

THE IMPACTS OF THE MARCELLUS SHALE INDUSTRY ON WATER, SEWER AND STORMWATER INFRASTRUCTURE IN LYCOMING COUNTY



August 29, 2012

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1.0: Introduction

While the Marcellus Shale gas play presents unprecedented opportunities in shale gas development and domestic gas production, the extraction process and the related economic development have put unforeseen demands on public infrastructure. The County of Lycoming has undertaken a set of four studies to assess these impacts and opportunities in four broad areas – Housing, Transportation, Water/Sewer/Stormwater, and Social Justice. Each study is intended to provide decision makers with a better understanding of the challenges and opportunities we collectively face.



The subject of this study is the water, sewer, stormwater, and wastewater treatment resources needed to support industry (gas and non-gas), population growth, and related economic development. These key drivers influence the consumption of water resources and production of wastewater and our management of stormwater.

The Backstory

Unconventional natural gas wells in our area are reported to need about 4 to 5 million gallons of water for fracking of each well. An



unconventional gas well drilling rig is also reported to use about 60 million gallons of water per year, assuming fairly continuous operation. Of that volume, reportedly only about 5% to 10% is recovered as flowback in the days and weeks immediately following completion, with the balance being recovered over much longer time periods, perhaps for years, as produced water. The amount and type of wastewater capacity needed is dependent on how much of the flowback and produced water is able to be recycled for ongoing fracking operations. The degree

to which recovered wastewater is required to be treated for reuse varies from company to company.

Public water authorities as well as municipalities with water resources (and potentially wastewater authorities) now seek to take full advantage of the opportunity for additional water sale revenues, but in a manner that improves the basic infrastructure of their water systems and reduces truck traffic impacts throughout the Williamsport metro area. Public water supplies for Williamsport, Jersey Shore, and Montoursville urbanized areas are primarily from surface water sources. The supplemental water supplies for these three regions as well as water sources for other authorities/municipalities throughout Lycoming County are from groundwater sources. Protection of all of these water sources is critically important. In addition, there is a need in Lycoming County for additional permitted gas industry wastewater treatment capacity meeting Chapter 95.10 standards for discharge of the Pennsylvania Code.

Funding Challenge

All seven of the wastewater treatment plants (WWTPs) in Lycoming County are undergoing very costly infrastructure upgrades to meet the stringent nutrient discharge requirements imposed by the US EPA and PA DEP to satisfy the Chesapeake Bay Tributary Strategy. In addition, several of the municipalities in the Williamsport area are in the midst of very costly upgrades to their sanitary sewer collection systems in response to other PA DEP mandates. These capital-intensive projects were in the planning stages as the Gas Industry arrived. To be fair, the gas industry did not drive the need for these projects but does benefit by these initiatives being rapidly completed. Moreover, the financing of this list of water and sewer projects has severely strained the capital reserves and borrowing capacities of these entities authorities/municipalities. Thus, many authorities and municipalities find it very difficult to muster the funding needed to expand infrastructure to respond quickly to gas industry needs and related community growth. What is clear is that federal, state, and local funds are needed now more than ever before. It is equally clear that the infrastructure needs cited in the Marcellus Shale Commission Report to the Governor in 2011, and subsequently identified in Pennsylvania's Act 13 legislation, are critical to our growth and economic vitality.

The needs and opportunities of the gas industry have emerged at a very challenging time for public officials.

Objective

This study will provide insight into industry trends and growth projections that will be used to address the future needs of the various wastewater systems based on population estimates, drilling and well projections, and commercial and industrial development within the County. These impacts will be analyzed from at least three perspectives:

- Water and wastewater needs for drilling operations at well pad sites
- Water and wastewater needs for companies located or planning to locate in growth areas that support the gas industry



- Water, wastewater, and stormwater needs of “induced growth” in commercial and residential areas

Study Approach

This study examines an array of data gathered from the past five years to attempt to gauge the impact of the gas industry on the local economy, community infrastructure, and the workforce and then translate that assessment into meaningful priorities for limited funding. What is abundantly clear is that this is a very dynamic picture and the full, long-term impact of the increased gas industry on the domestic sewage treatment capacity is not yet known. The current increase in housing demand and occupancy and development of hotels and apartments over the last two years has reversed a downward trend in organic loadings for some of our WWTPs, but it will take several years to determine if significant steady growth will occur and impact the capacity constraints of our treatment plants.

- Review Existing Documents
- Interview Key Participants
- Conduct Focus Groups with Local Stakeholders
- Collect Data
- Analyze the Results

The GOAL of this study is to assess the impact of the natural gas industry on the authorities and municipalities that provide water and sewer services and, conversely, to determine the adequacy of these authorities and municipalities to support the industry and surrounding communities.

Applicability

This study was designed to assess the water, sanitary sewer, and stormwater infrastructure impacts within Lycoming County and may not accurately reflect the unique issues facing other counties in the shale play for a number of reasons. While Lycoming County has a sizeable number of drilled wells (471 as of December 31, 2011), what distinguishes the County is the number of well field support companies that have established depots or regional distribution centers in or near the county seat of Williamsport. The presence of an excellent network of interstate highways, first-class rail freight service, a regional airport, and a growing number of major flag hotels has prompted over 80 companies to establish field headquarters in the area. Companies establishing bases of operation in Lycoming County range from gas producers to drilling, fracking, and service companies, as well as engineering, legal firms, and other support operations. Each company or firm has its own set of demands on the water and sewer infrastructure within the growth areas of Lycoming County.

Recommendations

- Closely monitor all potential game changers and be prepared to react accordingly



- ☑ Aggressively pursue Commonwealth funds made available through the state’s H2O PA Program and other applicable funding programs, such as the Pennsylvania Infrastructure Investment Authority (PENNVEST)
- ☑ Aggressively pursue all federal funding sources, including the United States Department of Agriculture (USDA), the United States Environmental Protection Agency (EPA), and the United States Economic Development Administration (EDA)
- ☑ Secure a Public Utility Commission (PUC) agreement to allow Act 13 funds to be allocated or used to “reimburse” the incurred costs of water and/or sewer infrastructure projects that were initiated over the past three years in response to gas industry needs
- ☑ Request the Susquehanna River Basin Commission (SRBC) streamline its application process to promote effective decision making on water infrastructure projects involving more than 100,000 gallons per day (gpd), while insuring adequate water resources for the residents of Lycoming County
- ☑ Complete the WWTP upgrades of the Williamsport Sanitary Authority’s (WSA) Central and West Plant, the Lycoming County Water & Sewer Authority’s (LCWSA) plant, and the Hughesville-Wolf Authority’s (HWA) facility
- ☑ Construct the new WWTPs for the West Branch Regional Authority (WBRA) and the Tiadaghton Valley Municipal Authority (TVMA)
- ☑ Immediately initiate a baseline water quality monitoring program for the County’s five major streams
- ☑ Expand water infrastructure by the Williamsport Municipal Water Authority (WMWA) to the Lycoming Creek corridor and by the LCWSA to the Muncy-Montoursville corridor
- ☑ Streamline the National Pollutant Discharge Elimination System (NPDES) process by which the PA DEP approves the addition of centralized wastewater treatment (CWT) by a public WWTP
- ☑ Initiate coordinated planning with multiple gas companies for water system infrastructure improvements (such as pipelines) to deliver more effectively water to gas operations
- ☑ Be prepared to define, fund, design, and construct appropriate stormwater infrastructure projects to meet the nutrient reduction requirements of the Chesapeake Bay Strategy
- ☑ Continually encourage the gas industry to employ Best Management Practices (BMPs) that help reduce the potential for undesirable impacts to the public water supplies

2.0: Study Approach

The approach and methodology pursued in this assessment was structured to better understand the current condition of the water and sewer systems in Lycoming County as well as the expected future



conditions affected by both anticipated growth trends and the Marcellus Shale natural gas industry. This study is limited to an assessment of water, sewer, and stormwater infrastructure and capacity, but does not address related environmental concerns such as the quality of surface, groundwater, purchased, or treated water, or the composition of drilling waste.

The County's zoning ordinances were reviewed to determine any regulations or restrictions related to the Marcellus Shale industry and water and sewer usage. The study team completed quantitative research, reviewed past studies completed elsewhere in the U.S., and obtained qualitative insight through personal interviews and a focus group session with primary stakeholders. This information provided a baseline understanding of the potential impact that the Marcellus Shale gas drilling industry will have on water and sewer facilities as the industry grows. More details about the study approach and methodology are outlined below.

Review of Existing Documents

Existing County documents, including its Comprehensive Plan, the Lycoming County Water Supply Plan, and zoning ordinances were reviewed for policies associated with Marcellus Shale related to water, stormwater, and sewer infrastructure and/or capacity. The recent study completed by Lycoming College titled, "Marcellus Natural Gas Development's Effect on Housing in Pennsylvania" and the Marcellus Shale Education and Training Center's report¹ were also reviewed to gather available data, both quantitative and qualitative, and to avoid duplication of efforts. The study team also conducted online research and engaged in follow-up outreach, where necessary, to better understand the use of water and sewer service, perceived concerns related to water and sewer within the Marcellus Shale industry, and how those issues may apply to Lycoming County. Additionally, Lycoming County is currently undergoing an initiative to assess and catalog existing infrastructure in the County growth areas to understand and accommodate increased economic development while balancing community and environmental needs. Data collected during this initiative was also utilized to serve as a baseline for capacity as well as determining future needs.

Interviews with Key Participants

Interviews were conducted with stakeholders from six water and sewer authorities and three gas industry experts to obtain additional insight as to the impact of the Marcellus Shale gas development on Lycoming County resources and residents. These interviews primarily provided qualitative data and local viewpoints; however, in some cases, more detailed quantitative data was shared with the study team. This data provided an understanding of elements such as the cost of service of infrastructure; the volume of water sold to, received from, or treated for the natural gas industry; the process used by natural gas drilling companies to receive and dispose of water; etc. These stakeholders were selected with the input of the Lycoming County Planning and Community Development staff to represent a cross section of perspectives.

¹ Pennsylvania Marcellus Shale Workforce Needs Assessment, Summer 2011.



Focus Group with Local Stakeholders

A focus group session was held on January 20, 2012, to engage stakeholders related to water and sewer management. The focus group, consisting of local authorities, planning staff, and industry experts, reviewed the data collected by the project team and discussed possible “game changers” that could occur in the Marcellus Shale industry and—if they did—could impact water and sewer infrastructure, capacity, and/or operations. The results of this focus group discussion are detailed more fully later in this document.

Data Collection

This analysis relied heavily on publicly available data sources, including the PA DEP’s Oil and Gas Reporting website, Range Resources, and the SRBC to gather well completion and water utilization information. Topics that this data collection focused on were permitted and drilled wells, water supply, water sources, and water treatment processes.

Analysis

Analysis was based upon existing information from county, state, and other sources; multiple interviews; focus group discussion; and mining of appropriate databases. The study team derived certain conclusions and recommendations that could help guide infrastructure investment decisions moving forward.

3.0: Marcellus Shale in Lycoming County

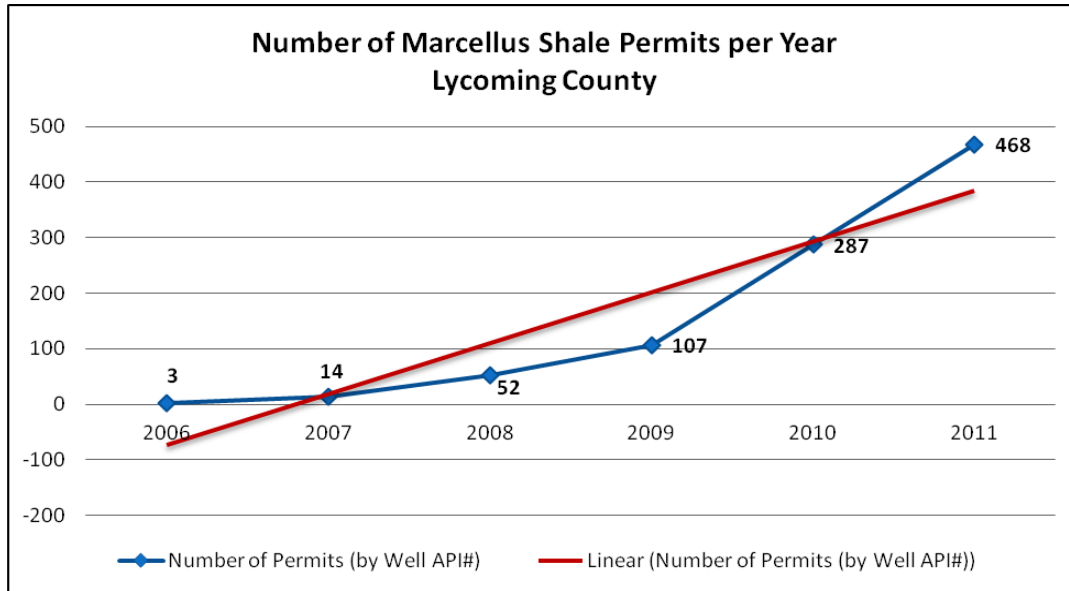
Drilling Activity in Lycoming County

The first Marcellus Shale well in Lycoming County was drilled in 2007 in Cogan House Township. Over the past five years the drilling activity has significantly increased. The natural gas industry in northern Pennsylvania is a relatively new industry and is still in its growth stage. This fact, combined with the volatile nature of the industry, creates a challenge to establish meaningful historical trends. Nevertheless, good planning and fluctuating natural gas commodity prices dictate that reasonable efforts be made to quantify what the future might portend.

In an effort to forecast the drilling activity and the associated economic growth and industry influence within the County, several sources of data have been collected and evaluated, including permit, drilling, and waste production reports. For example, the PA DEP spud data for wells drilled in the first six months within Lycoming County are as follows: 2010 (54), 2011 (123), and 2012 (120). The following data will be used to define the historical reality of Marcellus Shale natural gas drilling in Lycoming County, determine indicators of future drilling, and will use this data to estimate future drilling activity.



Figure 1: Well Site Permits per Year in Lycoming County (Tabulated via Well API#)



Source: DEP Oil and Gas Reporting, Well Permit Report.

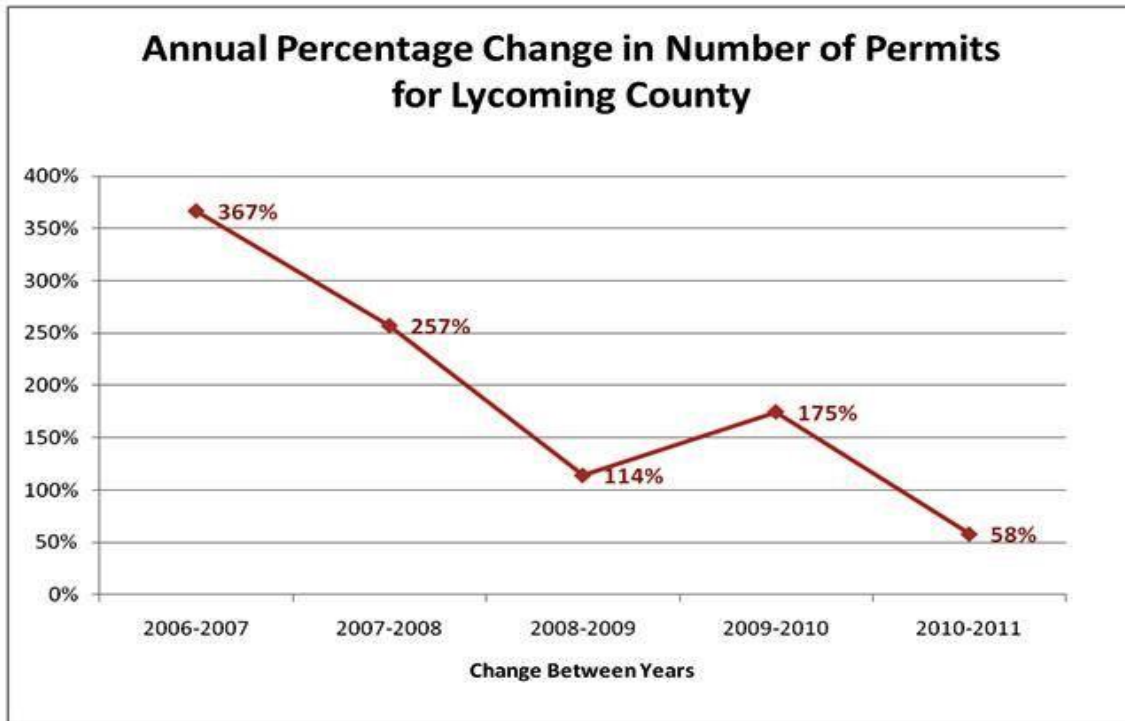
Permits Issued in Lycoming County

In 2006, the first Marcellus Shale drilling permits were issued for sites within Lycoming County. As illustrated in Figure 1, the numbers of permits have drastically increased from 2006 to 2011, from only three permits in 2006 to nearly 470 during 2011, a 15,500% increase.

The annual percentage change in the number of issued permits gives some indication that this trend may be slowing and the industry’s rapid growth is beginning to stabilize. While the amount of drilling is expected to continue to increase, the number of new wells drilled annually will probably not increase at the same breathtaking rate as they have in the past five years.

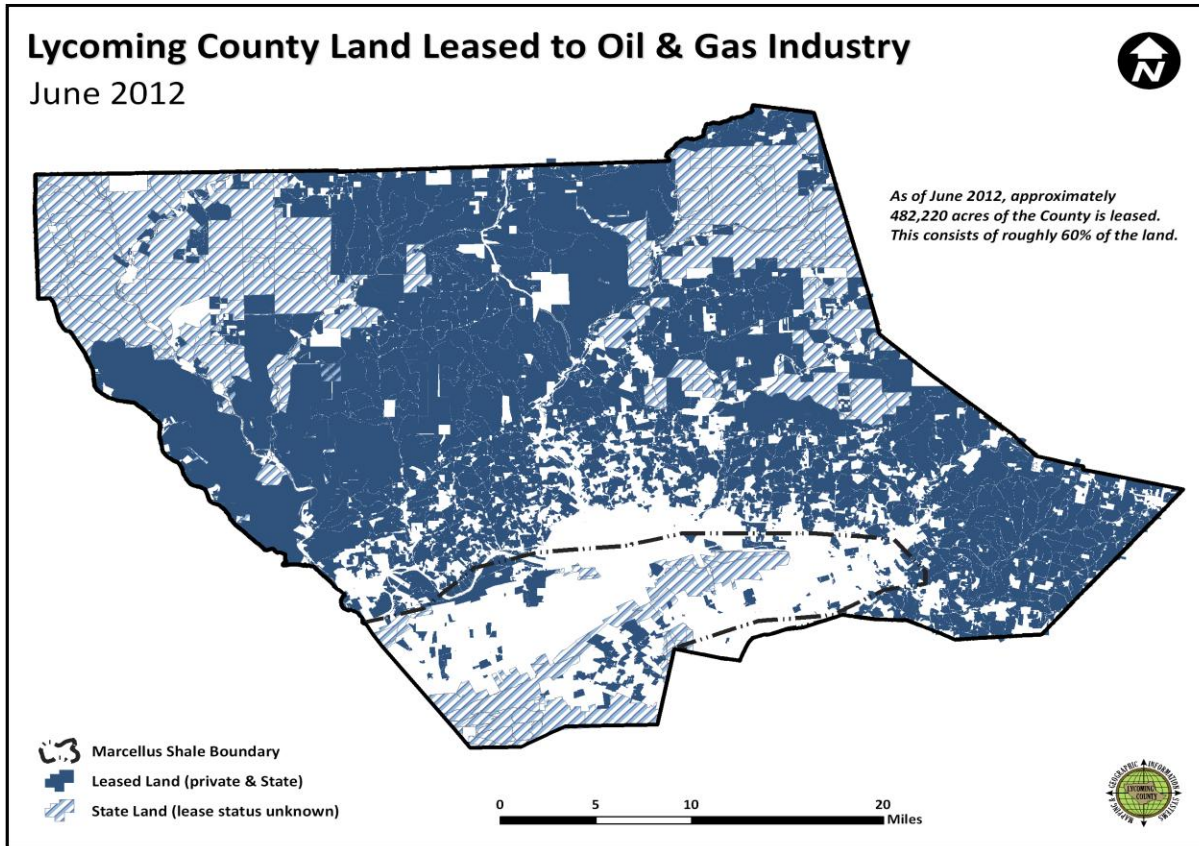


As depicted in Figure 2 below, between 2006 and 2007 the number of permits issued for Marcellus Shale wells to be drilled increased over 360%; however, the percentage change from 2010 to 2011 was approximately 58%. Interviews from the natural gas industry and operators within Lycoming County noted that a major driver to drilling is the expiration and value of the land lease. The rapid number of permits issued and consequently, the number of wells drilled may be due to the land leases that were secured in previous years.



Source: Lycoming County Planning and Economic Development, 2012.

The impact of this drilling on the landscape of Lycoming County may be better visualized by Figure 3, which portrays parcels of land that are either privately leased or leased from the state for drilling, as well as other state lands that may become available for drilling in the future. **The key point is that approximately 60% of Lycoming County is currently under lease for gas exploration—this is an area of about 691 square miles.** By August 2012, there were approximately 600 well spuds in Lycoming County. Given the size of the land area currently under lease, the potential exists for the number of wells throughout the County to reach 3,000 or more.

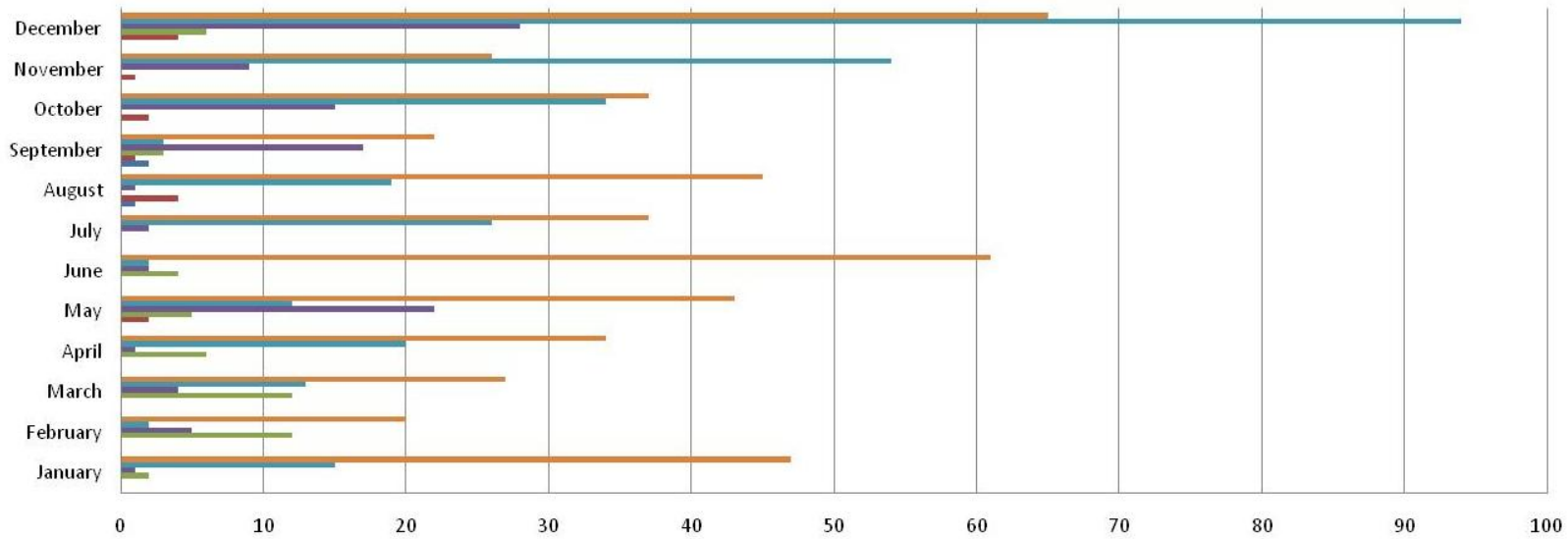


Source: Lycoming County Planning and Community Development, Lycoming County GIS, ESRI, and TeleAtlas Street Data.

The following chart illustrates the monthly trends of the permitting activity. The highest spike in permitting activity occurred in December 2010. In fact, over the past five years, the month of December has been the most active period for permitting and serves as a reasonable indicator of future drilling activity for the upcoming year.

Figure 4: Well Permits by Month

Marcellus Shale Permit Activity by Month in Lycoming County



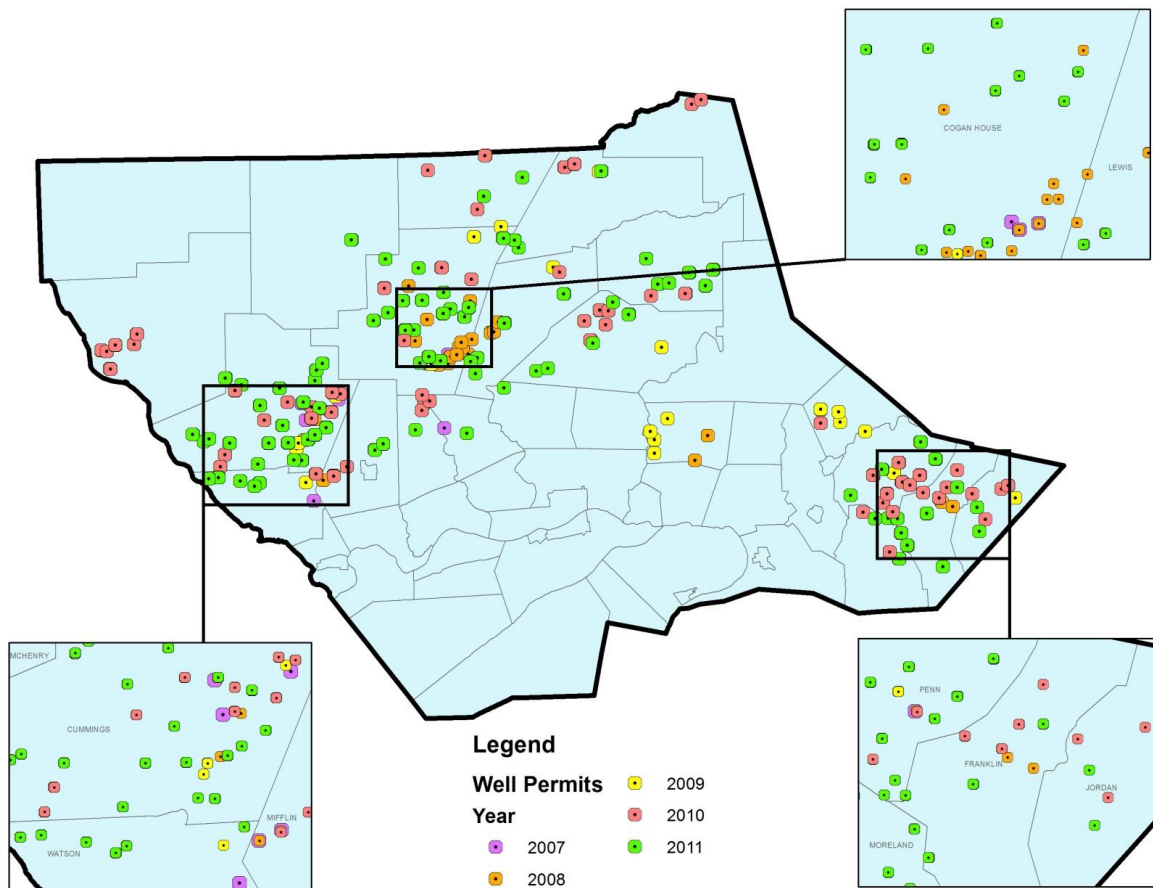
	January	February	March	April	May	June	July	August	September	October	November	December
2011	47	20	27	34	43	61	37	45	22	37	26	65
2010	15	2	13	20	12	2	26	19	3	34	54	94
2009	1	5	4	1	22	2	2	1	17	15	9	28
2008	2	12	12	6	5	4			3			6
2007					2			4	1	2	1	4
2006								1	2			

Source: PA DEP Oil and Gas Reporting, Well Permit Report.



The following map displays the location of the permits issued for sites throughout Lycoming County from 2007 to 2011.

Figure 5: Location of Well Permits in Lycoming County



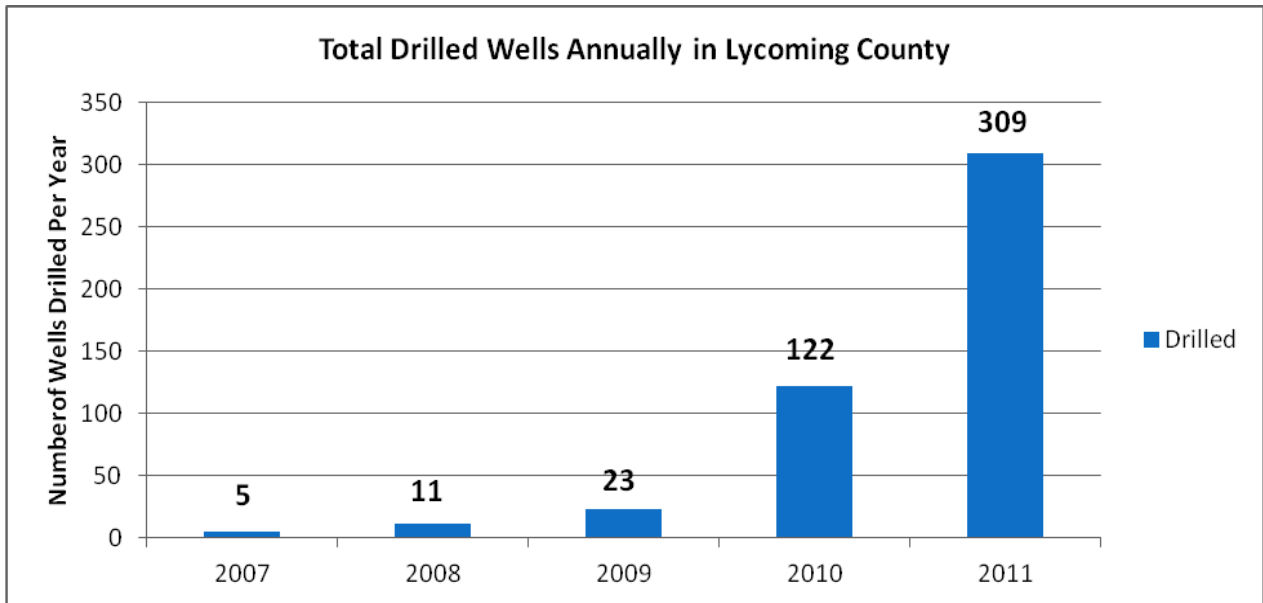
Source: PA DEP Oil and Gas Management, Well Permit Report.

As shown, the bulk of well permits have been granted in three areas of the County – the western, southeast, and north-central regions. These areas are proximal to both natural gas transmission pipelines and major roadway connections. However, these areas are not necessarily located close to established water and/or sewer lines. While locations near waterlines, paired with an access point to withdraw water directly from the waterlines, would lessen the volume of trucks carrying water from municipal water authorities to well sites, the majority of water withdrawal and discharge activities at Marcellus Shale wells would remain the same as they are today.

Wells Drilled in Lycoming County

Data was gathered from PA DEP spud reports, which report oil and gas wells drilled within the Commonwealth. The following charts profile the number of Marcellus-only wells drilled within Lycoming County. The numbers of wells drilled have increased considerably from 2007 to 2011, growing over 6,080% between these years. Over the first six months of 2012, an additional 120 wells had been drilled in Lycoming County. This is very close to the 123 wells drilled during the first half of 2011 and suggests that the drilling activity in Lycoming County has *not* declined or contracted but simply “leveled off.”

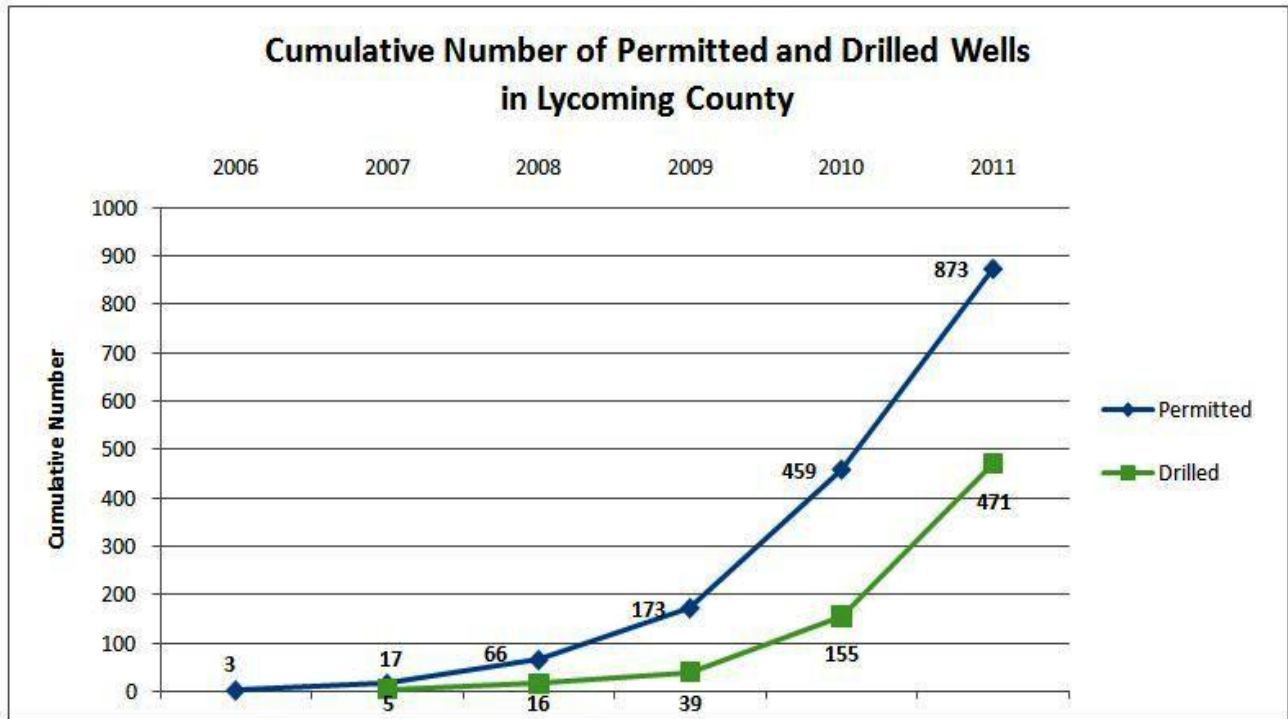
Figure 6: Drilling Trends by Year in Lycoming County



Source: PA DEP Office of Oil and Gas Management, Oil and Gas Reports, February 2012, and Lycoming County Planning and Community Development.



Figure 7: Cumulative Number of Permitted and Drilled Wells in Lycoming County



Source: Lycoming County Planning and Community Development and DEP Oil and Gas Management Reports.

Projected Drilling Activity Statewide and in Lycoming County

The Marcellus Shale and the Utica formations are expected to be a source for natural gas for many years; however, the exact duration and intensity of activity from the industry is highly unpredictable. The three key factors affecting the volatility of this industry and its growth in Pennsylvania are as follows:

- Changes in the price of natural gas
- Changes in state and federal legislation and regulation
- Changes to energy consumption patterns – residential, commercial, and industrial

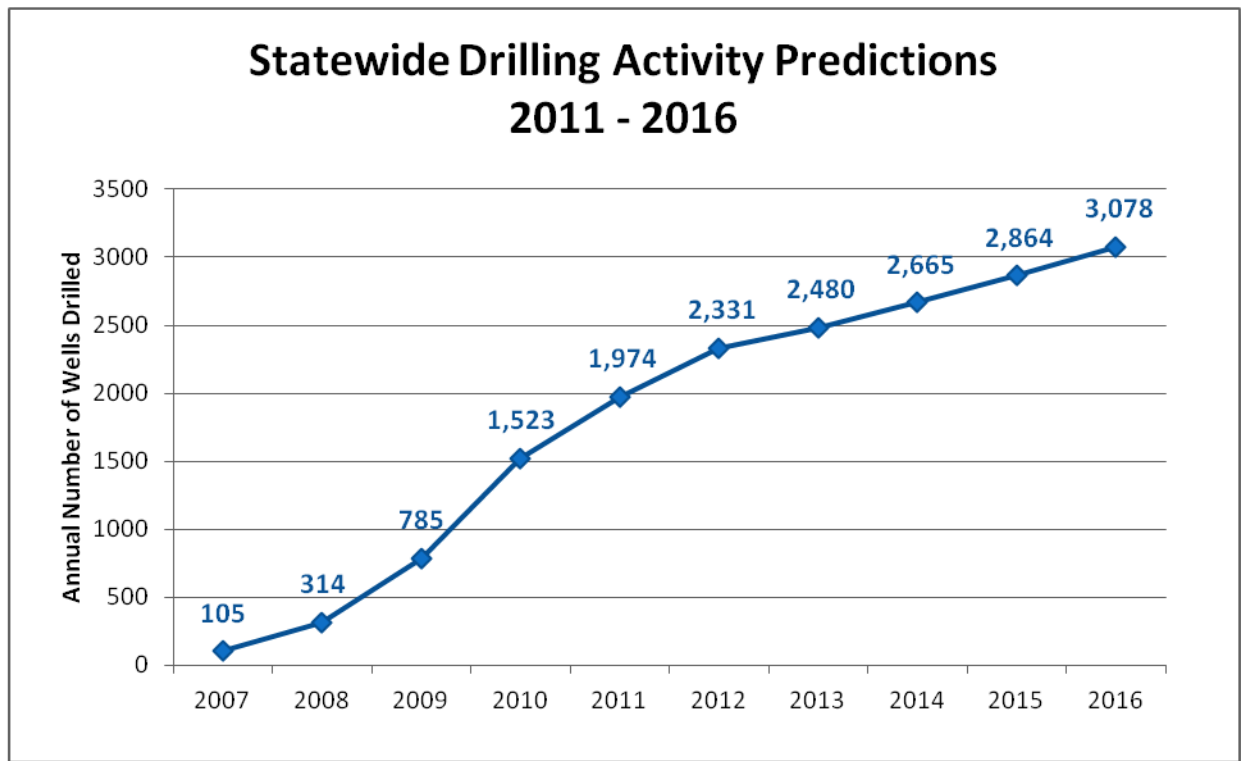
These factors drive industry decisions such as the rate of drilling and location of wells. Since January 1, 2012, there has been increasing discussion about the industry moving its workforce from the “dry gas” found in Lycoming County to the “wet gas” located in Western Pennsylvania and Ohio. Supporting this



perception is the drop in the price of “dry” natural gas, making it more profitable to mine the wet gas and utilize the oil and liquid hydrocarbons to make plastics and other heating fuels².

The following graphs estimate the number of wells projected to be drilled statewide and within Lycoming County for the five-year projection period. A study prepared by the Marcellus Shale Education & Training Center³ estimated statewide drilling from 2011 to 2014. As previously indicated in the permit analysis, it was assumed that the drilling activity would begin to stabilize and thus the annual rate of change from 2014 to 2016 is believed to be less than 8%. Using the annual percentage change for these years and the actual number of wells drilled in 2011; it is possible that over 3,000 wells will be drilled in 2016 across the Marcellus Shale play. This “estimated” growth represents a 56% increase in industry activity since 2011. **To reiterate, this sustained level of drilling activity is highly influenced by and dependent upon the three factors mentioned above.**

Figure 8: Statewide Drilling Activity



Source: Pennsylvania Marcellus Shale Workforce Needs Assessment and Delta Development Group, Inc.

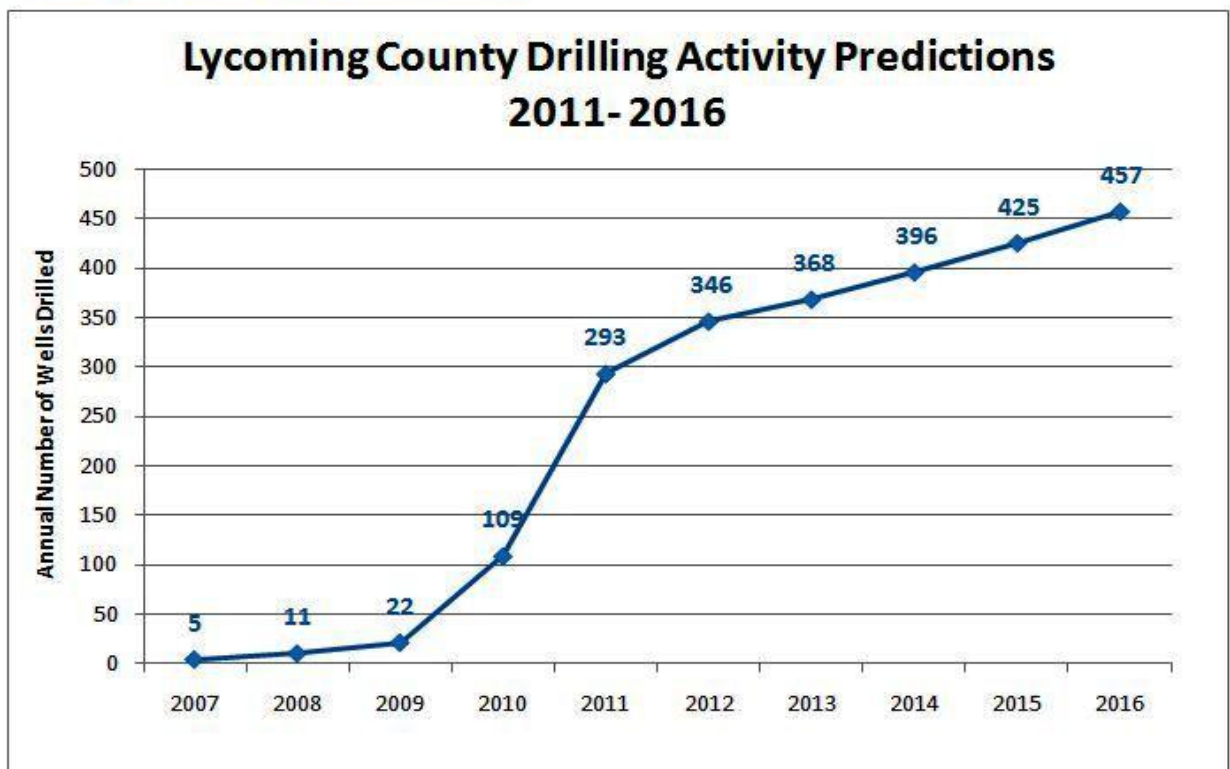
² “Chesapeake to Cut Natural Gas Production Drastically,” *Pittsburgh Tribune*, January 24, 2012.

³ Pennsylvania Marcellus Shale Workforce Needs Assessment, Summer 2011.



The statewide “extrapolation or prediction” methodology was reviewed for its applicability to wells drilled in Lycoming County. Recognizing that Lycoming County has DRY gas and the current desire for drilling for WET gas found primarily in the western part of our state, it is not unreasonable to expect a more conservative growth estimate for our region over the next few years. In fact, there has been recent speculation of an industry contraction due to the factors discussed above. Yet, PA DEP’s spud data for Lycoming County wells offers a more positive note for the near term as the drilling rates for the first six months of 2012 versus 2011 are nearly identical.

Figure 9: Lycoming County Drilling Activity Predictions



Source: Pennsylvania Marcellus Shale Workforce Needs Assessment and Delta Development Group, Inc.

4.0: Impacts on Water, Sewer, and Stormwater Infrastructure

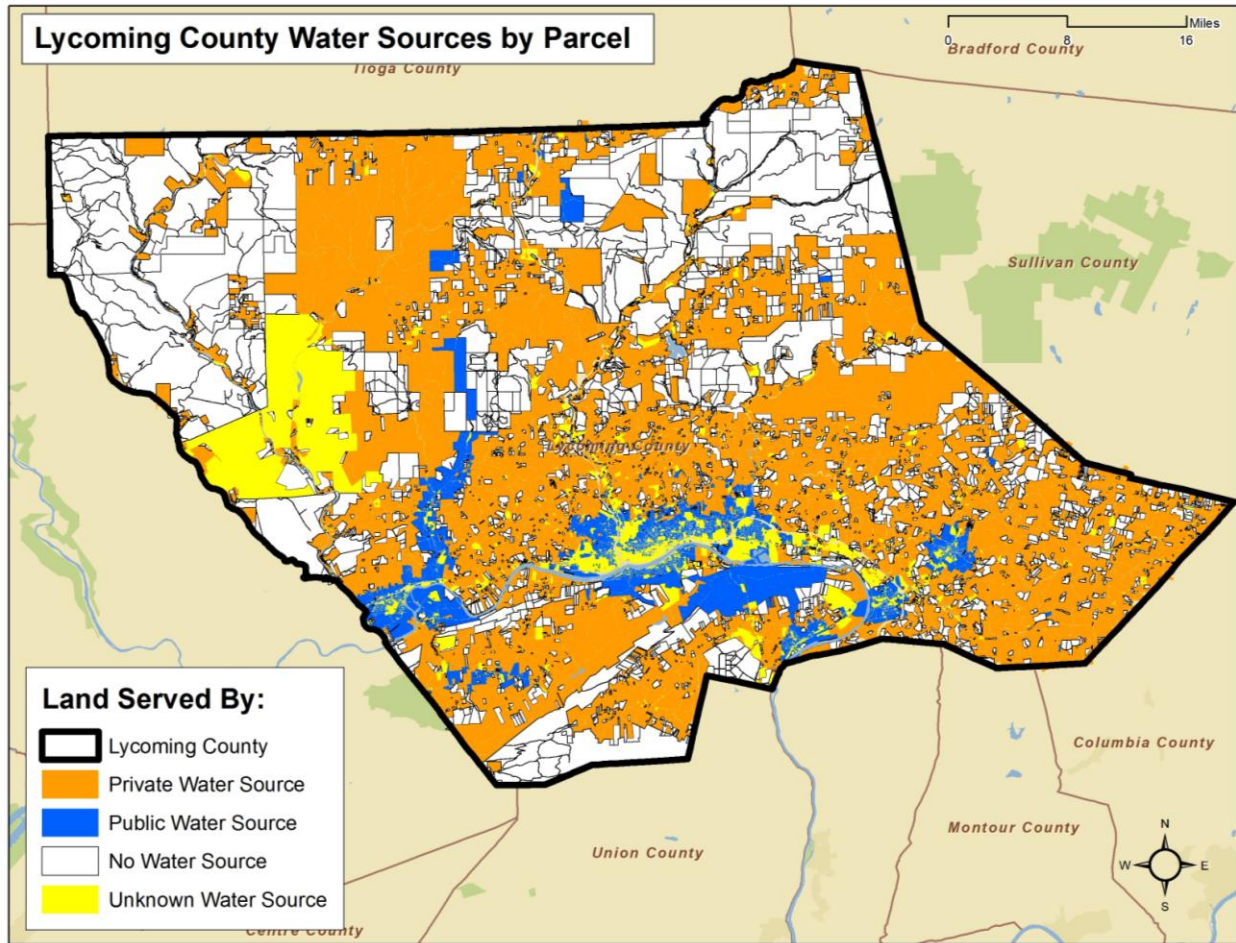
The potential water and sewer infrastructure impacts include water supply, management of drilling waste, stormwater controls, and economic development.



4.1: Water Supply

According to Lycoming County’s 2001 Water Supply Plan, the County’s community water supply comes from 79 wells, four streams, and three springs throughout the County⁴. These sources are funneled through 37 public water systems, which provide public water to area communities.

Figure 10: Lycoming County Water Sources



Source: Lycoming County Planning and Community Development, Lycoming County GIS, ESRI, and TeleAtlas Street Data.

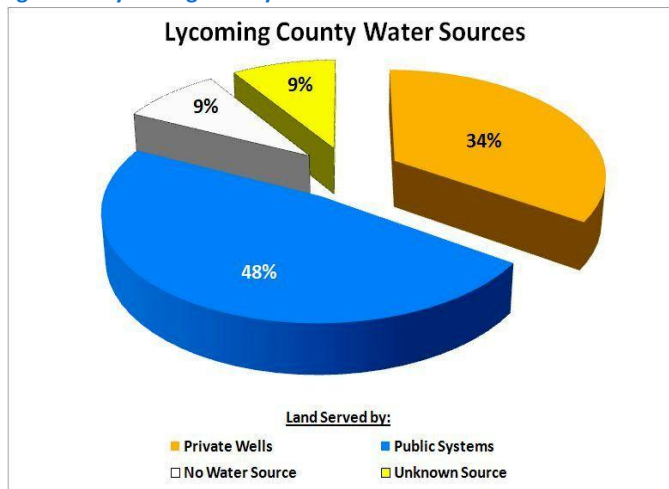
⁴ It should be noted that at the current time, NO community water system in Lycoming County takes a direct withdrawal from the West Branch Susquehanna River.



In 1999, these water systems collectively provided approximately 4.488 million gallons per day (mgd) for residential purposes alone. According to data provided by the WMWA, that authority alone provided nearly 57% of the residential water volume in 1999 to Lycoming County households. In addition, the WMWA delivered another 3.891 mgd to its commercial, institutional, and industrial customers, as well as for capacity that was unaccounted for.

“Safe Yield” is a measurement used as a conservative estimate of year-round stream and groundwater availability and is defined by the PA DEP as the maximum quantity of water that can be drawn from surface

Figure 11: Lycoming County Water Sources



Source: Lycoming County Planning Department, June 2012.

or groundwater sources without ultimate depletion of the source during a drought interval of 50 years. In general, the safe yield for the County’s public water supplies and systems (as noted in the 2001 Water Study Report) has been quite adequate. This message was reinforced through several interviews with the local authorities.

However, it was discussed during focus group meetings that public water authorities recognize that catastrophic environmental factors and dynamics of the industry could change this assessment.

Water Sales to the Industry

The industry has presented many opportunities for generating revenue from water sales. Many authorities and some municipalities have reported the positive impacts, such as using this unexpected revenue for replacement and expansion projects. They additionally reported that only excess water is sold to the industry, and the demand on this commodity does not affect the supply to their customers. As a matter of fact, the WMWA has indicated that since 1999, the volume of water sold to all sectors (residential, commercial, institutional, and industrial) has shown a steady decline for a number of reasons until recently, with the sales to the gas industry and related business activity being the noteworthy uptick in their sales volumes. Furthermore, they indicated that they provided an average of 100,000 gpd in direct bulk water sales to the gas industry in 2011.



Involvement of Water in the Drilling Process

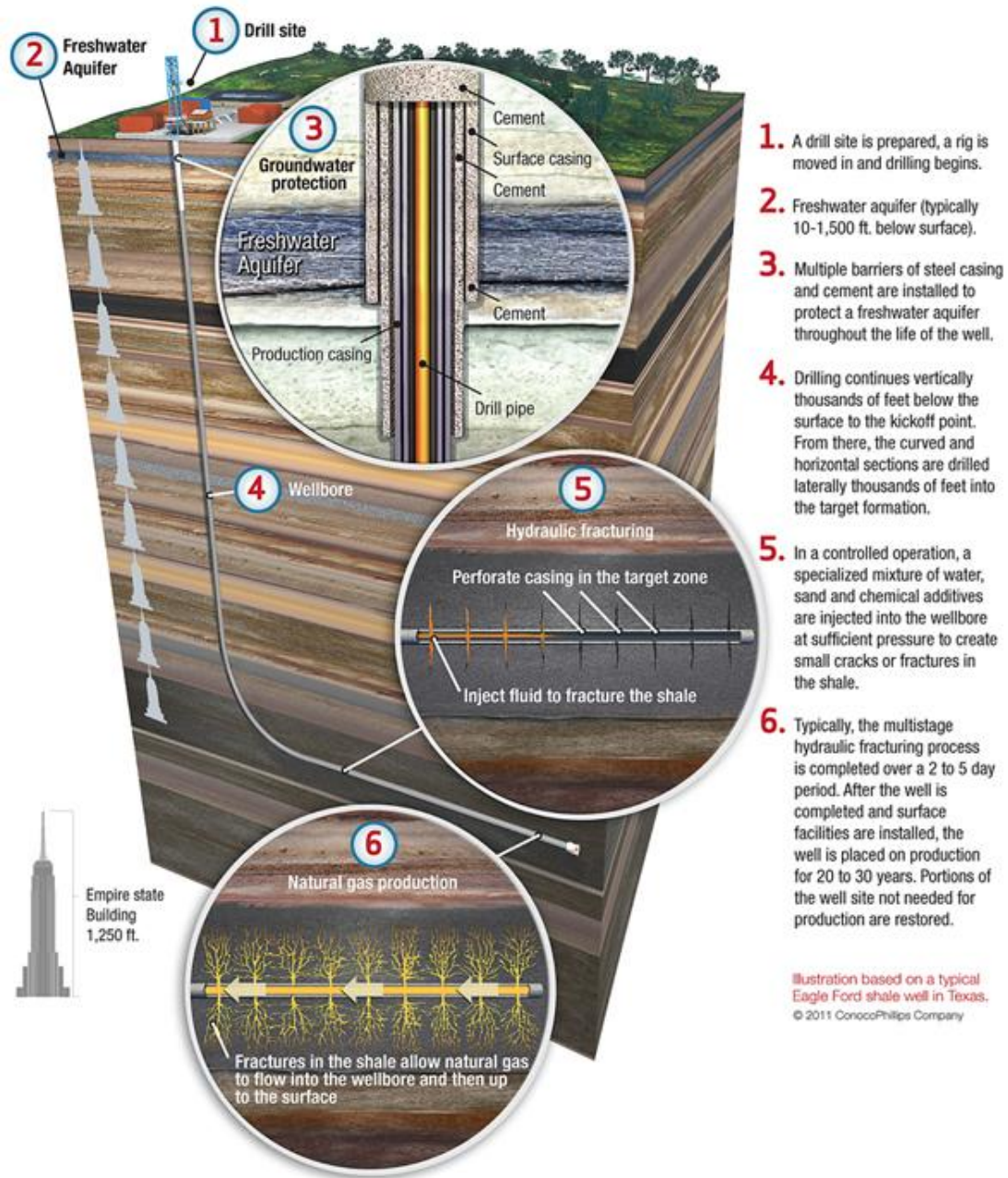
Projections of water use within the gas industry are highly speculative due to the dynamic nature of well drilling activity as well as environmental factors, including depth of the shale, thickness of the formation, presence of features impeding well completion, proximity of a water source, and regulatory factors.

Advances in new and existing drilling process technologies have allowed for the capture of large commercial quantities of natural gas that historically have not been available due to inefficient drilling techniques and dense fine-grained rock. The improved process, which includes horizontal drilling and hydraulic fracturing, has made water a valuable commodity due to the need for large volumes of water to cool and lubricate the drill and assist in fracturing the rock.

In hydraulic fracturing, or hydrofracking, a solution of water, sand, and chemicals are injected into the rock formation at high pressure causing fissures that are then propped open by the sand (see graphic on following page). These fissures enable the effective release of the large quantities of gas from the wells. Depending on the type of gas well, there appears to be a wide range of water needed: estimates vary from as little as 1.2 to 3.5 million gallons of water per well to as much as 5 to 8 million gallons (fresh and recycled water) used during the hydraulic fracturing process — a process that typically takes one month to complete.



Figure 12: Illustration of a Typical Marcellus Shale Unconventional Gas Well



- 1.** A drill site is prepared, a rig is moved in and drilling begins.
- 2.** Freshwater aquifer (typically 10-1,500 ft. below surface).
- 3.** Multiple barriers of steel casing and cement are installed to protect a freshwater aquifer throughout the life of the well.
- 4.** Drilling continues vertically thousands of feet below the surface to the kickoff point. From there, the curved and horizontal sections are drilled laterally thousands of feet into the target formation.
- 5.** In a controlled operation, a specialized mixture of water, sand and chemical additives are injected into the wellbore at sufficient pressure to create small cracks or fractures in the shale.
- 6.** Typically, the multistage hydraulic fracturing process is completed over a 2 to 5 day period. After the well is completed and surface facilities are installed, the well is placed on production for 20 to 30 years. Portions of the well site not needed for production are restored.

Illustration based on a typical Eagle Ford shale well in Texas.
© 2011 ConocoPhillips Company

Source: <http://www.powerincooperation.com/drilling-and-completion.html>.



The data gathered from water management plans provides a maximum permitted withdraw amount as well as an intended public water purchase amount. However, these documents do not detail the actual water usage for natural gas drilling operations. To determine the actual water volume utilized as well as the water sources being used to support the drilling efforts, approximately 42 PA DEP Well Completion Reports were compiled from wells located within the County. These reports describe the water sources used and gallons consumed for each well. This study does not include a comprehensive analysis of all Well Completion Reports, but was based on available information. These reports indicated that approximately 14% of the total water used in the drilling process is estimated to be supplied from groundwater sources.

Water Withdrawals

According to PA DEP regulations, natural gas well operators must complete a Water Management Plan detailing the water sources utilized for fracture stimulation for each Marcellus Shale natural gas well project. These plans list all water sources — groundwater, surface water, wastewater/cooling, water/mine water, public water — proposed for utilization in the development of the wells, and also show the anticipated water withdraws and detail a monitoring plan, among other more specific elements.

Withdrawal estimates are provided in the form of maximum 30-day average daily quantities in gpd and the maximum rate of withdraw in gallons per minute (gpm). It is important to note that most drilling operations rely on multiple water sources rather than one surface water withdrawal point, including water purchased from public water sources.

Considering that Lycoming County falls within the basin of the Susquehanna River, water management plans in the County are reviewed by both the SRBC and the PA DEP. The SRBC reviews the details of the plan and provides the well operator with a permit detailing their acceptable withdrawal volumes and water sources.

In Lycoming County, groundwater sources located near well pads are not readily utilized for drilling operations. The vast majority of water sources for Marcellus Shale natural gas well drilling operations in Lycoming County are as follows:

- Surface water withdrawals permitted to the gas companies or their support companies by the SRBC
- Public water purchased from public water suppliers

Surface water utilized by well operators purchased from public water suppliers must be approved by the SRBC. Public water supplies allocated to gas industry customers are managed by individual public water authorities and municipalities via contractual business arrangements and by using a letter of commitment form supplied by the SRBC. More recently, the PA DEP has also developed a bulk water management form that public water suppliers need to fill out and submit in order to sell bulk water to the gas industry users. The volume of water provided is based on the amount of water available after the needs of public water customers are met.



Approved surface water withdrawals issued specifically for Marcellus Shale activity were obtained from the SRBC to determine a baseline of the water volume associated with the well drilling industry. The chart below details the permitted withdrawal amount from specified water sources per the SRBC data. This indicates the potential surface water usage attributed to Marcellus Shale drilling activities. It is recognized that there are additional withdrawals of surface and groundwater from public water suppliers for sale to the gas industry sanctioned via Approval by Rule (ABR) letters to the SRBC.

Table 1: Potential Marcellus Shale-Related Surface Water Withdrawals in Lycoming County as approved by the SRBC

Water Source	Permitted Withdraw Amount – Peak Day (mgd)	Municipality
West Branch Susquehanna River	0.999	Clinton Township
Pine Creek	0.099	Cummings Township
Little Muncy Creek	0.091	Franklin Township
Little Muncy Creek-Jordan	0.041	Franklin Township
Loyalsock Creek	0.918	Gamble Township
Lycoming Creek	1.5	Lewis Township
Lycoming Creek-2	0.2	Lewis Township
Lycoming Creek	1.5	Lewis Township
Pine Creek-2	0.499	McHenry Township
Pine Creek	1.5	McHenry Township
Little Muncy Creek	0.249	Moreland Township
Loyalsock Creek	0.099	Montoursville Borough
West Branch Susquehanna River	0.72	Nippenose Township
West Branch Susquehanna River	3.0	Piatt Township



Water Source	Permitted Withdraw Amount – Peak Day (mgd)	Municipality
Muncy Creek-1	0.099	Picture Rocks Borough
Muncy Creek-2	0.099	Picture Rocks Borough
Pine Creek	1.0	Porter Township
Lick Run	0.249	Shrewsbury Township
Pine Creek	0.918	Watson Township
Pine Creek	0.72	Watson Township
West Branch Susquehanna River	0.1	Williamsport City
WTJMA-WWTP Effluent Discharge	0.249	Wolf Township
Totals:		
12 Water Sources	13.751 *	16 Municipalities

* This water withdrawal total does NOT include the “approved by rule” quantities provided to the industry by public water suppliers. It is noted that the WMWA alone has 1.8 mgd approved for sale through letters of commitment. Neither does this total figure include the recently approved permit amounts allocated to the Township of Muncy Creek.

Source: Sample of Water Management Plans accessed by Delta Development Group, Inc., January 2012.

As shown in the information above, the peak, single day withdrawal amounts are monitored closely by the SRBC. These amounts range widely between 0.041 mgd and 3 mgd, as do the water sources and locations of withdrawals. In many cases, local streams and creeks are the surface water sources for these drilling operations. However, in four instances, the larger West Branch Susquehanna River was reported as the surface water source with its withdrawals being closely monitored by the SRBC.

The SRBC permits currently allow for the withdrawal of over 14 mgd across various surface water sources in Lycoming County.

Point of Emphasis

The SRBC has low-flow stream protection policies that are implemented via their “pass-by requirements.” The SRBC is now revising the policy to allow the pass-by levels to modulate on a seasonal basis to better protect aquatic habitat.



The key point is that water to support drilling operations is provided or supplied by direct withdrawals from local creeks or the West Branch Susquehanna River or by commercial sale by an authority or borough, or both. Thus, in a very real sense these water withdrawals may constitute a significant revenue source to local authorities and municipalities, which in turn, helps to fund upgrades to other capital facilities owned by these entities. Moving forward, the challenge is to determine the feasibility and preferred approach for getting public water from municipal or authority providers directly to gas operations via pipelines in order to reduce the heavy dependency on trucks and the resulting truck traffic.

The table below details the ACTUAL water sources and volumes utilized for drilling activities at a sample of gas wells in Lycoming County, per information gathered from Well Completion Reports filed with the PA DEP no more than 30 days after well drilling is complete. The information in the table below is based on a sample of 15 Well Completion Reports that were readily available for review at the time of this report. Drilling activities covered by these reports extended between June 2009 and June 2011. The total water volume used during this period was approximately 105.4 million gallons of water. The five water sources with the highest volume of water withdrawals are highlighted in yellow in the chart below. The numbers presented herein are meant to provide an understanding of the order of magnitude of water usage related to drilling activities.



Table 2: Actual Water Sources Utilized for a Sample of Gas Wells Drilled in Lycoming County, 2011

Water Source	Volume (million gallons)	% of Total Volume
Appalachian Utilities (Avis) (Clinton County)	1.40	1.3%
Boroughs / Water Authorities	66.50	63.1%
Impoundments	0.95	0.9%
Jersey Shore at Larry's Creek	5.60	5.3%
Jersey Shore at Larry's Creek and Pine Creek	8.10	7.6%
Justus Creek (Venango County)*	0.14	0.1%
Justus Lake (Venango County)*	0.06	0.1%
LHP Management	10.20	9.7%
Mill Hall (Clinton County)	2.00	1.9%
Unused Water from Other Wells	4.00	3.8%
West Branch Susquehanna River at Goshen Township (Clearfield County)	1.20	1.1%
West Branch Susquehanna River at Nippenose Township (Lycoming County)	5.40	5.1%
Total	105.40	100.0%

Source: Sample of Water Management Plans accessed by Delta Development Group, Inc., January 2012.

*It is unexpected that wells in Lycoming County would utilize water from sources located in Venango County, over 150 miles from the drilling site. However, the use of such outlying sources further illustrates the common practice of drilling operators to utilize a variety of water sources based primarily on what is available and cost effective at the time of drilling. As expected, the vast majority of water used for drilling operations in Lycoming County is from the County itself or other counties in the immediate vicinity.

Impacts of Water Usage

Considering that surface water withdrawal volumes around Lycoming County are carefully permitted and strictly monitored by both the SRBC and the PA DEP, there is no indication at this time that the use of surface water for drilling operations has had an adverse impact on the region's water supply. However, water levels of surface water sources, particularly local creeks and streams, are closely monitored to ensure that any potential water shortages are identified early and appropriate actions can be taken to manage the water supply.

Item of Administrative Concern

The SRBC reviews applications for water withdrawals throughout the watershed on a first-come/first-served basis with no priority provided to public water suppliers. The impact of this policy is the protracted timeline to secure the SRBC permit approval for community water needs.



As shown in Table 2, local water authorities and boroughs in Lycoming County provide over 63% of the water used during recent drilling operations. This new market for water sales is a clear benefit for the revenue generation capacity of many local governments and authorities, yet it is accompanied by considerable responsibilities. Each of these agencies manage their water supply independently and determine how much of their supply can be safely sold to the drilling industry without jeopardizing the supply and services available to their local customers. Likewise, each authority and/or borough oversees the revenue generated from water sales to the drilling industry and is able to utilize this added income as necessary to support their organizational goals.

Through research and stakeholder interviews, it was learned that local organizations are using water sale revenue in a variety of ways, ranging from rate decreases for their current customer base to infrastructure upgrades and expansions to capital reserve accounts for future projects. It is the responsibility of these local authorities and boroughs to continually monitor and balance their water sale volumes with the needs of their current customer base. Considering the infancy of the drilling-related water sales market in Lycoming County, the future of this practice and its resulting revenue levels is unknown and unprecedented. The uncertainty of this market and revenue stream only furthers the need for individual organizations to be cautious and strategic in their investments.

Source Water Protection

It is understood that each major stream within Lycoming County provides water to or influences groundwater utilized by the largest number of public water supply sources, including those of the WMWA, the Jersey Shore Area Joint Water Authority (JSAJWA), Montoursville Borough, and Muncy Borough. Additionally, much of the remaining water supplies utilized in Lycoming County rely on groundwater drawn from the area underlain by Marcellus Shale.

With the assistance of the PA DEP and US EPA, many public water suppliers developed Source Water Protection Plans several years ago. Those plans describe the water sources used, potential sources of contamination, and delineations of prescribed geographic protection zones around the water intakes and wells. As gas development activities in Lycoming County intensify, there is the potential for up to a thousand unconventional gas wells to be drilled in the Lycoming Creek watershed, which supplies water to the WMWA well-field source. In addition to the WMWA, there are other major public water suppliers with similar concern for the potential level of gas development in Larry's Creek, Pine Creek, Loyalsock Creek, and Muncy Creek watersheds.

Recognizing the need to assess the potential impact to the quantity and quality of one of its primary water sources, WMWA then enlisted the help of the U.S. Geological Survey (USGS) in order to develop a methodology for monitoring the WMWA's water supplies relative to the extensive land use changes

The Goal

Establish a baseline assessment of source water quality in each of the county's five major streams in order to properly assess future impacts (if they occur) and be prepared to determine measures needed to protect source water supplies.



occurring in the Lycoming Creek watershed and to create a model for watershed monitoring that could be used in the WMWA's surface supply watersheds and "exported" throughout Lycoming County as well.

WMWA funded 58% of the \$130,000 program cost to develop an innovative ambient water quality baseline for the Lycoming Creek watershed. In 2011, the USGS conducted most of the sampling and analyses with the assistance and cooperation of the WMWA and the PA DEP. It is expected that the results and recommendations from the study will be used to develop coordinated efforts among the regulatory agencies responsible for various aspects of gas industry monitoring and compliance. The WMWA expects to experience additional monitoring and laboratory services costs in the order of \$20,000 to \$50,000 or more in each of the upcoming years in order to implement an effective, ongoing source water impact assessment and protection program in its water supply sources alone.

Lycoming County has over 2,200 miles of waterways, many of which are classified by the PA DEP as Exceptional Value (EV) or High Quality (HQ) streams. In 2010, Lycoming and Loyalsock Creeks were added to the list of EV streams. Due to the fact that the County's major population centers are primarily located along the West Branch Susquehanna River, many of the public drinking water sources are withdrawn from surface waters or aquifers that are located at the mouths of these major creeks entering the West Branch Susquehanna River.

A diligent countywide process of water quality monitoring is lacking, which would establish existing water quality conditions, and in the future would serve as a reliable information source to address any concerns regarding potential impacts by the Marcellus Shale gas drilling activity. Partnering with the PA DEP, the SRBC, the USGS, and other government agencies and local public water providers, Lycoming County is planning to design and implement a Countywide water quality monitoring program to develop a baseline of water quality conditions of the aquifers and streams of the five major watersheds north of the West Branch Susquehanna River. This initiative is seen as an opportunity to protect our EV streams, to safeguard our major public water supplies, to establish an objective baseline of water quality, and to avoid unnecessary and protracted legal battles. The planned approach is to inventory existing water quality monitoring programs now being undertaken by various agencies and determine the most effective way to collect the existing scientific water quality data and to fill the "data gaps" where necessary by either (1) conducting watershed sampling, or (2) installing means of water quality monitoring where appropriate. This effort needs to be initiated immediately.

4.2: Management of Drilled Waste

Production of Waste in the Drilling Process

According to industry experts, approximately 10% to 15% of the water used in the fracking process will be returned to the surface as flowback fluids, which are generally defined as fluids returned to the surface within a specified length of time and comprised of as little as 3% or as much as 80% of the total amount of water and other material used to fracture the well. Also, during production, fluids continue to flow up to



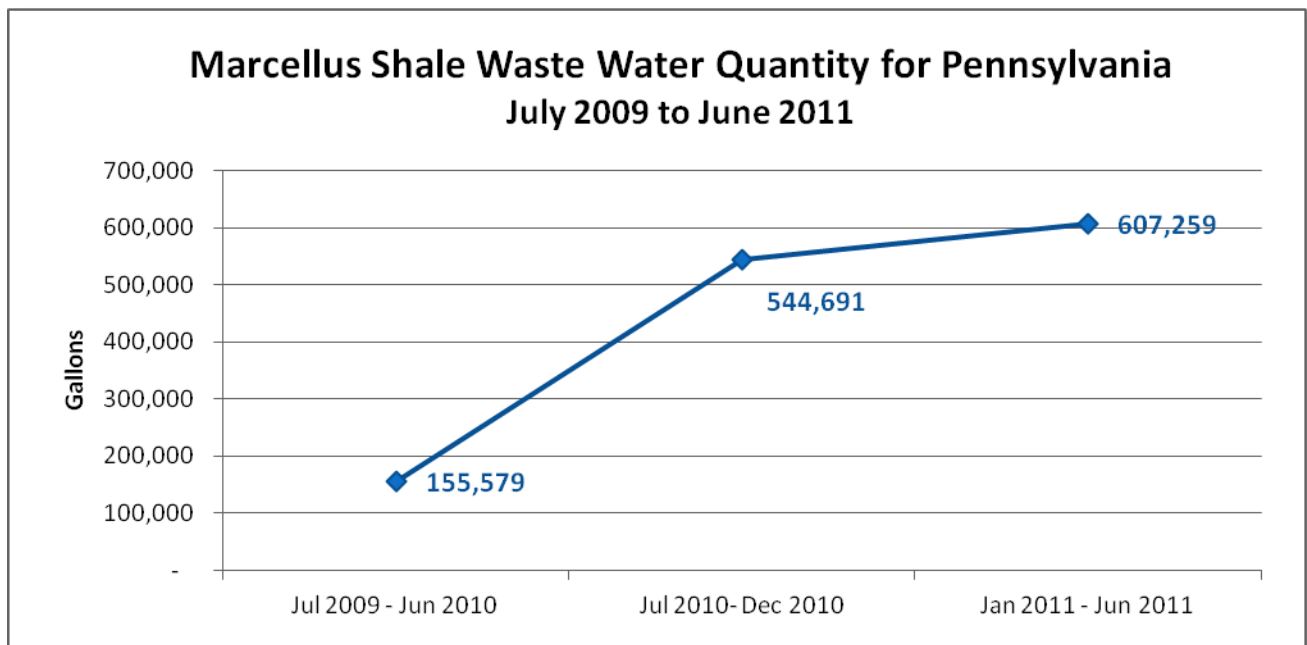
the surface in what is referred to as “produced wastewater.” This waste can be contained in either a PA DEP-approved holding pond (a lined pit) or an approved storage tank. The amount of gas well wastewater has also increased exponentially with the increase in drilling and the addition of new producing wells.

These fluids can be treated in a number of ways:

1. Treated on-site and reused for another well fracking
2. Transported to a commercial/industrial CWT facility for waste treatment then discharged to a receiving stream or to a publically owned treatment works (POTWs) facility
3. Underground Injection (currently the PA DEP does not support this method in Pennsylvania, but several disposal wells are located in Ohio)
4. Treated and discharged to Surface Water

Neither the PA DEP nor the US EPA will allow the transport of fluids to a POTW facility.

Figure 13: Drilling Wastewater



Source: PA DEP Oil and Gas Waste Production Reports, 2012.

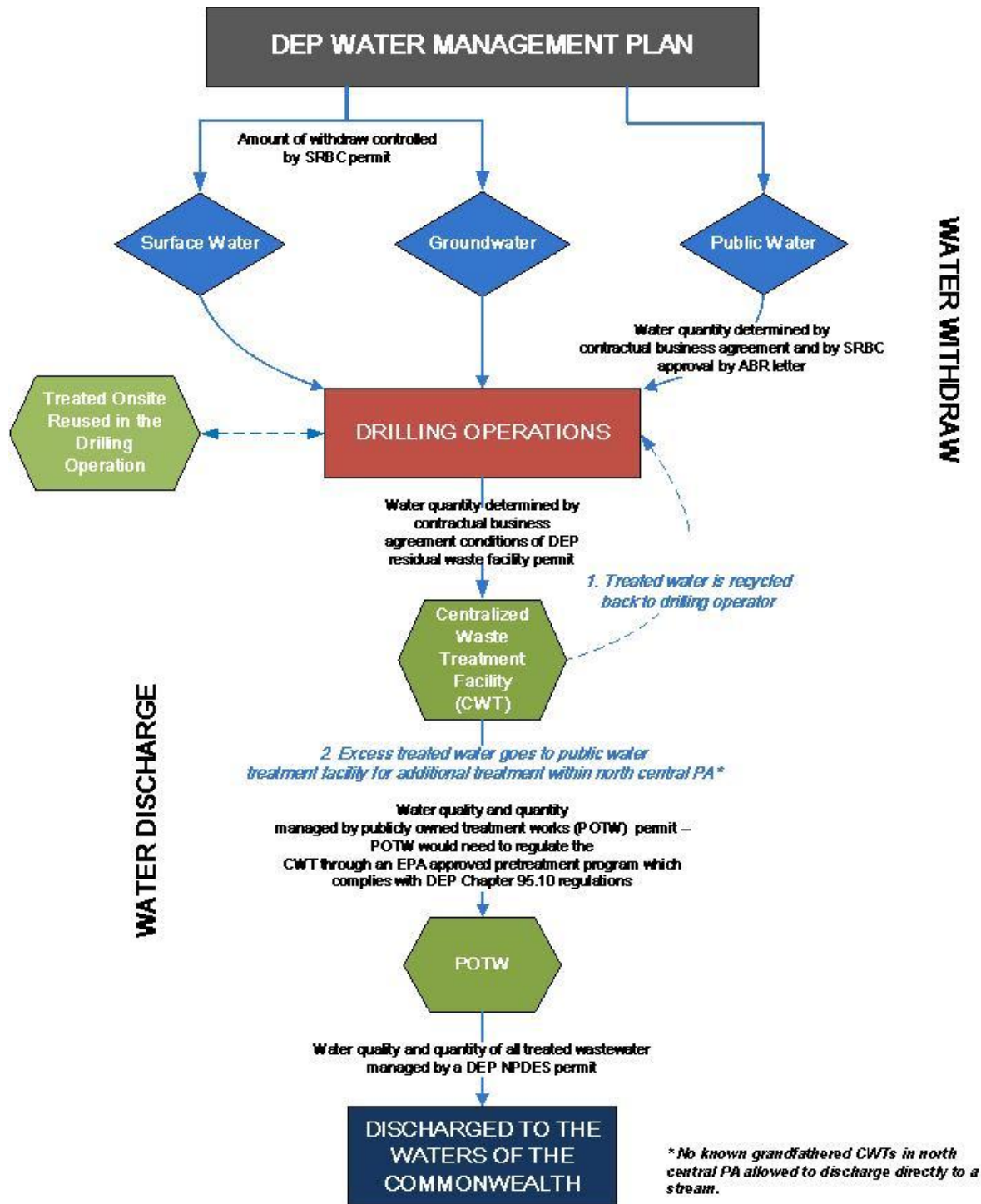
In addition to waste fluid, the gas industry and commercial wastewater treatment or CWT facilities need to dispose of waste streams, such as sludges, from the treatment processes, concentrated brines, and drilling



muds and cuttings. Generally it is believed that landfills permitted by the PA DEP can accept gas industry wastewater treatment sludges if proper regulatory protocols are followed. Concentrated brines resulting from CWT treatment processes are reportedly shipped to Ohio to brine disposal wells for underground injections, although some CWTs may be investigating crystallization and other beneficial use options. Brines from unconventional gas development are generally not suitable for standard beneficial uses such as dirt and gravel road wetting due to high concentrations of toxic chemicals (barium and strontium), total dissolved solids, and radiological constituents (Radium 226,228), which could accumulate in roadside soils and/or runoff into nearby streams. There is also a movement within the gas industry to test and apply for application of drilling cuttings on roads as aggregate material.



Figure 14: Role of Water in the Drilling Process



The PA DEP's chapter 95.10 regulation requires that prior to discharge to a stream or WWTP, all wastewater from gas development must first be treated to extensive standards, generally attainable only with multiple chemical/physical processes and clarification followed by a thermal process such as distillation (evaporation/condensation). The untreated drilling waste contains extremely high levels of salt and other contaminants that cannot be managed by the typical public wastewater treatment process.

At present, none of Lycoming County's seven POTWs receives wastewater directly from drilling sites. One POTW—the WSA—receives drilling wastewater after it is pretreated at a CWT facility, namely Eureka Resources, LLC (Eureka). The WSA is the only POTW system that has an EPA-approved pretreatment program and has applied for an NPDES permit modification to allow the discharge of the extensively treated CWT wastewater.

If drilling wastewater is being reused by a drilling operation, it does not need to go through the entire treatment process. If drilling operators are interested in reusing the drilling wastewater, the water can be minimally pretreated either on-site or at pretreatment facilities and sent back to the drilling operations in the resulting semi-treated state to reuse in fracking.

On March 12, 2012, the PA DEP released an announcement revising the permits required for the processing and beneficial use of liquid waste from oil and gas well sites. The new permit replaces three existing general permits, WMGR119, WMGR121, and WMGR123.

As stated by the PA DEP, the revised "Residual Waste Beneficial Use" general permit (WMGR123) encourages using the closed-loop process, which is the reuse of liquid waste after it has been treated or processed. The liquid waste includes brine, flowback water, drilling muds, and stormwater. This process minimizes water withdrawals and reduces impacts on Pennsylvania's valuable water resources.

Across the Commonwealth, there are 10 facilities operating under the prior general permits for processing and beneficially using oil and gas wastewater, and these facilities will continue to operate under the revised permit. Ten additional facilities have pending permit applications with the PA DEP.

Three new private companies in Lycoming County have entered the market to provide various levels of wastewater treatment for the gas companies. These intermediate processing companies are Eureka Resources, LLC (Eureka), TerraAqua Resource Management (TARM), and Clean Streams LLC (Clean Streams).

Photo 1: Eureka Plant in Williamsport



Eureka Resources, LLC

In 2008, Eureka was formed to provide wastewater treatment options to the natural gas drilling industry in the region. The Eureka facility, referred to as a CWT plant, is located in Williamsport and processes 200,000 gallons of drilling wastewater daily. According to the PA DEP, the company processed 10.3 million gallons of wastewater during the second half of 2010. The process involves treatment of raw wastewater from drilling sites to meet current standards for reuse and discharge to POTWs.



At Eureka, this process includes both pretreatment and distillation. The process begins with pH adjustment and clarification to remove solids and some heavy metals. After sediments are removed, Eureka uses a thermal process to effectively distill the wastewater, which can then be released into the POTW sewer system or reused by the drilling industry to frack wells. The residue of this process is highly concentrated brine that is utilized by other industries through Eureka's water pickup services offered to other clients or sent to Ohio for underground injection. Eureka expanded its facility in 2010 to include three distiller units.

The WSA, under its EPA-approved pretreatment program, issued a nondomestic wastewater discharge permit to Eureka to discharge pretreated distilled gas industry wastewater to the WSA system under very detailed conditions, which require prescribed treatment through all of the processes necessary to meet the PA DEP Chapter 95.10 standards as a BMP, and as verified by extensive monitoring, analysis, and record keeping. Eureka's business plan is to have the gas companies recycle as much of the treated water as possible back to the well pads for reuse. Eureka has indicated that discharge of treated wastewater to the WSA is necessary when gas companies do not wish to return the treated wastewater back to the well pads under a number of circumstances, such as during seasonal wet weather and after the end of fracking operations.

*TerrAqua Resource Management*

TARM began its operations in 2010 and has treated and recycled over 60 million gallons of water as of August 1, 2011. The company specializes in processing flowback and produced water from gas wells and reuse standards for additional well operations. TARM is intended to be the first zero-liquid discharge facility in the market (note: there is some liquid in the sludge). Since TARM facilities are located in or near established drilling



Photo 2: TARM Plant in Williamsport

fields, the costs associated with transporting flowback and produced waters is reduced. While some of these fluids are integrated into the sludge, the vast majority are delivered to the plant for treatment via an armada of 16-wheeled vehicles. Trucks travel fully loaded both to and from drilling sites. By bringing flowback and produced water to TARM and returning with treated water, the number of truck trips is reduced. Delivered volumes are segregated by drilling company and the same fluids are provided back to the company for reuse after treatment. This acts as a predictable water source that buffers the client’s dependency on permitted water withdrawals. TARM provides flexible processing options for the gas industry, including contract duration and treated products, based on the operational needs.

Clean Streams LLC



Located in Old Lycoming Township, Clean Streams is another company in the WSA’s collection area. Clean Streams is operating a facility that uses an evaporation/condensation system to extensively

reduce parameters of concern and has made application to the WSA for a discharge permit. In short, Clean Streams is a water treatment and recycling company that serves the natural gas industry by providing a sustainable solution for flowback, frack fluids, and produced water. The facility operates 24 hours per day, seven days per week, turning wastewater into recycled distilled water. The facility processes approximately 95,500 gallons of water per day, with the clean recycled distilled water that results available for use by oil and gas producers in their ongoing drilling operations. The residual concentrate water, containing nearly 100% of the salt products that enter the facility, is reused as regulations permit or removed from the site and transferred to an approved commercial disposal facility in Ohio.

Water Discharge

The Pennsylvania Clean Streams Law (Act of June 22, 1937, P.L. 1987, as amended, 35 P.S. §691.1 *et seq.*) provides the PA DEP the authority to prevent and abate water pollution in the Commonwealth. Article III of this law requires persons and municipalities to obtain permits to discharge "industrial wastes" into Pennsylvania waters. In Pennsylvania, these discharge permits are



Photo 3: Tankers at TARM Facility



provided to wastewater treatment plants, industrial dischargers, and other point sources by the PA DEP as part of a program known as the NPDES.

NPDES Permits

NPDES permits regulate the volume and quality of processed household and industrial waste that is collected in sewers and treated at municipal wastewater treatment plants, as well as industrial and agricultural point sources that discharge into other wastewater collection systems or directly into receiving waters of Pennsylvania. The goals of this program are to protect public health and aquatic life and to ensure that wastewater is properly treated by appropriate facilities. To achieve these goals, permits include site-specific discharge (or effluent) limits, as well as management requirements, including monitoring and reporting terms. NPDES permits have a fixed term that cannot exceed five years.

Gas well operators in Lycoming County are not typically required to obtain a NPDES permit because their wastewater is not discharged into the streams or rivers of the Commonwealth. Usually, wastewater from the gas well operations is sent to a CWT water pretreatment facility and then directed to either a municipal wastewater treatment plant or recycled back into the well drilling operation. If a POTW decides to accept pretreated wastewater, it is required by the PA DEP to amend its NPDES permits accordingly.

4.3: Stormwater Concerns

The amount of land needed for drilling a new unconventional gas well goes beyond the well pad where the well is located. The operator also typically clears areas to accommodate water holdings, drill cuttings, and the many trucks and equipment elements used in the drilling operation. This cleared and graded area may require approximately 5 to 7 acres of land, plus any space needed to provide an access road between the drilling site and the nearest public roadway. Disturbance of the land increases the stormwater runoff at these sites and has the potential to affect local streams. Many of the drill operators utilize stormwater BMPs, such as ditches or strategically located and graded gravel paths to control runoff caused by drill-related land disturbances. These mountaintop and mountainside drill pads and/or compressor stations generate stormwater runoff into rural creeks and streams, thus increasing the local flooding conditions we face.

The zoning ordinance in Lycoming County encourages screening of well sites via the local natural habitat and discourages disturbance of trees and their root system where possible.

From a stormwater infrastructure perspective, the state had already implemented the Municipal Separate Storm Sewer System (MS4) program for stormwater analysis and management. Today, there is a growing recognition about being prepared to define, fund, design, and construct appropriate stormwater infrastructure projects to meet the nutrient reduction requirements of the Chesapeake Bay Strategy.



4.4: Gas Drilling-Related Solid Waste Disposal

One Marcellus Shale well can produce up to 1,000 tons of solid waste during the vertical and horizontal drilling process. Drill cuttings, underground rock, and chemical additives brought to the surface during the drilling process are sent to an approved regional landfill for disposal. Drill cuttings are considered residual waste, a category removed from household waste, and all licensed Pennsylvania state landfills are allowed to take the drill cuttings under their general municipal waste permit (note: Lycoming County's landfill does not accept these materials). The state regulators also review individual well pad sites and privately owned off-site locations for potential disposal pits.

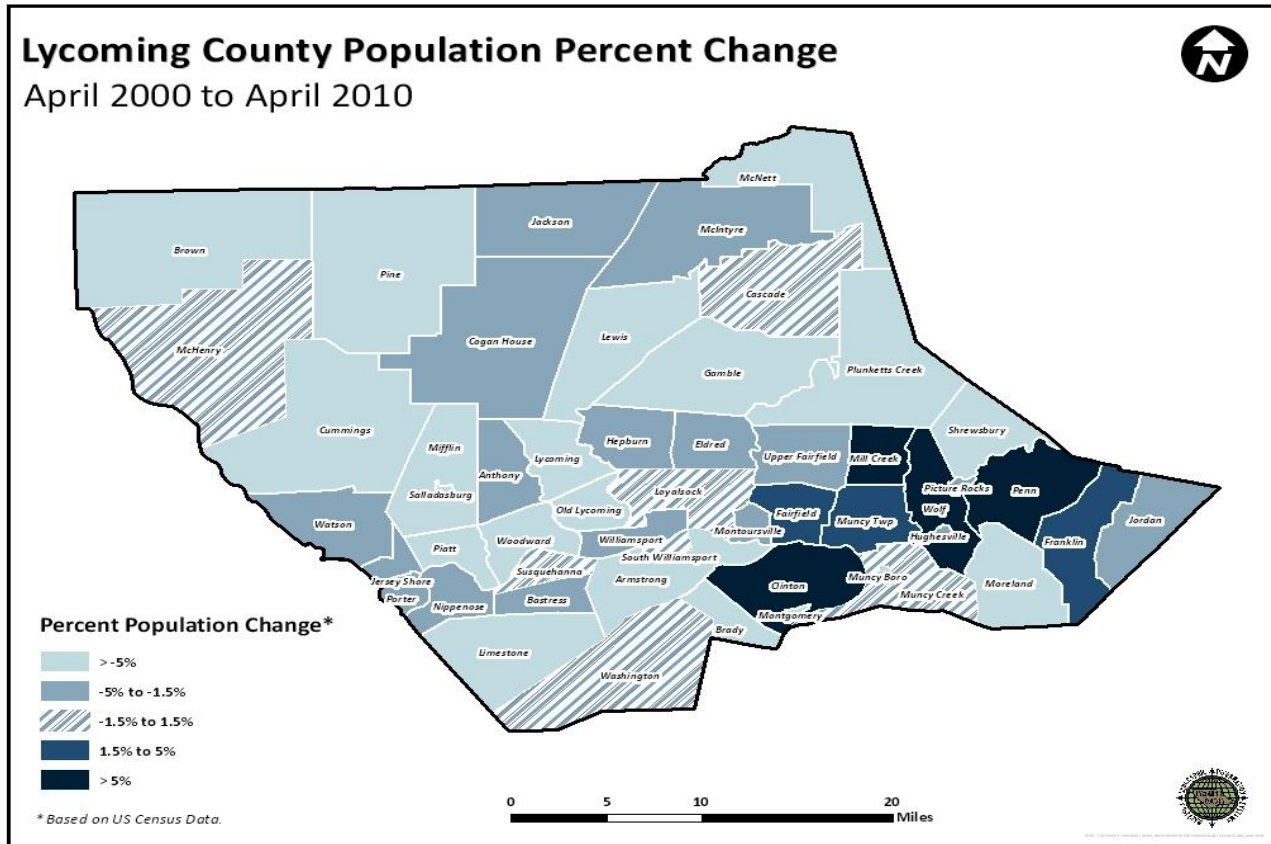
5.0: Economic Development within the County

Population and Workforce Growth

According to the 2010 Census, Lycoming County as a whole reported a decline in total population. While the County lost population, 10 of its municipalities have reported growth. The largest growth was reported in Wolf Township, followed closely by Loyalsock Township and Fairfield Township.



Figure 15: 2000-2010 Population Change

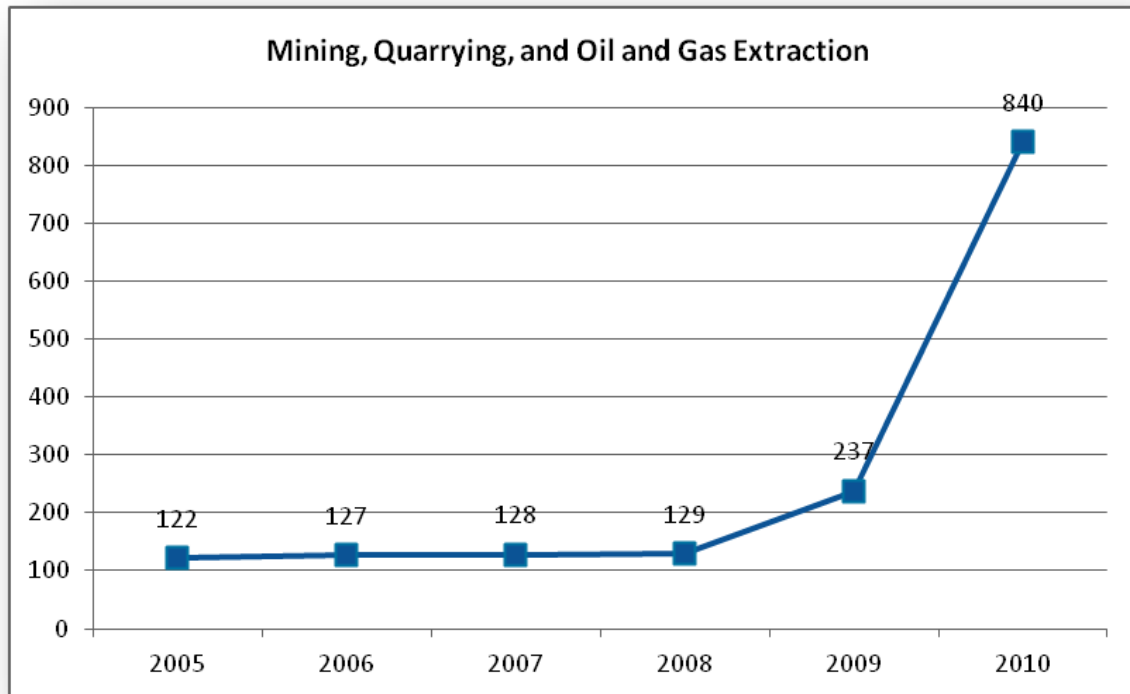


Source: Lycoming County Planning and Community Development, Lycoming County GIS, U.S. Census Bureau.

While the local population may not yet be reporting an increase, the natural gas industry has undoubtedly created an increase in employees that are traveling to the area to work. This is evident in the increase in employment numbers for Lycoming County. Figure 16 shows the profound impact on only one North American Industry Classification (NAIC) sector - natural gas extraction. From a broader perspective, the total impact of gas drilling on job creation we believe is in the range of 3,500 to 4,200 as defined more fully in the analyses found in Appendix 3.



Figure 16: Employment Trends in Lycoming County's Mining Sector

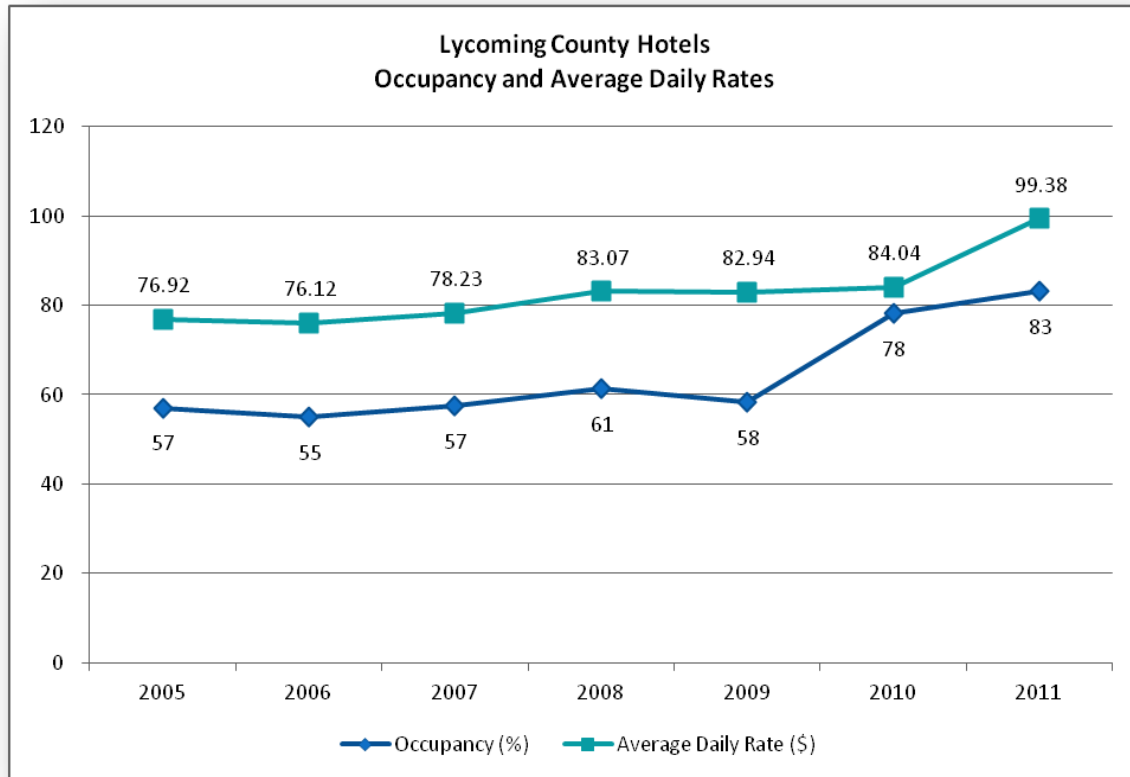


Source: Local Employment Dynamics, December 2011.

Many of these workers are currently looking for appropriate housing and are utilizing hotel rooms for their accommodations. The hotel occupancies have increased from approximately 57% in 2005 to 83% in 2011. These occupancy rates are associated with 12 existing hotels in Lycoming County. A listing of the hotels included in this assessment is provided in the attached Appendix 2.



Figure 17: Lycoming County Average Annual Hotel Occupancy and Rates



Source: Smith Travel Research (STR), December 2011.

This increase in hotel occupancies has spurred on additional hotel developments within the County. As of May 2012, the Lycoming County Planning Commission is aware of four hotel projects in the planning stages and one hotel that opened in November of 2011.

Hotels use between 100 and 200 gallons of water per occupied guestroom per day. The following table displays the new hotels that have recently opened, are under construction, or are proposed for development. Using an estimated average of 150 gpd per room, the chart illustrates the NEW water demand and an equivalent increase in sanitary sewage. These demands must be handled by (1) public water sources, (2) public wastewater treatment plants, and (3) conveyance lines for water and/or sanitary sewer. The addition of the defined hotel projects has the potential to increase water usage by over 20.6 million gallons annually.



Table 9: Recent and Proposed Hotels in Lycoming County and Potential Water Usage

Hotel Name	Location	Number of Rooms	Annual Available Rooms (Rooms x 365 x 75% Occupancy)	Potential Annual Water Usage (Assumes 200 gpd Usage)
Liberty Lodge ⁽¹⁾	Loyalsock	48	13,140	1,971,000
Marriot Residence Inn	Williamsport	81	22,173	3,325,950
Chartwell Hotel	Williamsport	55	15,056	2,258,400
Hilton Inn (Faxon)	Loyalsock	102	27,922	4,188,300
Hampton Inn (Faxon)	Loyalsock	91	24,911	3,736,650
Total		377	103,203⁽²⁾	14,700,150⁽²⁾

Source: Lycoming County Planning and Community Development and Delta Development Group, Inc., June 2012.

Notes: (1) This hotel opened in November 2011.

(2) Figures may not total due to rounding.



Photo 4:
New, 81-room hotel being constructed between West Third and Church Streets in downtown Williamsport— August 2012.

Along with its municipalities, Lycoming County has taken a proactive approach to responsible land development by defining designated growth areas for the purpose of expanding business opportunities and residential developments. While some authorities in the County have indicated that their current infrastructure is sufficient to support today’s needs and future expansion, others need significant help. The LCWSA, formed in 1989, is very active in infrastructure deployment due to the relatively young age of the authority and its proximity to the growth corridors. Gas industry growth in their service area and related commercial expansion is demanding steep infrastructure investments today. Also, active in water system development is the WMWA, which seeks to serve new customers through infrastructure expansion to the north and west. Each of the hotels listed in Table 9 is in the service area for the WMWA.

6.0: Water and Sewer Infrastructure Overview

6.1: The Players – The Major Public Entities

The following table provides the major public entities within Lycoming County who currently serve the growth areas within the County and those who are affected by changes in the natural gas drilling industry and associated development.

Water and Sewer	Water Only	Sewer Only
Lycoming County Water & Sewer Authority	Montoursville Borough Water Works	West Branch Regional Authority
Muncy Borough Municipal Authority*	Hughesville Borough Water	Tiadaghton Valley Municipal Authority
Montgomery Borough Water and Sewer Authority*	Jersey Shore Area Joint Water Authority	Williamsport Sanitary Authority
	Williamsport Municipal Water Authority	Hughesville-Wolf Authority

Source: *Lycoming County Planning and Community Development, April 2012.*

*The sanitary sewer assets of both of these authorities have been transferred/turned over to the West Branch Regional Authority.

6.2: The Challenge

Lycoming County underwent an initiative to develop an electronic database of all infrastructure projects within the County as a precursor to the release of the Act 13 funds. The purpose of that initiative was to



identify existing deficiencies and planned expansions in infrastructure within the growth areas of the County as well as newly planned expansions. This database includes details of each project, estimated budgets, congressional districts, potential funding sources, milestones, and other relevant material.

Information for the database was gathered from a variety of County stakeholders, including the County's Planning and Community Development Office, municipal governments, sewer authorities, water authorities, the Airport Authority, the Metropolitan Planning Organization, the SED-DOG Joint Rail Authority, and the Chamber of Commerce.

The County has developed an infrastructure assessment process to evaluate identified infrastructure projects. Projects were/will be profiled, evaluated and supported through resources and investments in the infrastructure system. This database also provided potential funding strategies to access and leverage public funding. Some of these projects provide either direct or indirect support to the Marcellus Shale gas development in our County. Yet many of these initiatives were initiated prior to the arrival of the gas industry and represent "pre-existing" issues. But, from a countywide viewpoint, this collection of projects helps ensure the integrity and sustainability of the infrastructure system needed by the gas industry as well as commercial and residential life around the County.

Aging public infrastructure that requires expensive system improvements, the expanding natural gas industry, and changes to the environmental regulations to meet the Chesapeake Bay Strategy as well as the wet-weather overflow issues driven by the Clean-Water Act are having a compounding demand for additional financial sources.

Overwhelming Funding Demands

Aging public infrastructure that requires expensive system expansions or improvements, the emerging natural gas industry, and changes to the environmental regulations to meet the Chesapeake Bay Strategy, as well as the wet weather overflow issues that emerge from the Clean Water Act are having a compounding demand for additional financial sources.

All seven of the County's major WWTPs are undergoing upgrades—the cumulative total cost of which is approximately \$200,000,000. Sanitary Sewer Collection System projects in four of the County's municipalities will cost over \$30,000,000. Expansion of public water systems in response to economic development forces or public safety issues demands another \$15,000,000 to \$20,000,000. These demands are occurring at a time when public funding from federal and state sources is limited and becoming increasingly difficult to obtain. Grants and low-interest loans are extremely competitive and difficult to secure.

The WSA's WWTP is significantly increasing its pretreatment program investigations and monitoring due to the large number of new gas industry support companies, such as drilling services subcontractors who are



moving into the area. Additionally, an increase in field services, laboratory services, and administrative and clerical work has been required to monitor and respond to the actual and potential wastewater impacts of the industry, including monitoring for gas industry pollutants of concern throughout the treatment plant process.

The LCWSA has already been borrowing and expending significant funds, far beyond the level that its current revenues can support, to fulfill its mission. The existence and continued development of water and sewer facilities within the Montoursville-Muncy Growth Corridor over the past few years, for example, has made it possible for companies to establish bases of operation and for developers to provide additional housing.

Demands on Skilled Workforce and Knowledge Workers

Wastewater authorities are also dealing with changes to their skilled workforce. In years past, employees of a water authority would remain at their jobs for many years, and the facility would experience minimal turnover. Now with changes to the Chesapeake Bay regulations, authorities need to employ technicians with current training. These younger, skilled employees are being attracted away from local authorities to large gas companies who provide higher salaries. The local authorities are essentially serving as a training opportunity for new graduates, which place a strain on current operations.

6.3: Overview of Selected Projects

Five of the major water and sewer projects being planned by various authorities or municipalities around Lycoming County are summarized below to acquaint the reader to the types of infrastructure projects being planned or currently undertaken. These are massive public infrastructure projects that support industrial, commercial and residential customers. The beneficiaries include the gas industry and/or non-gas related enterprises. The key point is that each of these five infrastructure projects requires a huge funding stream and a commitment to long term planning. Given the limited funding available at state and federal levels for water and sewer infrastructure, it is critical for authorities and municipalities to “strategically and concurrently develop their projects” to benefit BOTH the gas industry and the surrounding communities. It is fully recognized that planning for the three sanitary sewer projects was underway prior to the arrival of the gas industry and were initiated to resolve environmental mandates. The two water system expansion projects, however, have a much more tangible connection to the industry. The common theme for all five initiatives is that they all demand huge sums of capital thus reducing the ability of these authorities to quickly respond to new opportunities created by the Marcellus Shale companies.



Photo 5: LCWSA's Wastewater Treatment Plant Improvements

WMWA’s Williamsport North Water System Project

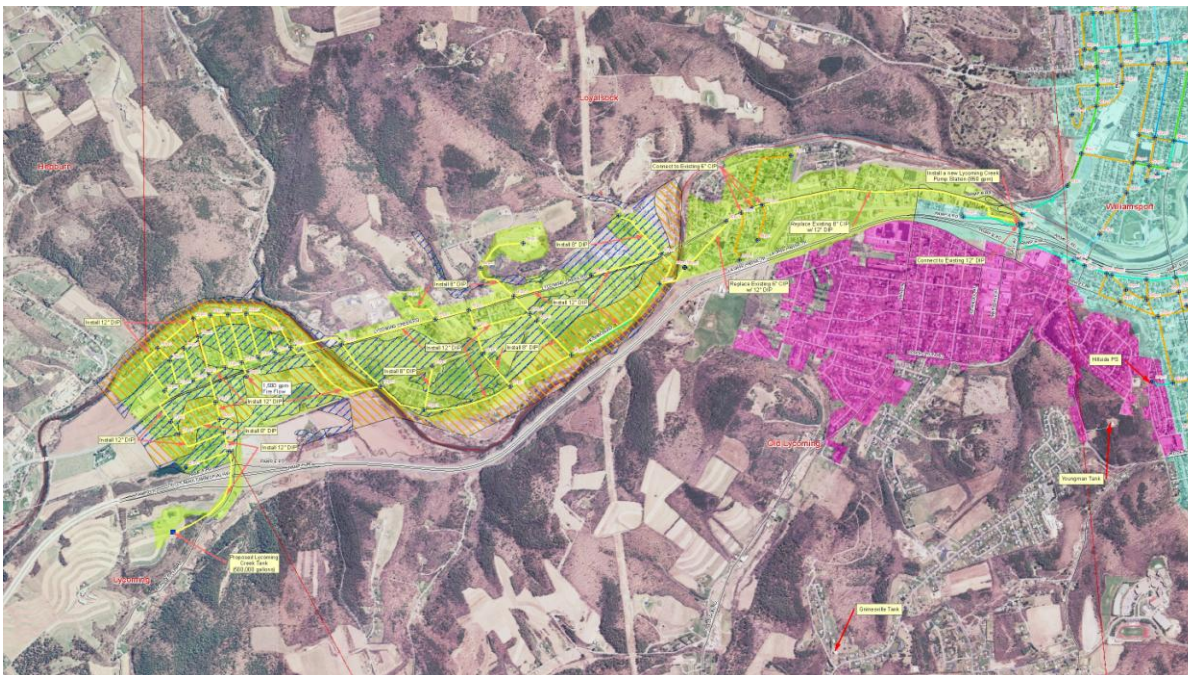
The **Williamsport North Water System Project** is the culmination of a three-phase water infrastructure system initiated over three years ago. The first two phases involved the design and construction of a 24- to 30-inch water main across the West Branch Susquehanna River proceeding north through the Newberry section of the City of Williamsport, at a cost of approximately \$6,000,000. About 75% of this cost was funded by the WMWA. The final phase involves the construction of nearly 11 miles of waterlines through three municipalities, a 500,000-gallon water storage tank, and a 1.2 mgd Water Booster Station.



When completed, the system will provide public water service connections to approximately 522 residential, commercial, and industrial properties currently on untreated private wells, including a major bakery and producer of Stroehmann bread products, as well as the Lycoming Valley Middle School. Water pressures to meet fire flow requirements in the industrial and commercial corridor are needed more today than ever before. Within the past 18 months, Loysock Township alone has witnessed the openings of four new businesses.

This proposed water infrastructure project will also facilitate future bulk water sales to the natural gas industry. The water infrastructure is coincidentally located at the foothills of the shale gas drilling fields and is ideally placed to enable WMWA to sell bulk water to the gas drillers from a location much closer to the drilling activity. The rough budgeted total project cost is approximately \$12,538,000.

Figure 18: Williamsport North Proposed Service Area



In 2011, the Susquehanna River Basin Commission approved the WMWA's historical documented water withdrawals from its existing sources, giving the WMWA the ability to provide more than two million gpd of uninterrupted water supply to the gas industry. Currently, the trucking logistics for supplying water are not optimal, relying on trucking from water withdrawal points within the Williamsport urban area. A much more acceptable solution would be to extend the WMWA water transmission and distribution system out to the vicinity of the Transco pipeline to which gas companies are building midstream gathering lines from their various well pad areas. Delivering water via pipeline would provide advantages to the greater Williamsport community such as getting truck traffic off of urban roadways and creating revenues that could be used for the WMWA system improvements and to extend water infrastructure into new growth areas. Advantages for the gas industry would be to reduce trucking costs and secure water withdrawals from a more plentiful, reliable source rather than streams from which withdrawals would be subject to curtailments during drier periods in order to protect in-stream uses.

LCWSA's Fairfield Road Business Corridor Water System Project



The LCWSA completed a comprehensive feasibility study in 2005 to identify water infrastructure needs in the growth corridor between the Montoursville and Muncy Boroughs. The main objective of that study was to provide a public water system to (1) achieve desperately needed public safety, and (2) support economic growth and development in this area.

The LCWSA's strategy is to design and construct the following:

- A "backbone water main" or pipeline infrastructure system throughout the corridor
- Four water storage tanks strategically located to serve the various and diverse topographic regions—two of them now exist
- Timely and adequate source water development to meet the growing needs of this area

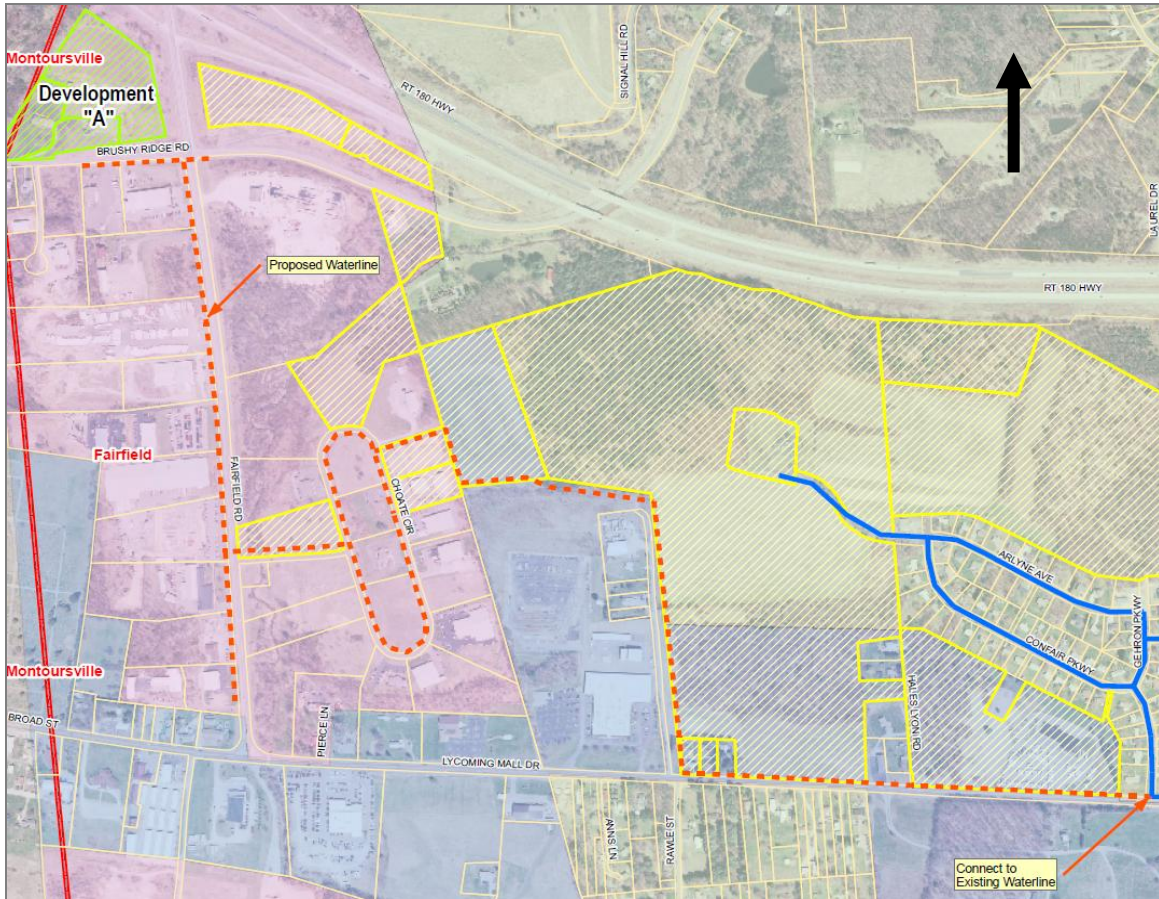
The Muncy to Montoursville growth corridor is geographically separated into four contiguous regions (or phases) with work progressing rapidly in each phase to support the pressing water needs of commercial, residential, and industrial customers. The LCWSA, in turn, is pursuing a three-pronged approach to acquiring additional water sources: well development, neighboring water system interconnections, and possible surface water withdrawals.

Within the next 6 to 12 months, the LCWSA is planning to install new lines or connect to existing water mains that will enable the authority to provide public water throughout all four geographic phases of this growth corridor—from the Fairfield Road interchange to Muncy Creek and Limebluff Road.

A significant element of the LCWSA Strategy is the Fairfield Road Business Corridor Water System Project, which will provide water service to the commercial and industrial properties located along Fairfield Road and Choate. The project proposes the construction of 12,500 linear feet of waterline, fire hydrants, and

associated appurtenances to provide water service to properties located along Lycoming Mall Drive, Choate Circle, and Fairfield Road in Fairfield Township, Lycoming County. There are currently 251 parcels within the project area along Fairfield Road, Choate Circle, and Lycoming Mall Drive that would be served by the extension of water infrastructure. This project will provide access to the growth corridor and encourage economic growth where it has been deemed appropriate. The project has an estimated cost of \$1,400,000.

Figure 19: The Fairfield Road Business Corridor Water System Project (LCWSA)



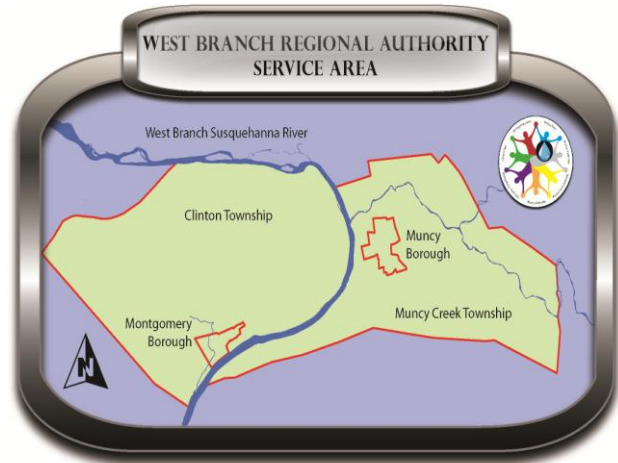
Source: Lycoming County Planning Department, 2012.

WBRA New Wastewater Treatment Plant & Sanitary Sewer System Project



The new West Branch Regional Authority’s (WBRA) new wastewater treatment plant will support the

Route 405 corridor businesses, including Halliburton Corporation which is closely associated with the gas industry. At an estimated cost of \$25,000,000, this multi-municipal project includes the elimination of the existing Muncy and Montgomery WWTPs and the construction of a new regional WWTP at a location within the WBRA region, as well as pumping and conveyance systems to redirect sewage flows to the new WWTP. The new WWTP will provide capacity for the existing population and will allow for future growth. By converting existing infrastructure and constructing a new 2.4 mgd WWTP, the new WBRA will serve a population of more than 11,800 people and will bring each municipality into compliance with the Chesapeake Bay Recovery. The primary activities associated with this project include the following:



- ☑ Construction of a new 2.4 mgd WWTP
- ☑ Conversion of the Muncy Water Street pump station and decommissioning of the Muncy WWTP
- ☑ Construction of a new Montgomery pump station and decommissioning of Montgomery’s old WWTP
- ☑ Installation of 30,000 feet of force main connecting pump stations to the new WWTP
- ☑ Consolidation of administration, maintenance, and operation services
- ☑ Dramatically increased efficiency for delivery of sewer services and in-house technical capability

TVMA New Wastewater Treatment Plant & Sanitary Sewer System Project

The Tiadaghton Valley Municipal Authority (TVMA) is constructing a new wastewater treatment plant near the western boundary of Lycoming County that will



support three municipalities in central Pennsylvania and numerous gas drilling companies in their service region. This \$21,800,000 regional sewer project will provide efficient and cost-effective sanitary treatment service for three rural municipalities in central Pennsylvania. Specifically, the TVMA will construct a 1.05 mgd WWTP located outside the 100-year floodplain to serve more than 6,800 people throughout 20.6 square miles of land in order to bring each of the three municipalities into compliance with the Chesapeake Bay requirements. The specific scope of activity includes the following:

- ☑ Construction of a new 1.05 mgd WWTP—sequential batch reactor technology
- ☑ Construction of a new collection system to serve the Village of Antes Fort
- ☑ Construction of new “elevated/flood proofed” pump station on the site of Jersey Shore’s old WWTP
- ☑ Increased efficiency for delivery of sewer services
- ☑ Consolidation of administration, maintenance, and operation services
- ☑ Installation of 5,000 feet of force main connecting pump station to new WWTP



WSA’s Central Wastewater Treatment Plant Project

Enhanced treatment at the authority-owned wastewater treatment plant is necessary in order to comply with mandated reductions in Nitrogen and Phosphorus discharged to the West Branch Susquehanna River and ultimately to the Chesapeake Bay. The \$100,000,000 **Central Wastewater Treatment Plant Project** — a 21 mgd peak flow facility — includes the following improvements:




- ☑ Construction of a new headworks facility
- ☑ Construction of four new secondary clarifiers, including related interconnection piping
- ☑ Conversion of the existing secondary clarifiers to bioreactors (with new submersible mixing and aeration systems)
- ☑ Construction of two new chlorine contact tanks (CCTs) and related piping
- ☑ Construction of a new plant effluent chamber/outfall and piping



- ☑ Conversion of existing chlorine contact tanks to a re-aeration tank with new aeration system
- ☑ Construction of improvements to the existing aeration basins to provide anoxic zones using baffles and submersible mixers
- ☑ Construction of a new return activated sludge (RAS) control chamber
- ☑ Construction of a sidestream treatment tank and associated piping and aeration systems
- ☑ Addition of a gravity belt thickener for sludge thickening and associated polymer system
- ☑ Construction of piping modifications between the solids handling process units and new/reconfigured wet stream processes

6.4: Additional Water, Sewer, and Stormwater Infrastructure Projects


In addition to the five projects described in section 6.3, there were over 80 other water, sewer, and storm water infrastructure projects identified during the County’s 2011 infrastructure assessment. **A few of them are related *directly* to the gas drilling industry, others are supportive of economic growth for other segments of our economy, while still others are specifically designed to address the needs of the surrounding community.** But, collectively, all of these projects are part of the infrastructure workload these authorities and municipalities must finance. The following chart profiles a number of these projects and the estimated cost implications. NOTE: This list of projects is expansive but should NOT be considered an all-inclusive list of every public water, sanitary sewer and stormwater initiative planned or underway around the County.

PROJECTS	DESCRIPTION	ESTIMATED COSTS
WATER AND SEWER INFRASTRUCTURE NEEDS ASSOCIATED WITH MARCELLUS SHALE		
Woodward and Piatt Township Regional Water System Project (WMWA)	The Woodward and Piatt Township Regional Water System Project is aimed to construct approximately 15 miles of water mains, a water storage tank, fire hydrants, and a pump station necessary to serve the project area with water provided by the WMWA. The area is strategically located along US Route 220 at the gateway to Route 287 through the gas fields.	 \$14,507,600

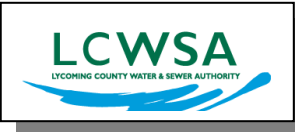


Maybe Hill Water Extension – A second phase to the Williamsport North Water System Project (WMWA)	Extend Water Service to the Maybe Hill section of Loyalsock Township. Currently this area is completely served by private wells.	\$1,500,000
West WWTP Upgrade Project (WSA)	Rehabilitation and upgrade of the WSA’s West WWTP.	\$20,700,000
Systemwide Infrastructure Upgrade Program (WMWA)	The WMWA has begun a multiyear program to address its aging infrastructure in an attempt to reduce the occurrence of main breaks, improve fire flows and water pressure, and reduce unaccounted-for water. Water mains are assessed and prioritized based on criteria, including dependability (failure rate history, size of service area, damage potential), asset assessment (taste and odor, poor flow rates), sizing inadequacies, and project participation (city paving, bridge replacements, etc). Approximately \$1,000,000 in infrastructure upgrades will be scheduled each year, and the WMWA will monitor progress against benchmarks, such as unaccounted-for water and main breaks. Annual expenditure amounts will be adjusted to achieve benchmark goals.	\$1,000,000 each year
Systemwide Inflow and Infiltration (I&I) Reduction Program (WSA)	The WSA plans to aggressively address inflow of stormwater and infiltration of groundwater into its sewer system through a comprehensive analysis that will use flow meters and field observations to prioritize rehabilitation/replacement projects. Structural condition, impact on I&I reduction, regulatory compliance, customer complaints, and capacity issues will all be taken into consideration, and benchmarks will be established to note progress and further define the level of work necessary. This is a multiyear program with anticipated capital expenditures initially approaching \$1,000,000 per year.	\$1,000,000 each year
Upgrade Aging Building and Equipment at Central Wastewater Treatment Plant (WSA)	A significant upgrade made necessary due to the age of the plant. Potential scope items include: replacement of digester covers, conversion of disinfection system from chlorine gas to liquid hypochlorite, and	\$6,000,000






	improvement in odor control (Phase 2).	
Upgrade Aging Building and Equipment at West Wastewater Treatment Plant (WSA)	 <p>WSA's significant upgrade made necessary due to the age of the plant. Potential scope items include: new headworks facility, new outfall to increase plant capacity, replacement of digester cover, security gates, and cameras (Phase 2).</p>	\$17,000,000
Tank and Main Improvements (WMWA)	To provide increased fire flow protection and expand service to newer developments in South Williamsport that have been built higher than the current system can accommodate, a new storage tank and upgraded mains will be necessary. An important consideration for this project is the close vicinity to the Little League baseball field and the benefits a new tank and main grid will have in providing appropriate pressures and fire protection.	\$4,500,000
Fairview/Hepburn Hill System Expansion (WMWA)	This project involves the restructuring of pressure zones in Loyalsock Township, construction of a new pump station, a new main installation, and upgrades to existing mains. Benefits include supplying Anadarko's needs on Fairview Road and maintaining adequate water pressure to existing customers, while providing a substantial increase in capacity for potential increases in water consumption, improving water pressure at the end of the Loyalsock pressure zone, and providing redundancy within the northern portion of the Loyalsock system to protect a community that includes a senior living facility and County facilities from water outages.	\$6,000,000
Telemetry System for Network Communication with all Facilities (WMWA and WSA)	The ability to securely send and receive data from both wastewater and water facilities to other locations is critical to optimizing manpower and achieving better organizational efficiency. This project would be a joint	\$1,400,000





	effort between the water and sanitary authorities, and would consist of a radio tower strategically placed in the line of site to 41 remote sites for the purposes of collecting data via radio frequency and transmitting to a central location.	
Timber Run Industrial Park (TRIP) Water and Sewer Infrastructure (Lycoming County)	Lycoming County owns a 300-plus acre industrially and commercially zoned property adjacent to the County landfill that needs permanent water and sewer infrastructure to facilitate phased development to support gas support companies.	\$3,500,000
Grey Fox Plaza Aboveground Water Storage Tank (LCWSA)	 <p>Installed a 200,000-gallon Water Storage Tank, associated piping, and redundant waterline infrastructure to address public safety/fire protection to the service area.</p>	\$2,400,000
Wastewater Treatment Plant Phase I Upgrade (LCWSA)	Compliance with the Chesapeake Bay/BNR, other compliance-related and sludge dewatering improvements.	\$9,500,000
400,000-gallon Water Storage Tank for MIP Phases II and III support (LCWSA)	Install an elevated 400,000-gallon Water Storage Tank and associated piping to enhance fire protection pressures to serve both industrial parks (MIP Phases II and III) as well as Muncy Borough and Muncy Creek Township.	\$2,500,000
Public Water Additional Source (LCWSA)	Ongoing project to explore location and construction of a larger well and treatment system along the Rt. 220 corridor.	\$500,000
Tules Run Area Sewer Improvements, North of Interstate 180 (LCWSA)	The Tules Run (172+ homes) area currently experiences a rate of 20% septic tank failure. The sewer infrastructure needs to be improved and expanded to address this need.	\$3,784,000
Administration Facilities Build-Out	The Administration Facilities Build-Out project is	\$4,000,000





<p>Project (LCWSA)</p>	<p>necessitated by the MRSS Wastewater Phase I Upgrades, which require the existing footprint of the MRSS facilities to be utilized for wastewater purposes. The project will allow the LCWSA the opportunity to create a professional work environment that offers greater efficiency in operations, inventory management, and additional space to offer services to its growing water and sewer partners.</p>	
<p>Sanitary Sewer Rehabilitation (South Williamsport Borough)</p>	 <p>Substantial upgrade of the borough’s sewer collection system to meet the requirements of the PA DEP consent order and agreement.</p>	<p>\$12,200,000</p>
<p>New Sewer WWTP and Collection System (Franklin Township)</p>	<p>The Village of Lairdsville in Franklin Township requires the construction of a new WWTP and collection system. This village is surrounded by gas drilling activity.</p>	<p>\$2,000,000</p>
<p>Lawshee Run Culvert and Flood Damage Reduction Project (Jersey Shore Borough)</p>	 <p>Rehabilitate northern portion of old, deteriorating stormwater culvert system to avoid catastrophic collapse of Allegheny Street in the borough.</p>	<p>\$2,000,000</p>
<p>Water Quality Monitoring – a Baseline Study⁽²⁾(County, WMWA/USGS)</p>	<p>A baseline water quality study to be conducted for the County to fully understand and monitor the effects of the drilling and development on the source water supplies that draw from the five major creeks within the County.</p>	<p>\$250,000</p>
<p>Pine Filter Plant – Filter Media and Controls (JSAJWA)</p>	 <p>The JSAJWA will replace the filter media in 2 to 350 gpm rapid sand filters, improve the backwash lagoon, and update controls and</p>	<p>\$750,000</p>



	pumps at the facility.	
Establish Pressure Zone Distribution 16" Main (JSAJWA)	Install a pressure-reducing station on the 16" transmission main in the Village of Larryville in Piatt Township.	\$75,000
Pine Creek Well Pump (JSAJWA)	The JSAJWA will replace the existing 1954 well pump and motor with variable frequency drive with remote control access.	\$100,000
Water Main 12" 10,000 Feet Replacement (JSAJWA)	Cleaning and lining 60,000' of 16" CI transmission main installed in 1902 from the Larry's Creek Plant to the Jersey Shore Borough.	\$5,000,000
Outer Loop Waterline Extension (Hughesville Borough)	 Complete water loop around Hughesville Borough.	TBD
Shaffer Path Road Extension Project (WBRA)	Sewer provisions at a commercial industrial park along Route 15.	\$4,000,000
Route 405 Water System Loop (Montgomery WSA)	Interconnect Halliburton's new water service line with a second waterline to create a loop in the MWSA system; new line will also benefit Moxie Energy.	TBD
Muncy Pump Station (WBRA)	 This project involves the elimination of the existing Muncy WWTP and conversion of that facility to a pumping station to redirect sewage flows to the WBRA's new 2.4 mgd WWTP. The primary activities include the following: <ul style="list-style-type: none"> • Construction of a new Muncy pump station and decommissioning of Muncy's old WWTP • Installation of 6,900 feet of force main connecting pump stations to a new WWTP 	\$1,400,000
Montgomery Pump Station (WBRA)	 This project involves the elimination of the existing Montgomery WWTP and	\$4,800,000



	<p>conversion of that facility to a pumping station to redirect sewage flows to WBRA’s new 2.4 mgd WWTP. The project includes the following:</p> <ul style="list-style-type: none"> • Construction of a new Montgomery pump station and decommissioning of its old WWTP – new pump station will be a totally flood proofed facility • Installation of 22,800 feet of force main connecting pump station to the new WWTP 	
<p>Jersey Shore Pump Station (TVMA)</p>	 <p>This project involves the elimination of the existing Jersey Shore WWTP and construction of a flood proofed, elevated pumping station on that site to redirect sewage flows to the TVMA’s new 1.05 mgd WWTP to be constructed in neighboring Nippenose Township. The primary activities associated with this project include the following:</p> <ul style="list-style-type: none"> • Construction of a new Jersey Shore pump station and decommissioning of Jersey Shore’s old WWTP – new pump station (with a maximum flow of four mgd) will be a totally flood proofed facility • Installation of 5,000 feet of force main connecting pump station to the new WWTP 	<p>\$2,300,000</p>
<p>Bull Run/McClures Run Sewer Pump Station Project (Loyalsock Township)</p>	 <p>Four projects: Bull Run PS, McClures PS, sewer overflow tank (3mg), interconnecting force main and SCADA – purpose is to help handle wet weather sewer flows and to eliminate sewer overflows into the waterways of the Commonwealth of Pennsylvania.</p>	<p>\$14,000,000</p>



Sewer Laterals Replacement and/or Lining (Loyalsock Township)	Sewer laterals to private property owners required by the PA DEP per the provisions of the Consent Order.	\$8,000,000
Sewer Rehab (Loyalsock Township)	Replacement of sewer mains, main interceptor, and sewer piping in response to the PA DEP consent order.	\$8,000,000
Specialized Emergency Response Vehicle and Equipment	Additional chemical truck traffic warrants the creation of a specialized emergency response vehicle. This truck would be equipped to respond to minor leaks or major spills. This truck would be equipped with truck spill containment booms, catch basin spill containment booms, sewer manhole spill containment booms, stream bank booms, etc., along with chemical identification capabilities. Additionally suitable for day or night operation. This rapid response unit would secure the chemical leak or spill until a cleanup contractor is dispatched and mobilized.	\$1,000,000

Notes: (1) This is the cost for stormwater elements only. Water and sanitary sewer improvements will also be necessary, but their cost is unknown at this time.

(2) The focus group held on January 20, 2012, resulted in a desire for a baseline study to document the water quality and yield. The County should actively engage in a water quality study to baseline the minerals and chemicals in their five major streams.

7.0: Potential Game Changers

There are a number of potential events that could occur in the Marcellus Shale gas industry or in Lycoming County that would impact water and sewer infrastructure, capacity, or operations. Local industry experts helped identify these potential issues and address mitigation strategies. Much of the following information was revealed during the January 20, 2012, focus group meeting. These are the key sensitivities that could affect the gas industry, their successful production of gas, and/or the supporting infrastructure that the local communities could provide.

GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
Legislation/Regulations			
Local Impact Fee Funding	State legislation enabling Marcellus Shale counties	Funding generated by the impact fee may assist	Strategic planning should be encouraged



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
	to require well operators to pay an impact fee to the state government to contribute toward mitigating natural gas drilling-related impacts at the state, county, and municipal levels	local authorities and municipalities in maintaining and improving their infrastructure and service delivery to both the public users and gas drillers.	at both a municipal and county level to ensure that the use of impact fee revenue will support infrastructure improvements and service delivery over the long term.
Change in Chesapeake Bay Tributary Strategy Regulations	Chesapeake Bay standards may become more stringent or restrictive due to national level pressure from the US EPA or the Chesapeake Bay Foundation, or both	To meet Chesapeake Bay standards, local governments and authorities may have to reduce the amount of wastewater pretreatment and/or treatment processes they can accept from drilling operators, or change other practices as yet unforeseen.	Local stakeholders should keep alert to any new changes to Chesapeake Bay regulations and how those changes may impact their operations related to the Marcellus Shale industry.
Environmental regulations governing “fracking”	As the environmental regulations governing the natural gas industry are updated, it is possible that the process of fracking will become more restricted to carry out, or banned altogether.	Such additional restrictions could require very costly changes in current fracking practices. This could dampen the gas industry’s growth.	Public water authorities should consider the possibility of a drop in the revenue they are now receiving from selling water to drilling operators. Strategic planning should ensure that this revenue is not over-allocated or relied upon for routine, recurring operations.
Deep well injection disposal of frack fluids is	Disposing of frack water by injecting it into deep	If the sites for deep well injection are not found,	Local pretreatment and treatment facilities



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
no longer permitted	wells is currently practiced in Ohio. Some Pennsylvania well operators haul their wastewater to Ohio to take advantage of this disposal option. This practice is allowed in Pennsylvania only if the right geology is found.	then we could expect an increased demand for pretreatment services at CWTs, which could lead to a large-scale expansion of the current use of recycled frack water.	should analyze their treatment methods and capacity of their infrastructure to handle a possible increase in demand for their services.
PA DEP permit review of hydrogeology and sensitive issues such as proximity to public water system wells and intakes near proposed gas well sites	Currently, neither hydrogeology nor orphaned wells in the radius of the fracking area are considered when PA DEP grants permits for drilling.	If hydrogeology is considered when locating well sites, there may be a more restricted area where wells can be safely drilled. This could reduce the risk of public water source contamination and undermining.	PA DEP could consider adding hydrogeology review and the requirement to identify and plug orphaned wells to the permitting process, ideally statewide.
Change in the SRBC pass-by conditions	A pass-by is a mandate that requires operators to cease water withdrawal when a water source reaches a prescribed critically low level. In Lycoming County, the SRBC determines which surface water withdrawals will have “pass-by conditions” and at what water level those conditions will take effect. A new proposal from the SRBC is considering a	An increase in the pass-by level would make smaller, EV streams, unavailable to water withdrawals because their water volume would fall below the pass-by threshold. This would cause drilling operators to rely solely on larger surface water sources and purchased water.	The construction by certain mid-stream companies of water infrastructure lines from West Branch Susquehanna River to the mountaintop water impoundments should help relieve the impact cited. The alternative is that water buffalos/trucks would have to travel greater distances to connect impoundment ponds



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
	relaxation of the current pass-by level.		with approved water withdrawal points. But, this could have a positive impact on the revenue flows to public water providers.
Regulations governing the use of treated municipal wastewater for fracking	Utilizing treated municipal wastewater for fracking is a relatively new concept in Pennsylvania; however, current regulations make this option far more costly and cumbersome than using surface or public water for fracking.	The volume of “new,” clean water for fracking may decrease if drilling operators are allowed and encouraged to utilize municipal wastewater instead. Revenue generated by the SRBC, water authorities, or municipal water providers from the sale of public water to drilling operators may decrease while revenue generated by sanitary sewer authorities from the sale of effluent would increase. The residual wastewater from fracking using municipal wastewater may require pretreatment facilities to alter their methods or equipment to produce the same water quality that is currently being discharged to municipal treatment authorities or recycled into additional	The use of municipal wastewater effluent in fracking is one way to reduce the volume of “clean” water allocated to drilling operations. Counties should encourage and participate with the PA DEP to determine how treated effluent can be safely utilized in fracking operations. Drilling operators could define what incentives would be most effective for both parties. The goal is to create a policy that incentivizes the use of this water for fracking operations. This would only be feasible if PA DEP incentivizes or encourages well operators to secure processed effluent and operators agree to do so.



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
		well fracking operations.	
Technology			
Fracking technology changes to no water methods	As the industry becomes more technology savvy, fracking may be done with less water or no water.	Surface water withdrawals and water purchases from public water facilities would decrease. Additional impacts will depend on what type of technology replaces hydrofracking.	Local agencies and drilling industry stakeholders should engage in frequent conversation to ensure that upcoming industry changes are shared with local policy makers. Local water authorities that receive revenue from drilling company water purchases should also carefully plan the utilization of these funds, considering that their longevity may be short term.
Artificial lift	To extract the most natural gas from a well as possible, drilling operators often use a variety of artificial lift techniques to either extract the gas directly, or remove water from the well that may be trapping the lighter weight gas below.	If natural gas prices remain low, drilling operators will likely attempt to retrieve as much gas as possible from their current wells rather than invest in rather expensive new well sites. To extract the most gas possible, operators could begin using artificial lift techniques to extract water from the wells, which will increase the	Pretreatment facilities should continually monitor their maximum capacity and coordinate with industry stakeholders to ensure that any increase in frack wastewater volume can be accommodated by the pretreatment facilities.



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
		amount of wastewater coming from drilling activities.	
Environmental			
Accidental contamination of major drinking water sources	An accident involving fracking fluids or an undetected break in well casing could contaminate a drinking water source.	The SRBC and/or PA DEP may be pressured to enact more strict industry regulations or enforce a temporary moratorium on drilling if an accident is significant.	The PA DEP should be diligent in researching BMPs related to drilling operations and amend and rigorously enforce regulations to best protect the public and environment.
Illegal pump or dumping into a sewer system	Lycoming County sewer authorities are not structured to receive drilling waste. If an operator desires to dispose of wastewater directly through a public sewer authority, the operator must obtain an agreement with the sewer authority to accept that waste and the authority would need to obtain a Part II permit, if they do not already have one.	The addition of frack water in a sewer system will change the composition of the resulting effluent. The authority may not be able to meet PA DEP quality standards or the authority may require special treatment techniques to bring that frack-contaminated water to the proper quality level. In general, this would result in contamination of the WWTP's biosolids, higher cost to dispose of its sludge, and the imposition of PA DEP fines for effluent violations.	The careful monitoring by sanitary sewer officials is required to ensure that their systems are not compromised. If a suspected compromise occurs, swift action must be taken to avoid contamination of the Commonwealth's rivers and streams.



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
Changes in Water Operations			
Increase in water demand	Continued economic development may result in an increased need for public water to serve local residents and businesses while concurrently meeting the needs of drilling operations.	If more public water is needed to support local growth, the excess water available for use by the drilling operators could decrease, thus resulting in a price increase for everyone or greater reliance on surface water or hauling of water from neighboring counties where public water is more readily available.	Lycoming County will remain abreast of new development(s) and their impact on water and sewer infrastructure and service capacity and will consider these needs when allocating local impact fee funds.
Deep Well – Aquifers/Water supply decreases	If public water supply relies on deep well aquifers and too much water is extracted from the aquifer, the life of the aquifer will be decreased.	A decreased aquifer life may necessitate a new well to be drilled for public water consumption, resulting in significant costs for the local water authority and possibly the rate payers in their service area.	Public water authorities that sell water to drilling operators should continually assess both the short- and long-term impacts of this water allocation on their groundwater sources.
Gas companies limit their water sources to stream withdrawals and holding ponds	Water used in the drilling process comes largely from surface water sources and public water authorities. Drillers may elect not to purchase water from authorities.	Revenue to authorities or municipalities generated by water sales to drilling companies could decrease or vanish.	Water authorities and municipalities that sell water to drilling operators should strategically allocate that revenue source to ensure that future expenses do not rely on drilling company revenue.



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
<p>New water distribution systems created via pipeline</p>	<p>Midstream companies that support drilling operators could invest in utilizing pipeline to transport water between the source and the well sites where possible.</p>	<p>With more efficient water distribution options, hauling water by truck will likely be reduced.</p>	<p>Lycoming County officials could explore if pipelines could be placed to also serve the long-term needs of County residents and businesses in addition to the gas industry. This could prove to be very beneficial to local public water suppliers.</p>
Global			
<p>Drought</p>	<p>During drought conditions, both surface water withdrawals and public water usage are carefully regulated or restricted.</p>	<p>In times of drought, drilling operators may be restricted from withdrawing water from surface water sources, public water authorities, and municipalities. Drilling operators will need to rely heavily on recycled frack water or sources from nearby public water authorities or municipalities that are not undergoing the same restrictions.</p>	<p>Encourage drillers to use a variety of water sources and frack water recycling techniques so that the lack of surface or public water does not greatly impact the drilling industry.</p>
<p>Price of natural gas increases</p>	<p>The price of natural gas in the commodity market continually fluctuates and impacts the business decisions of drilling operators.</p>	<p>Currently, the price of natural gas in the commodity market is fairly low. As the price of natural gas increases, drilling operators will have a larger profit</p>	<p>Engage in an open dialogue with drilling companies related to any significant changes in price to allow local agencies as much time as possible to prepare</p>



GAME CHANGER	DESCRIPTION	POTENTIAL IMPACT(S)	MITIGATION STRATEGIES
		margin and may engage in activities, such as creating water pipeline infrastructure, more extensive use of treated wastewater for fracking, or directly tapping groundwater sources.	for potential increased drilling activity.
New York ends moratorium on gas drilling	The State of New York contains multiple shale formations that could support the extraction of natural gas, including Marcellus Shale. However, at the moment, the state has placed a moratorium on natural gas extraction. New York could decide to end the moratorium.	Depending on the restrictions placed on drilling activities by New York government agencies compared to Pennsylvania, drilling in Lycoming County may decrease as drilling companies invest in New York projects that may be more cost effective.	Monitor the political atmosphere in New York and engage in an open dialogue with drilling companies related to any significant changes in New York’s moratorium on drilling.
Export of natural gas to other countries ramps up	At the moment, gas extracted from Marcellus Shale formations in Lycoming County is primarily utilized for domestic (US) purposes. If exportation of this gas to other countries increases, its demand and associated price may increase.	An increase in the value of natural gas may allow drilling companies to engage in more costly activities to produce the maximum amount of gas and may encourage additional well drilling and infrastructure investments.	Monitor natural gas activity and begin engaging drilling companies in discussions about their long-term plans in Lycoming County if exportation of natural gas rises.

8.0 Recommendations



- ☑ Closely monitor all potential game changers and be prepared to react accordingly
- ☑ Aggressively pursue Commonwealth funds made available through the state's H2O PA Program and other applicable funding programs, such as PENNVEST
- ☑ Aggressively pursue all federal funding sources, including the USDA, the US EPA, and the US EDA
- ☑ Secure a PUC agreement to allow Act 13 funds to be allocated or used to "reimburse" the incurred costs of water and/or sewer infrastructure projects that were initiated over the past three years in response to gas industry needs
- ☑ Request the SRBC streamline its application process to promote effective decision making on water infrastructure projects involving more than 100,000 gpd, while insuring adequate water resources for the residents of Lycoming County
- ☑ Complete the WWTP upgrades of WSA's Central and West Plant, the LCWSA's plant, and the HWA's facility
- ☑ Construct the new WWTPs for the WBRA and the TVMA
- ☑ Immediately initiate a baseline water quality monitoring program for the County's five major streams
- ☑ Expand water infrastructure by the WMWA to the Lycoming Creek corridor and by the LCWSA to the Muncy-Montoursville corridor
- ☑ Streamline the NPDES process by which the PA DEP approves the addition of the CWT facilities by a public WWTP
- ☑ Continually coordinate with private frack water treatment companies and industry professionals to remain abreast of the most accurate industry needs and standards and to ensure that industry demands can be managed between the services provided by both private treatment facilities and the public wastewater treatment infrastructure
- ☑ Coordinate water and sewer infrastructure projects and strategic planning efforts to leverage and support related Marcellus Shale impacts and available funding (e.g., senior housing developments through the Pennsylvania Housing Finance Agency [PHFA])
- ☑ Initiate coordinated planning with multiple gas companies for water system infrastructure improvements (such as pipelines) to deliver more effectively water to gas operations
- ☑ Be prepared to define, fund, design, and construct appropriate stormwater infrastructure projects to meet the nutrient reduction requirements of the Chesapeake Bay Strategy



- Continually encourage the gas industry to employ BMPs that help reduce the potential for undesirable impacts to the public water supplies



Appendix 1 – Summary of Interviewees and Focus Group Participants

The following people participated in individual interviews and/or focus groups:

Doug Keith, WMWA/WSA
Richard Miller, Montgomery Water and Sewer
Authority
Eric Moore, West Branch Regional Authority
Walter Nicholson, WMWA/WSA
Quay Schappell, TerraAqua Resource Management
Ron Smith, Montoursville Borough Water Works
Christine Weigle, Lycoming County Water &
Sewer Authority
Mary Wolf, Anadarko Petroleum Corporation
Mike Zeller, Jersey Shore Area Joint Water
Authority

Lycoming County Commissioners

Tony Mussare
Jeff Wheeland

Lycoming Planning & Community Development

Kurt Hausammann
Bill Kelly
Mark Maurawski
Cliff Kanz
Megan Lehman

Delta Development Group, Inc.

Darren Asper
Debbie Tollett
Alicia Titus
Kelly Rossiter
Ashley Miller



Appendix 2 - Existing Hotels in Lycoming County

Existing Hotels in Lycoming County Included in Occupancy Figures⁽¹⁾

Name	Municipality	Rooms	Date Opened
Fairfield Inn & Suites	Williamsport	83	Aug. 2005
The Genetti Hotel & Suites	Williamsport	202	June 1922
TownePlace Suites	Williamsport	81	July 2011
Hampton Inn	Williamsport	110	June 1998
Holiday Inn	Williamsport	102	June 1983
Holiday Inn Express & Suites	Williamsport	96	Sept. 2009
Williamsport Inn (formerly Quality Inn and/or Days Inn)	South Williamsport	117	June 1984
Candlewood Suites	Loyalsock	122	Oct. 2005
Best Western Williamsport Inn	Loyalsock	116	Aug. 1965
Comfort Inn & Suites	Loyalsock	58	April 2009
Econo Lodge	Loyalsock	100	Feb. 1988
Super 8	Loyalsock	43	June 1988

Source: Smith Travel Research (STR)

(1) STR Participants



Appendix 3 - A Comparative Analysis of the Employment Estimates

Approach #1

A recent study conducted by the Marcellus shale Education and Training Center (MSETC) estimates pre-production activities such as leasing, permitting, site preparation, drilling, hydraulic fracturing (fracking), pipelines, construction of compression stations, and support activities are estimated to require between 9.46 and 12.9 employees per well, depending upon operating efficiencies associated with the drilling of multiple wells at a single well pad. If we assume that the mid-point of this range (11.18) as the most likely employment scenario, this means that an estimated 3,533 employees were physically working in Lycoming County during 2011 either in the natural gas industry or its support activities.

Estimated Full-Time Employees (FTEs) Required to Support Drilling Activities in Lycoming County

Year	Number of Wells Drilled in Lycoming County	Estimated FTEs Required at 9.46 Employees/Well ⁽¹⁾	Estimated FTEs Required at 12.9 Employees/Well ⁽¹⁾	Assuming Mid-Point Range (11.18) as Most Likely Scenario
2007	5	47	65	56
2008	11	104	142	123
2009	23	218	297	257
2010	116	1,097	1,496	1,297
2011	316	2,989	4,076	3,533

⁽¹⁾ Source: Pennsylvania Marcellus Shale Workforce Needs Assessment, Marcellus Shale Education and Training Center (MSETC), Summer 2011; PA DEP (Permits and Drilling); and Lycoming County Planning and Community Development

Approach #2

We used the IMPLAN⁶ model to estimate the total number of employees required to support the increased business activity in NAICS sector 21 (Mining, Quarrying, and Oil and Gas Extraction). Within Lycoming County, between 2008 and 2011 this sector increased from 129 to 840 jobs or an increase of 711 positions. To put this in better context, we considered recent data reported by the Pennsylvania Department of Labor & Industry in their *Marcellus Shale Fast Facts*. Across all of the state's workforce investment areas, this

⁶ IMPLAN is a nationally recognized input/output model developed by Minnesota IMPLAN Group, Inc. (MIG) and is widely used by academic institutions, government agencies, and private sector economists to estimate the economic and fiscal impacts of changes in local economies.



NAICS sector rose from 7,308 to 19,865 reflecting an increase of 12,567 positions. This would suggest that Lycoming County was responsible for approximately 6% of this statewide increase.

Using the 711 positions identified in Lycoming County with the Mining, Quarrying, and Oil and Gas Extraction NAICS code, we modeled the “total” employment impact in two ways: (1) constrained by the businesses located in Lycoming County in 2010 that could provide the required workforce; and (2) with no geographic constraints on the availability of companies that could provide the required workforce. As shown below, the non-constrained IMPLAN model estimated there to be **3,741** direct and indirect employees.

Estimated “Ripple” Effect of Natural Gas Industry Employment

Impact Type	Required Employment – Constrained by Lycoming County Business Mix	Required Employment – Not Constrained	Estimated Employment from Outside Lycoming County
Direct Employment	711	711	-
Indirect Effect (Business-to-Business Activity)	113	3,030	2,917
Total	824	3,741	2,917

Approach #3

We examined the *Workforce Investment Area Marcellus Shale Related Industries Data* in the previously mentioned *Marcellus Shale Fast Facts* with a focus on the Central region, which includes nine counties, including Lycoming. The Fast Facts database defines two major categories for Marcellus Shale gas activity: core industries (6 sectors) and ancillary industries (30 sectors).

We also considered that the PA DEP’s Oil & Gas Management web site identifies that these nine counties hosted 616 spud wells as of December 2011. Per DEP, Lycoming County is the host for 75% of these wells. Bearing this in mind, we revisited the Fast Facts database.

Fast Facts reports approximately 2,304 core industry jobs as of December 2011 within the Central region. Assuming a direct relationship between the number of wells and the number of core jobs in a county, it would not be unreasonable to conclude that Lycoming County is credited with 1,728 of those jobs (75% x 2,304).

Next, we considered the 11,446 Central region jobs defined as “ancillary”. Although there are nine counties in the Central region, it would not be unreasonable to expect to find that at least 25% of these ancillary jobs are located in Lycoming County because of its proximity to the drilling operations. This suggests that about 2,861 jobs (25% x 11,446) could be found within Lycoming County boundaries. Taken together, the core



jobs and ancillary jobs associated with Lycoming County are estimated to be approximately **4,589** (1,728 + 2,861).

But perhaps the best indicator is to measure the increase in employment in both the core and ancillary industries in Lycoming County between the ramp-up for Marcellus exploration in 2008 and where the County stood at the end of 2011. From that perspective, the growth in these categories is a very strong indicator of Marcellus Shale induced job increases. That total is 2,188 (Core) + 1,986 (Ancillary) for a total of **4,174**.



Appendix 4 - List of Acronyms

- ABR.....Approval by Rule
- CWT.....centralized wastewater treatment
- gpd.....gallons per day
- gpm.....gallons per minute
- HWA.....Hughesville-Wolf Authority
- JSAJWA.....Jersey Shore Area Joint Water Authority
- LCWSA.....Lycoming County Water & Sewer Authority
- mgd.....million gallons per day
- MS4.....municipalities with separate storm sewer systems
- NPDES.....National Pollutant Discharge Elimination System
- POTW.....publicly owned treatment work
- PA DEP.....Pennsylvania Department of Environmental Protection
- PHFA.....Pennsylvania Housing Finance Agency
- SRBC.....Susquehanna River Basin Commission
- TVMA.....Tiadaghton Valley Municipal Authority
- US EPA.....United States Environmental Protection Agency
- USDA.....United States Department of Agriculture
- WBRA.....West Branch Regional Authority
- WMWA.....Williamsport Municipal Water Authority
- WSA.....Williamsport Sanitary Authority

