 25 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	2075	353	29
2014 Q2	8	3167	538	97
2014 Q3	9	1909	325	100
2014 Q4	10	1490	253	100
2015 Q1	11	1289	219	100
2015 Q2	12	1102	187	100
2015 Q3	13	378	64	38
2015 Q4	14	836	142	99
2016 Q1	15	879	149	100
2016 Q2	16	751	128	100
2016 Q3	17	701	119	100
2016 Q4	18	546	93	100
2017 Q1	19	459	78	100

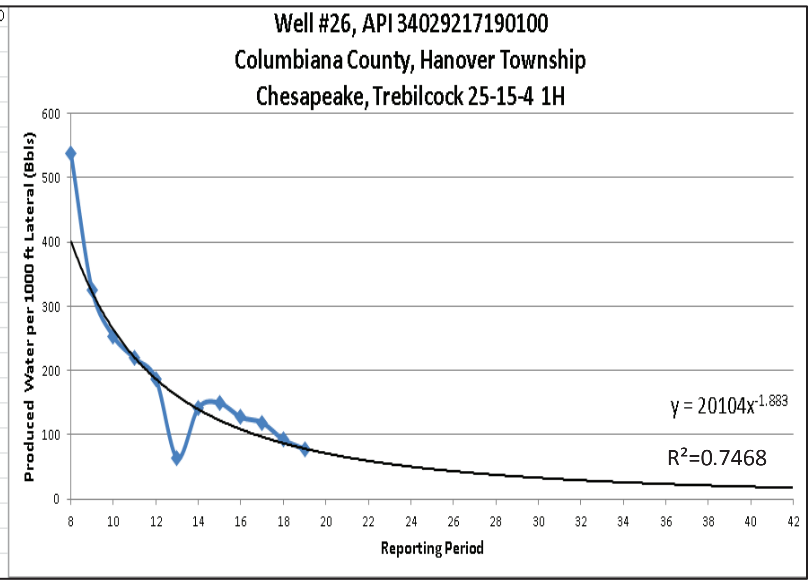

Figure A.26 Well 26 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	816	200	2
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	4321	1061	90
2014 Q4	10	1706	419	99
2015 Q1	11	1353	332	99
2015 Q2	12	1073	264	100
2015 Q3	13	937	230	100
2015 Q4	14	822	202	99
2016 Q1	15	671	165	100
2016 Q2	16	607	149	100
2016 Q3	17	731	180	100
2016 Q4	18	507	125	100
2017 Q1	19	441	108	100

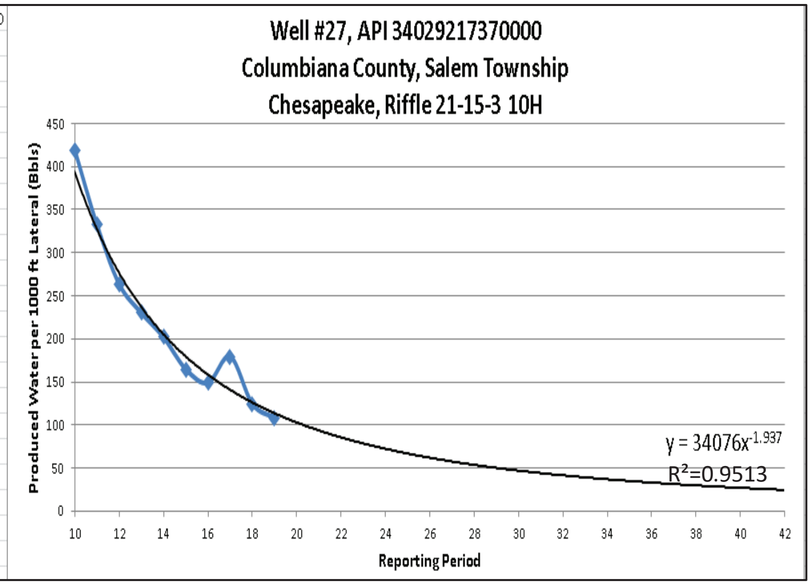

Figure A.27 Well 2 (see Figure 27 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	138	22	0
2014 Q3	9	1745	277	76
2014 Q4	10	318	50	100
2015 Q1	11	1991	316	100
2015 Q2	12	1520	241	98
2015 Q3	13	1120	178	100
2015 Q4	14	1100	175	100
2016 Q1	15	710	113	100
2016 Q2	16	880	140	99
2016 Q3	17	795	126	100
2016 Q4	18	581	92	100
2017 Q1	19	643	102	100

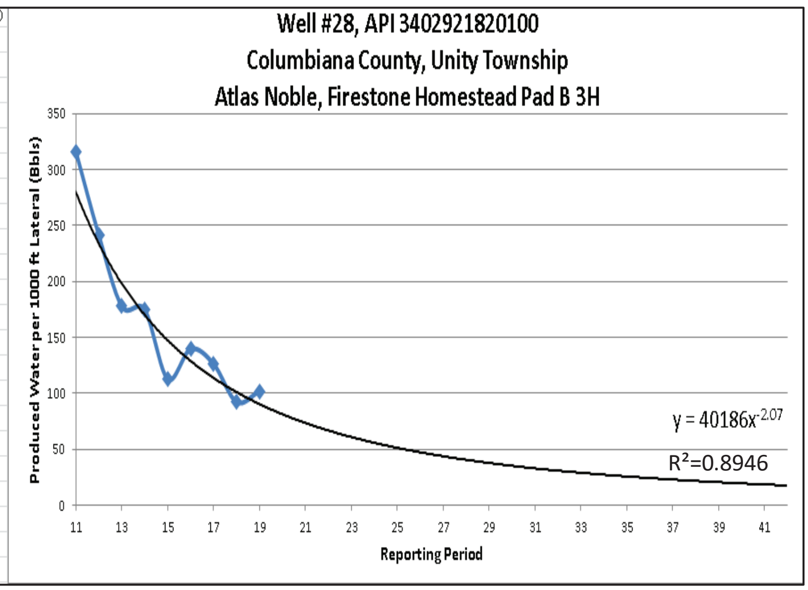

Figure A.28 Well 28 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	4757	1090	6
2013 Q1	3	2622	601	98
2013 Q2	4	1145	262	95
2013 Q3	5	658	151	96
2013 Q4	6	530	121	84
2014 Q1	7	498	114	97
2014 Q2	8	412	94	92
2014 Q3	9	299	68	90
2014 Q4	10	243	56	91
2015 Q1	11	175	40	73
2015 Q2	12	359	82	100
2015 Q3	13	367	84	100
2015 Q4	14	222	51	97
2016 Q1	15	232	53	100
2016 Q2	16	335	77	100
2016 Q3	17	174	40	100
2016 Q4	18	191	44	99
2017 Q1	19	142	33	100

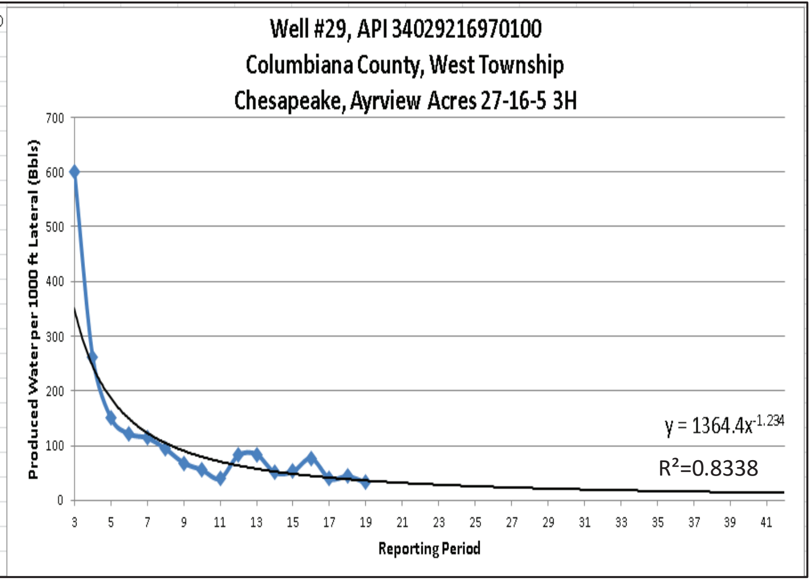

Figure A.29 Well 29 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	10589	2018	56
2015 Q2	12	7033	1341	100
2015 Q3	13	5690	1085	99
2015 Q4	14	3615	689	99
2016 Q1	15	2530	482	97
2016 Q2	16	2496	476	99
2016 Q3	17	1901	362	88
2016 Q4	18	1308	249	98
2017 Q1	19	1033	197	98

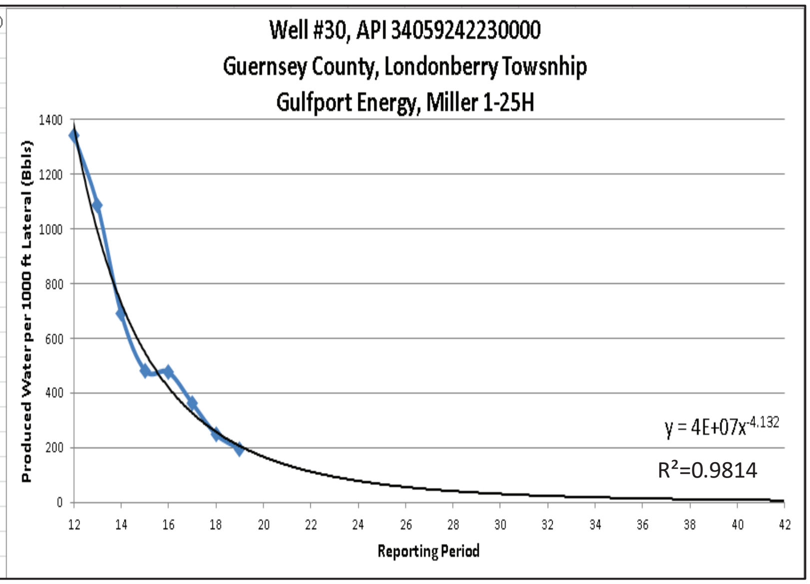

Figure A.30 Well 30 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	7198	1551	2
2013 Q1	3	0	0	0
2013 Q2	4	1044	225	14
2013 Q3	5	695	150	22
2013 Q4	6	2303	496	92
2014 Q1	7	1412	304	91
2014 Q2	8	989	213	97
2014 Q3	9	848	183	99
2014 Q4	10	1166	251	88
2015 Q1	11	647	139	87
2015 Q2	12	672	145	100
2015 Q3	13	618	133	91
2015 Q4	14	485	104	99
2016 Q1	15	431	93	96
2016 Q2	16	410	88	99
2016 Q3	17	375	81	99
2016 Q4	18	267	58	100
2017 Q1	19	335	72	99

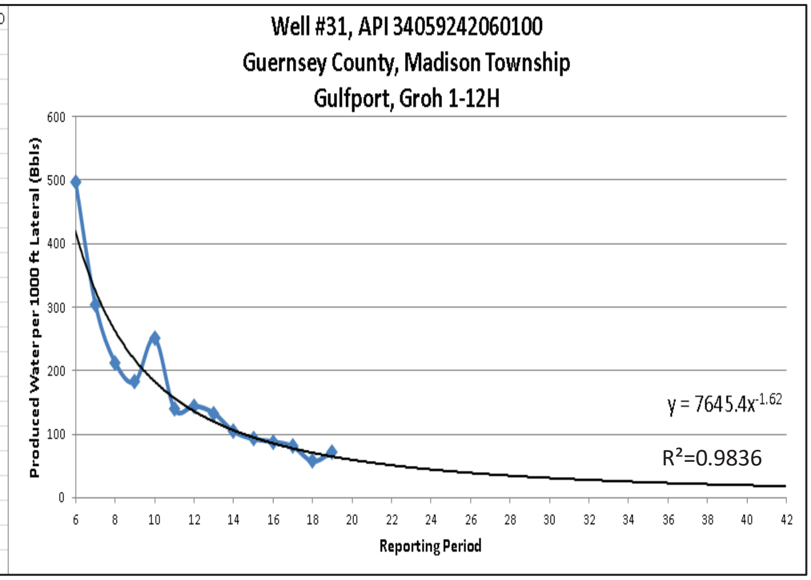

Figure A.31 Well 31 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4557	718	36
2015 Q1	11	4484	707	100
2015 Q2	12	7959	1254	99
2015 Q3	13	2002	315	99
2015 Q4	14	3783	596	99
2016 Q1	15	151	24	99
2016 Q2	16	751	118	99
2016 Q3	17	2621	413	98
2016 Q4	18	2247	354	98
2017 Q1	19	1826	288	100

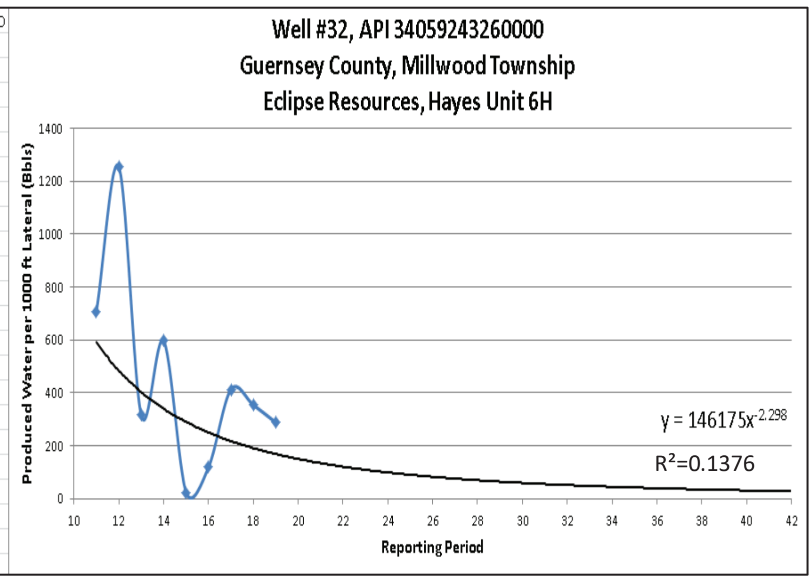

Figure A.32 Well 32 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4724	779	14
2015 Q1	11	17346	2861	100
2015 Q2	12	9417	1553	100
2015 Q3	13	5191	856	100
2015 Q4	14	3549	585	100
2016 Q1	15	2490	411	100
2016 Q2	16	1994	329	100
2016 Q3	17	1699	280	100
2016 Q4	18	1471	243	100
2017 Q1	19	1389	229	100

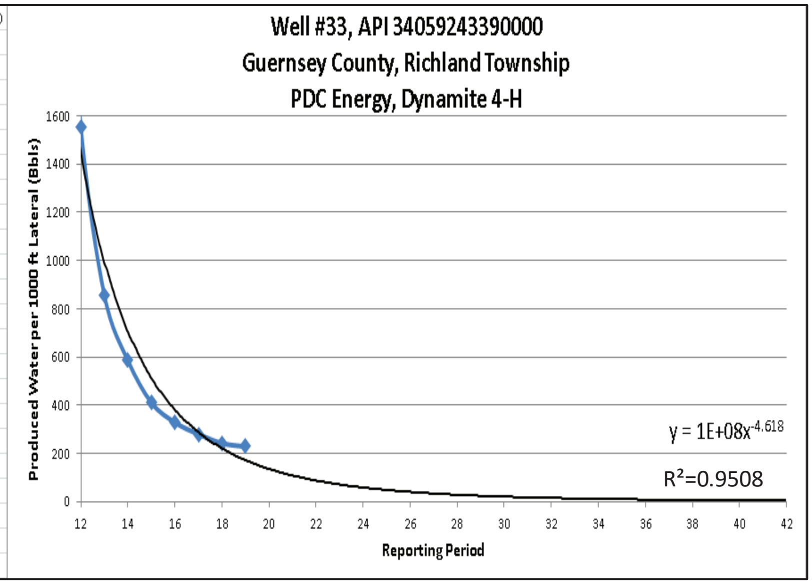

Figure A.33 Well 33 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	1241	285	28
2014 Q1	7	6762	1554	100
2014 Q2	8	3299	758	100
2014 Q3	9	1606	369	100
2014 Q4	10	1570	361	100
2015 Q1	11	1158	266	99
2015 Q2	12	980	225	100
2015 Q3	13	896	206	100
2015 Q4	14	803	185	100
2016 Q1	15	749	172	100
2016 Q2	16	669	154	100
2016 Q3	17	633	146	100
2016 Q4	18	712	164	100
2017 Q1	19	657	151	99

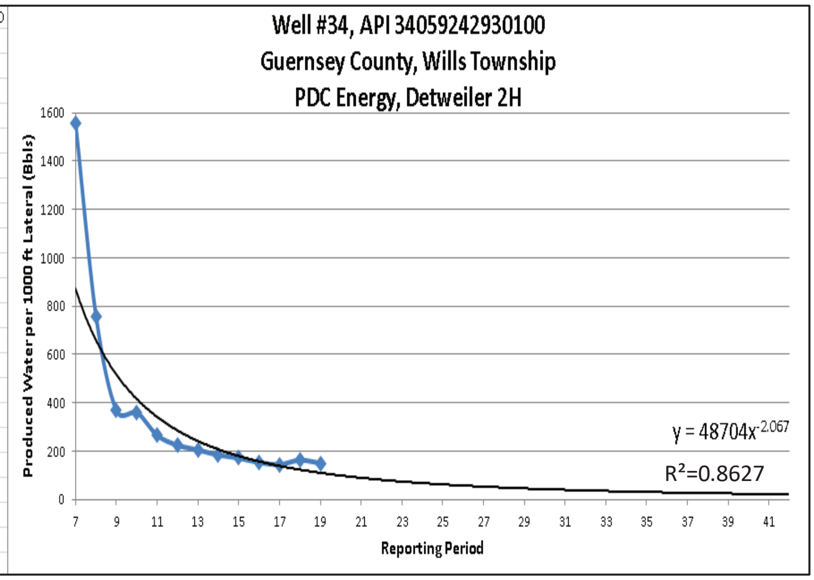

Figure A.34 Well 34 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	2525	428	24
2014 Q4	10	6423	1089	97
2015 Q1	11	3590	608	97
2015 Q2	12	2641	448	97
2015 Q3	13	1685	286	98
2015 Q4	14	1209	205	100
2016 Q1	15	901	153	93
2016 Q2	16	860	146	93
2016 Q3	17	903	153	100
2016 Q4	18	754	128	100
2017 Q1	19	508	86	91

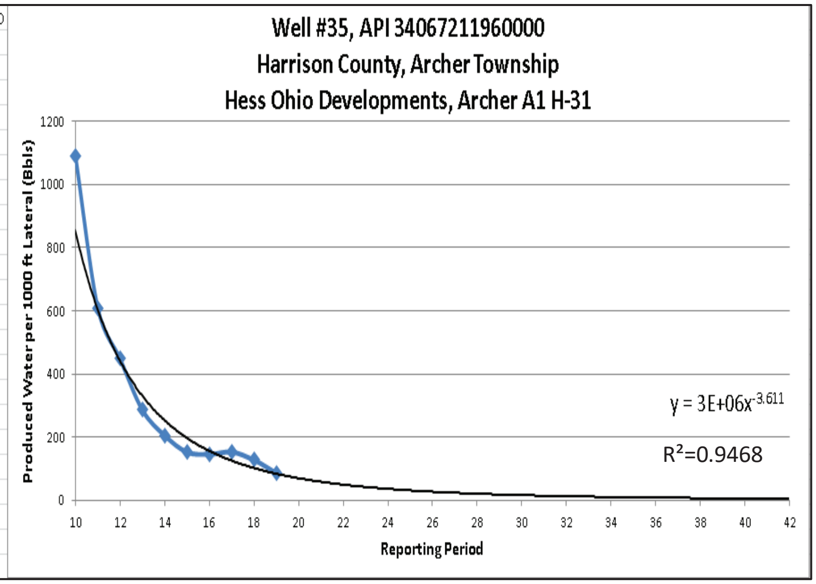

Figure A.35 Well 35 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	7217	1433	11
2014 Q3	9	4078	809	78
2014 Q4	10	5603	1112	77
2015 Q1	11	3349	665	92
2015 Q2	12	12690	2519	93
2015 Q3	13	9725	1930	99
2015 Q4	14	3166	628	99
2016 Q1	15	2561	508	100
2016 Q2	16	2258	448	99
2016 Q3	17	1677	333	100
2016 Q4	18	1673	332	100
2017 Q1	19	1571	312	99

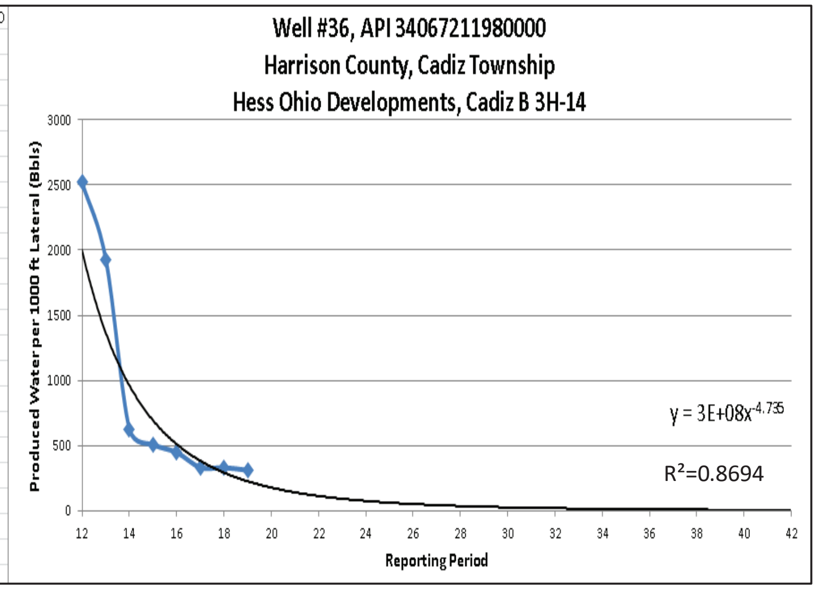

Figure A.36 Well 36 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	34355	5063	15
2013 Q4	6	14305	2108	96
2014 Q1	7	4779	704	92
2014 Q2	8	6784	1000	79
2014 Q3	9	3729	550	100
2014 Q4	10	630	93	41
2015 Q1	11	424	62	67
2015 Q2	12	492	73	100
2015 Q3	13	640	94	99
2015 Q4	14	796	117	98
2016 Q1	15	680	100	99
2016 Q2	16	639	94	100
2016 Q3	17	539	79	100
2016 Q4	18	443	65	100
2017 Q1	19	509	75	99

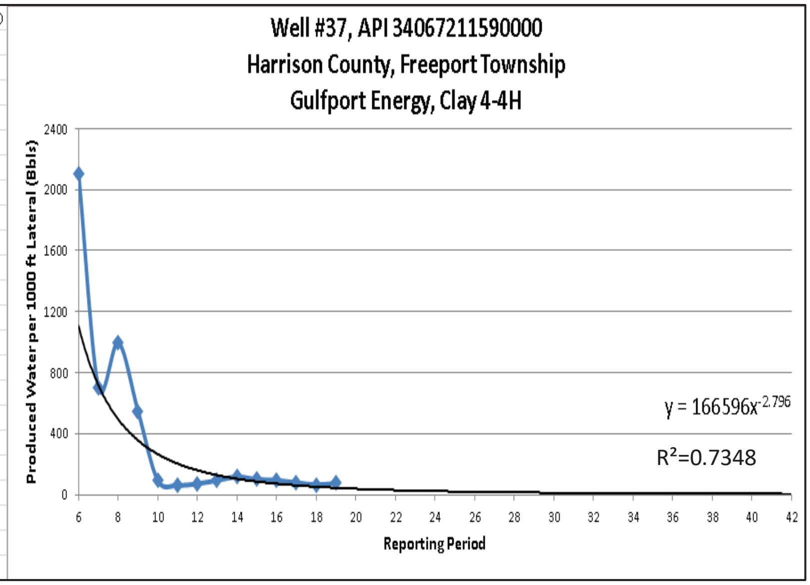

Figure A.37 Well 37 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	3515	524	17
2015 Q1	11	2750	410	79
2015 Q2	12	1982	296	89
2015 Q3	13	3056	456	99
2015 Q4	14	2107	314	99
2016 Q1	15	1591	237	99
2016 Q2	16	1109	165	100
2016 Q3	17	928	138	100
2016 Q4	18	730	109	100
2017 Q1	19	577	86	98

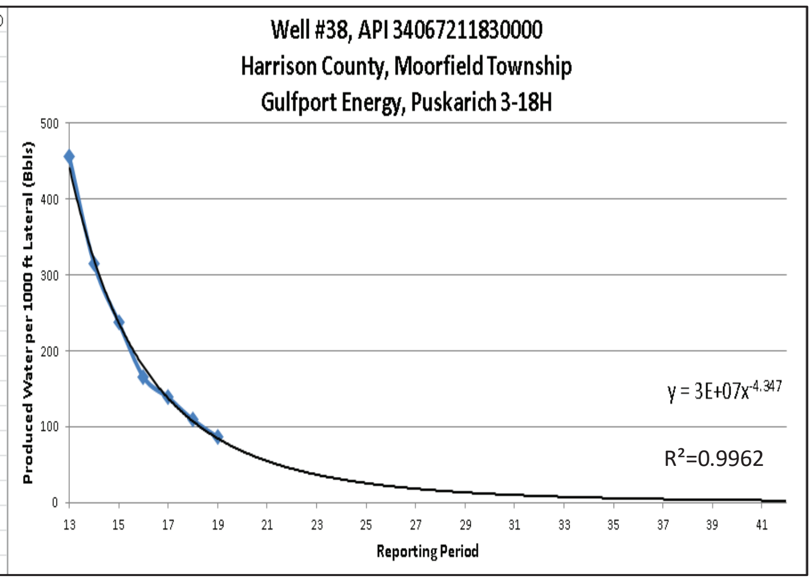

Figure A.38 Well 38 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	3685	471	2
2015 Q2	12	25729	3286	100
2015 Q3	13	8706	1112	97
2015 Q4	14	4722	603	100
2016 Q1	15	3060	391	100
2016 Q2	16	1175	150	100
2016 Q3	17	1314	168	100
2016 Q4	18	996	127	100
2017 Q1	19	782	100	100

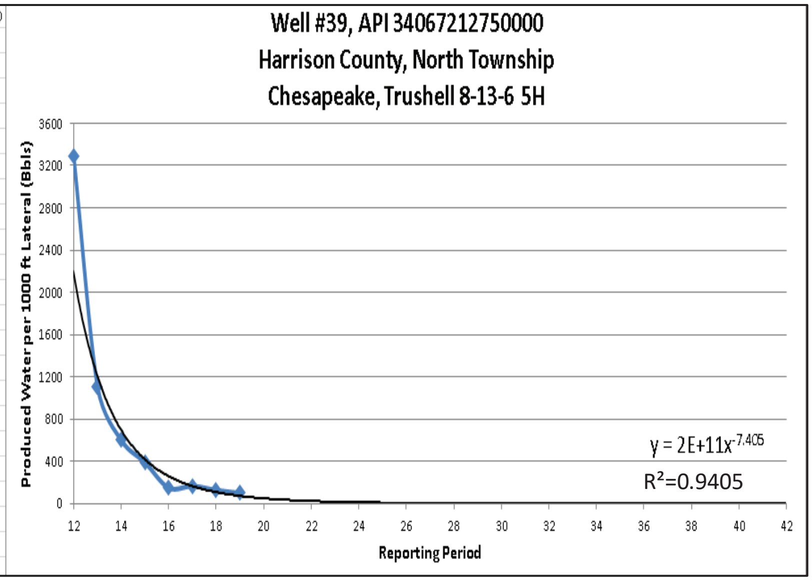

Figure A.39 Well 39 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	7148	1072	51
2014 Q3	9	6156	923	100
2014 Q4	10	3489	523	98
2015 Q1	11	1950	293	97
2015 Q2	12	4373	656	99
2015 Q3	13	4216	632	100
2015 Q4	14	3180	477	100
2016 Q1	15	3157	474	100
2016 Q2	16	1777	267	100
2016 Q3	17	1250	188	100
2016 Q4	18	833	125	100
2017 Q1	19	727	109	100

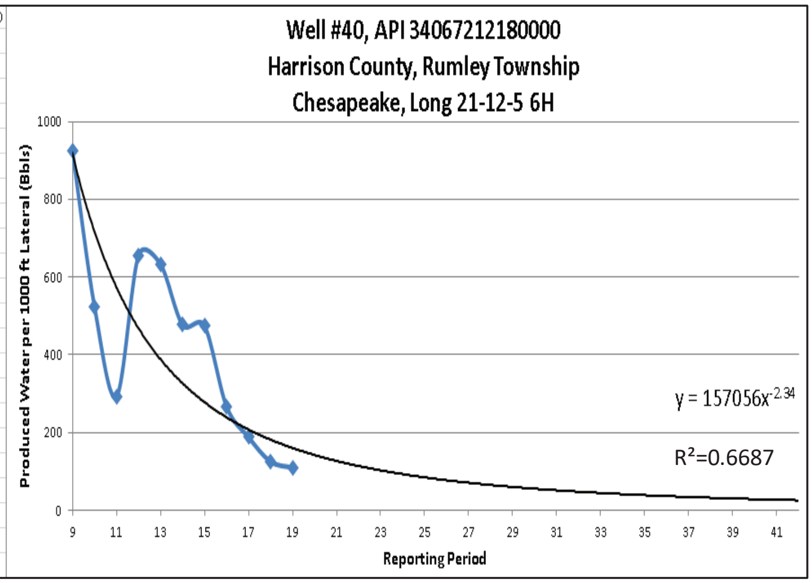

Figure A.40 Well 40 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	9407	1594	36
2014 Q4	10	10628	1800	100
2015 Q1	11	6072	1029	100
2015 Q2	12	3079	522	99
2015 Q3	13	5890	998	99
2015 Q4	14	2498	423	99
2016 Q1	15	1774	301	99
2016 Q2	16	1757	298	99
2016 Q3	17	1372	232	98
2016 Q4	18	1150	195	98
2017 Q1	19	1141	193	100

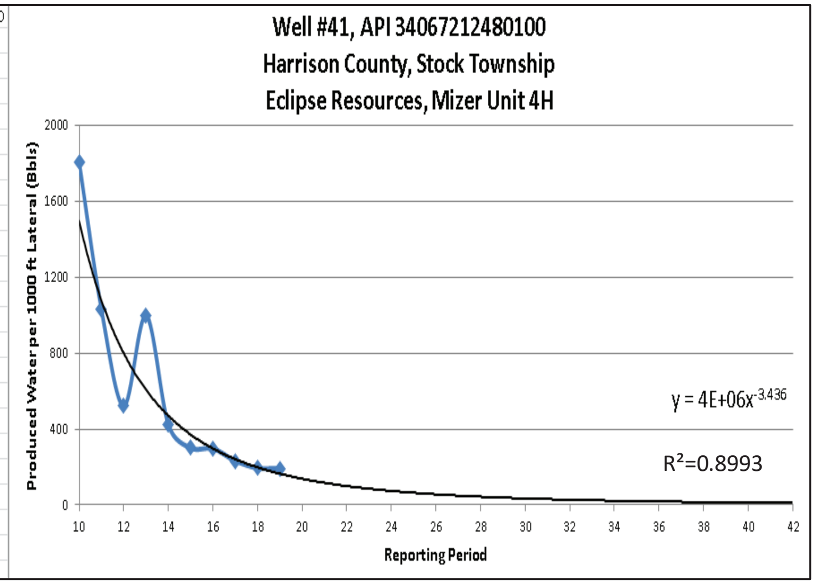

Figure A.41 Well 41 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	% DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	4705	873	71
2015 Q3	13	2581	479	80
2015 Q4	14	2225	413	90
2016 Q1	15	2048	380	100
2016 Q2	16	1683	312	100
2016 Q3	17	1550	288	100
2016 Q4	18	1261	234	100
2017 Q1	19	1131	210	100

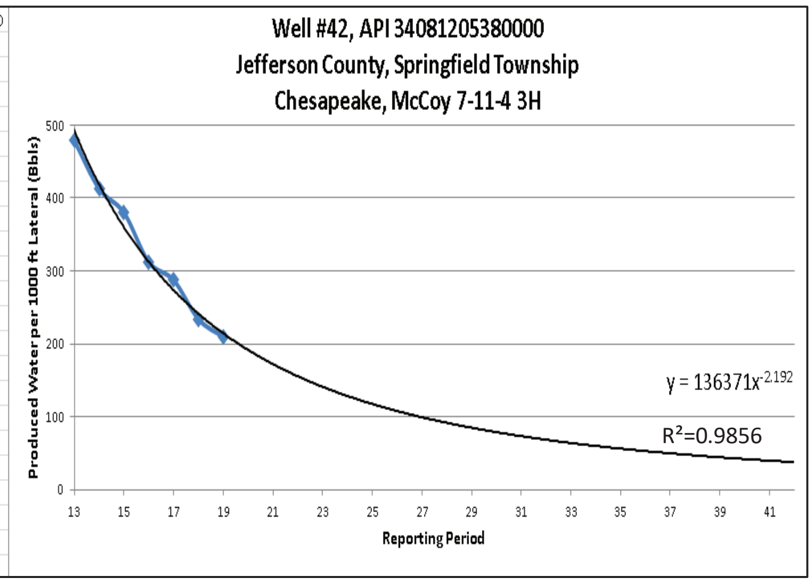

Figure A.42 Well 42 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	6353	940	54
2013 Q3	5	2783	412	36
2013 Q4	6	2525	374	95
2014 Q1	7	970	143	88
2014 Q2	8	3620	536	100
2014 Q3	9	2827	418	100
2014 Q4	10	1872	277	97
2015 Q1	11	1627	241	100
2015 Q2	12	1572	233	100
2015 Q3	13	142	21	10
2015 Q4	14	1205	178	90
2016 Q1	15	1213	180	100
2016 Q2	16	1028	152	100
2016 Q3	17	967	143	100
2016 Q4	18	887	131	100
2017 Q1	19	857	127	100

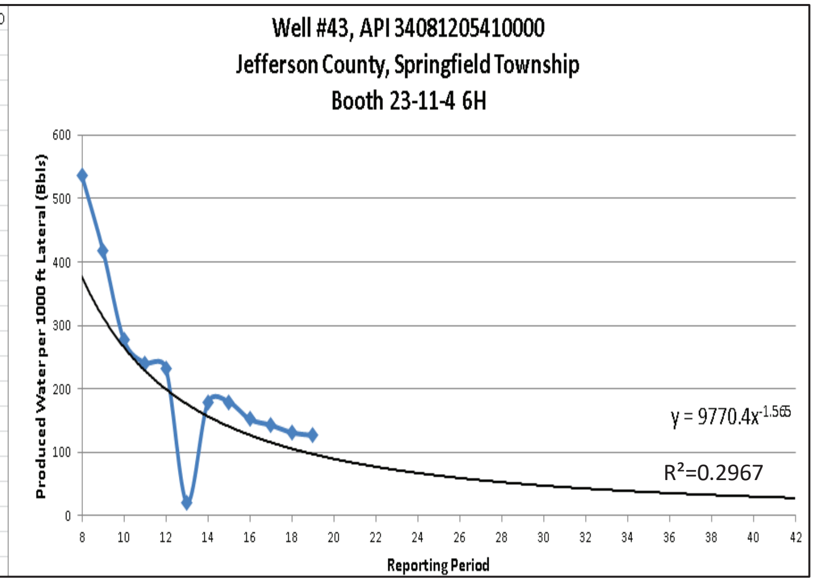

Figure A.43 Well 43 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	7791	1073	11
2014 Q2	8	10789	1486	93
2014 Q3	9	3725	513	98
2014 Q4	10	1672	230	100
2015 Q1	11	1046	144	100
2015 Q2	12	820	113	93
2015 Q3	13	720	99	100
2015 Q4	14	614	85	100
2016 Q1	15	541	75	100
2016 Q2	16	454	63	99
2016 Q3	17	400	55	100
2016 Q4	18	391	54	100
2017 Q1	19	401	55	100

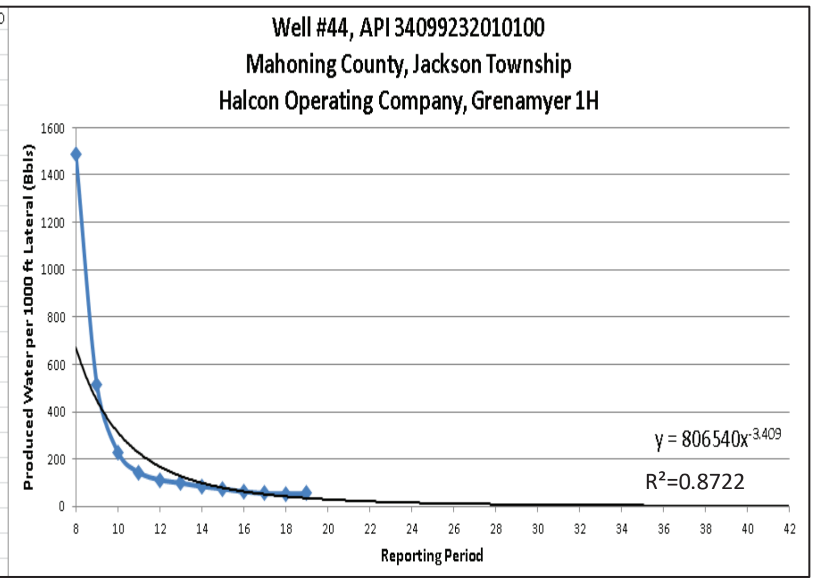

Figure A.44 Well 44 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	4580	556	37
2013 Q3	5	6741	818	100
2013 Q4	6	0	0	0
2014 Q1	7	7774	943	99
2014 Q2	8	5366	651	96
2014 Q3	9	4397	534	100
2014 Q4	10	4134	502	99
2015 Q1	11	4063	493	100
2015 Q2	12	3898	473	96
2015 Q3	13	3578	434	92
2015 Q4	14	3240	393	72
2016 Q1	15	3852	467	100
2016 Q2	16	3380	410	100
2016 Q3	17	3288	399	96
2016 Q4	18	3497	424	100
2017 Q1	19	3229	392	98

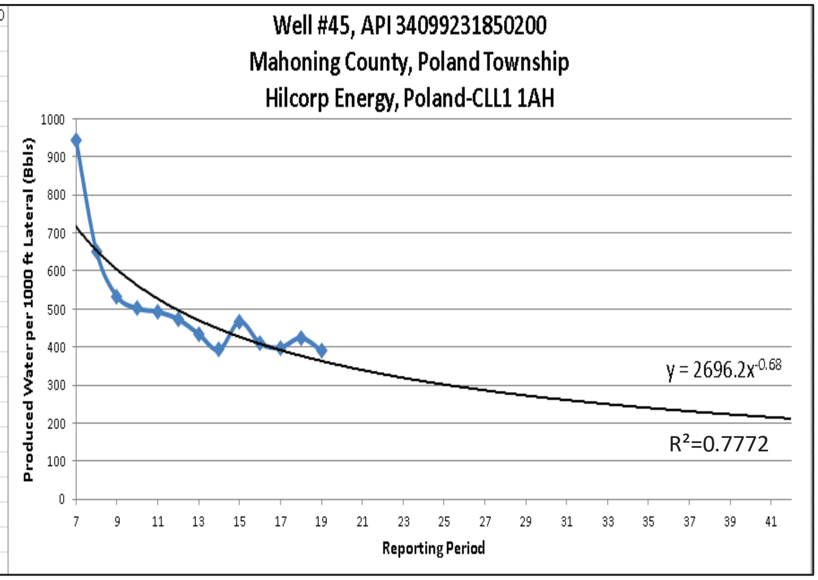

Figure A.45 Well 45 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	9320	1486	34
2015 Q3	13	20226	3226	98
2015 Q4	14	8283	1321	99
2016 Q1	15	4418	705	92
2016 Q2	16	3354	535	100
2016 Q3	17	2458	392	99
2016 Q4	18	2074	331	92
2017 Q1	19	1964	313	88

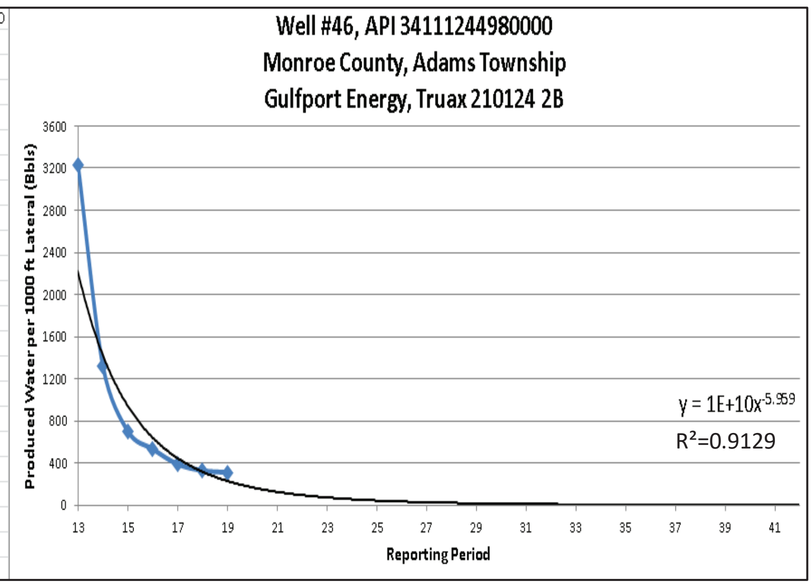

Figure A.46 Well 46 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	4371	796	34
2015 Q3	13	11970	2180	98
2015 Q4	14	4655	848	89
2016 Q1	15	3119	568	98
2016 Q2	16	2242	408	98
2016 Q3	17	1612	294	99
2016 Q4	18	1574	287	100
2017 Q1	19	1413	257	91

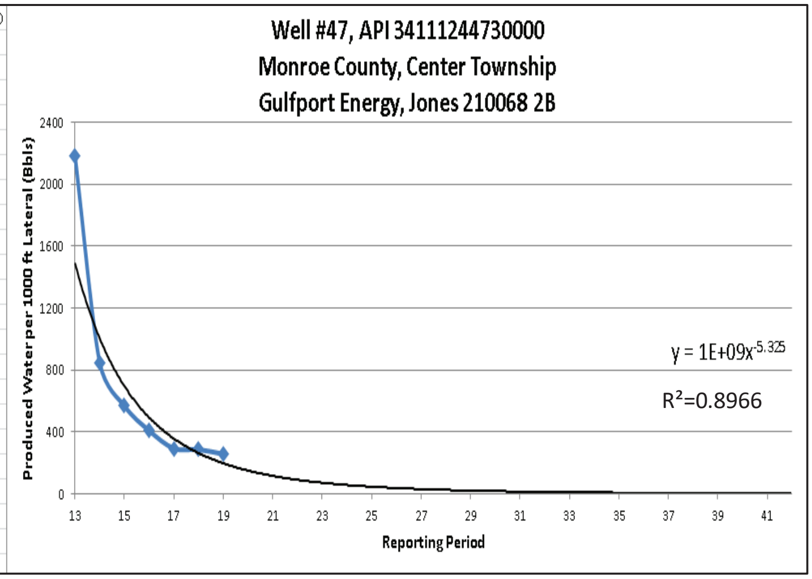

Figure A.47 Well 47 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	15644	2919	42
2015 Q2	12	5130	957	80
2015 Q3	13	6829	1274	99
2015 Q4	14	4592	857	80
2016 Q1	15	4274	797	100
2016 Q2	16	4168	778	100
2016 Q3	17	3786	706	100
2016 Q4	18	2488	464	100
2017 Q1	19	2066	385	100

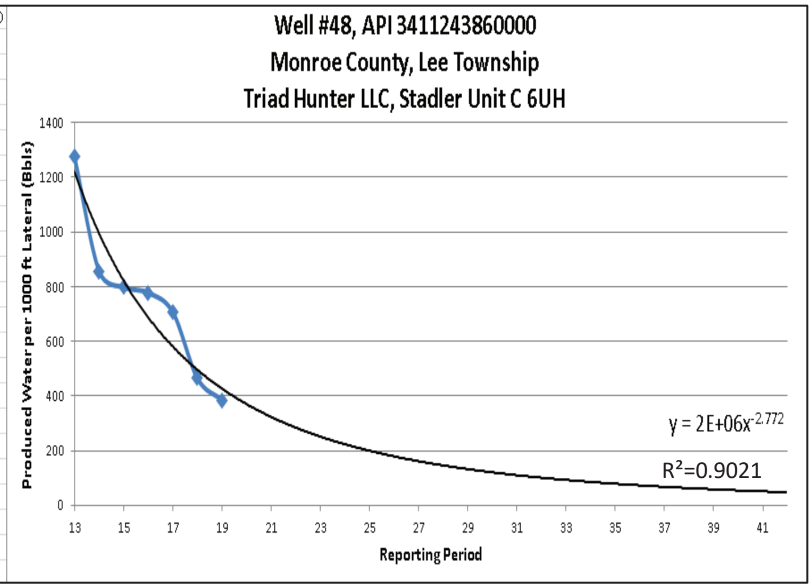

Figure A.48 Well 48 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4153	1179	100
2015 Q1	11	2742	779	93
2015 Q2	12	2780	789	100
2015 Q3	13	2403	682	100
2015 Q4	14	1356	385	98
2016 Q1	15	1590	451	100
2016 Q2	16	1279	363	101
2016 Q3	17	926	263	100
2016 Q4	18	675	192	100
2017 Q1	19	788	224	100

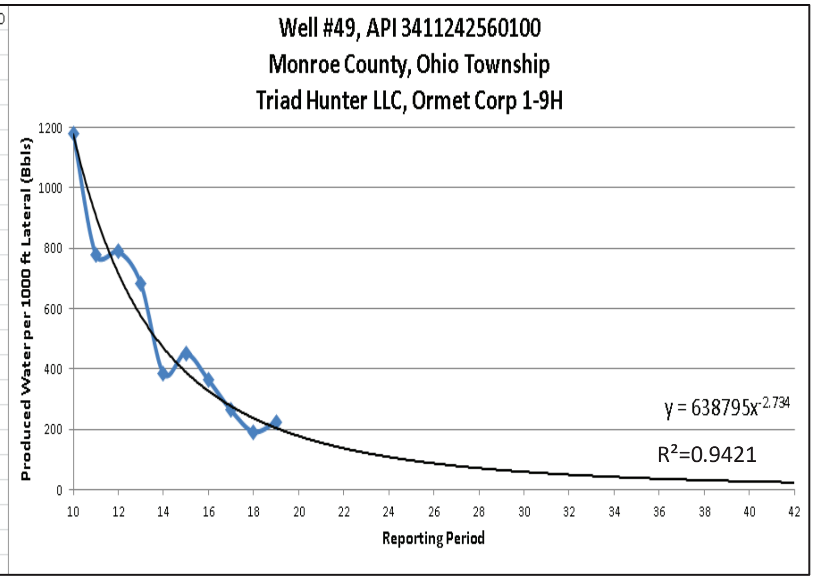

Figure A.49 Well 49 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	8080	997	22
2015 Q1	11	27083	3342	100
2015 Q2	12	11346	1400	98
2015 Q3	13	4583	566	100
2015 Q4	14	6320	780	100
2016 Q1	15	5227	645	100
2016 Q2	16	4972	614	100
2016 Q3	17	2202	272	100
2016 Q4	18	2234	276	100
2017 Q1	19	1933	239	100

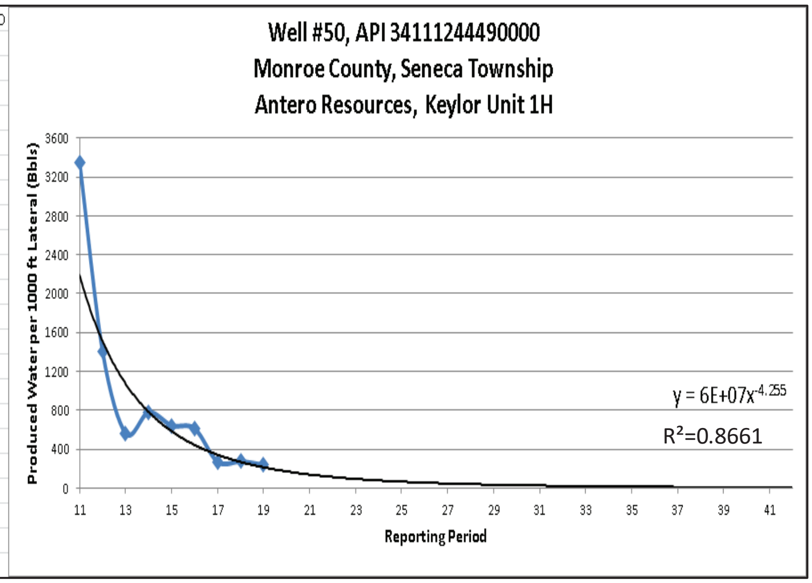

Figure A.50 Well 50 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	29559	3776	76
2015 Q1	11	18892	2413	100
2015 Q2	12	10456	1336	100
2015 Q3	13	3624	463	100
2015 Q4	14	4958	633	100
2016 Q1	15	3733	477	100
2016 Q2	16	2955	377	100
2016 Q3	17	1352	173	100
2016 Q4	18	1576	201	100
2017 Q1	19	1370	175	100

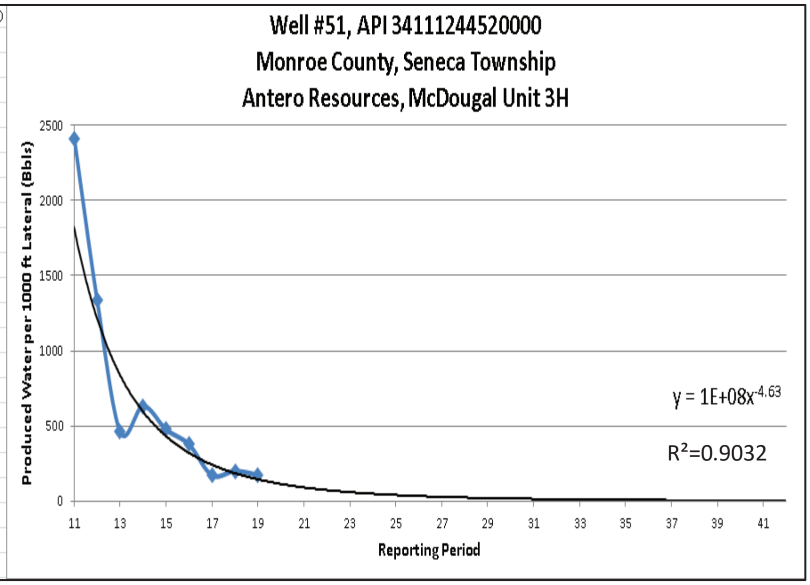

Figure A.51 Well 51 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	3049	679	21
2014 Q4	10	7117	1584	100
2015 Q1	11	9252	2060	99
2015 Q2	12	7545	1680	89
2015 Q3	13	8963	1995	99
2015 Q4	14	7037	1567	100
2016 Q1	15	4416	983	96
2016 Q2	16	2210	492	52
2016 Q3	17	3609	803	100
2016 Q4	18	2452	546	82
2017 Q1	19	1634	364	68

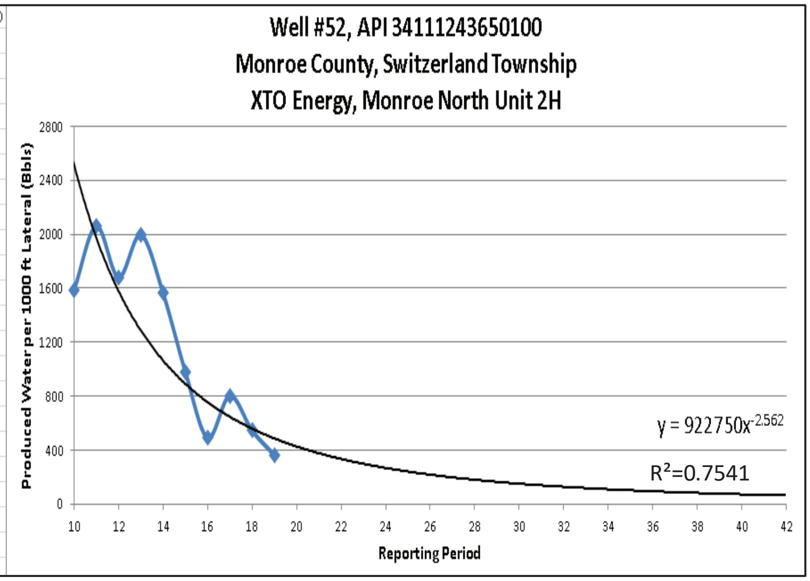

Figure A.52 Well 52 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	7129	950	30
2014 Q4	10	9362	1248	100
2015 Q1	11	4408	588	100
2015 Q2	12	3574	476	98
2015 Q3	13	2210	295	100
2015 Q4	14	1694	226	100
2016 Q1	15	1358	181	100
2016 Q2	16	1076	143	100
2016 Q3	17	757	101	100
2016 Q4	18	664	89	99
2017 Q1	19	410	55	99

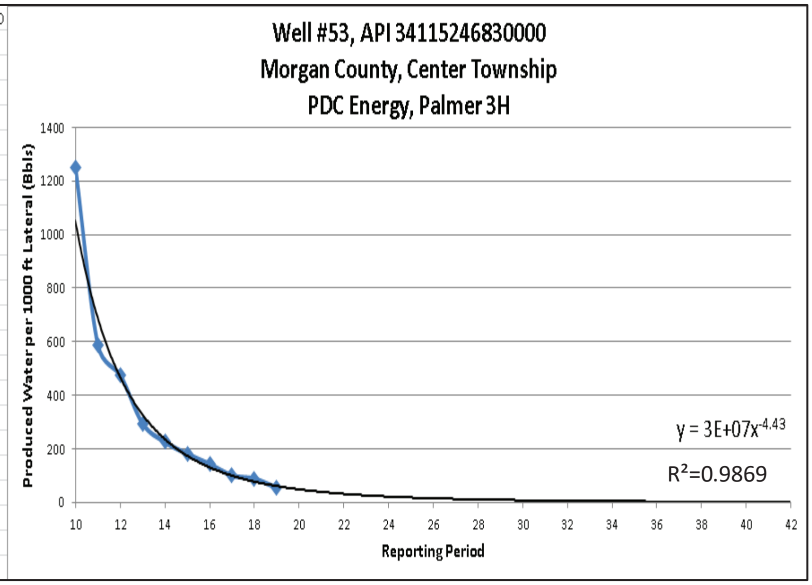

Figure A.53 Well 53 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	5052	468	67
2015 Q3	13	2852	264	100
2015 Q4	14	7443	689	100
2016 Q1	15	7179	665	100
2016 Q2	16	5244	486	100
2016 Q3	17	4037	374	95
2016 Q4	18	3047	282	100
2017 Q1	19	2712	251	100

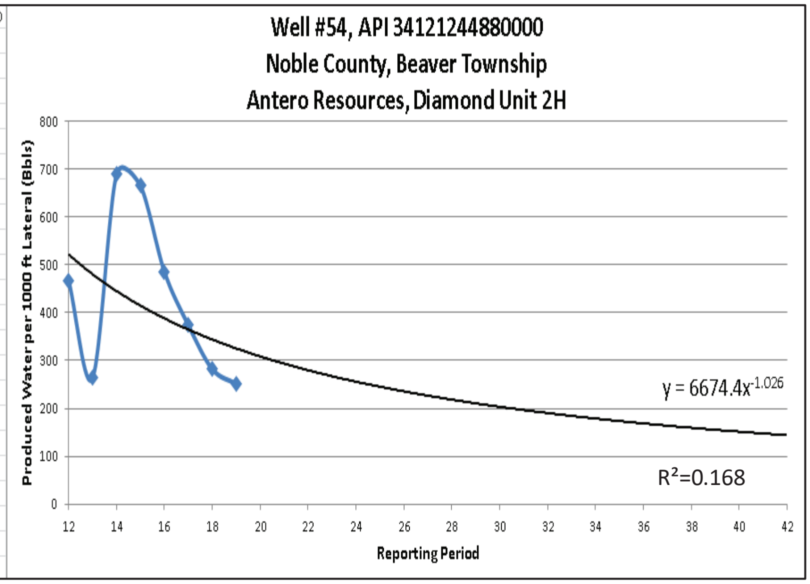

Figure A.54 Well 54 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	2531	495	8
2015 Q2	12	8907	1741	100
2015 Q3	13	7803	1526	98
2015 Q4	14	6343	1240	100
2016 Q1	15	4395	859	100
2016 Q2	16	2633	515	91
2016 Q3	17	2499	489	100
2016 Q4	18	2094	409	100
2017 Q1	19	1656	324	100

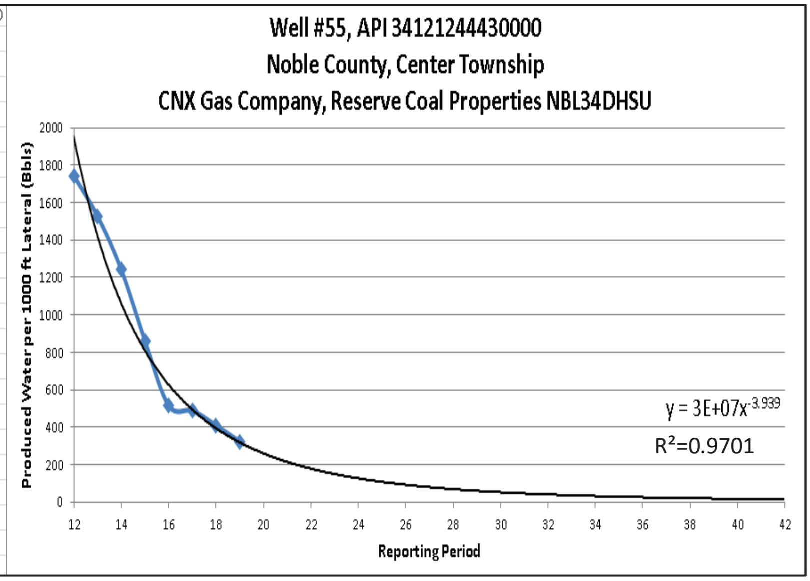

Figure A.55 Well 55 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	9050	1881	13
2013 Q4	6	0	0	100
2014 Q1	7	1641	341	27
2014 Q2	8	1845	383	84
2014 Q3	9	7193	1495	97
2014 Q4	10	3718	773	90
2015 Q1	11	2702	562	99
2015 Q2	12	2005	417	100
2015 Q3	13	1681	349	100
2015 Q4	14	1342	279	96
2016 Q1	15	1149	239	95
2016 Q2	16	1011	210	98
2016 Q3	17	1022	212	100
2016 Q4	18	1300	270	99
2017 Q1	19	941	196	96

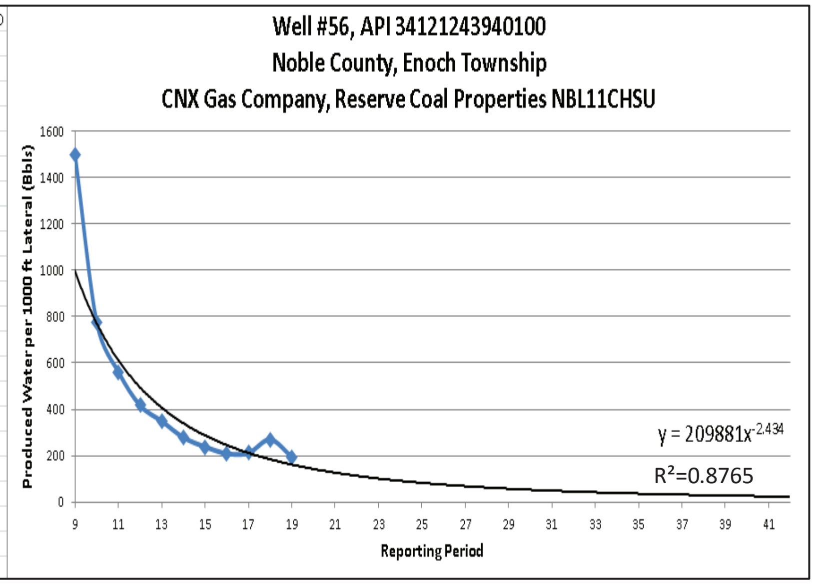

Figure A.56 Well 56 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	11343	2552	67
2014 Q4	10	1944	437	50
2015 Q1	11	920	207	71
2015 Q2	12	5209	1172	98
2015 Q3	13	4030	907	99
2015 Q4	14	3027	681	100
2016 Q1	15	2228	501	100
2016 Q2	16	1929	434	97
2016 Q3	17	1855	417	99
2016 Q4	18	1587	357	99
2017 Q1	19	1454	327	100

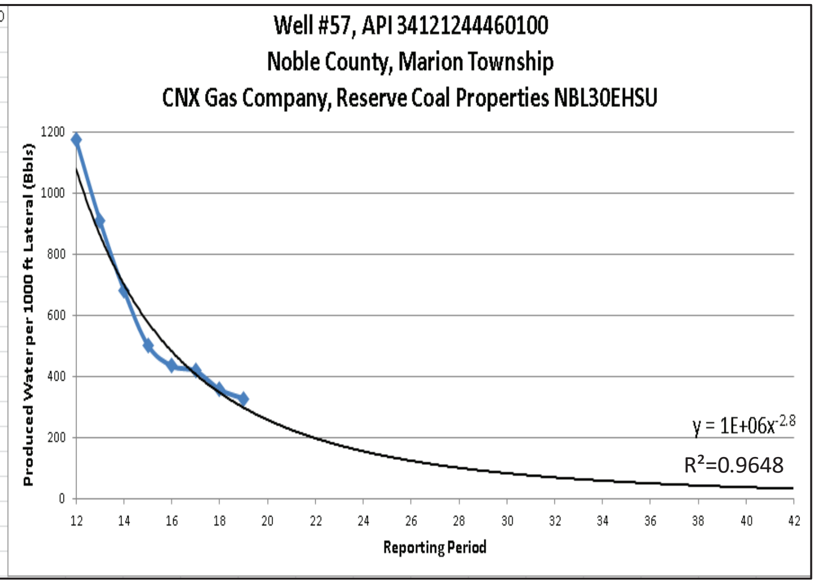

Figure A.57 Well 57 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	15529	2102	53
2014 Q2	8	4684	634	100
2014 Q3	9	1624	220	99
2014 Q4	10	1380	187	98
2015 Q1	11	582	79	100
2015 Q2	12	625	85	97
2015 Q3	13	510	69	100
2015 Q4	14	450	61	93
2016 Q1	15	395	53	100
2016 Q2	16	359	49	99
2016 Q3	17	334	45	100
2016 Q4	18	333	45	100
2017 Q1	19	288	39	100

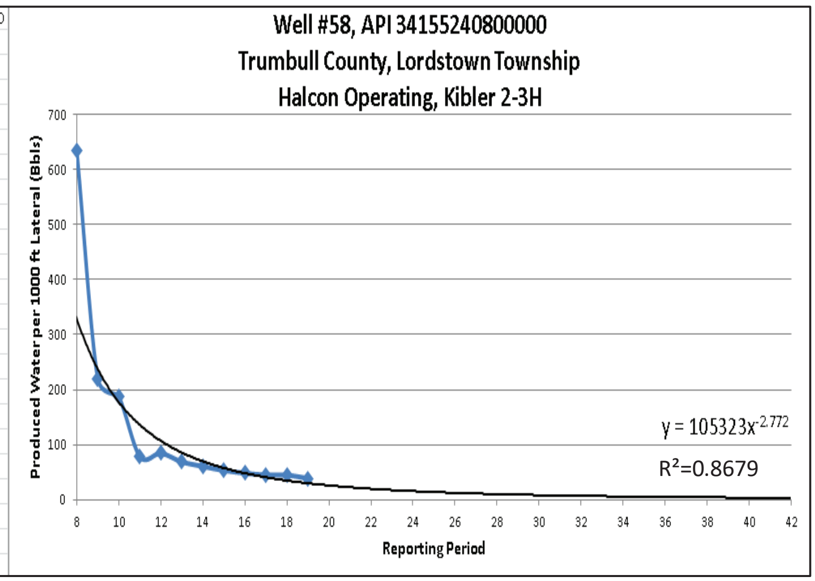

Figure A.58 Well 58 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	2914	646	19
2014 Q2	8	12496	2771	69
2014 Q3	9	8139	1805	100
2014 Q4	10	5077	1126	100
2015 Q1	11	3427	760	100
2015 Q2	12	2474	549	98
2015 Q3	13	1671	371	100
2015 Q4	14	1369	304	100
2016 Q1	15	1063	236	100
2016 Q2	16	959	213	100
2016 Q3	17	777	172	100
2016 Q4	18	761	169	99
2017 Q1	19	814	180	100

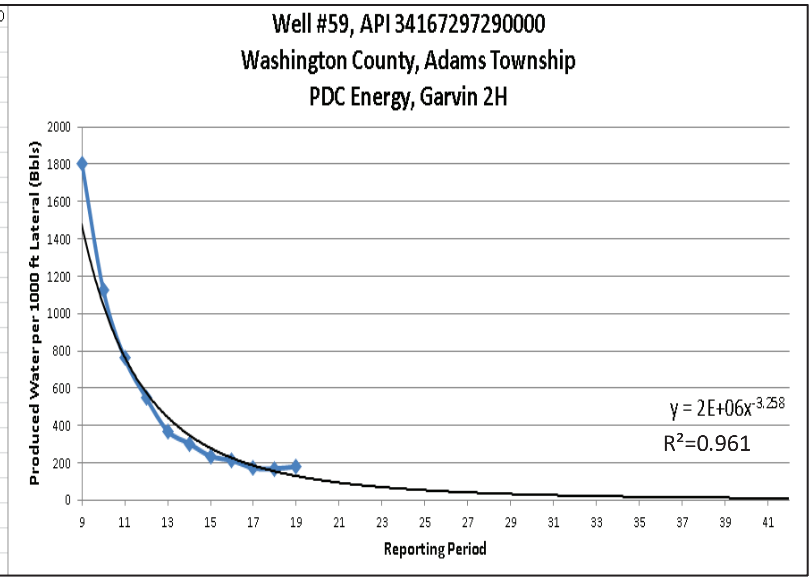

Figure A.59 Well 59 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	19855	3489	68
2014 Q1	7	7899	1388	47
2014 Q2	8	4404	774	100
2014 Q3	9	2033	357	92
2014 Q4	10	1534	270	92
2015 Q1	11	1196	210	100
2015 Q2	12	1251	220	98
2015 Q3	13	1170	206	100
2015 Q4	14	1102	194	100
2016 Q1	15	1028	181	100
2016 Q2	16	936	164	100
2016 Q3	17	933	164	100
2016 Q4	18	801	141	98
2017 Q1	19	785	138	100

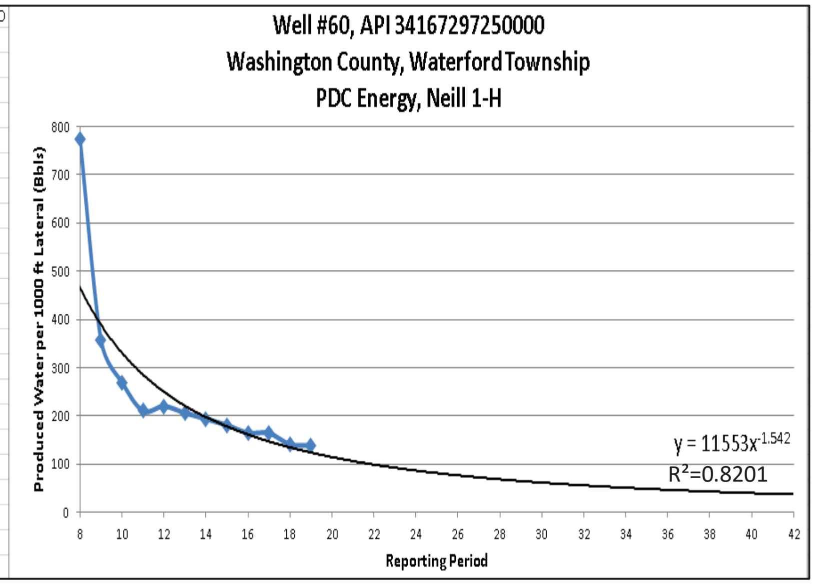

Figure A.60 Well 60 (see Figure 2 for location)

APPENDIX B: RESULTS VALIDATION PRODUCTION DECLINE PLOTS FOR THE SELECTED SIXTY POINT PLEASANT FORMATION WELLS

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	3494	355	9
2015 Q3	13	22593	2299	100
2015 Q4	14	25840	2629	100
2016 Q1	15	19955	2030	34
2016 Q2	16	10761	1095	73
2016 Q3	17	14494	1475	100
2016 Q4	18	12327	1254	100
2017 Q1	19	7931	807	100
2017 Q2	20	6067	617	100
2017 Q3	21	0	0	100
2017 Q4	22	4916	500	100
2018 Q1	23	3955	402	100

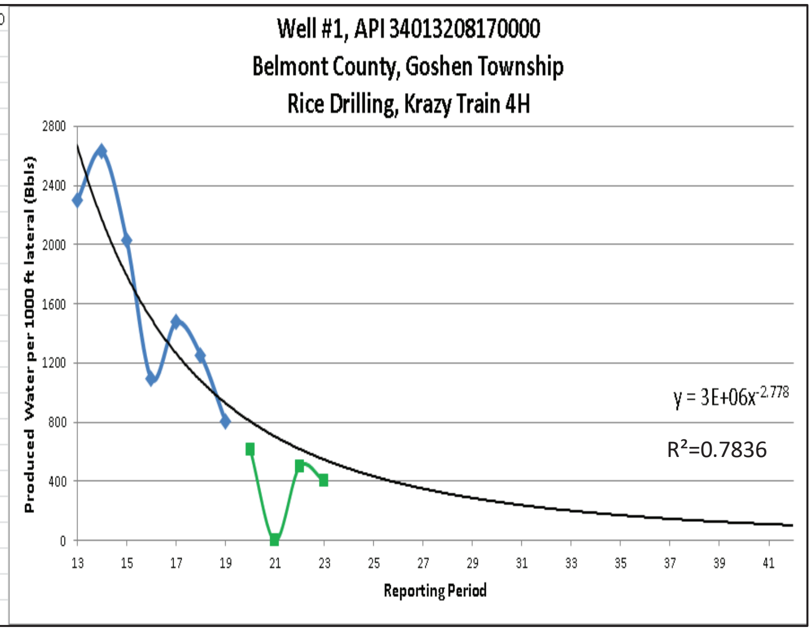

Figure B.1 Well 1 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	3513	503	43
2015 Q1	11	2415	346	81
2015 Q2	12	2410	345	93
2015 Q3	13	3003	430	100
2015 Q4	14	2157	309	100
2016 Q1	15	2803	401	98
2016 Q2	16	2234	320	99
2016 Q3	17	1496	214	99
2016 Q4	18	1508	216	99
2017 Q1	19	1416	203	99
2017 Q2	20	1132	162	100
2017 Q3	21	411	59	49
2017 Q4	22	686	98	86
2018 Q1	23	779	111	100

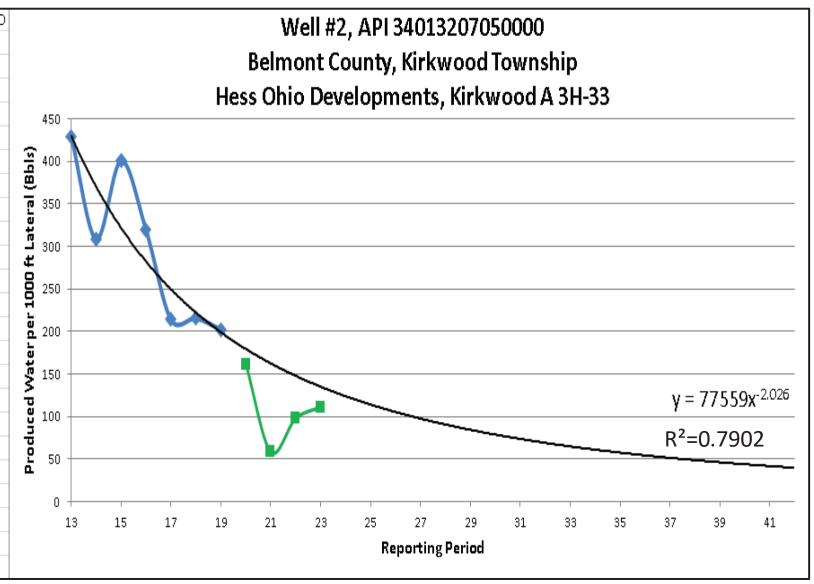

Figure B.2 Well 2 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	2219	489	21
2014 Q4	10	4625	1020	98
2015 Q1	11	3236	713	94
2015 Q2	12	3045	671	99
2015 Q3	13	2723	600	96
2015 Q4	14	2093	461	98
2016 Q1	15	1658	366	99
2016 Q2	16	1288	284	98
2016 Q3	17	961	212	99
2016 Q4	18	995	219	100
2017 Q1	19	681	150	100
2017 Q2	20	640	141	100
2017 Q3	21	446	98	98
2017 Q4	22	425	94	100
2018 Q1	23	594	131	99

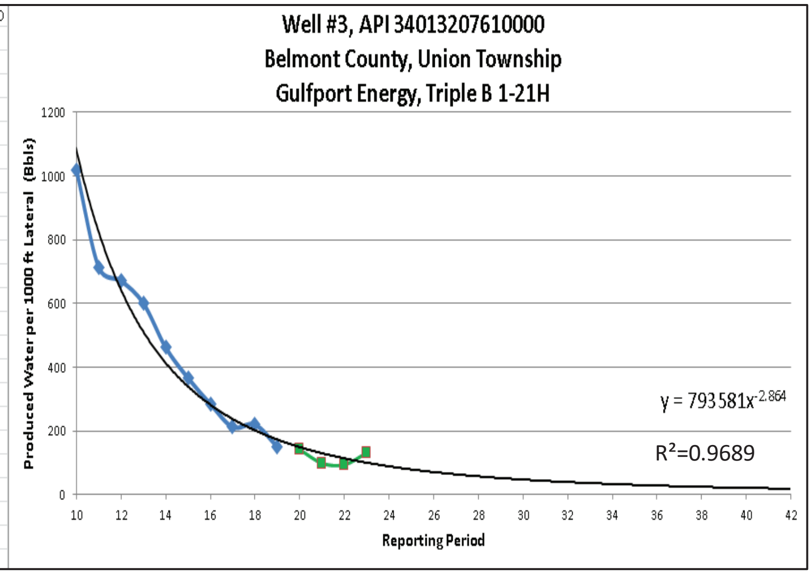

Figure B.3 Well 3 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	2886	373	20
2014 Q3	9	5019	649	96
2014 Q4	10	3401	440	97
2015 Q1	11	3126	404	94
2015 Q2	12	2836	367	99
2015 Q3	13	2811	363	97
2015 Q4	14	2129	275	99
2016 Q1	15	1782	230	99
2016 Q2	16	1635	211	98
2016 Q3	17	1353	175	99
2016 Q4	18	1300	168	99
2017 Q1	19	1113	144	100
2017 Q2	20	951	123	99
2017 Q3	21	947	122	100
2017 Q4	22	857	111	100
2018 Q1	23	746	96	98

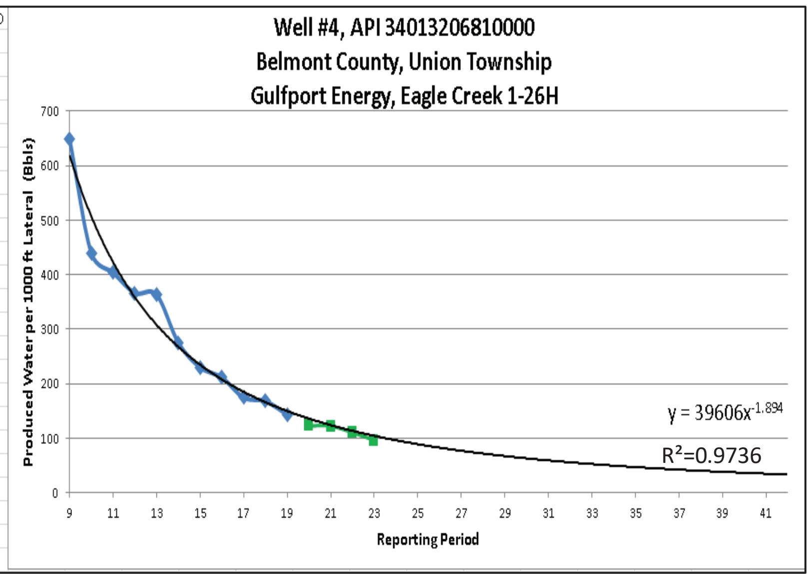

Figure B.4 Well 4 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	2830	367	86
2015 Q3	13	3240	420	100
2015 Q4	14	3848	498	100
2016 Q1	15	3128	405	99
2016 Q2	16	2514	326	100
2016 Q3	17	1918	248	100
2016 Q4	18	1584	205	100
2017 Q1	19	1369	177	100
2017 Q2	20	5131	665	62
2017 Q3	21	4785	620	38
2017 Q4	22	42731	5534	82
2018 Q1	23	9786	1267	60

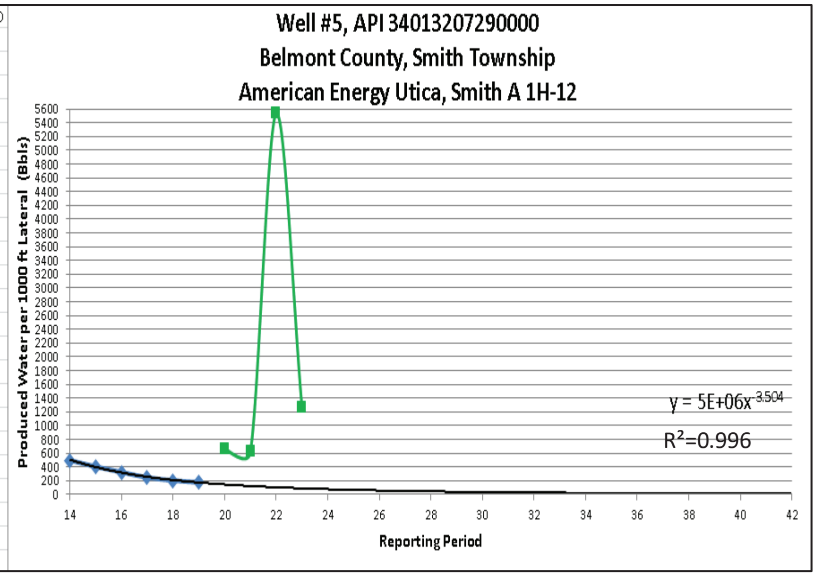

Figure B.5 Well 5 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	4581	582	87
2014 Q4	10	813	103	93
2015 Q1	11	1963	249	97
2015 Q2	12	3210	408	98
2015 Q3	13	4568	580	96
2015 Q4	14	3462	440	99
2016 Q1	15	2614	332	99
2016 Q2	16	2337	297	100
2016 Q3	17	1781	226	98
2016 Q4	18	1561	198	99
2017 Q1	19	1366	173	100
2017 Q2	20	1264	160	100
2017 Q3	21	1170	149	100
2017 Q4	22	1009	128	97
2018 Q1	23	973	124	99

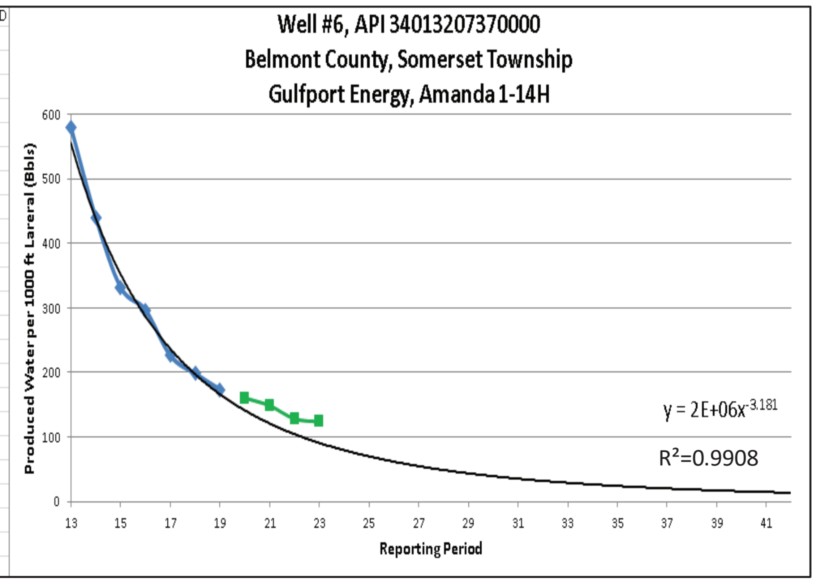

Figure B.6 Well 6 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	3266	363	7
2015 Q2	12	11948	1327	62
2015 Q3	13	10823	1202	98
2015 Q4	14	7056	784	100
2016 Q1	15	5851	650	99
2016 Q2	16	4902	544	95
2016 Q3	17	4031	448	99
2016 Q4	18	3631	403	100
2017 Q1	19	3009	334	100
2017 Q2	20	2797	311	99
2017 Q3	21	2650	294	100
2017 Q4	22	2323	258	100
2018 Q1	23	2150	239	100

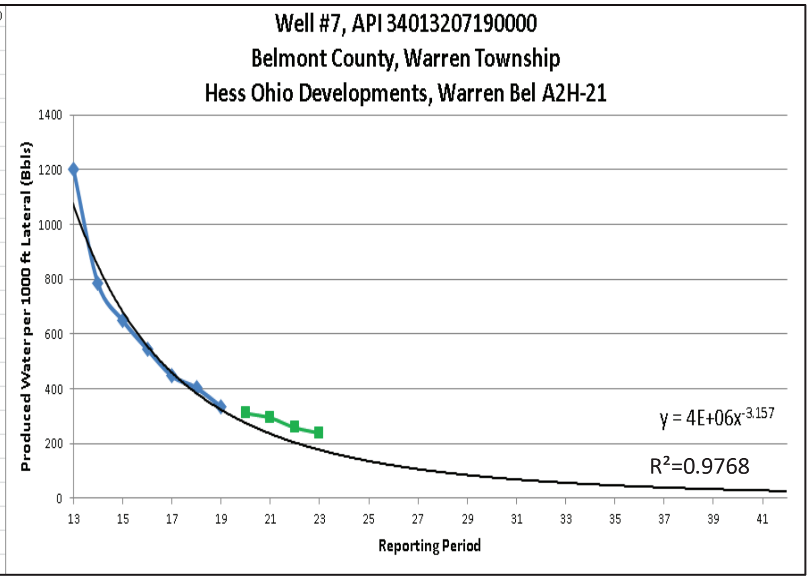

Figure B.7 Well 7 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	6366	1058	97
2015 Q3	13	5183	861	99
2015 Q4	14	3542	589	100
2016 Q1	15	1971	328	99
2016 Q2	16	1485	247	98
2016 Q3	17	1869	311	100
2016 Q4	18	1117	186	100
2017 Q1	19	886	147	100
2017 Q2	20	822	137	100
2017 Q3	21	589	98	100
2017 Q4	22	358	59	100
2018 Q1	23	203	34	97

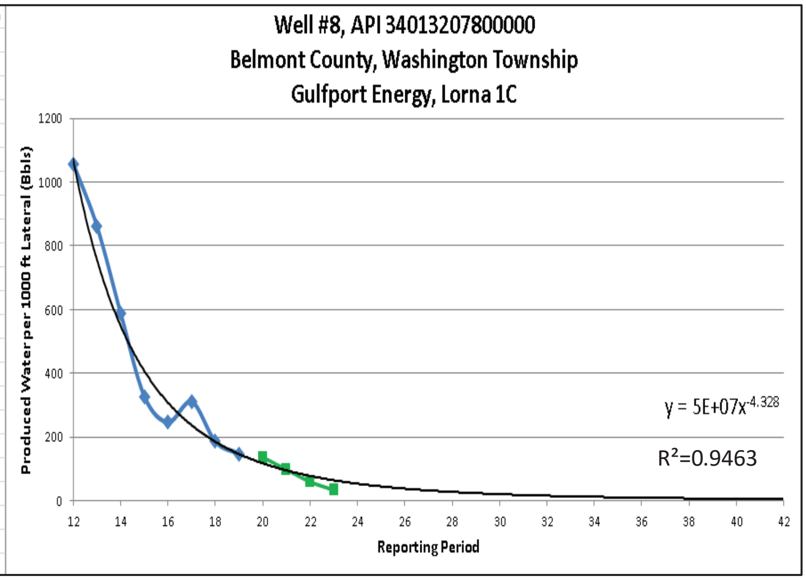

Figure B.8 Well 8 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	11449	1747	81
2015 Q3	13	12091	1845	98
2015 Q4	14	7117	1086	97
2016 Q1	15	5125	782	99
2016 Q2	16	3954	603	100
2016 Q3	17	3104	474	92
2016 Q4	18	2844	434	99
2017 Q1	19	2418	369	100
2017 Q2	20	2454	374	99
2017 Q3	21	2382	363	95
2017 Q4	22	1382	211	93
2018 Q1	23	3555	542	100

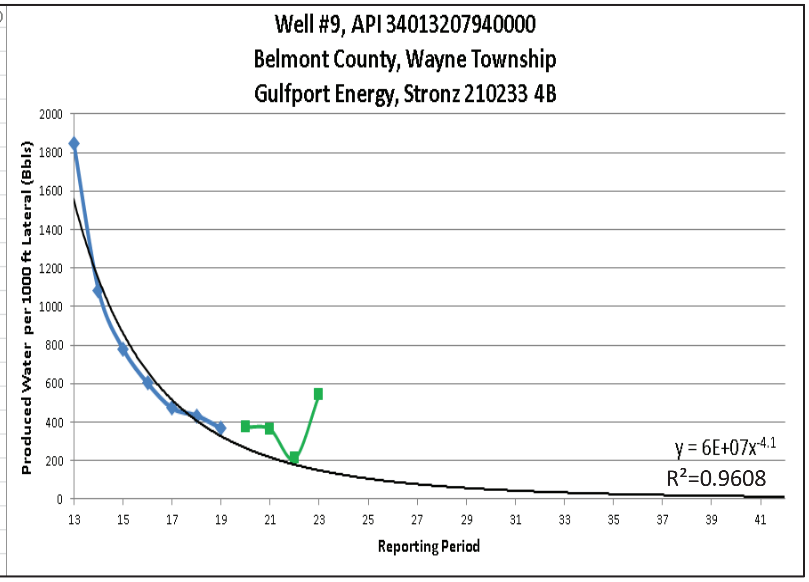

Figure B.9 Well 9 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	3557	750	9
2015 Q3	13	15386	3246	95
2015 Q4	14	8380	1768	100
2016 Q1	15	7653	1615	100
2016 Q2	16	5740	1211	100
2016 Q3	17	3955	834	100
2016 Q4	18	2177	459	100
2017 Q1	19	2055	434	74
2017 Q2	20	1319	278	97
2017 Q3	21	789	166	73
2017 Q4	22	0	0	0
2018 Q1	23	1871	395	16

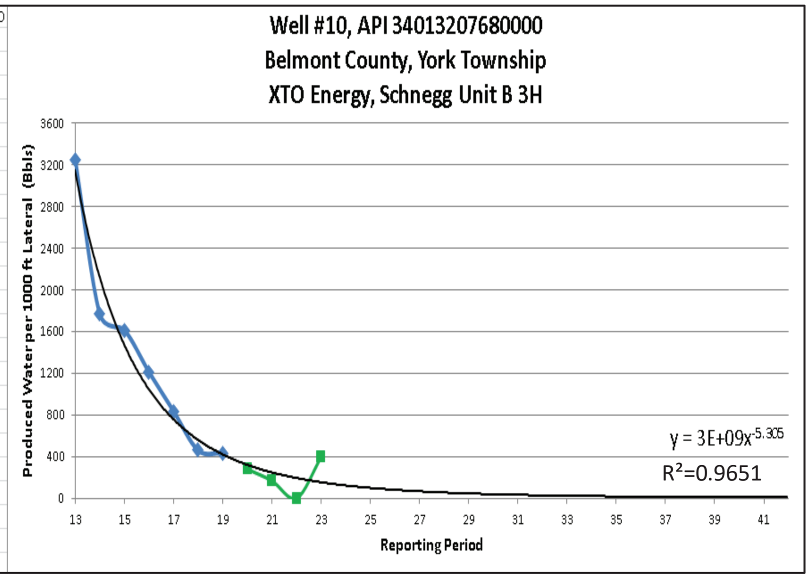

Figure B.10 Well 10 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	6521	1162	32
2015 Q2	12	4584	817	99
2015 Q3	13	1437	256	100
2015 Q4	14	551	98	100
2016 Q1	15	713	127	100
2016 Q2	16	628	112	100
2016 Q3	17	557	99	100
2016 Q4	18	546	97	100
2017 Q1	19	489	87	100
2017 Q2	20	375	67	100
2017 Q3	21	278	50	100
2017 Q4	22	338	60	100
2018 Q1	23	342	61	100

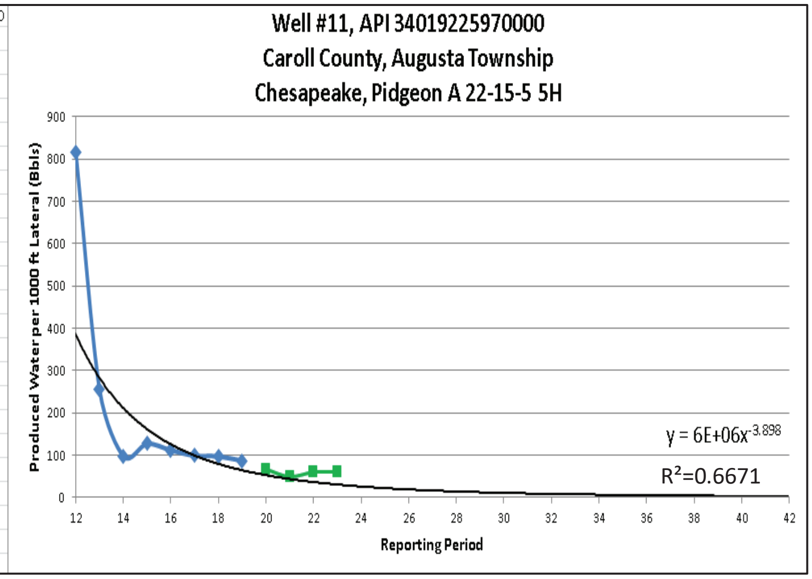

Figure B.11 Well 11 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	2999	382	11
2014 Q4	10	11802	1503	97
2015 Q1	11	9045	1152	100
2015 Q2	12	6052	771	100
2015 Q3	13	3460	441	100
2015 Q4	14	2491	317	100
2016 Q1	15	2082	265	100
2016 Q2	16	1662	212	100
2016 Q3	17	1556	198	100
2016 Q4	18	1391	177	100
2017 Q1	19	1284	163	100
2017 Q2	20	1227	156	100
2017 Q3	21	1154	147	100
2017 Q4	22	1149	146	100
2018 Q1	23	1004	128	100

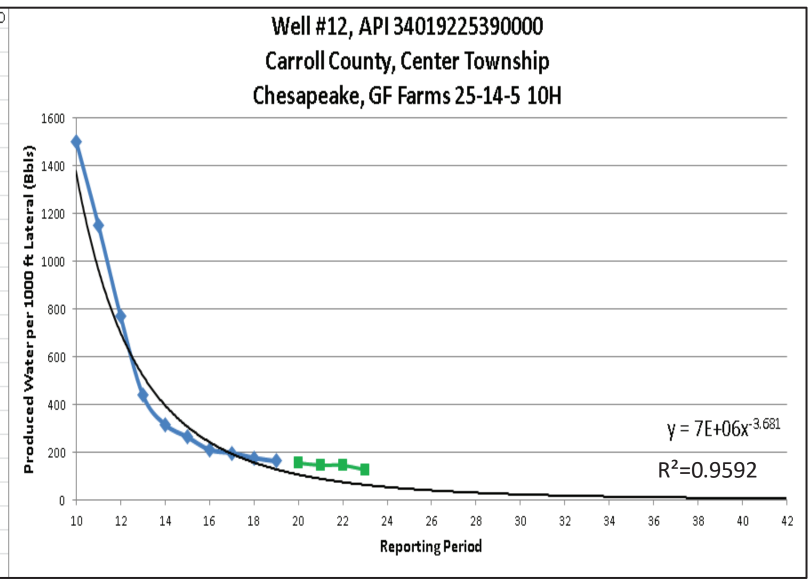

Figure B.12 Well 12 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	6386	753	41
2015 Q2	12	6439	759	99
2015 Q3	13	2481	292	100
2015 Q4	14	3050	360	100
2016 Q1	15	2805	331	100
2016 Q2	16	1473	174	100
2016 Q3	17	1243	147	100
2016 Q4	18	681	80	100
2017 Q1	19	503	59	100
2017 Q2	20	483	57	100
2017 Q3	21	833	98	100
2017 Q4	22	511	60	100
2018 Q1	23	1830	216	100

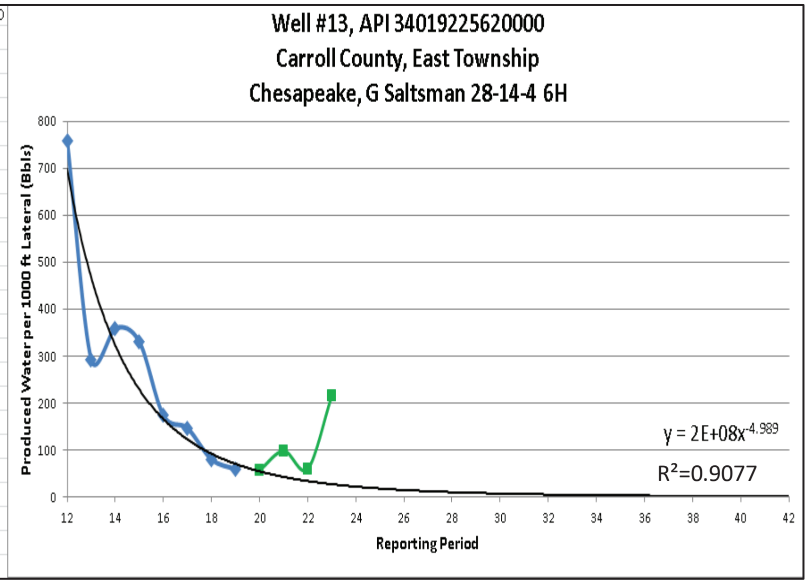

Figure B.13 Well 13 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	13054	1628	39
2015 Q2	12	4352	543	100
2015 Q3	13	2063	257	100
2015 Q4	14	1528	191	100
2016 Q1	15	1122	140	100
2016 Q2	16	1003	125	100
2016 Q3	17	935	117	100
2016 Q4	18	792	99	100
2017 Q1	19	698	87	100
2017 Q2	20	652	81	100
2017 Q3	21	581	72	100
2017 Q4	22	560	70	100
2018 Q1	23	433	54	99

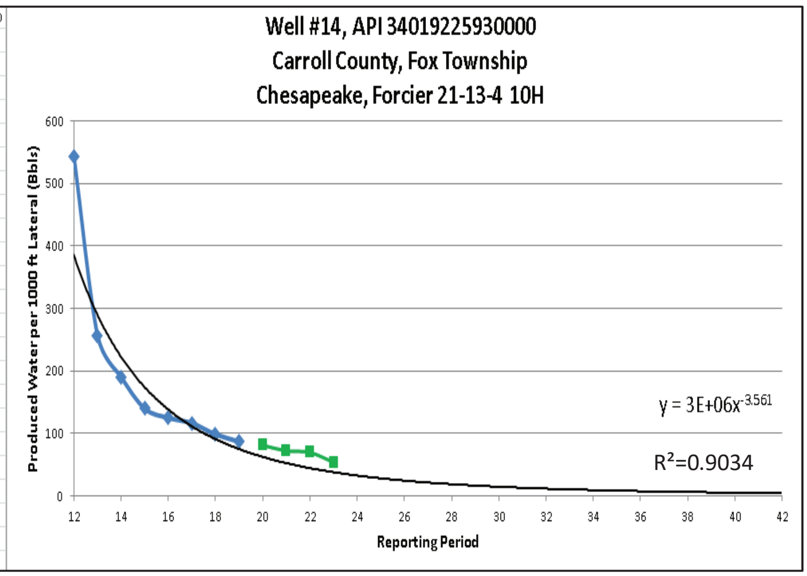

Figure B.14 Well 14 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	861	158	8
2014 Q2	8	5215	959	100
2014 Q3	9	3790	697	100
2014 Q4	10	1118	206	98
2015 Q1	11	561	103	34
2015 Q2	12	1139	209	100
2015 Q3	13	941	173	100
2015 Q4	14	913	168	95
2016 Q1	15	668	123	100
2016 Q2	16	728	134	100
2016 Q3	17	573	105	100
2016 Q4	18	537	99	100
2017 Q1	19	249	46	100
2017 Q2	20	342	63	100
2017 Q3	21	298	55	100
2017 Q4	22	318	58	99
2018 Q1	23	231	42	100

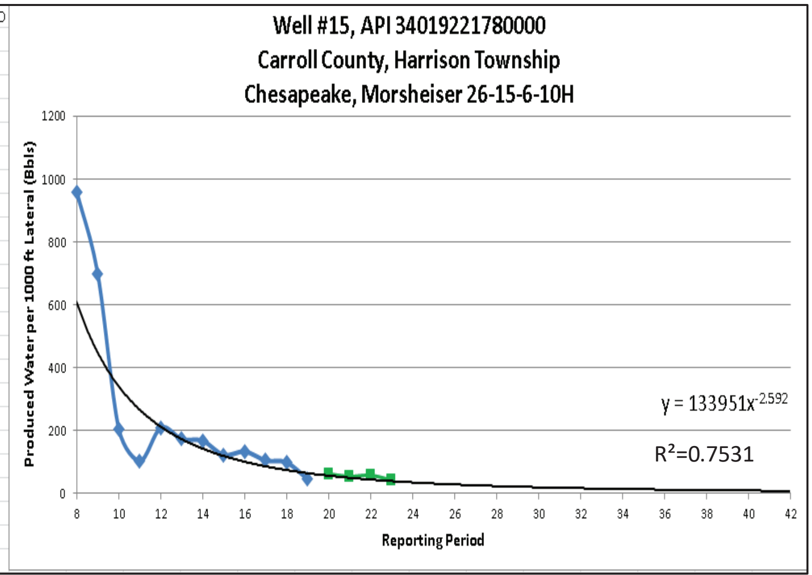

Figure B.15 Well 15 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	4165	775	71
2014 Q1	7	1202	223	99
2014 Q2	8	1097	204	100
2014 Q3	9	952	177	100
2014 Q4	10	703	131	100
2015 Q1	11	523	97	100
2015 Q2	12	528	98	100
2015 Q3	13	313	58	39
2015 Q4	14	442	82	100
2016 Q1	15	367	68	99
2016 Q2	16	356	66	100
2016 Q3	17	337	63	100
2016 Q4	18	328	61	100
2017 Q1	19	262	49	100
2017 Q2	20	286	53	100
2017 Q3	21	264	49	100
2017 Q4	22	288	54	100
2018 Q1	23	187	35	100

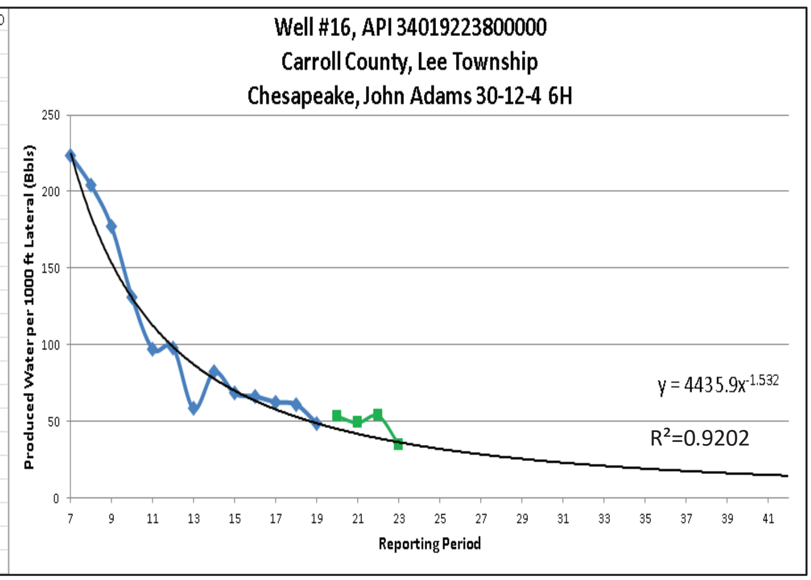

Figure B.16 Well 16 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	1219	299	8
2013 Q4	6	1146	281	37
2014 Q1	7	0	0	0
2014 Q2	8	1638	402	54
2014 Q3	9	6524	1602	40
2014 Q4	10	6085	1494	99
2015 Q1	11	3890	955	100
2015 Q2	12	3769	925	100
2015 Q3	13	269	66	10
2015 Q4	14	1933	475	100
2016 Q1	15	1717	422	78
2016 Q2	16	1407	345	100
2016 Q3	17	1849	454	100
2016 Q4	18	1561	383	100
2017 Q1	19	1196	294	100
2017 Q2	20	1221	300	100
2017 Q3	21	1705	419	100
2017 Q4	22	831	204	100
2018 Q1	23	841	206	100

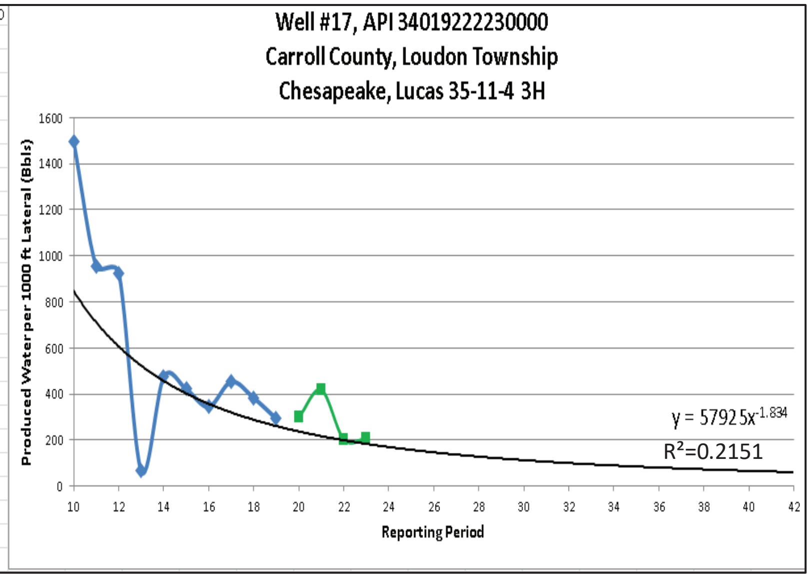

Figure B.17 Well 17 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	4974	927	80
2013 Q4	6	1092	203	57
2014 Q1	7	290	54	32
2014 Q2	8	1445	269	97
2014 Q3	9	1007	188	100
2014 Q4	10	723	135	93
2015 Q1	11	644	120	80
2015 Q2	12	383	71	100
2015 Q3	13	477	89	100
2015 Q4	14	500	93	97
2016 Q1	15	237	44	100
2016 Q2	16	272	51	100
2016 Q3	17	261	49	100
2016 Q4	18	252	47	100
2017 Q1	19	209	39	100
2017 Q2	20	327	61	100
2017 Q3	21	202	38	100
2017 Q4	22	178	33	100
2018 Q1	23	162	30	100

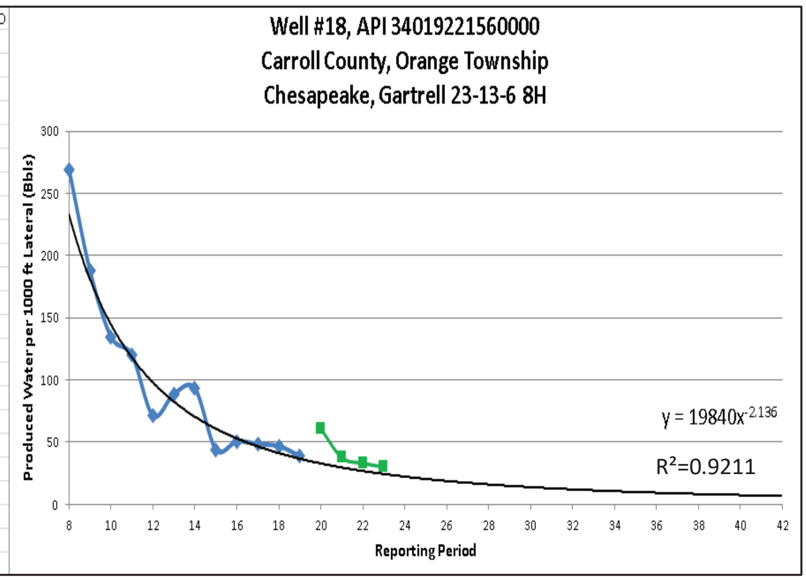

Figure B.18 Well 18 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	13700	2378	77
2015 Q1	11	6393	1110	100
2015 Q2	12	2348	408	100
2015 Q3	13	2728	474	100
2015 Q4	14	2470	429	88
2016 Q1	15	1220	212	100
2016 Q2	16	1656	287	100
2016 Q3	17	1308	227	100
2016 Q4	18	804	140	100
2017 Q1	19	711	123	100
2017 Q2	20	792	137	100
2017 Q3	21	723	125	100
2017 Q4	22	719	125	100
2018 Q1	23	675	117	100

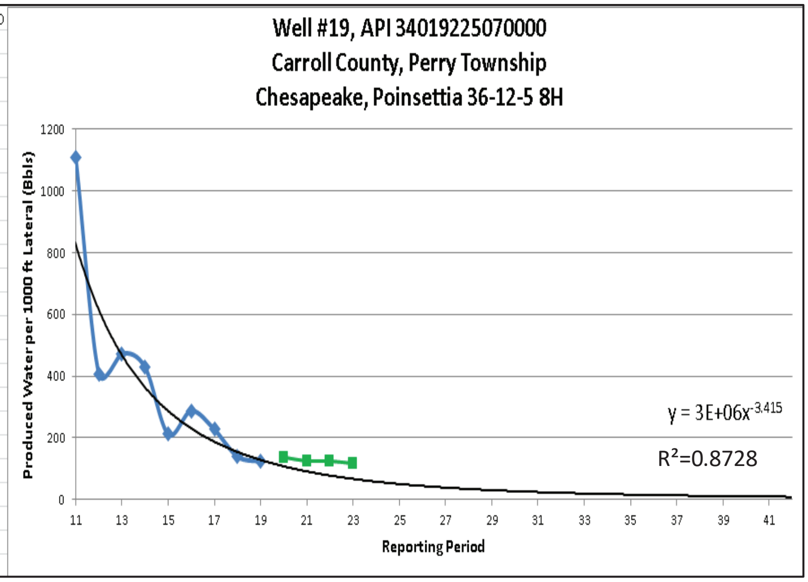

Figure B.19 Well 19 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	4780	728	69
2014 Q2	8	3408	519	100
2014 Q3	9	2253	343	98
2014 Q4	10	2090	319	98
2015 Q1	11	2350	358	93
2015 Q2	12	1313	200	100
2015 Q3	13	776	118	100
2015 Q4	14	687	105	100
2016 Q1	15	641	98	100
2016 Q2	16	625	95	100
2016 Q3	17	591	90	100
2016 Q4	18	603	92	100
2017 Q1	19	554	84	100
2017 Q2	20	480	73	100
2017 Q3	21	460	70	100
2017 Q4	22	468	71	100
2018 Q1	23	416	63	100

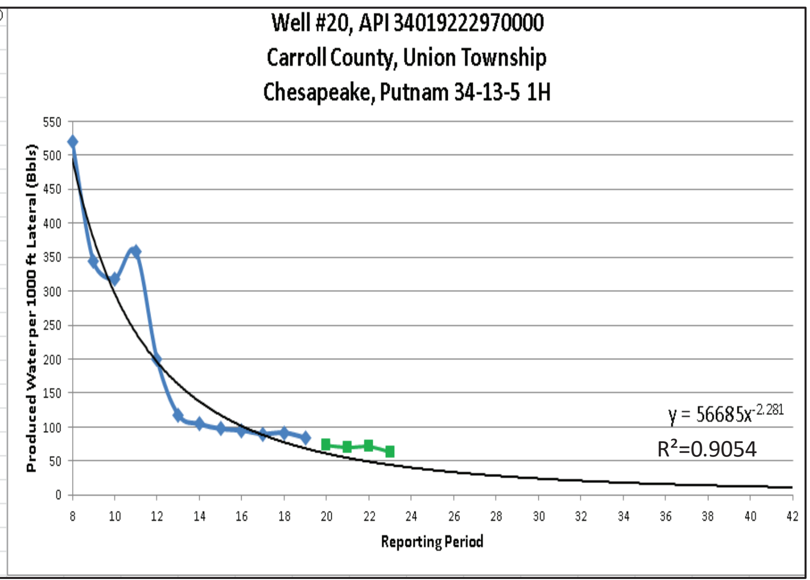

Figure B.20 Well 20 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	11528	2298	68
2013 Q4	6	5824	1161	93
2014 Q1	7	3096	617	96
2014 Q2	8	1714	342	96
2014 Q3	9	1328	265	97
2014 Q4	10	1012	202	100
2015 Q1	11	1044	208	100
2015 Q2	12	1053	210	100
2015 Q3	13	1429	285	100
2015 Q4	14	863	172	100
2016 Q1	15	855	170	100
2016 Q2	16	753	150	100
2016 Q3	17	664	132	100
2016 Q4	18	609	121	100
2017 Q1	19	510	102	100
2017 Q2	20	457	91	100
2017 Q3	21	389	78	100
2017 Q4	22	337	67	96
2018 Q1	23	301	60	100

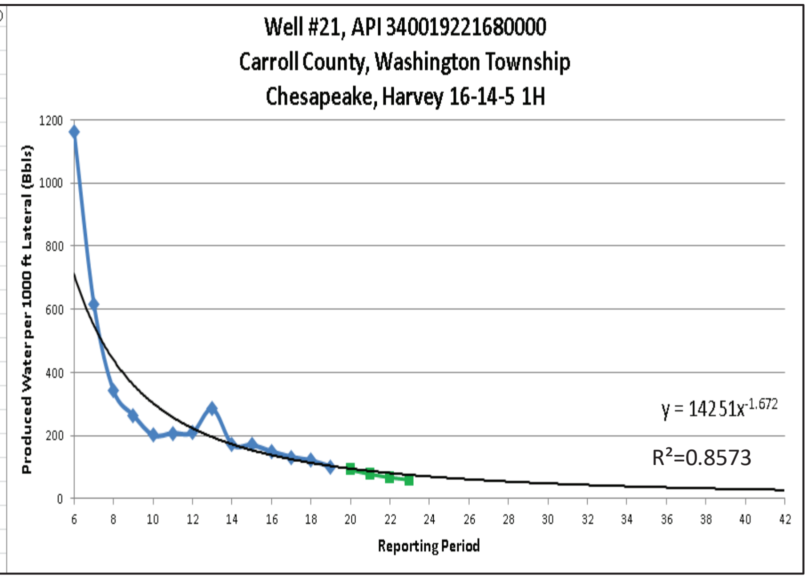

Figure B.21 Well 21 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4525	503	53
2015 Q1	11	6454	718	100
2015 Q2	12	5354	596	100
2015 Q3	13	2720	303	100
2015 Q4	14	2010	224	98
2016 Q1	15	2006	223	100
2016 Q2	16	1268	141	100
2016 Q3	17	786	87	100
2016 Q4	18	805	90	100
2017 Q1	19	628	70	100
2017 Q2	20	568	63	100
2017 Q3	21	592	66	100
2017 Q4	22	584	65	100
2018 Q1	23	508	57	100

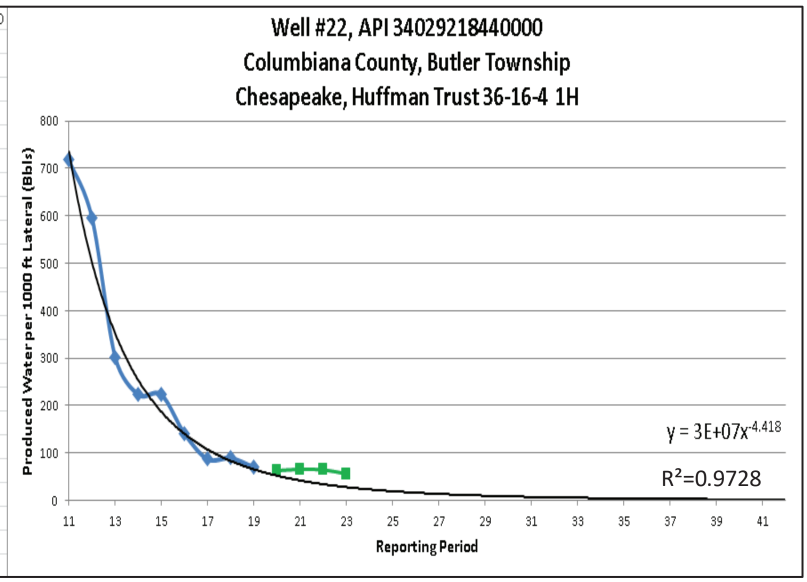

Figure B.22 Well 22 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	757	139	27
2014 Q2	8	2345	430	92
2014 Q3	9	2491	457	100
2014 Q4	10	2099	385	100
2015 Q1	11	1435	263	100
2015 Q2	12	1315	241	100
2015 Q3	13	454	83	39
2015 Q4	14	1098	201	100
2016 Q1	15	974	179	100
2016 Q2	16	947	174	100
2016 Q3	17	763	140	100
2016 Q4	18	730	134	100
2017 Q1	19	641	118	100
2017 Q2	20	597	109	100
2017 Q3	21	557	102	100
2017 Q4	22	506	93	100
2018 Q1	23	457	84	97

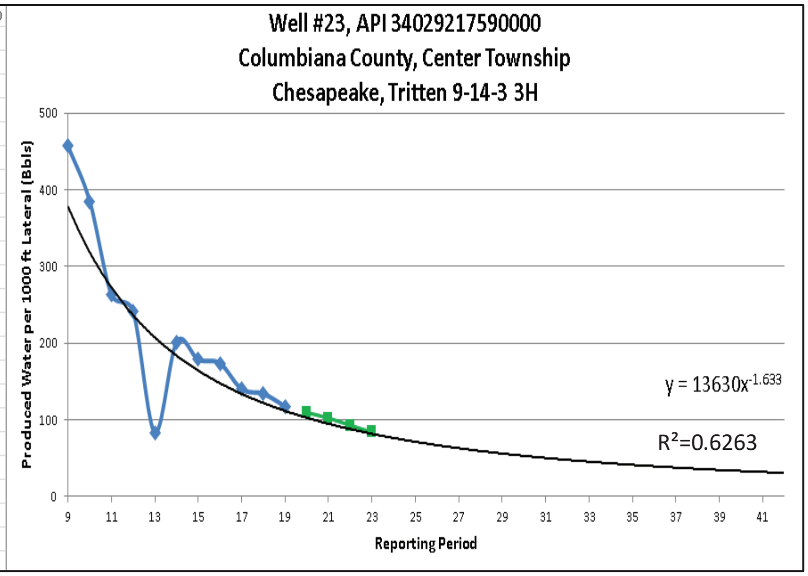

Figure B.23 Well 23 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	5359	1500	82
2014 Q4	10	1392	390	100
2015 Q1	11	598	167	90
2015 Q2	12	689	193	100
2015 Q3	13	484	135	100
2015 Q4	14	450	126	99
2016 Q1	15	390	109	98
2016 Q2	16	283	79	100
2016 Q3	17	242	68	99
2016 Q4	18	210	59	99
2017 Q1	19	187	52	99
2017 Q2	20	171	48	100
2017 Q3	21	154	43	100
2017 Q4	22	129	36	97
2018 Q1	23	105	29	99

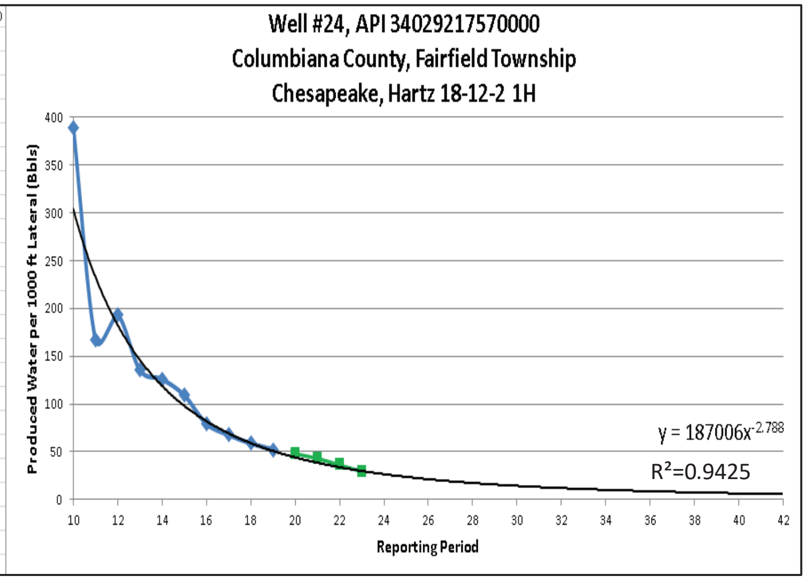

Figure B.24 Well 24 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	497	90	51
2014 Q4	10	1973	356	98
2015 Q1	11	1497	270	100
2015 Q2	12	1585	286	100
2015 Q3	13	493	89	39
2015 Q4	14	1305	235	100
2016 Q1	15	953	172	100
2016 Q2	16	843	152	100
2016 Q3	17	743	134	100
2016 Q4	18	802	145	100
2017 Q1	19	647	117	100
2017 Q2	20	581	105	100
2017 Q3	21	531	96	100
2017 Q4	22	566	102	100
2018 Q1	23	488	88	100

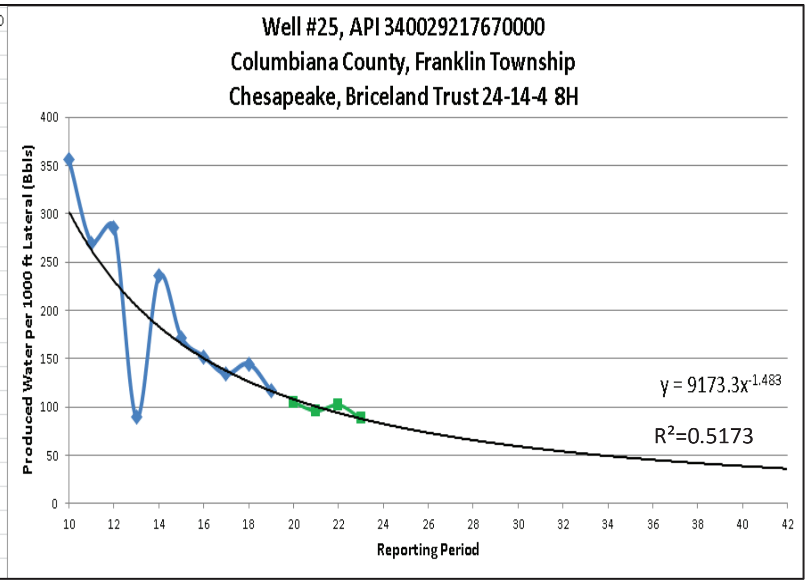

Figure B.25 Well 25 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	2075	353	29
2014 Q2	8	3167	538	97
2014 Q3	9	1909	325	100
2014 Q4	10	1490	253	100
2015 Q1	11	1289	219	100
2015 Q2	12	1102	187	100
2015 Q3	13	378	64	38
2015 Q4	14	836	142	99
2016 Q1	15	879	149	100
2016 Q2	16	751	128	100
2016 Q3	17	701	119	100
2016 Q4	18	546	93	100
2017 Q1	19	459	78	100
2017 Q2	20	448	76	100
2017 Q3	21	108	18	100
2017 Q4	22	205	35	100
2018 Q1	23	6	1	100

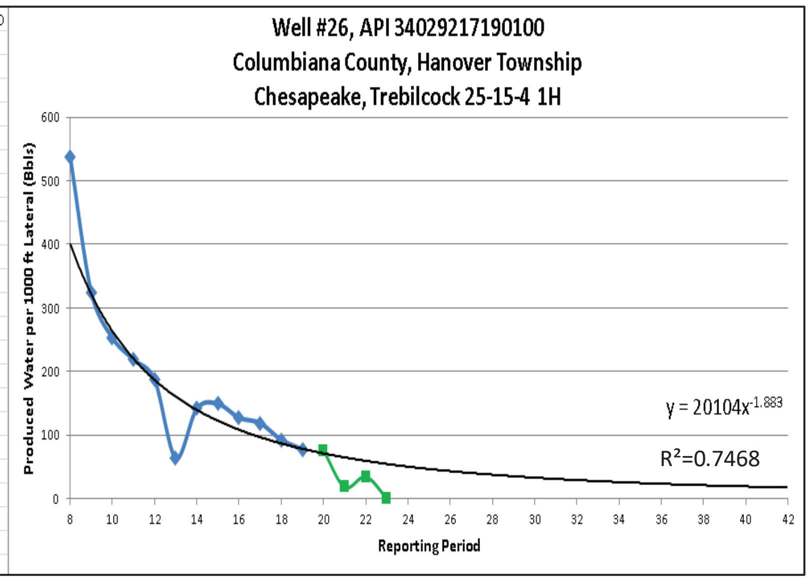

Figure B.26 Well 26 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	816	200	2
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	4321	1061	90
2014 Q4	10	1706	419	99
2015 Q1	11	1353	332	99
2015 Q2	12	1073	264	100
2015 Q3	13	937	230	100
2015 Q4	14	822	202	99
2016 Q1	15	671	165	100
2016 Q2	16	607	149	100
2016 Q3	17	731	180	100
2016 Q4	18	507	125	100
2017 Q1	19	441	108	100
2017 Q2	20	414	102	100
2017 Q3	21	407	100	100
2017 Q4	22	340	83	100
2018 Q1	23	299	73	100

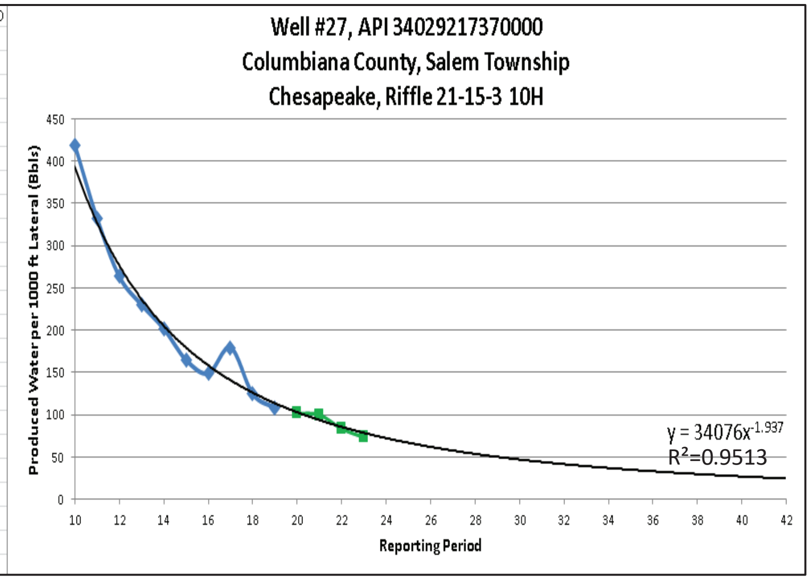

Figure B.27 Well 27 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	138	22	0
2014 Q3	9	1745	277	76
2014 Q4	10	318	50	100
2015 Q1	11	1991	316	100
2015 Q2	12	1520	241	98
2015 Q3	13	1120	178	100
2015 Q4	14	1100	175	100
2016 Q1	15	710	113	100
2016 Q2	16	880	140	99
2016 Q3	17	795	126	100
2016 Q4	18	581	92	100
2017 Q1	19	643	102	100
2017 Q2	20	323	51	98
2017 Q3	21	339	54	100
2017 Q4	22	336	53	100
2018 Q1	23	464	74	100

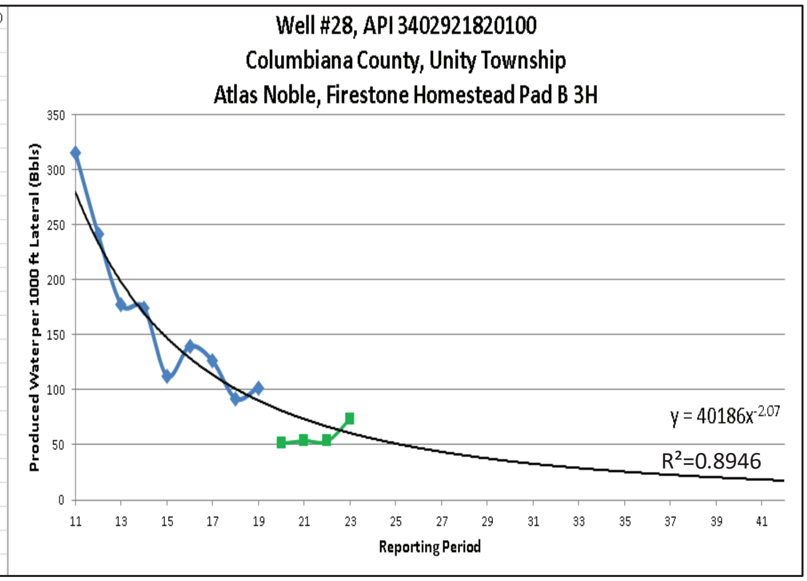

Figure B.28 Well 28 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	4757	1090	6
2013 Q1	3	2622	601	98
2013 Q2	4	1145	262	95
2013 Q3	5	658	151	96
2013 Q4	6	530	121	84
2014 Q1	7	498	114	97
2014 Q2	8	412	94	92
2014 Q3	9	299	68	90
2014 Q4	10	243	56	91
2015 Q1	11	175	40	73
2015 Q2	12	359	82	100
2015 Q3	13	367	84	100
2015 Q4	14	222	51	97
2016 Q1	15	232	53	100
2016 Q2	16	335	77	100
2016 Q3	17	174	40	100
2016 Q4	18	191	44	99
2017 Q1	19	142	33	100
2017 Q2	20	158	36	100
2017 Q3	21	200	46	100
2017 Q4	22	178	41	100
2018 Q1	23	115	26	100

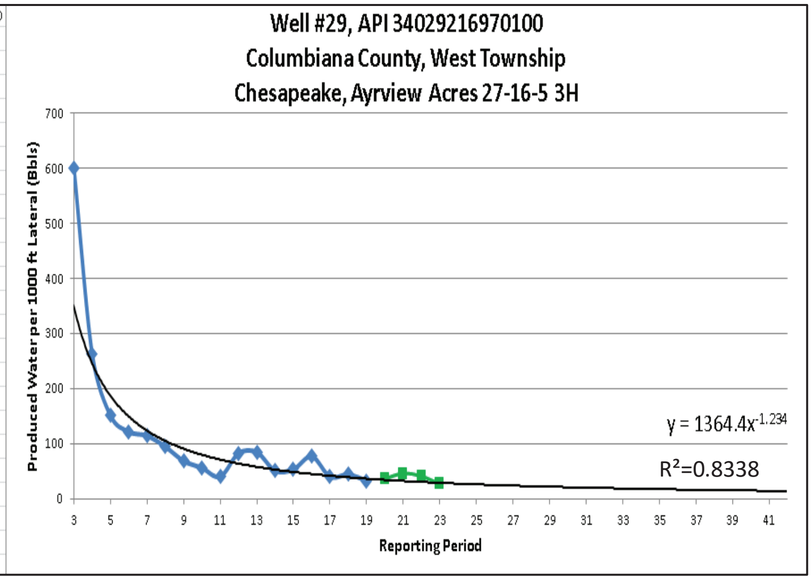

Figure B.29 Well 29 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	10589	2018	56
2015 Q2	12	7033	1341	100
2015 Q3	13	5690	1085	99
2015 Q4	14	3615	689	99
2016 Q1	15	2530	482	97
2016 Q2	16	2496	476	99
2016 Q3	17	1901	362	88
2016 Q4	18	1308	249	98
2017 Q1	19	1033	197	98
2017 Q2	20	894	170	97
2017 Q3	21	750	143	99
2017 Q4	22	680	130	100
2018 Q1	23	626	119	99

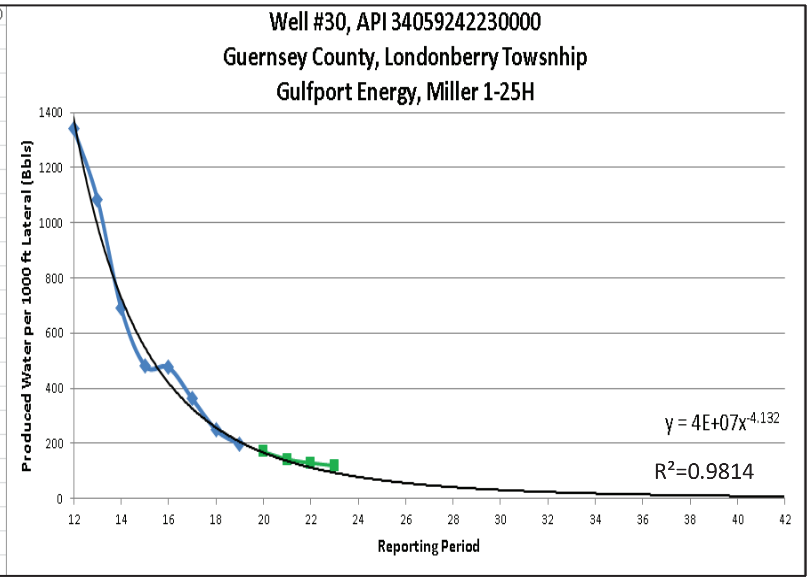

Figure B.30 Well 30 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	7198	1551	2
2013 Q1	3	0	0	0
2013 Q2	4	1044	225	14
2013 Q3	5	695	150	22
2013 Q4	6	2303	496	92
2014 Q1	7	1412	304	91
2014 Q2	8	989	213	97
2014 Q3	9	848	183	99
2014 Q4	10	1166	251	88
2015 Q1	11	647	139	87
2015 Q2	12	672	145	100
2015 Q3	13	618	133	91
2015 Q4	14	485	104	99
2016 Q1	15	431	93	96
2016 Q2	16	410	88	99
2016 Q3	17	375	81	99
2016 Q4	18	267	58	100
2017 Q1	19	335	72	99
2017 Q2	20	336	72	86
2017 Q3	21	430	93	99
2017 Q4	22	376	81	99
2018 Q1	23	335	72	98

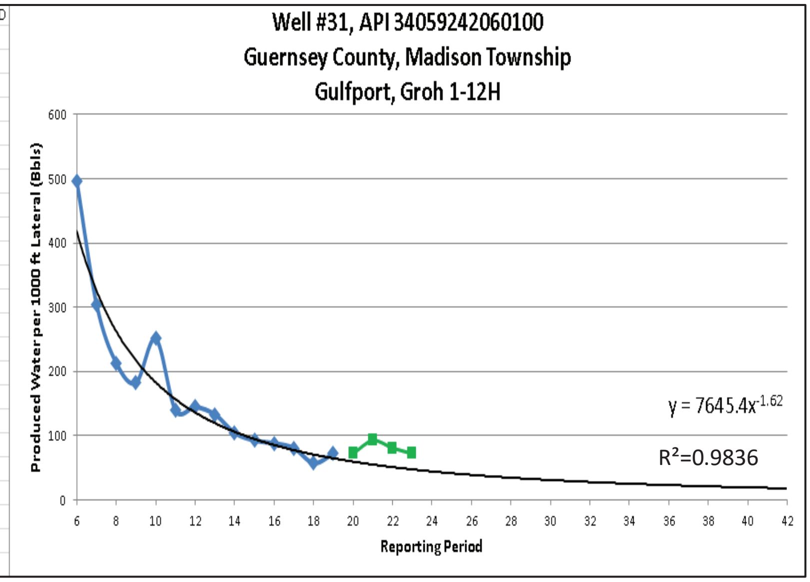

Figure B.31 Well 31 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4557	718	36
2015 Q1	11	4484	707	100
2015 Q2	12	7959	1254	99
2015 Q3	13	2002	315	99
2015 Q4	14	3783	596	99
2016 Q1	15	151	24	99
2016 Q2	16	751	118	99
2016 Q3	17	2621	413	98
2016 Q4	18	2247	354	98
2017 Q1	19	1826	288	100
2017 Q2	20	1642	259	100
2017 Q3	21	1408	222	96
2017 Q4	22	946	149	100
2018 Q1	23	5402	851	57

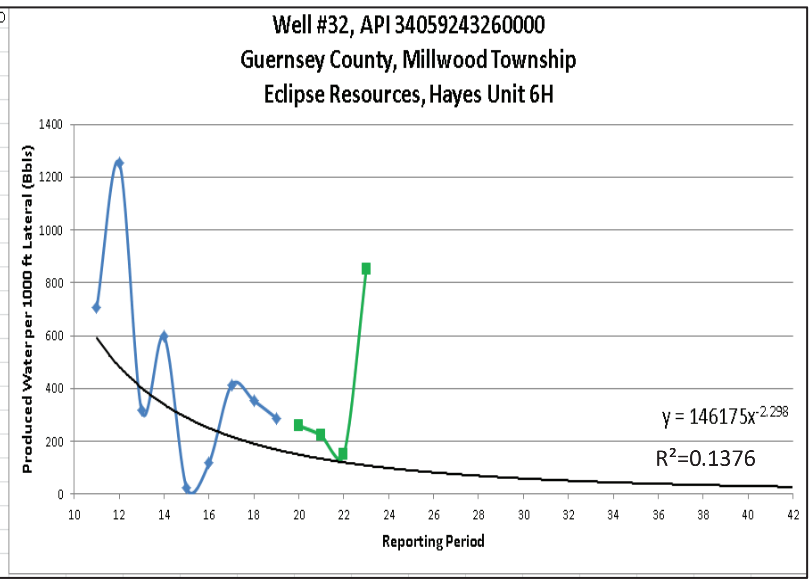

Figure B.32 Well 32 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4724	779	14
2015 Q1	11	17346	2861	100
2015 Q2	12	9417	1553	100
2015 Q3	13	5191	856	100
2015 Q4	14	3549	585	100
2016 Q1	15	2490	411	100
2016 Q2	16	1994	329	100
2016 Q3	17	1699	280	100
2016 Q4	18	1471	243	100
2017 Q1	19	1389	229	100
2017 Q2	20	1308	216	100
2017 Q3	21	995	164	100
2017 Q4	22	961	159	100
2018 Q1	23	890	147	100

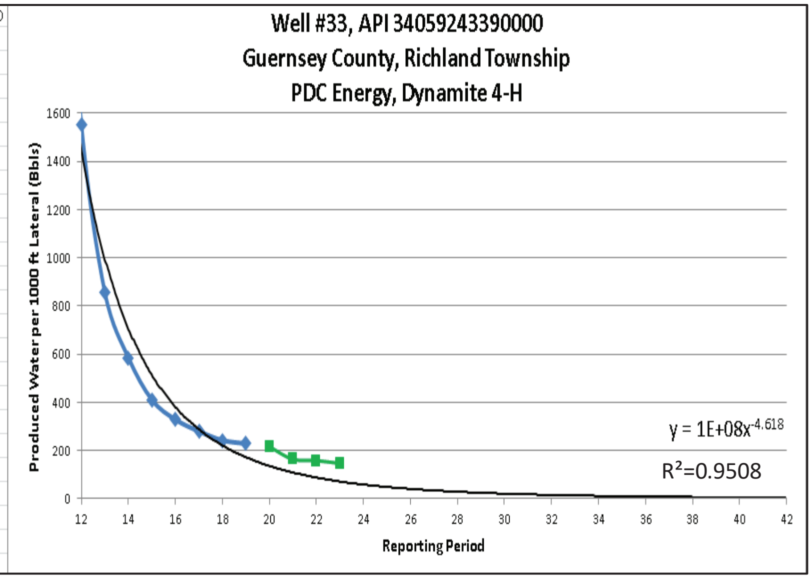

Figure B.33 Well 33 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	1241	285	28
2014 Q1	7	6762	1554	100
2014 Q2	8	3299	758	100
2014 Q3	9	1606	369	100
2014 Q4	10	1570	361	100
2015 Q1	11	1158	266	99
2015 Q2	12	980	225	100
2015 Q3	13	896	206	100
2015 Q4	14	803	185	100
2016 Q1	15	749	172	100
2016 Q2	16	669	154	100
2016 Q3	17	633	146	100
2016 Q4	18	712	164	100
2017 Q1	19	657	151	99
2017 Q2	20	549	126	100
2017 Q3	21	627	144	100
2017 Q4	22	406	93	100
2018 Q1	23	361	83	100

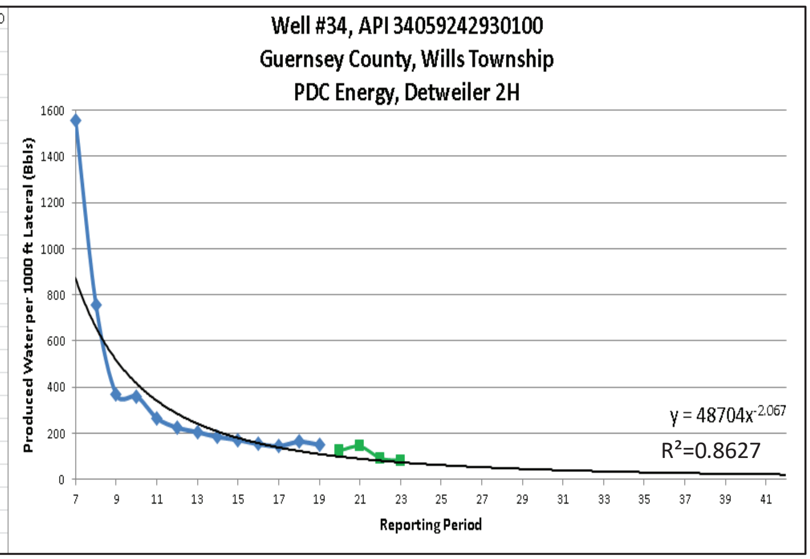

Figure B.34 Well 34 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	2525	428	24
2014 Q4	10	6423	1089	97
2015 Q1	11	3590	608	97
2015 Q2	12	2641	448	97
2015 Q3	13	1685	286	98
2015 Q4	14	1209	205	100
2016 Q1	15	901	153	93
2016 Q2	16	860	146	93
2016 Q3	17	903	153	100
2016 Q4	18	754	128	100
2017 Q1	19	508	86	91
2017 Q2	20	463	78	87
2017 Q3	21	546	93	100
2017 Q4	22	523	89	100
2018 Q1	23	467	79	100

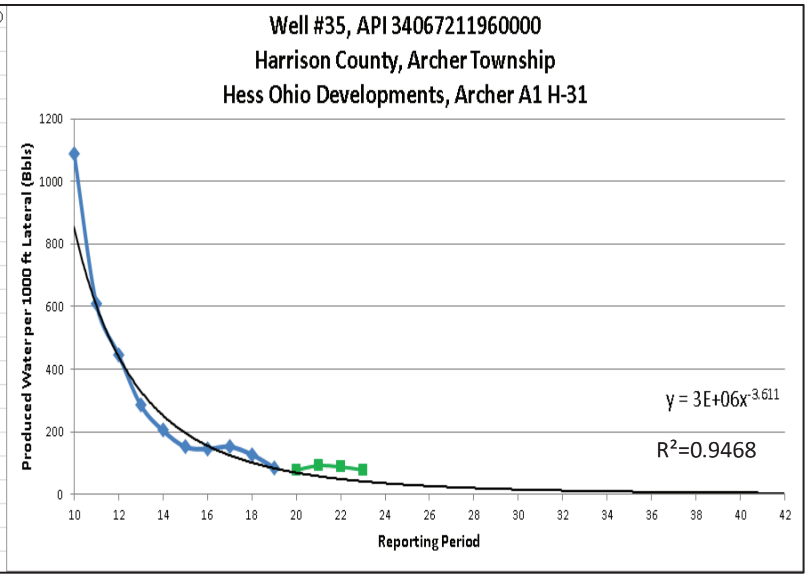

Figure B.35 Well 35 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	7217	1433	11
2014 Q3	9	4078	809	78
2014 Q4	10	5603	1112	77
2015 Q1	11	3349	665	92
2015 Q2	12	12690	2519	93
2015 Q3	13	9725	1930	99
2015 Q4	14	3166	628	99
2016 Q1	15	2561	508	100
2016 Q2	16	2258	448	99
2016 Q3	17	1677	333	100
2016 Q4	18	1673	332	100
2017 Q1	19	1571	312	99
2017 Q2	20	1355	269	99
2017 Q3	21	1213	241	100
2017 Q4	22	1176	233	100
2018 Q1	23	1183	235	100

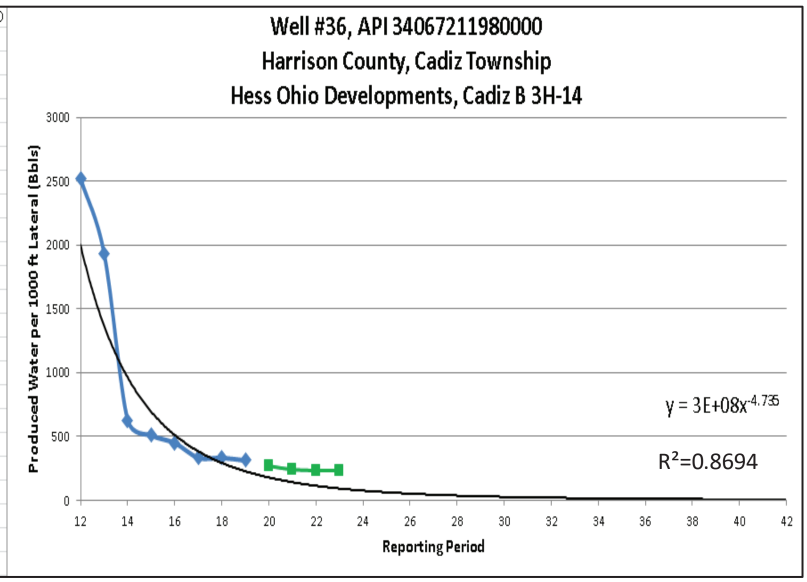

Figure B.36 Well 36 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	34355	5063	15
2013 Q4	6	14305	2108	96
2014 Q1	7	4779	704	92
2014 Q2	8	6784	1000	79
2014 Q3	9	3729	550	100
2014 Q4	10	630	93	41
2015 Q1	11	424	62	67
2015 Q2	12	492	73	100
2015 Q3	13	640	94	99
2015 Q4	14	796	117	98
2016 Q1	15	680	100	99
2016 Q2	16	639	94	100
2016 Q3	17	539	79	100
2016 Q4	18	443	65	100
2017 Q1	19	509	75	99
2017 Q2	20	470	69	92
2017 Q3	21	483	71	100
2017 Q4	22	436	64	100
2018 Q1	23	353	52	99

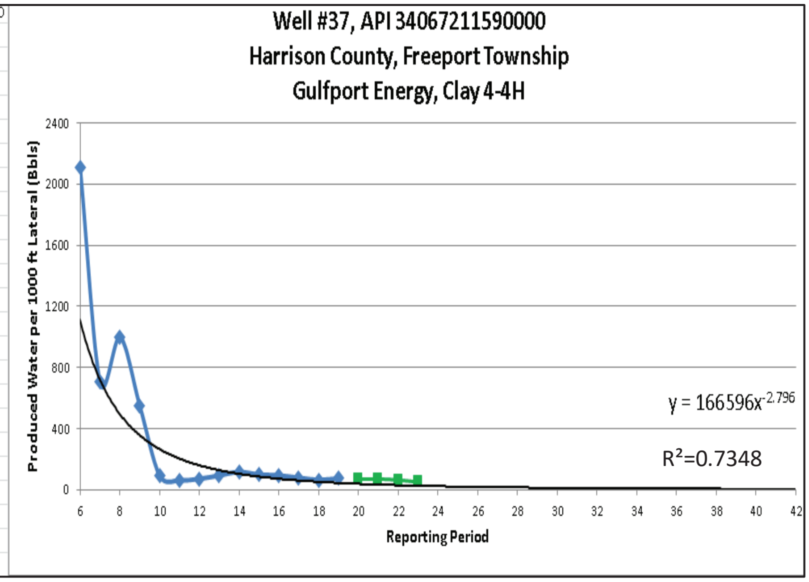

Figure B.37 Well 37 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	3515	524	17
2015 Q1	11	2750	410	79
2015 Q2	12	1982	296	89
2015 Q3	13	3056	456	99
2015 Q4	14	2107	314	99
2016 Q1	15	1591	237	99
2016 Q2	16	1109	165	100
2016 Q3	17	928	138	100
2016 Q4	18	730	109	100
2017 Q1	19	577	86	98
2017 Q2	20	624	93	99
2017 Q3	21	511	76	98
2017 Q4	22	483	72	100
2018 Q1	23	436	65	98

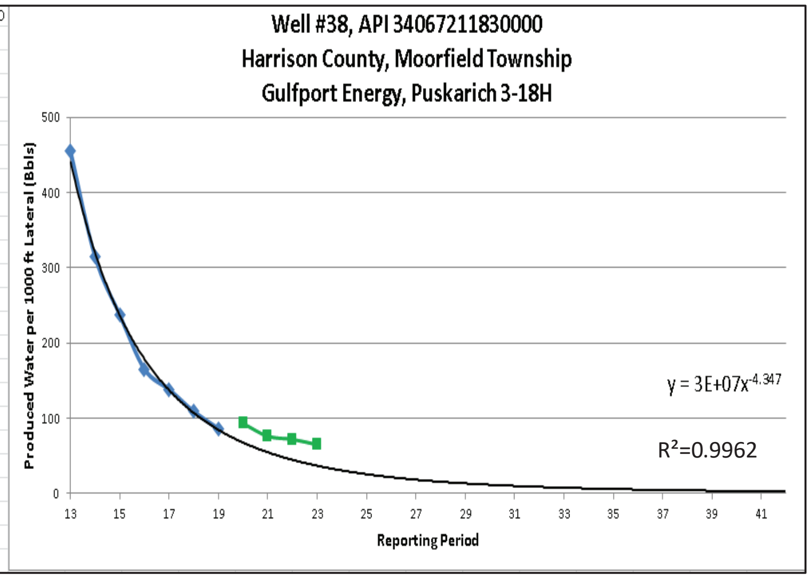

Figure B.38 Well 38 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	3685	471	2
2015 Q2	12	25729	3286	100
2015 Q3	13	8706	1112	97
2015 Q4	14	4722	603	100
2016 Q1	15	3060	391	100
2016 Q2	16	1175	150	100
2016 Q3	17	1314	168	100
2016 Q4	18	996	127	100
2017 Q1	19	782	100	100
2017 Q2	20	1152	147	100
2017 Q3	21	1388	177	100
2017 Q4	22	3720	475	63
2018 Q1	23	2147	274	80

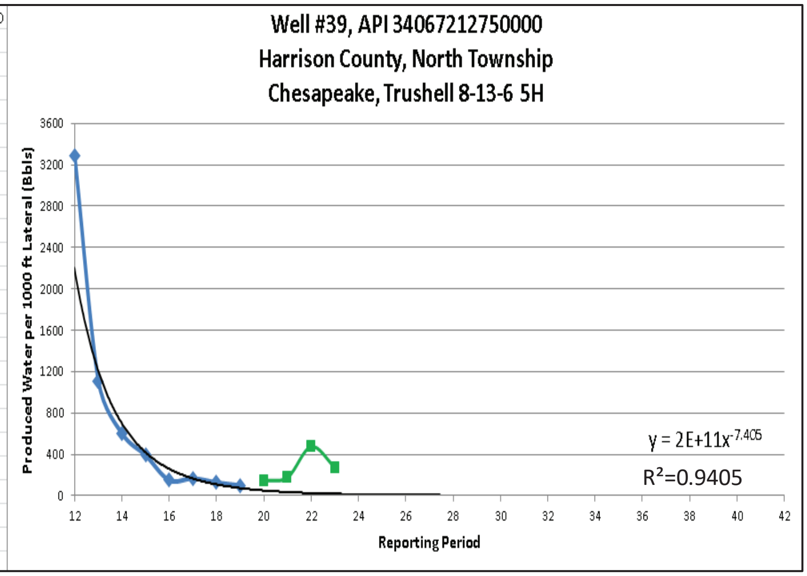

Figure B.39 Well 39 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	7148	1072	51
2014 Q3	9	6156	923	100
2014 Q4	10	3489	523	98
2015 Q1	11	1950	293	97
2015 Q2	12	4373	656	99
2015 Q3	13	4216	632	100
2015 Q4	14	3180	477	100
2016 Q1	15	3157	474	100
2016 Q2	16	1777	267	100
2016 Q3	17	1250	188	100
2016 Q4	18	833	125	100
2017 Q1	19	727	109	100
2017 Q2	20	902	135	100
2017 Q3	21	892	134	100
2017 Q4	22	857	129	100
2018 Q1	23	617	93	100

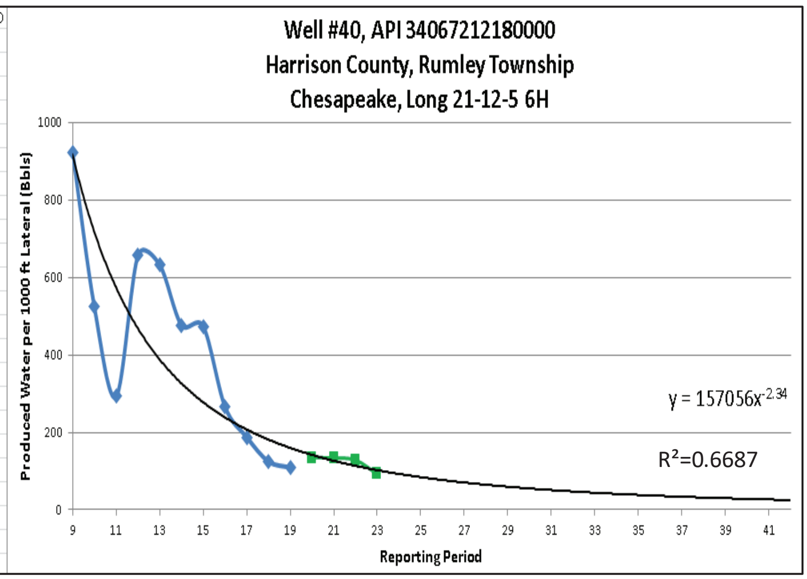

Figure B.40 Well 40 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	9407	1594	36
2014 Q4	10	10628	1800	100
2015 Q1	11	6072	1029	100
2015 Q2	12	3079	522	99
2015 Q3	13	5890	998	99
2015 Q4	14	2498	423	99
2016 Q1	15	1774	301	99
2016 Q2	16	1757	298	99
2016 Q3	17	1372	232	98
2016 Q4	18	1150	195	98
2017 Q1	19	1141	193	100
2017 Q2	20	1070	181	100
2017 Q3	21	1140	193	99
2017 Q4	22	1027	174	100
2018 Q1	23	1059	179	100

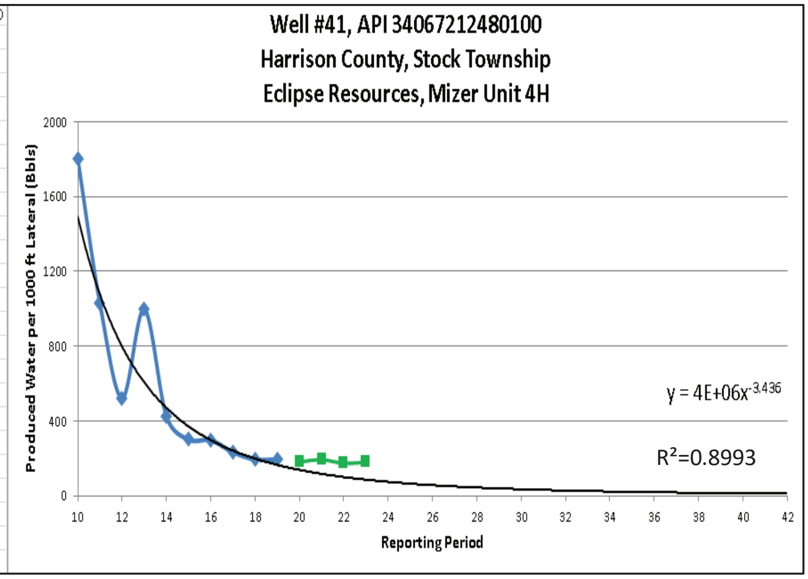

Figure B.41 Well 41 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	% DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	4705	873	71
2015 Q3	13	2581	479	80
2015 Q4	14	2225	413	90
2016 Q1	15	2048	380	100
2016 Q2	16	1683	312	100
2016 Q3	17	1550	288	100
2016 Q4	18	1261	234	100
2017 Q1	19	1131	210	100
2017 Q2	20	542	101	38
2017 Q3	21	4273	793	85
2017 Q4	22	1021	189	100
2018 Q1	23	862	160	100

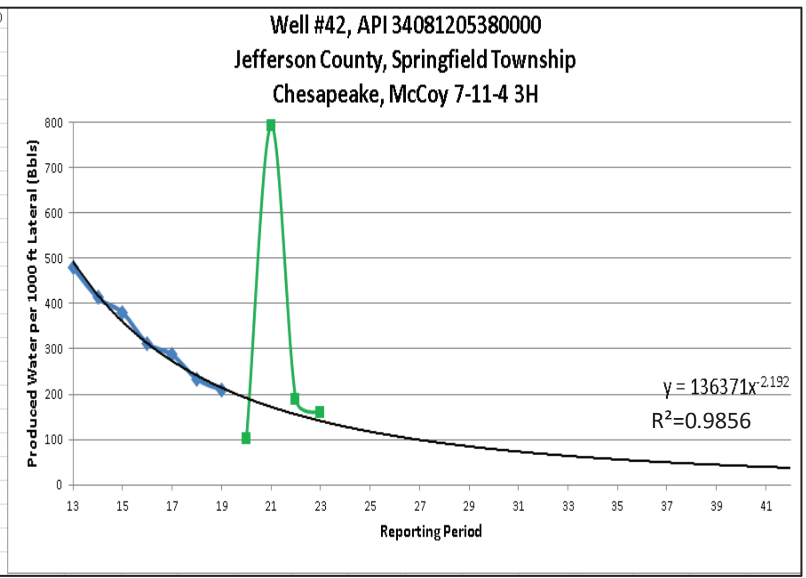

Figure B.42 Well 42 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	6353	940	54
2013 Q3	5	2783	412	36
2013 Q4	6	2525	374	95
2014 Q1	7	970	143	88
2014 Q2	8	3620	536	100
2014 Q3	9	2827	418	100
2014 Q4	10	1872	277	97
2015 Q1	11	1627	241	100
2015 Q2	12	1572	233	100
2015 Q3	13	142	21	10
2015 Q4	14	1205	178	90
2016 Q1	15	1213	180	100
2016 Q2	16	1028	152	100
2016 Q3	17	967	143	100
2016 Q4	18	887	131	100
2017 Q1	19	857	127	100
2017 Q2	20	754	112	100
2017 Q3	21	730	108	100
2017 Q4	22	657	97	100
2018 Q1	23	613	91	100

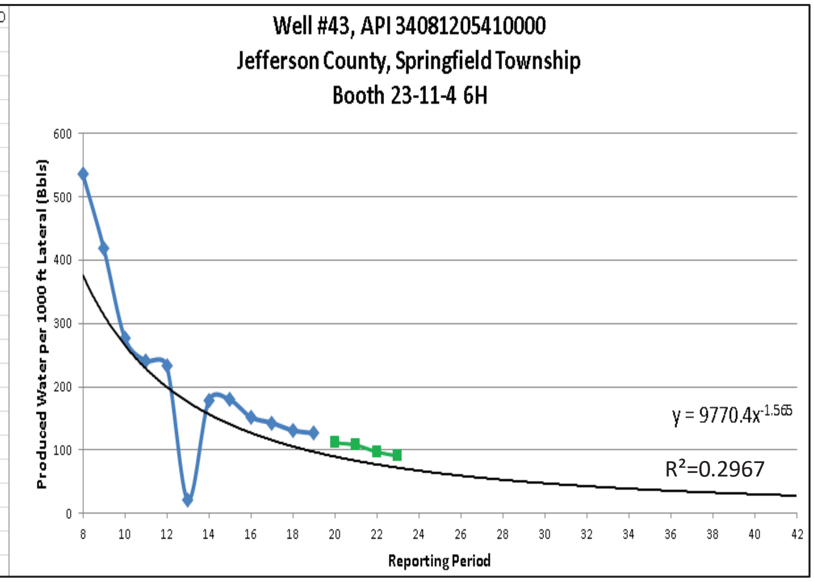

Figure B.43 Well 43 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	7791	1073	11
2014 Q2	8	10789	1486	93
2014 Q3	9	3725	513	98
2014 Q4	10	1672	230	100
2015 Q1	11	1046	144	100
2015 Q2	12	820	113	93
2015 Q3	13	720	99	100
2015 Q4	14	614	85	100
2016 Q1	15	541	75	100
2016 Q2	16	454	63	99
2016 Q3	17	400	55	100
2016 Q4	18	391	54	100
2017 Q1	19	401	55	100
2017 Q2	20	372	51	100
2017 Q3	21	155	21	65
2017 Q4	22	78	11	98
2018 Q1	23	367	51	100

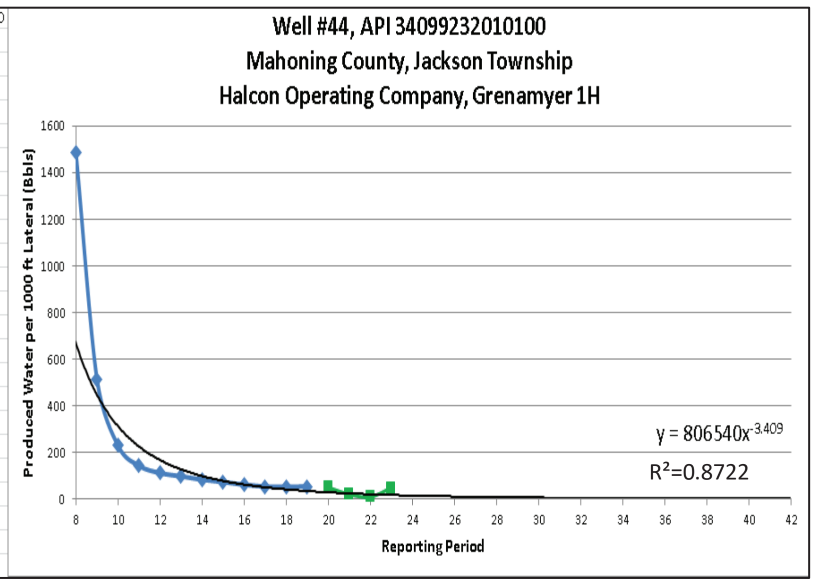

Figure B.44 Well 44 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	4580	556	37
2013 Q3	5	6741	818	100
2013 Q4	6	0	0	0
2014 Q1	7	7774	943	99
2014 Q2	8	5366	651	96
2014 Q3	9	4397	534	100
2014 Q4	10	4134	502	99
2015 Q1	11	4063	493	100
2015 Q2	12	3898	473	96
2015 Q3	13	3578	434	92
2015 Q4	14	3240	393	72
2016 Q1	15	3852	467	100
2016 Q2	16	3380	410	100
2016 Q3	17	3288	399	96
2016 Q4	18	3497	424	100
2017 Q1	19	3229	392	98
2017 Q2	20	3348	406	100
2017 Q3	21	3245	394	100
2017 Q4	22	3402	413	100
2018 Q1	23	3094	375	100

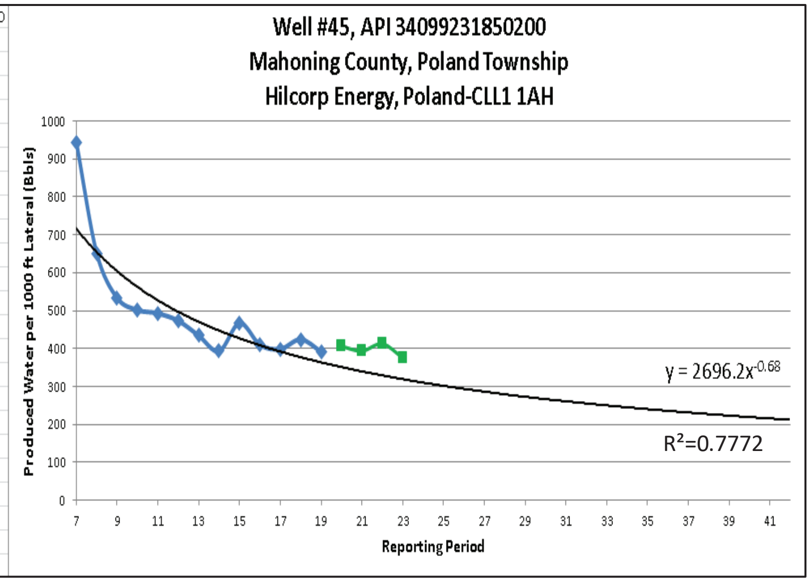

Figure B.45 Well 45 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	9320	1486	34
2015 Q3	13	20226	3226	98
2015 Q4	14	8283	1321	99
2016 Q1	15	4418	705	92
2016 Q2	16	3354	535	100
2016 Q3	17	2458	392	99
2016 Q4	18	2074	331	92
2017 Q1	19	1964	313	88
2017 Q2	20	2334	372	99
2017 Q3	21	1969	314	99
2017 Q4	22	1878	300	100
2018 Q1	23	1498	239	99

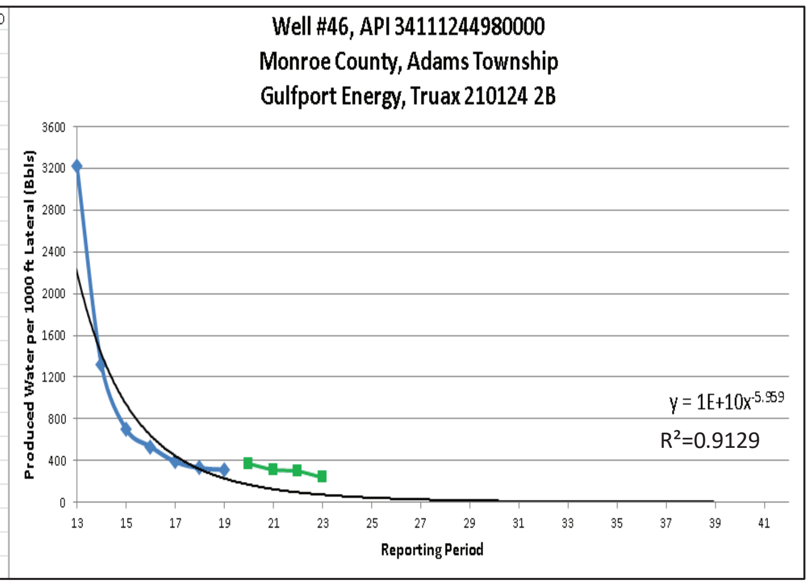

Figure B.46 Well 46 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	4371	796	34
2015 Q3	13	11970	2180	98
2015 Q4	14	4655	848	89
2016 Q1	15	3119	568	98
2016 Q2	16	2242	408	98
2016 Q3	17	1612	294	99
2016 Q4	18	1574	287	100
2017 Q1	19	1413	257	91
2017 Q2	20	1820	331	99
2017 Q3	21	1445	263	99
2017 Q4	22	1312	239	99
2018 Q1	23	1091	199	99

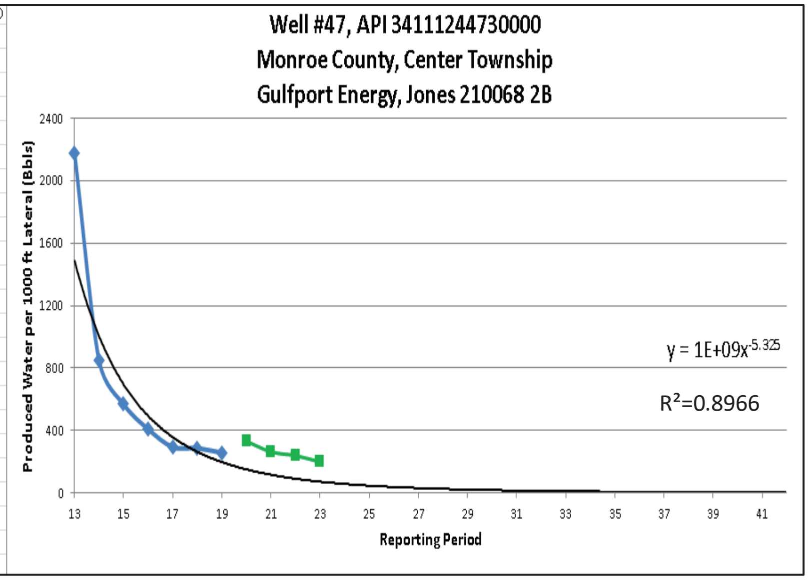

Figure B.47 Well 47 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	15644	2919	42
2015 Q2	12	5130	957	80
2015 Q3	13	6829	1274	99
2015 Q4	14	4592	857	80
2016 Q1	15	4274	797	100
2016 Q2	16	4168	778	100
2016 Q3	17	3786	706	100
2016 Q4	18	2488	464	100
2017 Q1	19	2066	385	100
2017 Q2	20	2764	516	100
2017 Q3	21	2720	507	100
2017 Q4	22	2019	377	100
2018 Q1	23	1419	265	96

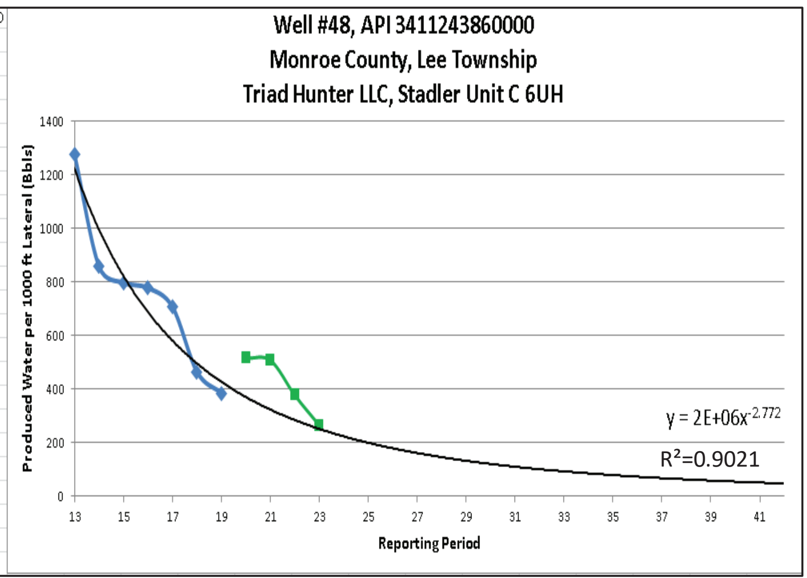

Figure B.48 Well 48 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	4153	1179	100
2015 Q1	11	2742	779	93
2015 Q2	12	2780	789	100
2015 Q3	13	2403	682	100
2015 Q4	14	1356	385	98
2016 Q1	15	1590	451	100
2016 Q2	16	1279	363	101
2016 Q3	17	926	263	100
2016 Q4	18	675	192	100
2017 Q1	19	788	224	100
2017 Q2	20	785	223	100
2017 Q3	21	1106	314	100
2017 Q4	22	914	260	100
2018 Q1	23	847	240	100

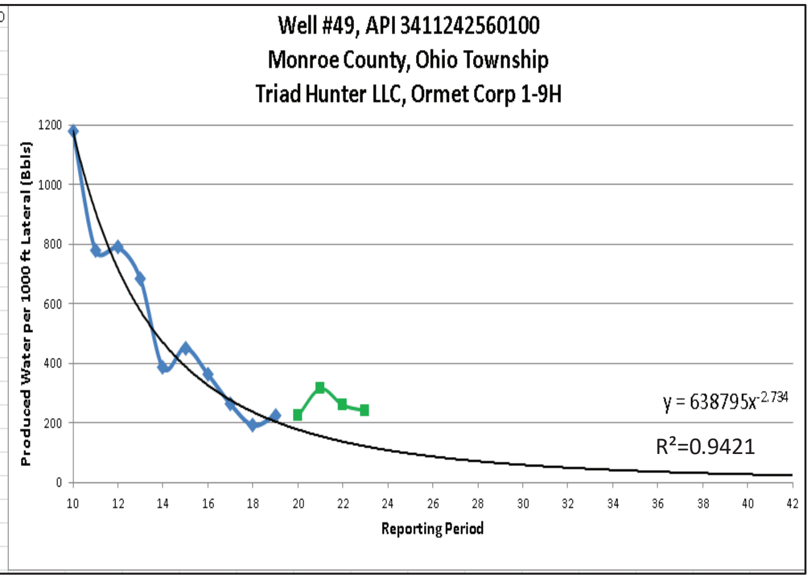

Figure B.49 Well 49 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	8080	997	22
2015 Q1	11	27083	3342	100
2015 Q2	12	11346	1400	98
2015 Q3	13	4583	566	100
2015 Q4	14	6320	780	100
2016 Q1	15	5227	645	100
2016 Q2	16	4972	614	100
2016 Q3	17	2202	272	100
2016 Q4	18	2234	276	100
2017 Q1	19	1933	239	100
2017 Q2	20	1661	205	100
2017 Q3	21	1890	233	100
2017 Q4	22	1672	206	100
2018 Q1	23	1363	168	100

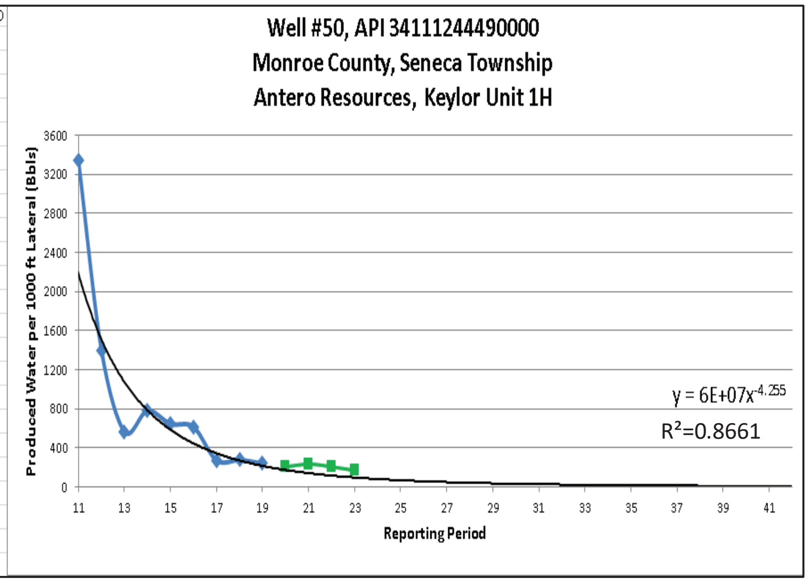

Figure B.50 Well 50 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	29559	3776	76
2015 Q1	11	18892	2413	100
2015 Q2	12	10456	1336	100
2015 Q3	13	3624	463	100
2015 Q4	14	4958	633	100
2016 Q1	15	3733	477	100
2016 Q2	16	2955	377	100
2016 Q3	17	1352	173	100
2016 Q4	18	1576	201	100
2017 Q1	19	1370	175	100
2017 Q2	20	1154	147	100
2017 Q3	21	1321	169	100
2017 Q4	22	1201	153	100
2018 Q1	23	1036	132	100

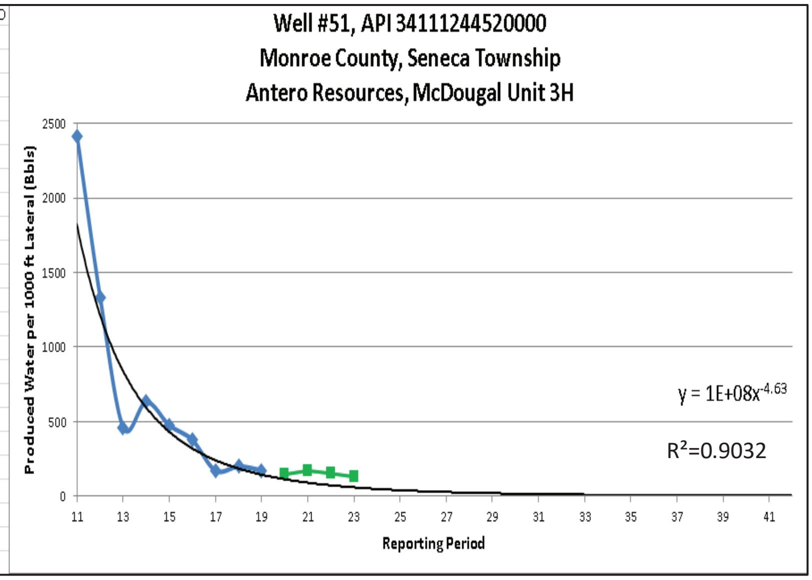

Figure B.51 Well 51 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	3049	679	21
2014 Q4	10	7117	1584	100
2015 Q1	11	9252	2060	99
2015 Q2	12	7545	1680	89
2015 Q3	13	8963	1995	99
2015 Q4	14	7037	1567	100
2016 Q1	15	4416	983	96
2016 Q2	16	2210	492	52
2016 Q3	17	3609	803	100
2016 Q4	18	2452	546	82
2017 Q1	19	1634	364	68
2017 Q2	20	2696	600	100
2017 Q3	21	2128	474	100
2017 Q4	22	1812	403	99
2018 Q1	23	1715	382	86

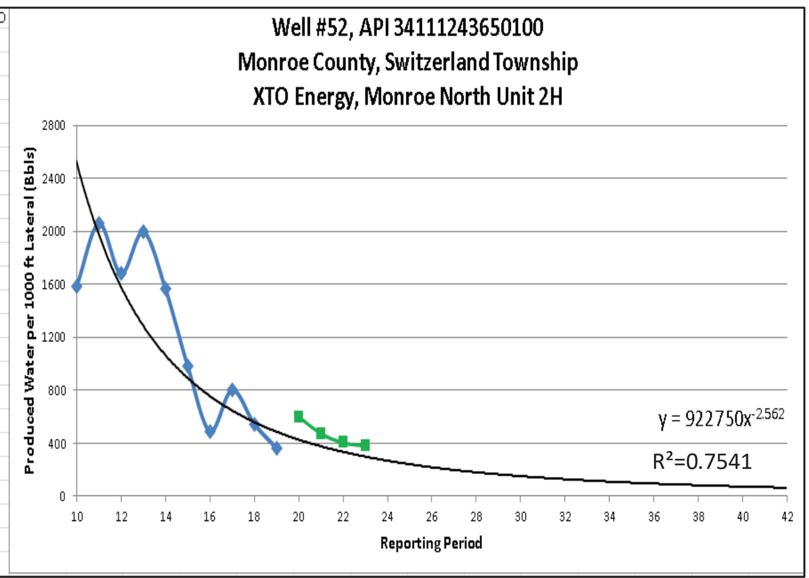

Figure B.52 Well 52 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	7129	950	30
2014 Q4	10	9362	1248	100
2015 Q1	11	4408	588	100
2015 Q2	12	3574	476	98
2015 Q3	13	2210	295	100
2015 Q4	14	1694	226	100
2016 Q1	15	1358	181	100
2016 Q2	16	1076	143	100
2016 Q3	17	757	101	100
2016 Q4	18	664	89	99
2017 Q1	19	410	55	99
2017 Q2	20	535	71	100
2017 Q3	21	524	70	93
2017 Q4	22	536	71	100
2018 Q1	23	504	67	100

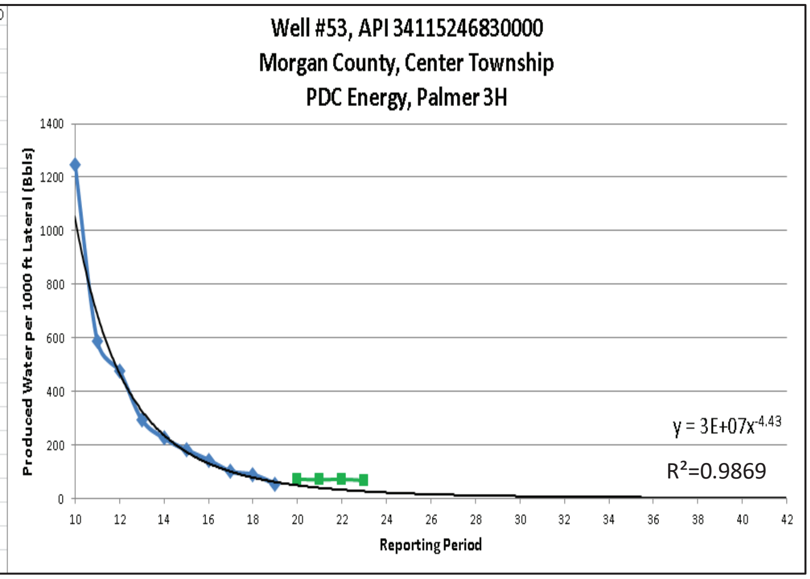

Figure B.53 Well 53 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	0	0	0
2015 Q2	12	5052	468	67
2015 Q3	13	2852	264	100
2015 Q4	14	7443	689	100
2016 Q1	15	7179	665	100
2016 Q2	16	5244	486	100
2016 Q3	17	4037	374	95
2016 Q4	18	3047	282	100
2017 Q1	19	2712	251	100
2017 Q2	20	3074	285	100
2017 Q3	21	3221	298	100
2017 Q4	22	2057	190	99
2018 Q1	23	1552	144	97

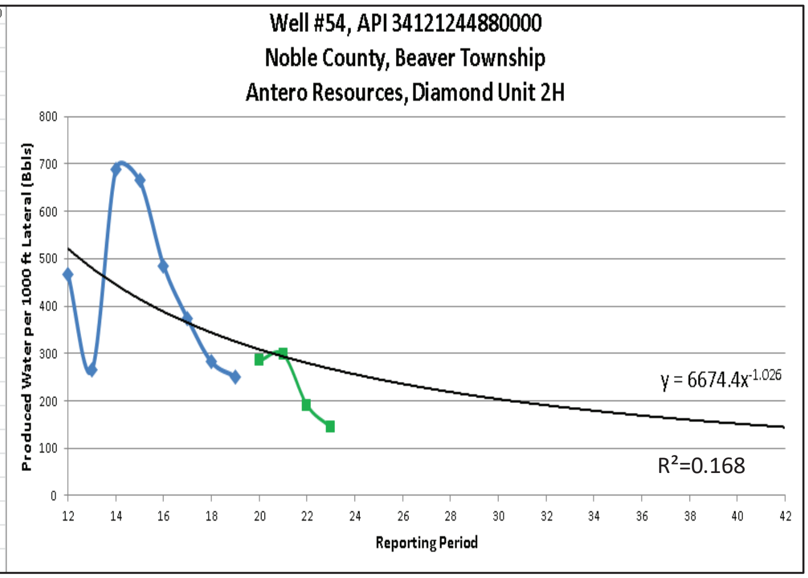

Figure B.54 Well 54 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	0	0	0
2014 Q4	10	0	0	0
2015 Q1	11	2531	495	8
2015 Q2	12	8907	1741	100
2015 Q3	13	7803	1526	98
2015 Q4	14	6343	1240	100
2016 Q1	15	4395	859	100
2016 Q2	16	2633	515	91
2016 Q3	17	2499	489	100
2016 Q4	18	2094	409	100
2017 Q1	19	1656	324	100
2017 Q2	20	1478	289	100
2017 Q3	21	1338	262	100
2017 Q4	22	1180	231	100
2018 Q1	23	1012	198	100

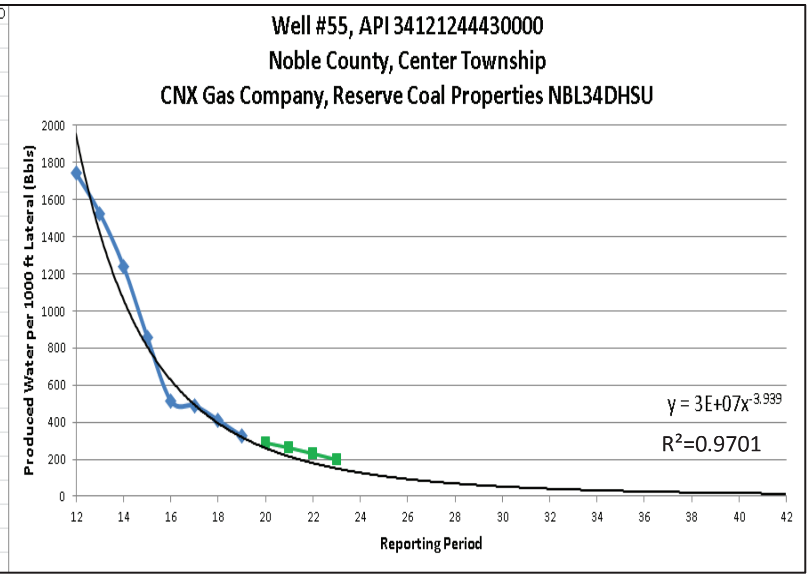

Figure B.55 Well 55 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	9050	1881	13
2013 Q4	6	0	0	100
2014 Q1	7	1641	341	27
2014 Q2	8	1845	383	84
2014 Q3	9	7193	1495	97
2014 Q4	10	3718	773	90
2015 Q1	11	2702	562	99
2015 Q2	12	2005	417	100
2015 Q3	13	1681	349	100
2015 Q4	14	1342	279	96
2016 Q1	15	1149	239	95
2016 Q2	16	1011	210	98
2016 Q3	17	1022	212	100
2016 Q4	18	1300	270	99
2017 Q1	19	941	196	96
2017 Q2	20	767	159	100
2017 Q3	21	738	153	99
2017 Q4	22	742	154	99
2018 Q1	23	621	129	97

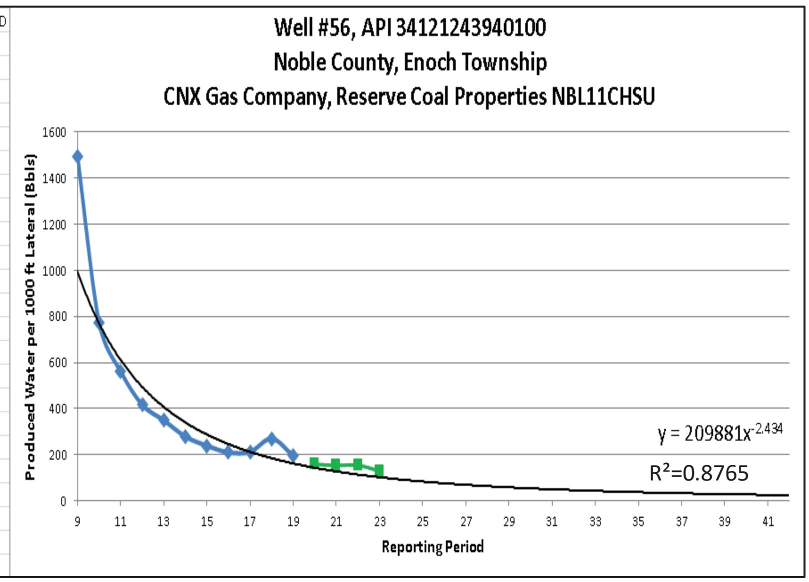

Figure B.56 Well 56 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	0	0	0
2014 Q2	8	0	0	0
2014 Q3	9	11343	2552	67
2014 Q4	10	1944	437	50
2015 Q1	11	920	207	71
2015 Q2	12	5209	1172	98
2015 Q3	13	4030	907	99
2015 Q4	14	3027	681	100
2016 Q1	15	2228	501	100
2016 Q2	16	1929	434	97
2016 Q3	17	1855	417	99
2016 Q4	18	1587	357	99
2017 Q1	19	1454	327	100
2017 Q2	20	1297	292	100
2017 Q3	21	1261	284	100
2017 Q4	22	1154	260	100
2018 Q1	23	967	218	90

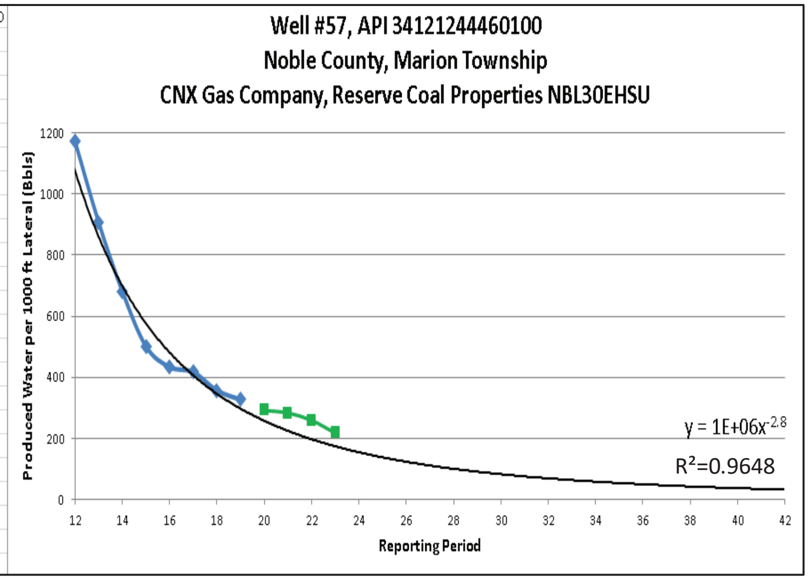

Figure B.57 Well 57 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	15529	2102	53
2014 Q2	8	4684	634	100
2014 Q3	9	1624	220	99
2014 Q4	10	1380	187	98
2015 Q1	11	582	79	100
2015 Q2	12	625	85	97
2015 Q3	13	510	69	100
2015 Q4	14	450	61	93
2016 Q1	15	395	53	100
2016 Q2	16	359	49	99
2016 Q3	17	334	45	100
2016 Q4	18	333	45	100
2017 Q1	19	288	39	100
2017 Q2	20	266	36	100
2017 Q3	21	146	20	65
2017 Q4	22	0	0	98
2018 Q1	23	0	0	100

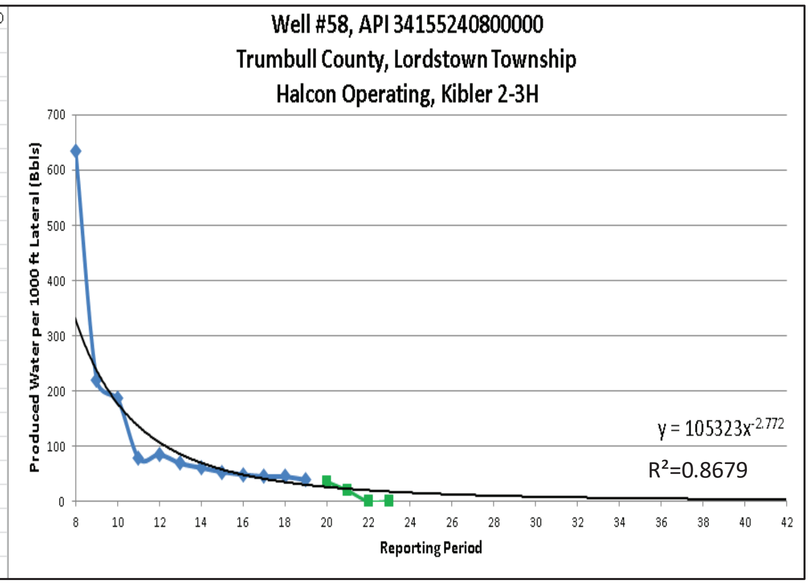

Figure B.58 Well 58 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	0	0	0
2014 Q1	7	2914	646	19
2014 Q2	8	12496	2771	69
2014 Q3	9	8139	1805	100
2014 Q4	10	5077	1126	100
2015 Q1	11	3427	760	100
2015 Q2	12	2474	549	98
2015 Q3	13	1671	371	100
2015 Q4	14	1369	304	100
2016 Q1	15	1063	236	100
2016 Q2	16	959	213	100
2016 Q3	17	777	172	100
2016 Q4	18	761	169	99
2017 Q1	19	814	180	100
2017 Q2	20	876	194	100
2017 Q3	21	766	170	92
2017 Q4	22	751	167	100
2018 Q1	23	577	128	100

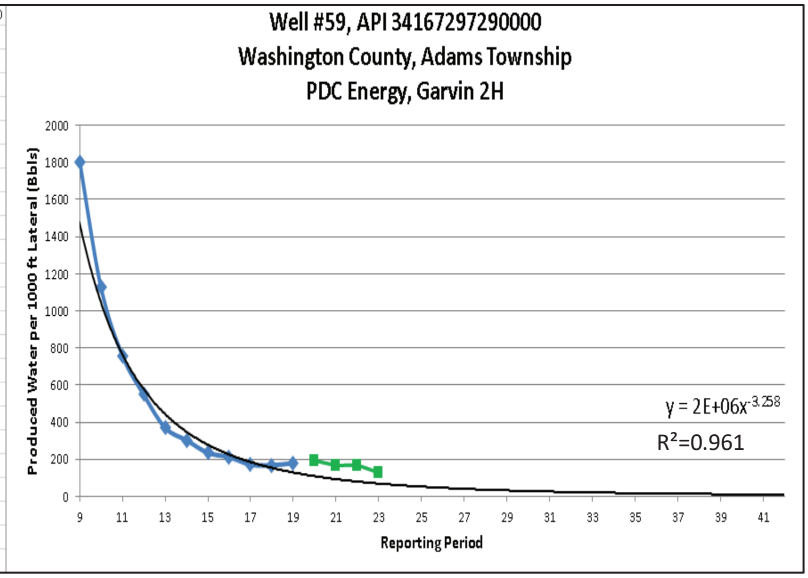

Figure B.59 Well 59 (see Figure 2 for location)

YEAR/QUARTER	PERIOD	WATER	WATER/1000'	%DAYS PROD
2011	1	0	0	0
2012	2	0	0	0
2013 Q1	3	0	0	0
2013 Q2	4	0	0	0
2013 Q3	5	0	0	0
2013 Q4	6	19855	3489	68
2014 Q1	7	7899	1388	47
2014 Q2	8	4404	774	100
2014 Q3	9	2033	357	92
2014 Q4	10	1534	270	92
2015 Q1	11	1196	210	100
2015 Q2	12	1251	220	98
2015 Q3	13	1170	206	100
2015 Q4	14	1102	194	100
2016 Q1	15	1028	181	100
2016 Q2	16	936	164	100
2016 Q3	17	933	164	100
2016 Q4	18	801	141	98
2017 Q1	19	785	138	100
2017 Q2	20	839	147	100
2017 Q3	21	665	117	94
2017 Q4	22	616	108	100
2018 Q1	23	480	84	96

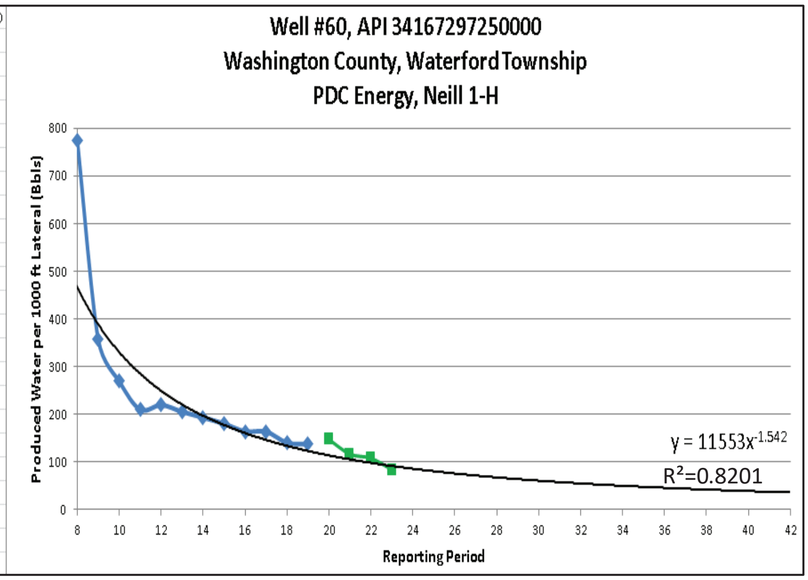

Figure B.60 Well 60 (see Figure 2 for location)