

**IMPACTS ON COMMUNITY CHARACTER OF HORIZONTAL DRILLING
AND HIGH VOLUME HYDRAULIC FRACTURING IN MARCELLUS
SHALE AND OTHER LOW-PERMEABILITY GAS RESERVOIRS**

Final Report

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PREFACE

This report is entitled Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in Marcellus Shale and Other Low-Permeability Gas Reservoirs and has been prepared for the New York State Energy Research & Development Authority (NYSERDA) under contract #11170. As outlined in the Statement of Work, “The objective of this work is to research, review, compile, and provide to NYSEDA a report that address issues identified in the final scope for the draft Supplemental Generic Environmental Impact Statement (dGEIS) for Natural Gas Production, which was developed by the New York State Department of Environmental Conservation (NYSDEC).”¹ NTC Consulting was retained to “complete a review and analysis of the cumulative impact and community character issues surrounding the use of horizontal drilling and high-volume hydraulic fracturing of tight formations, particularly of shale resources.”²

The update to this report serves to further explain the cumulative impact and community character issues surrounding the use of horizontal drilling and high-volume hydraulic fracturing of tight formations, particularly of shale resources. The updated text is differentiated by *italicized font* for clarity purposes and is intended to assist in addressing public comments related to such issues. The findings herein have not been altered as a result of the update and additional explanation provided.

¹ Statement of Work – Contract #11170

² Ibid

1 INTRODUCTION

The Department of Environmental Conservation is responsible for regulating the development and production of oil and gas resources in New York State. The Department has previously evaluated its oil and gas regulatory program through development of a Generic Environmental Impact Statement (GEIS) which was finalized in 1992 and sets parameters that are applicable statewide to the review of gas drilling under the State Environmental Quality Review Act (SEQRA). Natural gas exploration and production companies, and mineral rights owners, are interested in developing a potentially significant gas resource in the Marcellus Shale and other low-permeability reservoirs through the use of horizontal drilling and high volume hydraulic fracturing. This technique requires large volumes of water. The potential gas resource from the Marcellus Shale may approach 20 trillion cubic feet, which would be enough to fuel New York's demand for approximately 20 years. The revenue associated with development of this resource may exceed one billion dollars per year.

The Department has identified the action of gas development with horizontal drilling and high volume hydraulic fracturing as one which requires further review under SEQRA. The following documentation and discussion is to assist the Department's efforts to prepare a draft Supplemental GEIS (dSGEIS) in relation to "Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs." NTC was retained to review and assess the 1992 GEIS methodologies for evaluating and mitigating noise, visual, community character and cumulative impacts. In support of this effort, NTC conducted a literature review, visits to well sites under active drilling as well as producing sites, and received input from industry representatives. Working in conjunction with NYSDEC and NYSERDA, the 1992 GEIS was evaluated on its adequacy in addressing and mitigating the issues and impacts of horizontal drilling and high volume hydraulic fracturing along with the development of multi-well pads. For those impacts and issues not adequately addressed, additional mitigation measures will be recommended.

New York has a long history of natural gas production. The first gas well was drilled in 1821 in Fredonia, and the 40 billion cubic feet (bcf) of gas produced in 1938 remained the production peak until 2004 when 46.9 bcf were produced. More than 50 bcf have been produced every year since then.³ In 2007 there were reported to be 6,683 producing natural gas wells in New York, nearly one-half of which were in Chautauqua County.⁴ Most of these wells were drilled into shallow reservoirs utilizing "low impact" equipment and the majority of permits currently issued are for this type of development.

For certain deeper formations large scale commercially owned and operated equipment is required. These operations utilize larger, heavily built pads and normally operate on 24 hour per day schedule. The type of equipment, drilling technology, and pad design and construction techniques that will be used to develop the Marcellus shale and other low

³ Final Scope for dSGEIS (page 9)

⁴ Ibid

permeability gas reservoirs has been used in New York to develop plays such as the Trenton/Black River and Herkimer formations.

*Natural gas development involves several stages. The information to follow more fully describes the stages of natural gas development.*⁵

The stages of development of a natural gas play can be grouped into five general categories: Exploration/Early Development, Moderate Development, Large Scale Development, Post-Development Production, and Closure and Reclamation, although not every natural gas play progresses to the Large Scale Development stage. Each stage of development can result in differing socioeconomic and community character effects, depending on the characteristics of an area and its communities. It is important to note that these stages are not discrete. For example, initial production begins during development and wells may be closed and reclaimed as production continues elsewhere in a field.

Exploration is the process of locating and defining natural gas deposits. During exploration companies use a variety of techniques including seismology and exploratory drilling to locate, define and explore the economics of gas deposits. Operators may initially drill one or several wells in an area to help define the resource or to secure a lease, possibly returning to the well pad or elsewhere within the lease at a later date to drill multiple wells to fully develop the lease.

If exploration and early development activities do not identify economically productive natural gas resources, the Exploration and Early Development stage may be the only phase of development experienced in an area. Conversely, increases in gas prices or advances in technology may result in operators developing an area some time after initial exploration has occurred. Identification of commercially viable resources typically triggers efforts to plan and develop supporting infrastructure to gather, treat, and deliver gas from the field to markets.

Moderate Development is defined as a small number of rigs operating simultaneously in any one development area, with associated development of gathering systems and other support facilities. Moderate Development could include one operator employing several rigs or several operators developing leases in the same area.

Although some of the facilities associated with high volume hydraulic fracturing such as water withdrawal, drilling water impoundments, water reinjection wells and some gathering, compression, and transmission systems and other support facilities are developed during moderate levels of development, these facilities often do not achieve the highly consolidated and centralized nature that occurs during a Large Scale stage of development.

⁵ See Appendix B for additional information related to italicized text - “Socioeconomic Effects of Natural Gas Development” Sammons/Dutton, LLC & Blankenship Consulting LLC (August 2010), pages 8-10.

Moderate levels of development may occur for extended periods in some areas and for some areas may be the highest level of development that occurs, depending on gas prices, the extent and economic potential of the resource, the extent of leases held by individual operators in the area, and other factors.

Large Scale development involves multiple rigs operating in a local development area, with development occurring simultaneously in several development areas over a period of multiple years, and possibly decades. Prior to the release of the September 2009 sDGEIS, one industry official suggested that Marcellus shale development in New York could potentially reach 2,000 wells per year. Based on the current drilling experience in the Marcellus Shale, achieving that level of activity would imply as many as 100 to 125 drilling rigs deployed across the region, along with other supporting activity. In September 2010, the Independent Oil and Gas Association of New York (IOGA) provided information that indicated that while the rate of activity cannot be answered with certainty, the rate of new multi-well pad construction is estimated to be 1,108 during the year(s) of peak drilling activity⁶.

Large Scale Development would involve concurrent installation of drilling and completion support facilities, including those necessary to support high volume hydraulic fracturing, such as water withdrawal and storage facilities, centralized water/flowback storage facilities, and water treatment and transportation facilities. During this stage, access road construction, development of gas gathering systems, construction of offsite production facilities, construction of gas transmission facilities (pipelines) and other activities necessary to bring the gas resource into production are likely to occur on a more consolidated and centralized basis because of the overall vision for development and the potential for achieving economies of scale.

Large scale development typically occurs as a result of a well defined resource base, sustained high gas sales prices to support economic recovery, adequate pipeline capacity to transport gas to local and regional markets, and the absence of large, significantly lower cost natural gas production areas elsewhere in the region or nation.

The potential that large scale natural gas development will occur in the Marcellus Shale development area of New York is substantial. The geographic extent and productive potential of the resource, the proximity of the resource to markets and the development success in the Marcellus Shale in other states indicate that development could ramp up rapidly, once drilling begins.

As noted in the beginning of this section, natural gas production typically begins early in the development phase as wells are brought on line and gathering systems are connected to pipelines so that the gas can be transported to markets. Consequently production infrastructure is developed and production employment builds gradually as development proceeds. Typically the Post-Development Production phase extends many years beyond the completion of the development phase, with the volume of production declining over

⁶ NYSDEC SGEIS Information Requests Document Prepared for the Independent Oil & Gas Association of New York, September 16, 2010. (Page 13-15)

time. It is not uncommon for natural gas fields to be in production for decades, particularly if they are amenable to enhanced recovery techniques.

The Post-Development Production phase is also characterized by dramatic decreases in industrial activity and employment as compared to development, and, as interim reclamation occurs, a return of the well-pad to a landscape that maintains the surrounding landscape and the area's pre-development character.

Closure and reclamation often begins during the production phase as individual wells cease to be economically productive. However, gas prices and the economics of each field could result in wholesale closure of a field. Closure involves the decommissioning of wells and production facilities and the reclamation of well pads, production facilities and, if dictated by the leaseholder, reclamation of roads.

The 1992 GEIS has satisfactorily addressed the issues and impacts associated with this development. What has not been previously reviewed through the GEIS process is multi-well pads and high volume hydraulic fracturing. The adequacy of the 1992 GEIS in addressing impacts with regard to these issues will be discussed herein. Where it is found to be lacking additional mitigation measures will be recommended. Enhancements to the 1992 GEIS mitigation measures will also be provided where appropriate.



Well pad under development. Source: www.naturalgas.psu.edu

2 SUPERCEDURE

New York State’s Environmental Conservation Law Article 23, Title 3 (ECL §23-0303(2), known as the “Oil, Gas and Solution Mining Law”, delegates all authority to regulate the gas and oil industry to the New York State Department of Environmental Conservation (NYSDEC). Municipalities do retain jurisdiction over local roads and their rights under the Real Property Tax Law. Municipalities are precluded from requiring the gas industry to be subjected to local ordinances, laws, and planning and zoning board review (i.e. requests for a variance, rezoning, and site plan review). Additionally, municipalities cannot adopt local noise ordinances directed at the drilling industry, nor restrict the hours of operation of gas drilling.⁷



Active Well Drilling – Source: All Consulting

3 WELL DENSITY

The following is provided as reference as the different spacing options are discussed throughout the report.

The number of wells and well sites that may exist per square mile is dictated by reservoir geology and productivity, mineral rights distribution, and statutory well spacing requirements set forth in ECL Article 23, Title 5, as amended in 2008. The well spacing requirements are based on subsurface geologic and reservoir characteristics, have no relationship to the environmental reviews and do not authorize any specific type of drilling technology; regardless of the well spacing, each well undergoes an individual review in connection with the permit process. The statute provides three statewide spacing options for shale wells:

⁷ ECL §23-0303(2)

Vertical wells – Statewide spacing for vertical shale wells provides for one well per 40-acre spacing unit. This is the spacing requirement that has historically governed most gas well drilling in the State, and many square miles of Chautauqua, Seneca and Cayuga counties have been developed on this spacing. One well per 40 acres equates to 16 wells per square mile (i.e., 640 acres). The wells within any given area will not all be drilled at once, and previously drilled sites will be reclaimed as or before new locations are drilled. Infill wells, resulting in more than one well per 40 acres, may be drilled upon justification to the Department that they are necessary to efficiently recover gas reserves. Again, however, by the time an infill well is drilled, the sites of any previously drilled wells in the 40-acre spacing unit will have been partially reclaimed. As stated in the 1992 GEIS, production sites with one well per pad typically take up only 10 to 15% of the acreage used for drilling operations. Gas well development on 40-acre spacing, with the possibility of infill wells, was the prevalent gas well development method in New York prior to the GEIS (and remains so today) and is, therefore, part of the experience upon which the 1992 Findings were based.

Horizontal wells in single-well spacing units – Statewide spacing for horizontal wells where only one well will be drilled at the surface site provides for one well per 40 acres, plus the necessary and sufficient acreage to maintain a 330-foot setback between the wellbore in the target formation and the spacing unit boundary. This provision does not provide for infill wells, so the distance between wellbores in adjacent spacing units will always be at least 660 feet. Surface locations may be slightly closer together because of the need to begin turning the wellbore some distance above the target formation. However, it is likely that this scenario will result in fewer than 16 surface locations per square mile. This conclusion is based on the fact that the horizontal leg of each wellbore within the target formation is likely to be longer than 1,980 feet, which is the distance that would result in a 40-acre rectangular spacing unit. Therefore, spacing units are likely to be larger than 40 acres, and fewer than 16 will fit within a square mile. Although the wells are horizontal, well pads during both the drilling and production phases will be similar in size to those for vertical wells. Hence, horizontal shale drilling with one well per pad would not be expected to result in a well density greater than that contemplated when the GEIS and its Findings were finalized in 1992.

Horizontal wells with multiple wells drilled from common pads - The third statewide spacing option for shale wells provides, initially, for spacing units of up to 640 acres with all the horizontal wells in the unit drilled from a common well pad. While vertical infill wells may be drilled from separate surface locations, with justification, a far smaller proportion of vertical infill wells than 15 per 640-acre unit is expected. Therefore, fewer than 16 separate locations within a square mile area will be affected. Nevertheless, to accommodate multiple wells and wellheads, the initial well pad from which multiple horizontal wells will be drilled will be larger than is typical for single-well pads. With respect to overall land disturbance, however, the larger surface area of the well pad will be offset by the need for only a single access road and gathering system to service wells on the pad. The size of a multiple well pad will likely be substantially smaller than the cumulative number of acres that would be necessary to accommodate the same number of

single-well pads within the same area. This method also provides flexibility to avoid environmentally sensitive locations within the acreage to be developed.

4 NOISE IMPACTS

This is in response to the Noise Impacts section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009.

4.1 Overview

In NYS-DEC Policy DEP-00-1, noise is defined as any loud, discordant or disagreeable sound or sounds. More commonly, in an environmental context, noise is defined simply as unwanted sound⁸. The environmental effects of sound and human perceptions of sound can be described in terms of the following four characteristics:⁹

1. Sound Pressure Level (SPL may also be designated by the symbol L_p) or perceived loudness is expressed in decibels (dB) or A-weighted decibel scale dB(A) which is weighted towards those portions of the frequency spectrum, between 20 and 20,000 Hertz, to which the human ear is most sensitive. Both measure sound pressure in the atmosphere.
2. Frequency (perceived as pitch), the rate at which a sound source vibrates or makes the air vibrate.
3. Duration i.e., recurring fluctuation in sound pressure or tone at an interval; sharp or startling noise at recurring interval; the temporal nature (continuous vs. intermittent) of sound.
4. Pure tone which is comprised of a single frequency. Pure tones are relatively rare in nature and are very uncomfortable.

⁸ NYS-DEC Policy DEP-00-1 – Assessing and Mitigating Noise Impacts – Page 2 (10/06/00 – Last Revised 02/02/01)

⁹ NYS-DEC Policy DEP-00-1 – Assessing and Mitigating Noise Impacts – Page 7 (10/06/00 – Last Revised 02/02/01)



Electric Generators – Active Drilling Site: Source: NTC Consulting

While reviewing applications for natural gas wells with proposed locations close to potential receptors, NYSDEC require mitigation consistent with Program Policy DEP-00-1 entitled “Assessing and Mitigating Noise Impacts”. To aid staff in its review of a potential noise impact, the policy identifies three major categories of noise sources;

- 1) Fixed equipment or process operations;
- 2) Mobile equipment or process operations; and,
- 3) Transport movements of products, raw material or waste.

On Page 3 of its Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002), NYSDEC previously found that “Impacts associated with noise during drilling are directly related to the distance from a receptor.¹⁰ Drilling operations involve various sources of noise. The primary sources of noise were determined to be as follows:”¹¹

1. Air Compressors: Air compressors are typically powered by diesel engines, and generate the highest degree of noise over the course of drilling operations. Air compressors will be in operation virtually throughout the drilling of a well. However, the actual number of operating compressors will vary.
2. Tubular Preparation and Cleaning: Tubular preparation and cleaning is an operation that is conducted as drill pipe is placed into the wellbore. As

¹⁰Page 3, - Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002).

¹¹ Pages 4-5 - Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002).

tubulars are raised onto the drill floor, workers physically hammer the outside of the pipe to displace internal debris. This process, when conducted during the evening hours, seems to generate the most concern from adjacent landowners. While the decibel level is comparatively low, the acute nature of the noise is noticeable.

3. Elevator Operation: Elevators are used to move drill pipe and casing into and/or out of the wellbore. During drilling, elevators are used to add additional pipe to the drill string as the depth increases. Elevators are used on a constant basis when the drilling contractor is removing multiple sections of pipe from the well or placing drill pipe or casing into the wellbore. Elevator operation is not a constant activity and its duration is dependent on the depth of the well bore. The decibel level is low for elevator operation.
4. Drill Pipe Connections: As the depth of the well increases, the drilling contractor must connect additional pipe to the drill string. Most operators in the Appalachian Basins use a method known as “air-drilling.” As the drill bit penetrates the rock, the cuttings must be removed from the wellbore. Cuttings are removed by displacing pressurized air (from the air compressors discussed above) into the well bore. As the air is circulated back to the surface, it carries with it the rock cuttings. To connect additional pipe to the drill string, the operator will release the air pressure. It is the release of pressure that creates a noise impact.
5. Noise Generated by Support of Equipment and Vehicles: Similar to any construction operation, drill sites require the use of support equipment and vehicles. Specialized cement equipment and vehicles, water trucks and pumps, flatbed tractor trailers and delivery and employee vehicles are the most common forms of support machinery and vehicles. Noise generated from these sources are consistent with other road-based vehicles. Cementing equipment will generate additional noise during operations but this impact is typically short lived and is at levels below that of the compressors described above.

“It is important to note that noise associated with the above activities is temporary and end once drilling operations cease.”¹²

4.2 Discussion

The noise impacts associated with horizontal drilling and high volume hydraulic fracturing are, in general, similar to those addressed in the 1992 GEIS. Site preparation and access road building will have noise that is associated with a construction site including bulldozers, backhoes, and other types of construction equipment. The rigs and supporting equipment are somewhat larger than the commonly used equipment described in 1992 but with the exception of specialized downhole tools horizontal drilling is

¹² Page 4, - Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (February 13, 2002).

performed using the same equipment, technology and procedures as many wells that have been drilled in New York. The basic procedures described for hydraulic fracturing are also the same. Production phase well site equipment is very quiet with negligible impacts.

The largest difference with relation to noise impacts, however, is in the duration of drilling. A horizontal well takes 4 to 5 weeks of 24 hours per day drilling to complete. The 1992 GEIS anticipated that most wells drilled in New York with rotary rigs would be completed in less than one week though drilling could extend two weeks or longer.

High volume hydraulic fracturing is also of a larger scale than the water-gel fracs addressed in 1992. These were described as requiring 20,000 to 80,000 gallons of water pumped into the well at pressures of 2,000 to 3,500 psi. The procedure for a typical horizontal well requires 1 to 3 million or more gallons of water with a maximum casing pressure from 10,000 to 11,000 psi. This volume and pressure will result in more pump and fluid handling noise than anticipated in 1992. The proposed process requires 3 to 5 days to complete. There was no mention of the time required for hydraulic fracturing in 1992.

There will also be significantly more trucking and associated noise involved with high volume hydraulic fracturing than was addressed in the 1992 GEIS. In addition to the trucks required for the rig and its associated equipment, water may need to be trucked in for drilling and hydraulic fracturing, sand for proppant will need to be trucked to the site, flow back will need to be removed, and frac tanks may be brought on site if pits are not used. Estimates of truck trips per well are as follows¹³:

¹³ Independent Oil and Gas Association of New York response to DEC request for information (9/16/2010)

Traffic Estimate per Horizontal Well

Well Pad Activity	Early Well Pad Scenario (All water transport by truck)		Peak Well Pad Scenario (Pipelines may be used for some water transport)	
	Heavy Truck	Light Truck	Heavy Truck	Light Truck
Drill Pad Construction	45	90	45	90
Rig Mobilization	95	140	95	140
Drilling Fluids	45		45	
Non-Rig Drilling Equipment	45		45	
Drilling (rig crew etc.)	50	140	50	140
Completion Chemicals	20	326	20	326
Completion Equipment	5		5	
HF Equipment (Trucks & Tanks)	175		175	
HF Water Hauling	500		60	
HF Sand	23		23	
Produced Water Disposal	100		17	
Final Pad Prep	45		50	
Misc		85		85
TOTAL TRUCK TRIPS PER WELL	<i>1,148</i>	<i>831</i>	<i>625</i>	<i>795</i>

This level of trucking could lead to negative noise impacts for those living in close proximity to the well site and access road. Like other noise associated with drilling, this is temporary.

Multi-well pads have the same noise issues as single well pads but the duration is even longer. The times discussed above will be required for each well drilled on the pad. Typically one to three wells are drilled, stimulated and completed and the rig is taken down and moved to another location. If the well(s) are economically viable, the rig is brought back and the remaining planned wells are drilled, stimulated and completed. Current regulations require that all wells on a multi-well pad be drilled within three years of starting the first well. This will result in someone living in close proximity to the pad having potentially adverse noise impacts intermittently for up to three years. As industry gains confidence in the production of the play, there is the possibility that all wells on a pad would be drilled, stimulated and completed consecutively. This concept will shorten the time frame of noise generation and eliminate the noise generated by one rig disassembly/reassembly cycle.

The benefits of a multi-well pad are the reduced number of sites generating noise and, with the horizontal drilling technology, the flexibility to site the pad in the best location to mitigate the impacts. Current regulations allow for one single well pad per 40-acre spacing unit or one multi-well pad per 640-acre spacing unit. This provides the potential for one multi-well pad to drain the same area that could contain up to 16 single well pads. With proper pad location and design the adverse noise impacts can be significantly reduced. See appendix A.

Multi-well pads also have the potential to greatly reduce the amount of trucking and associated noise in an area. Rigs and equipment may only need to be delivered and removed one time for the drilling and stimulation of all of the wells on the pad. Reducing the number of truck trips required for frac water is also possible by reusing water for multiple frac jobs. In certain instances it also may be economically viable to transport water via pipeline to a multi-well pad.

4.3 Mitigation

4.3.1 Pad Siting

Noise is best mitigated by distance. The further from receptors the lower the impact. The second level of noise mitigation is direction. Directing noise generating equipment away from receptors greatly reduces associated impacts. Timing also plays a key role in mitigating noise impacts. Scheduling the more significant noise generating operations during daylight hours provides for tolerance that may not be achievable during the evening hours.¹⁴

As stated in 1992, many of the potential negative impacts of gas development hinge on the location chosen for the well and the techniques used in constructing the access road and well site. Before a drilling permit can be issued, DEC staff must ensure that the proposed location of the well and access road complies with the Department's spacing regulations and siting restrictions. To assist in this process DEC staff now has access to Policy Guidance Document DEP-00-1 entitled: "Assessing and Mitigating Noise Impacts". If the guidance provided in DEP-00-1 is applied consistently to well pad applications, it will be possible to avoid significant noise related impacts.

4.3.2 Access Road

With the extensive trucking and associated noise that is involved with water transportation for high volume hydraulic fracturing, attention should be given to the location of the access road. When appropriate, it should be located as far as practical from occupied structures and places of assembly. The purpose is to protect non-lease holders from noise impacts associated with trucking that conflict with their property use.

¹⁴ Notice of Determination of Non-Significance – API #31-015-22960-00-00, Permit 08828 (2/13/2002).

4.3.3 Multi-Well Pads

As discussed in the 1992 GEIS, moderate to significant noise impacts may be experienced within 1,000 feet of a well site during the drilling phase.¹⁵ With the extended duration of drilling and other activities involved with multi-well pads it is recommended that the pad not be located closer than 1,000 feet to occupied structures and places of assembly. When this threshold is infringed upon, DEC can add appropriate mitigating conditions to the permit if necessary.

4.4 **Conclusion**

Temporary, Short-Term Noise Impacts, as discussed in the 1992 GEIS will vary with the presence of topographic or vegetative barriers such as hills, trees and tall grass or shrubs. Drilling operations are the noisiest phase of development and usually continue 24 hours a day. Noise sources during the drilling phase include various drilling rig operations, pipe handling, compressors, and operations of trucks, backhoes, tractors and cement mixing. In most instances, the closest receptor is the residence of the property owner where the well is located and the owner has agreed to the disturbance by entering into a voluntary lease agreement with the well operator. Nevertheless, when necessary because of nearby receptors (regardless of lease status), noise impacts can be mitigated by a combination of site layout to take advantage of existing topography and special permit conditions.”¹⁶

The 1992 GEIS found that there were unavoidable negative noise impacts for those living in close proximity to a drill site. These were determined to be short term and could be mitigated with siting restrictions and setback requirements. Given that the noise issues have been found to be similar for horizontal drilling with high volume hydraulic fracturing these findings are consistent. The extended time period does make control of the noise impacts, while still temporary, essential. Since noise control is most effectively addressed at the siting and design phase it is important that the pad be properly located and planned and horizontal drilling provides the flexibility to accommodate this. New York State DEC guidance document ‘DEP-00-01 Assessing and Mitigating Noise Impacts’ along with a site plan and design guidelines document should be utilized for this purpose. See Appendix A. Additionally, the applicant should also be encouraged to review any applicable land use policy documents with the understanding that New York State Department of Environmental Conservation (NYSDEC) retains authority to regulate gas development.

¹⁵ 1992 GEIS (Page 8-11)

¹⁶ Final Scope for dGEIS (page 20)

4.5 Summary

1. Noise impacts are best mitigated through well site location and design.
2. Each well pad should be reviewed under the guidelines of DEP-00-1.
3. NYSDEC should develop and issue a “Best Practices Manual” to provide both DEC staff and industry representatives a single information source and to clarify what is expected of each applicant. See Appendix A
4. As subsequent applications are reviewed for additional wells on a multi-well pad, NYSDEC should reconfirm noise control methodologies based on actual experiences with earlier wells.
5. With the extensive trucking and associated noise that is involved with water transportation for high volume hydraulic fracturing, the access road should be located as far as practical from occupied structures and places of assembly.
6. With the extended duration of drilling and other activities involved with multi-well pads it is recommended the well pad be placed no closer than 1,000 feet to occupied structures and places of assembly. When an application is within this limit, appropriate mitigating conditions can be added to the permit if necessary.

4.6 Noise Impact Summary Table

Noise Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Pad Siting/Design	Yes	<ul style="list-style-type: none"> Utilize DEP-00-1 Assessing and Mitigation Noise Impacts Guidance Document. Utilize best practices guidelines and standards. 	None required
Multi-Well Pad	No		Noise issues of multi-well pads are the same as for single well pads and will be mitigated in the siting and design phase. Review previous well drilling activity on pad for subsequent wells. Locate well pad no closer than 1,000 feet to occupied structures and places of assembly.
Horizontal Drilling	No		Noise issues are the same as for vertical drilling discussed in 1992 and will be mitigated in the siting and design phase.
High Volume Hydraulic Fracturing	No		Noise issues of the pad will be mitigated in the siting and design phase.
Trucking	Yes		Access road and staging area siting and design to minimize negative noise impacts.
Production	Yes		None required

5 VISUAL IMPACTS

This is in response to the Visual Impacts section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009.

5.1 Overview

Aesthetic impact occurs when there is a detrimental effect on the perceived beauty of a place or structure. Significant aesthetic impacts are those that may cause a diminishment of the public enjoyment and appreciation of an inventoried resource, or one that impairs the character or quality of such a place.¹⁷

5.2 Discussion

The visual impacts associated with horizontal drilling and high volume hydraulic fracturing are, in general, similar to those addressed in the 1992 GEIS. They include drill site and access road clearing and grading, drill rig and equipment during the drilling phase, and production equipment if the well is viable. The 1992 GEIS stated that drill rigs vary in height from 30 feet for a small cable tool rig to 100 feet or greater for a large rotary, though the larger 100 foot rotary rigs are not commonly used in New York. By comparison, the rigs used for horizontal drilling will be 140 feet or greater and will have more supporting equipment. Additionally, the site clearing for the pad has increased from approximately 2 acres to approximately 5 acres. The important difference, however, is in the duration of drilling and hydraulic fracturing. A horizontal well takes 4 to 5 weeks of 24 hours per day drilling to complete with an additional 3 to 5 days for the hydraulic fracture. This compares to the approximately 1 to 2 weeks or longer drill time as discussed in 1992. There was no mention of the time required for hydraulic fracturing in 1992.

Multi-well pads will be slightly larger but the equipment used is often the same resulting in similar visual issues as those associated with a single well pad. Based on industry response, a taller rig with a larger footprint and substructure, 170' total height, may be used for drilling consecutive wells on a pad. In other instances, smaller rigs may be used to drill the initial hole and conductor casing to just above the kick-off point. The larger rig would then be used for the final horizontal portion of the hole. Typically one or two wells are drilled then the rig is removed. If the well(s) are viable, the rig is brought back and the remaining wells are drilled and stimulated. As industry gains confidence in the production of the play, there is the possibility that all wells on a pad would be drilled, stimulated and completed consecutively reducing the time frame of the visual impact. The regulations require that all wells on a multi-well pad be drilled within three years of starting the first well.

¹⁷ NYS-DEC Policy DEP-00-2 – Assessing and Mitigating Visual Impacts (7/31/00)

The benefit of the multi-well pad is that it decreases the number of pads on the landscape. Current regulations allow for one single well pad, either horizontal or vertical, per 40-acre spacing unit or one multi-well pad per 640-acre spacing unit. This will reduce the number of long term visual impacts that result from reclaimed pads and production equipment and reduce the overall amount of land disturbance. The drilling technology also provides flexibility in pad location allowing visual impacts, both long and short term, to be minimized as much as possible.

Long term visual impacts of a pad after the drilling phase are determined by whether the well is a producer or a dry hole. In either case, reclamation work must begin with closure of any pit within 45 days of cessation of drilling and stimulation. If the well is a dry hole, the entire site will be reclaimed with very little permanent visual impact unless the site was heavily forested. In this case it will take some time for trees to regrow. All that will remain at a producing gas well site is an assembly of wellhead valves and auxiliary equipment such as meters, a dehydrator, a gas-water separator, a brine tank and a small fire-suppression tank. Multi-well pads may have somewhat larger equipment to handle the increased production. The remainder of a producing well site will be reclaimed with current well pads leaving as much as 3 acres for production equipment compared to less than 1 acre as discussed in 1992.



Well Pad Under Preparation (PA) – Source: www.naturalgas.psu.edu

5.3 Areas of Statewide Importance

The 1992 GEIS addressed the visual impacts of gas drilling activities to visual resources of statewide significance on a case-by-case basis during the permit review process. When a proposed activity might have a negative visual impact, appropriate mitigating conditions are added to the permit.

In its guidance document, DEP-00-2 “Assessing and Mitigating Visual Impacts”, provides an inventory of aesthetic resources. It is important to note that the Department continuously updates the guidance document adding significant scenic and aesthetic resources that have not yet been designated in New York State; therefore the document should be referenced for each application. Currently, these resources can be derived from one or more of the following categories:

1. A property on or eligible for inclusion in the National or State Register of Historic Places [16 U.S.C. §470a et seq., Parks, Recreation and Historic Preservation Law Section 14.07].
2. State Parks [Parks, Recreation and Historic Preservation Law Section 14.07].
3. Urban Cultural Parks [Parks, Recreation and Historic Preservation Law Section 35.15];
4. The State Forest Preserve [NYS Constitution Article XIV]
5. National Wildlife Refuges [16 U.S.C. 668dd], State Game Refuges and State Wildlife Management Areas [ECL 11-2105]
6. National Natural Landmarks [36 CFR Part 62]
7. The National Park System, Recreation Areas, Seashores, Forests [16 U.S.C. 1c]
8. Rivers designated as National or State Wild, Scenic or Recreational [16 U.S.C. Chapter 28, ECL 15-2701 et seq.]
9. A site, area, lake, reservoir or highway designated or eligible for designation as scenic [ECL Article 49 or DOT equivalent and APA. Designated State Highway Roadside (Article 49 Scenic Road).
10. Scenic Areas of Statewide Significance [of Article 42 of Executive Law]
11. A State or federally designated trail, or one proposed for designation [16 U.S.C. Chapter 27 or equivalent]
12. Adirondack Park Scenic Vistas; [Adirondack Park Land Use and Development Map]
13. State Nature and Historic Preserve Areas; [Section 4 of Article XIV of State Constitution.
14. Palisades Park; [Palisades Park Commission]
15. Bond Act Properties purchased under Exceptional Scenic Beauty or Open Space category.

Many resources of the above type are found within the Marcellus and other shale regions. The applicant will consult the Inventory of Aesthetic Resources in DEP-00-2 and will identify any resources that could be impacted by their project. When a resource is identified, DEC staff will consult guidance document DEP-00-2 and add appropriate mitigating conditions to the permit on a case-by-case basis.

5.4 Mitigation

5.4.1 Pad Siting:

As stated in 1992, many of the potential negative impacts of gas development hinge on the location chosen for the well and the techniques used in constructing the access

road and well site. Before a drilling permit can be issued, DEC staff must ensure that the proposed location of the well and access road complies with the Department's spacing regulations and siting restrictions. To assist in this process DEC staff now has access to Policy Guidance Document DEP-00-2 entitled: "Assessing and Mitigating Visual Impacts". Applying the regulations and siting restrictions along with the guidance provided in DEP-00-2 as appropriate to well pad applications, it will be possible to avoid significant aesthetic impacts. See Appendix A.

5.4.2 Reclamation:

Current well pads, including those for horizontal drilling with or without multiple wells, are more substantially constructed than was addressed in 1992. A significant amount of crushed stone is brought in and compacted to stabilize the pad and access road to accommodate the equipment and truck traffic. As a result, it would be beneficial in reducing long term visual impacts if the 1992 GEIS topsoil conservation and redistribution practices required upon final plugging and abandonment in agricultural districts were required for all well pads. The specific procedures are:

1. Strip-off and set aside topsoil during construction
2. Protect stockpiled topsoil from erosion and contamination
3. Cut well casing to a safe buffer depth of 4 feet below the surface
4. Paraplow the area before topsoil redistribution if compaction has occurred
5. Redistribute topsoil over disturbed area during site reclamation

The United States Bureau of Land Management's *Surface Operating Standards and Guidelines for Oil and Gas Exploration and Development* has additional reclamation procedures that would be beneficial to mitigate visual impacts. They include:

1. Re-Vegetation – Disturbed areas should be revegetated after the site has been satisfactorily prepared; site preparation should include re-spreading topsoil to an adequate depth. Native perennial species or other plant materials specified by the surface management agency or private surface owner.
2. Pipeline Reclamation – Reclamation of pipelines includes re-contouring to the original contour, seeding, and controlling for noxious weeds.
3. Well Site Reclamation – to achieve final reclamation of an abandoned well site, the area should be re-contoured to blend into the contour of the surrounding landform, stockpiled topsoil evenly redistributed, and the site re-vegetated.
4. Road Reclamation – Reclamation of roads includes re-contouring the road to the original contour, seeding, and controlling for noxious weeds.

5.5 Conclusion

The 1992 GEIS conclusion was that visual impacts from gas drilling and completion activities are primarily minor and short-term, and would vary with topography, vegetation, and distance to viewer. It also found that temporary disruptions of scenic vistas and long term changes in the landscape and the installation of production facilities

if the well is economically viable will occur. Given that the visual issues are similar for horizontal drilling with high volume hydraulic fracturing these findings are consistent. The most significant disruptions will be of a longer duration, particularly for multi-well pads but they are still short term. The positive benefit of multi-well pads, as discussed previously, is that there will be fewer of them.

Since visual impacts are most effectively addressed at the siting and design phase it is important that the pad be properly located and planned. Horizontal drilling provides the flexibility to locate the pad in the best possible location and the utilization of multi-well pads will reduce the number of visual impacts in an area. New York State DEC guidance document 'DEP-00-02 Assessing and Mitigating Visual Impacts' along with a site plan and design guidelines document should be utilized for this purpose. See Appendix A. Additionally, the applicant should also be encouraged to review any applicable land use policy documents with the understanding that New York State Department of Environmental Conservation (NYSDEC) retains authority to regulate gas development.

5.6 Summary

1. Visual impacts are best mitigated through well site location and design.
2. When aesthetic resources are identified by the applicant as being potentially impacted, DEC will consult guidance in DEP-00-2 and add necessary mitigating conditions to the permit.
3. NYSDEC should prepare a "Best Practices Manual" to provide Staff and industry access to information relative to what is expected in terms of well siting and aesthetic mitigation, and to identify instances when aesthetic mitigation would be necessary. See Appendix A
4. To aid NYSDEC in its review of these applications, DEC should encourage municipalities to identify and/or map areas of high visual sensitivity and could require additional aesthetic mitigations in these areas.
5. As subsequent applications are reviewed for additional wells on a multi-well pad, NYSDEC should reconfirm visual control methodologies based on actual experiences with earlier wells.
6. Improved reclamation procedures should be used for all well sites.

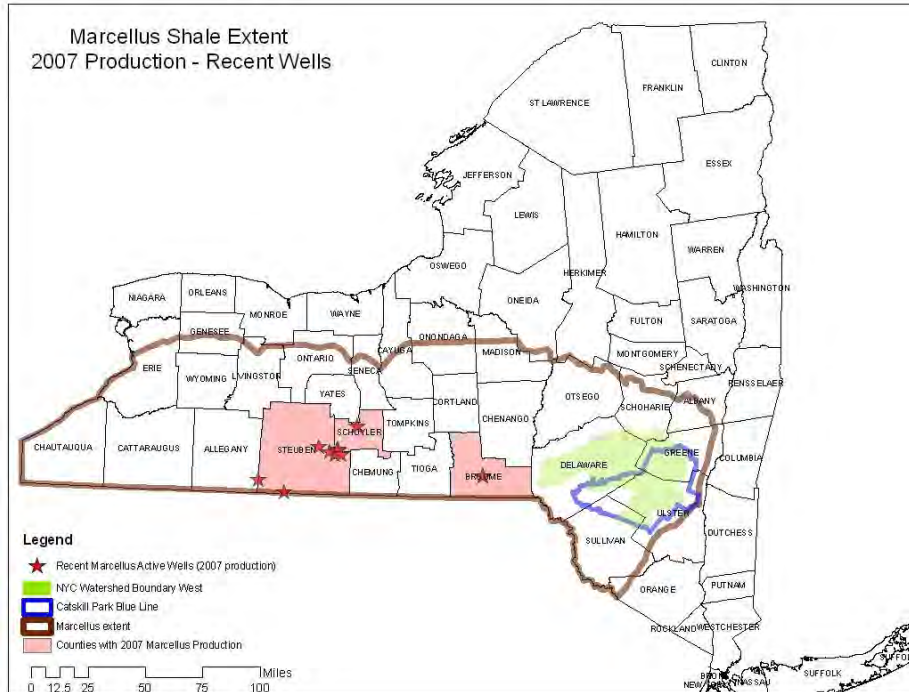
5.7 Visual Impact Summary Table

Visual Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Pad Siting/Design	Yes	<ul style="list-style-type: none"> Utilize DEP-00-2 Assessing and Mitigation Visual Impacts Guidance Document. Utilize best practices guidelines and standards. 	None required
Multi-Well Pad	No		Visual issues of multi-well pads are the same as for single well pads and will be mitigated in the siting and design phase. Review previous well drilling activity on pad for subsequent wells
Horizontal Drilling	No		Visual issues are the same as for vertical drilling discussed in 1992 and will be mitigated in the siting and design phase.
High Volume Hydraulic Fracturing	No		Visual issues of the pad will be mitigated in the siting and design phase.
Production	Yes		Visual issues of the larger production areas will be mitigated in the siting and design phase.
Site Reclamation	Yes		Reclamation procedures for agricultural districts and those from BLM should be required for all well pads.

6 COMMUNITY CHARACTER IMPACTS

This is in response to the Community Character section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009.

6.1 Overview



Location of Marcellus Shale – Source: NYSDEC

The Marcellus Play covers approximately 18,000 square miles of New York State. Many locations have previously experienced gas development while in others it will be a new experience. In general, the areas that have not had gas development are similar to those that have. They range from cities and villages to remote forested areas with small towns, farm lands, and many lakes and streams in between. Extensive gas development has occurred in New York in areas that have significant agriculture and tourism industries.

6.2 Discussion

Many of the community character impacts associated with horizontal drilling and high volume hydraulic fracturing are the same as those addressed in the 1992 GEIS and no further mitigation measures are required. These include:

1. Possible injury to humans or the environment if site access is not properly restricted to prevent accidents or vandalism
2. Temporal noise or visual impacts

3. Temporary land use conflicts are identified in the discussion of unavoidable impacts
4. Potential positive impacts from gas development identified including the availability of clean burning natural gas, generation of State and local taxes, revenues to landowners, and the multiplier effects of private investment in the State
5. Increased human activity and access to remote areas provided by the access roads as secondary impacts, with the former more intense during the drilling phase

Community Character issues related to horizontal drilling and high volume hydraulic fracturing needing further discussion include:

6.2.1 Trucking:

Increased road use was also discussed in 1992 as a factor that may affect community character. While the trucking for site preparation, rig, equipment, materials and supplies is similar for horizontal drilling to what was anticipated in 1992, the water requirement of high volume hydraulic fracturing could lead to significantly more truck traffic than was discussed. It is estimated that each horizontal well will need between 1 to 3 million gallons or more of water for stimulation. Estimates of truck trips per well are as follows¹⁸:

¹⁸ Independent Oil and Gas Association of New York response to DEC request for information (9/16/2010)

Traffic Estimate per Horizontal Well

Well Pad Activity	Early Well Pad Scenario (All water transport by truck)		Peak Well Pad Scenario (Pipelines may be used for some water transport)	
	Heavy Truck	Light Truck	Heavy Truck	Light Truck
Drill Pad Construction	45	90	45	90
Rig Mobilization	95	140	95	140
Drilling Fluids	45		45	
Non-Rig Drilling Equipment	45		45	
Drilling (rig crew etc.)	50	140	50	140
Completion Chemicals	20	326	20	326
Completion Equipment	5		5	
HF Equipment (Trucks & Tanks)	175		175	
HF Water Hauling	500		60	
HF Sand	23		23	
Produced Water Disposal	100		17	
Final Pad Prep	45		50	
Misc		85		85
TOTAL TRUCK TRIPS PER WELL PAD	<i>1,148</i>	<i>831</i>	<i>625</i>	<i>795</i>

As can be seen, trucking for hydraulic fracture equipment, water, sand and flow back removal is almost 70% of the total heavy truck trips. This trucking will take place in weeks-long periods before and after the hydraulic fracture.

Multi-well pads have the potential to reduce some of the total trucking in an area. Consecutively drilling and stimulating multiple wells from one pad will eliminate the trucking of equipment for single well pad to single well pad. Reduced water trucking is also a possibility. There is the potential to reuse flow back water for other fracturing operations. The centralized location of water impoundments may also make it economically viable for water to be brought by pipeline or means other than trucking.

As discussed in 1992 regarding conventional vertical wells, trucking during the long term production life of a horizontally drilled single or multi-well pad will be insignificant.

6.2.2 Land Use Patterns:

The spacing unit density for single well pads with horizontal drilling is the same as discussed and anticipated in 1992. This density has been experienced in New York in Chautauqua and Seneca Counties without significant changes in land use patterns. The new drilling technology should not be expected to change the 1992 GEIS findings.

As mentioned previously, there is the option, not discussed in 1992, to use multi-well pads with a 640 acre spacing unit. This option has the potential to be less of an impact on community character by significantly reducing the total area required for roadways, pipelines, and well pads. While the pad will be larger and the activity at the location will be longer than for single well pads, the fewer total sites will reduce the cumulative changes to the host community, and should minimize loss or fragmentation of habitats, agricultural areas, forested areas, disruptions to scenic view sheds, and the like.

6.2.3 Environmental Justice:

This is an issue that was not addressed the 1992 GEIS. The United States Environmental Protection Agency definition is as follows: “Environmental Justice is the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations, and policies. EPA has this goal for all communities and persons across this Nation. It will be achieved when everyone enjoys the same degree of protection from environmental and health hazards and equal access to the decision-making process to have a healthy environment in which to live, learn, and work.” The SEQRA process provides opportunity for public input and the resulting permitting procedures will apply state wide and provide equal protection to all communities and persons in New York. The location of drilling will be determined by where the gas is located and the resulting revenues will benefit the land owners and the surrounding community.

6.3 Mitigation

One of the largest and most obvious potential impacts on community character is the issue of trucking to develop and support the natural gas industry. Under New York State Highway Vehicle Traffic Laws local municipalities retain control over their roads. This makes it important for Municipalities to monitor the NYSDEC web site for information regarding gas development in their area. Local governments (County, Town and Village) should be encouraged to be proactive in exercising their authority under New York State Highway Vehicle Traffic Laws. This would include the completion of a road system integrity study to potentially assess fees for maintenance and improvements. DEC should encourage the applicant to obtain a road use agreement with the local Municipality and/or County to be filed with the application. When there is no agreement, applications should incorporate a trucking plan that includes estimated amount of trucking, hours of operations, appropriate off road parking/staging areas, and routes for informational purposes. Additionally, attempts to obtain a road use agreement should be documented in the application.

Recognizing DEC's authority under ECL§23-0303(2) municipalities are precluded from requiring the gas industry to be subjected to local ordinances, laws, and planning and zoning board review. However, there can be a requirement of the permit application that the applicant attest to having reviewed any existing comprehensive, open space and/or agriculture protection plan or similar policy document(s). It will then be the responsibility of the community to monitor the application/permit process and make any concerns known to the applicant/permittee.

6.4 Conclusion

Natural gas development – particularly large scale development – can affect community character in a variety of ways.¹⁹ The location, timing and magnitude of development relative to a specific community and the particulars of a community's predevelopment character are all factors that contribute to community character effects. Additional information is also found in Appendix B.

The availability of new jobs and new economic activity for communities with declining industrial and population bases could add vitality, diversity and renewed investment in commercial, industrial, residential and community infrastructure. Conversely, agricultural, tourism/outdoor recreation and second/retirement home-oriented communities that experience substantial and sustained industrial activity and traffic and large influxes of development employees relative to their predevelopment population could experience adverse changes in community character, particularly as perceived by residents and visitors who value the existing environmental, scenic and social setting of those communities.

Changes in community character would be most dramatic during the development phase, and the potential for extended, multi-year changes in character are substantial given the estimated size of the natural gas reserves and the time it may require to fully develop the resource and construct the required production and transportation facilities in any one development sub-area. Although some communities who place high value on their environmental, scenic and social setting may be able to regain their predevelopment character once development is completed and reclamation occurs, in some cases the sense that community character may have been adversely altered may persist for some residents and visitors after development ceases. It is also true that for some communities the change in community infrastructure and housing stock enabled by development may be seen as a lasting improvement over the community's predevelopment character. There are numerous examples of communities in the western US that have used natural resource development revenues to fund construction of new facilities, enhance public services and service delivery, redevelop historic buildings and develop and improve tourism and recreation infrastructure.

¹⁹ See Appendix B for additional information related to italicized text - "Socioeconomic Effects of Natural Gas Development" Sammons/Dutton, LLC & Blankenship Consulting LLC (August 2010) pages 23 -24

For many communities, particularly those that emerge as regional service centers, beneficial economic changes in community character are likely to persist well into the production phase.

Many of the community character impacts associated with horizontal drilling and high volume hydraulic fracturing are the same as those addressed in the 1992 GEIS, and the use of multi-well pads has the potential to reduce adverse impacts. The volume of trucking and related road maintenance issues were not anticipated in 1992. Roads are under the control of local government per New York State Highway Vehicle Traffic Laws. Additionally, ECL§23-0303(2) provides DEC authority to regulate gas development. As a result, communication between local government and DEC is essential to mitigate impacts from trucking.

6.5 Summary

1. Encourage road use agreement with local municipality.
2. When a road use agreement has not been obtained, require trucking plan for informational purposes.
3. Encourage review of local comprehensive, open space and/or agriculture protection plans or similar policy document(s).
4. NYSDEC should prepare a “Best Practices Manual” to provide Staff and industry access to information relative to what is expected in terms of well siting and aesthetic mitigation, and to identify instances when aesthetic mitigation would be necessary. See Appendix A.
5. As subsequent applications are reviewed for additional wells on a multi-well pad, NYSDEC should reconfirm control methodologies based on actual experiences with earlier wells.

6.6 Community Character Impact Summary Table

Community Character Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Site Access	Yes		None required
Temporal Noise and/or Visual Impacts	Yes		None required
Temporary Land Use Conflicts	Yes		None required
Multi-Well Pad	No		Review previous well drilling activity on pad for subsequent wells
Horizontal Drilling	No		Community Character issues are the same as for vertical drilling discussed in 1992.
High Volume Hydraulic Fracturing	No		None required
Trucking	Yes		Encourage road use agreement between applicant and municipality. Require submission of trucking plan when not obtained.
Environmental Justice	No		SGEIS/SEQRA process provides an equal opportunity for public input.
Positive Economic Impacts	Yes		None required

7 CUMULATIVE IMPACTS²⁰

This is in response to the Cumulative Impact section of the Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Regulatory Program – February 6, 2009.

A number of comments from the public and outside agencies on the dSGEIS concerned potential cumulative effects on community character and socioeconomic conditions within areas potentially affected by natural gas development. It is our perspective that fundamental differences in terminology and meaning exist between the use of the word “cumulative” in many of those comments and the term “cumulative” as it is used in the New York State Environmental Quality Review Act (“SEQRA”). We believe that most comments use the term “cumulative” as it has evolved under the National Environmental Policy Act (NEPA), as defined by the U.S. Council on Environmental Quality. The differences in meaning are explored below.

The Executive Office of the President’s Council on Environmental Quality issued Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act. (40 CFR Parts 1500-1508, July 1, 1986). Section 1508.7 defines cumulative impact.

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.”

NEPA requires general consideration of socioeconomic effects, but does not explicitly address effects on community character.

7.1 Discussion

Cumulative impacts are the effects of two or more single projects considered together. Adverse cumulative impacts can result from individually minor but collectively significant projects taking place over a period of time. The 1992 GEIS defined the project scope as an individual well with a limited discussion of cumulative impacts. Chapter 18 discussed the positive economic impacts of gas development for municipalities and for the entire State. Additionally, as an unavoidable adverse impact it stated: ‘Though the potential for severe negative impacts from any one site is low. When all activities in the State are considered together, the potential for negative impacts on water quality, land use, endangered species and sensitive habitats increases significantly’.

²⁰ See Appendix B for additional information related to italicized text - “Socioeconomic Effects of Natural Gas Development” Sammons/Dutton, LLC & Blankenship Consulting LLC (August 2010) pages 2-3

For the purposes of the dSGEIS, cumulative impacts will be discussed from two perspectives;

1. **Site Specific** cumulative impacts beyond those considered in the 1992 GEIS resulting from multi-well pads; and,
2. **Regional** impacts which may be experienced as a result of gas development.

7.2 Site Specific Cumulative Impacts

The potential for site specific cumulative impacts as a result of multi-well pads, while real, is easily quantified and can be adequately addressed during the application review process. General areas of concern with regard to noise, visual, and community character issues are the same those of individual well pads. While the pads may be slightly larger than those used for single wells, the significant impacts are due to the cumulative time and trucking necessary to drill and stimulate each individual well.

When reviewed in 1992, it was assumed that a well pad would be constructed, drilled and reclaimed in a period measured in a few months, with the most significant activity being measured in one or two weeks for the majority of wells. By comparison, a horizontal well takes 4 to 5 weeks of 24 hour per day drilling with an additional 3 to 5 days for the hydraulic fracture. This duration will be required for each well with industry indicating that it is common for 6 to 8 wells to be drilled on a multi-well pad. Typically one or two wells are drilled and stimulated and the equipment is removed. If the well(s) are economically viable, the equipment is brought back and the remaining wells drilled and stimulated. Current regulations require that all wells on a multi-well pad be drilled within three years of starting the first well. As industry gains confidence in the production of the play, there is the possibility that all wells on a pad would be drilled, stimulated and completed consecutively. This concept will shorten the time frame of noise generation and eliminate the noise generated by one rig disassembly/reassembly cycle.

The trucking requirements for rigging and equipment will not be significantly greater than for a single well pad, especially if all wells are drilled consecutively. Water and materials requirements, however, will greatly increase the amount of trucking to a multi-well pad compared to a single well pad. Estimates of truck trips per multi-well pad are as follows²¹ (assumes two rig and equipment deliveries and 8 wells):

²¹ Independent Oil and Gas Association of New York response to DEC request for information (9/16/2010)

Traffic Estimate per Horizontal Well Pad

Well Pad Activity	Early Well Pad Scenario (All water transport by truck)		Peak Well Pad Scenario (Pipelines may be used for some water transport)	
	Heavy Truck	Light Truck	Heavy Truck	Light Truck
Drill Pad Construction	45	90	45	90
Rig Mobilization	190	280	190	280
Drilling Fluids	360		360	
Non-Rig Drilling Equipment	90		90	
Drilling (rig crew etc.)	400	1,120	400	1,120
Completion Chemicals	160	2,608	160	2,608
Completion Equipment	10		10	
HF Equipment (Trucks & Tanks)	350		350	
HF Water Hauling	4,000		480	
HF Sand	184		184	
Produced Water Disposal	800		136	
Final Pad Prep	45		50	
Misc		400		400
TOTAL TRUCK TRIPS PER WELL PAD	6,634	4,548	2,450	4,548

As can be seen, the vast majority of trucking is involved in delivering water and removing flow back. Multiple wells in the same location provide the potential to reduce this amount of trucking by reusing flow back water for the stimulation of other wells on the same pad. The centralized location of water *storage or treatment facilities* may also make it economically viable to transport water via pipeline or rail in certain instances.

In the production phase multi-well pads are similar to what was addressed in 1992. There will be a small amount of equipment including valves, meters, dehydrators and tanks remaining on site which may be slightly larger than what is used for single wells but is still minor and is quiet in operation. The reclamation procedures are the same as for single well pads. There will be more area left for production equipment and activities however. It is anticipated that a multi-well pad will require up to 3 acres compared to 1 acre or less as discussed in 1992.

7.3 Site Specific Cumulative Impacts Conclusions

A single multi-well pad on a 640 acre spacing unit will drain the same area that could contain up to 16 single well pads. As discussed earlier the pad will be larger, the area left for production will be larger and, the duration of drilling and stimulating activities on the pad will be longer. The decrease in the number of drilling sites reduces the regional long term and short term cumulative impacts.

The 1992 GEIS found that the negative impacts associated with gas development were short term and could be mitigated with siting restrictions and setback requirements. This is also true for multi-well pads therefore the mitigation techniques discussed in the 1992 GEIS and in the previous sections of this report should be utilized. Given the extended time period involved in fully developing a multi-well pad, control of the impacts, while still temporary, is essential. As stated in 1992, many of the potential negative impacts of gas development hinge on the location chosen for the well and the techniques used in constructing the access road and well site. Before a drilling permit can be issued, DEC staff must ensure that the proposed location of the well and access road complies with the Department's spacing regulations and siting restrictions. To assist in this process, DEC staff now has access to Policy Guidance Documents DEP-00-1, "Assessing and Mitigating Noise Impacts" and DEP-00-2, "Assessing and Mitigating Visual Impacts". If the guidance provided in these documents is applied where appropriate to multi-well pad applications along with a proposed site plan and design guidelines (See Appendix A), it will be possible to avoid significant site-specific cumulative impacts. Additionally, the applicant should also be encouraged to review any applicable land use policy documents with the understanding that New York State Department of Environmental Conservation (NYSDEC) retains authority to regulate gas development.

7.4 Regional Cumulative Impacts

Other than those mentioned in the introduction of this section, cumulative impacts of gas development are not addressed in the 1992 GEIS. The level of impact on a regional basis will be determined by the amount of development and the rate at which it occurs. Accurately estimating this is inherently difficult due to the wide and variable range of the resource, rig, equipment and crew availability, permitting and oversight capacity, leasing, and most importantly economic factors. This holds true regardless of the type of drilling and stimulation utilized. Historically in New York, and in other plays, development has occurred in a sequential manner over years with development activity concentrated in one area then moving on with previously drilled sites fully or partially reclaimed as new sites are drilled. As with the development addressed in 1992, once drilling and stimulation activities are completed and the sites have been reclaimed, the long term impact will consist of widely spaced and partially re-vegetated production sites and fully reclaimed plugged and abandoned well sites.

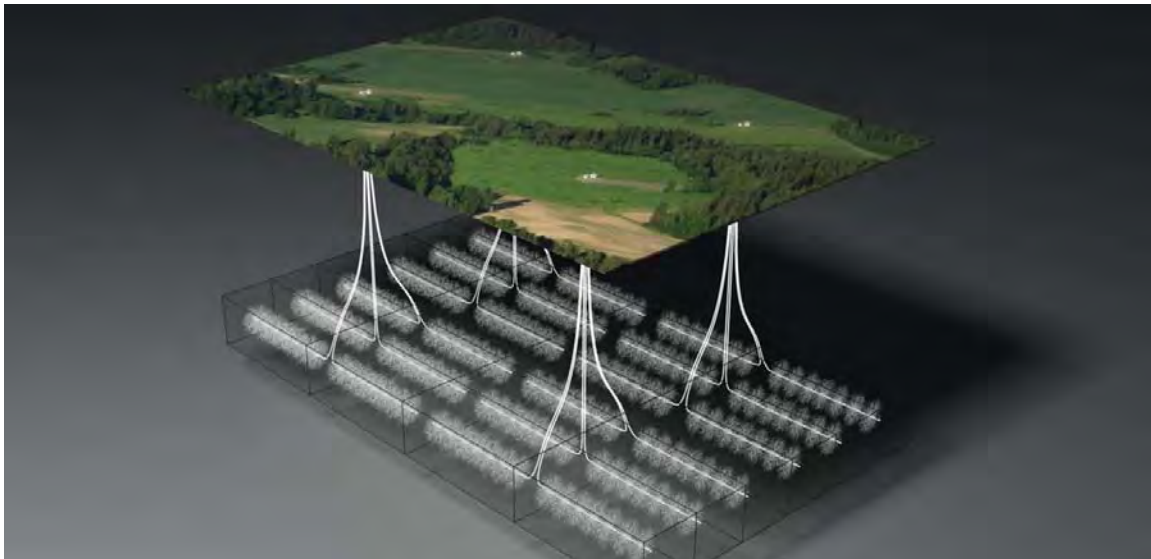
The statewide spacing regulations for vertical shale wells of one single well pad per 40-acre spacing unit will allow no greater density for horizontal drilling with high volume hydraulic fracturing than is allowed for conventional drilling techniques. This density was anticipated in 1992 and areas of New York, including Chautauqua, Cayuga and

Seneca Counties, have experienced drilling at this level without significant negative impacts to agriculture, tourism, other land uses or any of the topics discussed in this report.

As discussed earlier, the density for multi-well pads, one per 640-acre spacing unit, is significantly less than for single well pads reducing the total number of disturbances to the landscape. While multi-well pads will be slightly larger than single well pads the reduction in number will lead to a substantial decrease in the total amount of disturbed acreage providing additional mitigation for long term visual and land use impacts on a regional basis. The following table provides an example for a 10 square mile area (i.e., 6,400 acres), completely drilled, comparing the 640 acre spacing option with multi-well pads and horizontal drilling to the 40 acre spacing option with single well pads and vertical drilling.

Spacing Option	Multi-Well 640 Acre	Single Well 40 Acre
Number of Pads	10	160
Total Disturbance - Drilling Phase	50 Acres (5 ac. per pad)	480 Acres (3 ac. per pad)
% Disturbance - Drilling Phase	.78	7.5
Total Disturbance - Production Phase	30 Acres (3 ac. per pad)	240 Acres (1.5 ac. per pad)
% Disturbance - Production Phase	.46	3.75

As can be seen, multi-well pads will significantly decrease the amount of disturbance on a regional basis in all phases of development. The reduction in sites should also allow for more resources to be devoted to proper siting and design of the pad to mitigating the short term impacts that result during the drilling and stimulation phase.



Source: Chesapeake Energy

7.5 Rate of Development and Thresholds

In response to questioning *prior to release of the September 2009 dSGEIS*, a representative for one company estimated a peak activity for all of industry at 2,000 wells per year \pm 25% in the New York Marcellus play. Other individual companies did not provide an estimate, listing the variables mentioned above as the reason. *However in September 2010, the Independent Oil and Gas Association of New York (IOGA) did provide information in response to a specific request from NYSDEC regarding estimated peak activity and land disturbance. IOGA has indicated that the rate of activity cannot be answered with certainty due to several factors which cannot reliably be foreseen. The estimates are also based on a worst-case scenario and are not intended to represent average annual conditions. According to IOGA, the rate of new multi-well pad construction is estimated to be 1,108 during the year(s) of peak drilling activity. IOGA continues to estimate land disturbance in the form of well pads, construction of gravel roads and utility corridors in the following manner:*²²

- *Horizontal wells:*
 - *During the development phase, a multi-well pad for horizontal well development disturbs approximately 7.4 acres including the incremental portion of associated roads and utility corridors. The multi-well pad alone would disturb approximately 3.5 to 4.0 acres.*
 - *Based on 1,108 horizontal well pads constructed in the year of peak development, 8,197 acres of total land disturbance for horizontal drilling would be anticipated during that entire year.*
- *Following full development of each pad and interim reclamation once the wells are producing to the gas pipelines, a lesser amount of acreage would remain disturbed throughout the well's productive lifetime until the well(s) is plugged and abandoned and full site reclamation is completed. During the period of active production, disturbance is estimated at:*
 - *1.5 acres for a multi-well horizontal well pad plus incremental portion of associated roads.*

In Pennsylvania, where the Marcellus play covers a larger area and development has already occurred, the number of permits issued has increased in recent years as indicated in the following table. The source data provides information on the number of permits issued and is not indicative of the number of wells drilled.

Year	Marcellus Permits Issued (Pennsylvania)
2007	99
2008	529
2009	1,991
2010	3,446

SOURCE: <http://www.dep.state.pa.us/dep/deputate/minres/oilgas/RIG10.htm>

²² NYSDEC SGEIS Information Requests Document Prepared for the Independent Oil & Gas Association of New York, September 16, 2010. (Pages 13-15)

Recent development in the Barnett play in Texas, which utilizes the same horizontal drilling with high volume hydraulic fracturing that will be used in New York, has occurred at a rapid rate over the last decade. It is an approximately 4,000 square mile play located in and around the Dallas – Fort Worth area. In the eight year period from 2002 to 2008 approximately 10,500 wells were drilled.

The final scoping document summarizes the challenge of forecasting rates of development as follows:

“The number of wells which will ultimately be drilled cannot be known in advance, in large part because the productivity of any particular formation at any given location and depth is not known until drilling occurs. Changes in the market and other economic conditions also have an impact on whether and how quickly individual wells are drilled.”²³

Additional research has identified that “Experience developing shale gas plays in the past 20 years has demonstrated that every shale play is unique.”²⁴ Each individual play has been defined, tested and expanded based on understanding the resource distribution, natural fracture patterns, and limitations of the reservoir, and each play has required solutions to problems and issues required for commercial production. Many of these problems and solutions are unique to the play.²⁵



Source: www.naturalgas.psu.edu

“The timing, rate and pattern of development, on either a statewide or local basis, are very difficult to accurately predict.”²⁶ As detailed in Section 2.1.6 of the Final Scoping Document “overall site density is not likely to be greater than was experienced and envisioned when the GEIS and its Findings were finalized and certified in 1992.”

²³ Final Scoping Document (Page 39)

²⁴ Fractures Shale Gas Potential in New York (Page 1)

²⁵ Ibid

²⁶ Final Scoping Document (Page 39)

The rate of development cannot be predicted with any certainty based on the factors cited above and in the Final Scoping Document. Additionally, the threshold at which development results in adverse impacts to the topics studied in this report cannot be determined since it would be subjective. Some people will feel that one drilling rig on the landscape is too many while others will want full development of the resource as quickly as possible. Research has not found any scientifically backed or measurable threshold that could be used for the topics areas discussed in this report. As a result any limit to rate of development, or setting of thresholds, would be purely subjective and indefensible.

7.6 Regional Cumulative Impacts Conclusion/Recommendation²⁷

The approach for addressing regional cumulative impacts is to focus on the proactive siting of well pads as discussed in previous sections of this report. If the location and construction of each well pad is based on ‘Best Practices’ (See Appendix A) then the potential impacts will be lessened and/or eliminated. When applications are reviewed, it is recommended that DEC examine any negative issues that have occurred on adjacent well pads to determine if there is a potential problem in the area that needs further scrutiny.

In the Marcellus Shale and other low-permeability gas reservoir development areas of New York, cumulative socioeconomic effects (both adverse and beneficial) could occur as a result of concurrent natural gas development (multiple rigs operating at the same time within the same development area and potentially in multiple development areas), coupled with secondary development of production and transmission infrastructure. Given a productive and geographically extensive resource, such development could occur over an extended period of time, which could also contribute to cumulative socioeconomic effects. As the natural gas resource is developed, produced and transported to markets, production activities will begin, overlapping with the development phase and creating additional potential for cumulative socioeconomic effects. In addition, natural gas development may occur simultaneously with other types of development again resulting in cumulative effects under the NEPA definition.

A number of comments on the dSGEIS suggest that NYSDEC should prepare quantitative forecasts of development based on hypothetical scenarios formulated on assumptions regarding the pace, location and ultimate scale of development for the Marcellus Shale resource. Some of these comments reference the cumulative and programmatic assessments completed under NEPA for proposed development on federal lands in the western U.S. as examples of quantitative cumulative forecasts that could be developed for the SGEIS. The comments suggest that this type of quantitative assessment is necessary for disclosing the effects of development and for enabling communities to plan for development.

²⁷ See Appendix B for additional information related to italicized text - “Socioeconomic Effects of Natural Gas Development” Sammons/Dutton, LLC & Blakenship Consulting LLC (August 2010) pages 5-6

In response, it would be our contention that when adequate information becomes available, quantitative development scenarios would be useful not as specific predictions of activity and the effects thereof, but to foster an understanding of the cumulative socioeconomic and community character impacts of development. But absent the necessary information to adequately inform realistic development scenarios, it is premature to prepare forecasts that would be of value for communities and other interested parties.

To be useful for affected communities, agencies and other interested parties, quantitative cumulative analysis of development for a given geography requires a reasonable understanding of the timing, pace, magnitude and location of development and other factors. The less actual experience in a particular area with the type of development under consideration and the wider the geographic region covered, the higher the degree of uncertainty associated with the parameters chosen for those factors and the less useful forecasts based on the factors will be.

Across the western United States, natural gas development typically occurs on land in public ownership or on lands having a mix of public and private ownership on which one or a relatively small number of operators have proposed the majority of development. Although analysis may occur at a programmatic level in some cases, operators typically must file a Plan of Development (POD) outlining the pace, timing and general location in which development will occur for an assessment for National Environmental Policy Act compliance. Because the POD identifies proposed development within a relatively large area, the ensuing NEPA assessment addresses potential impacts in a regional context over a period of time, commonly 15 years or more. Subsequent to the completion of the NEPA assessment, individual wells are still subject to individual siting review associated with an Application for Permit to Drill (APD). While NYSDEC may require development plans for state lands when leased for oil and gas development, the outcome of the 1992 SEQRA process was that the scope of the project when reviewing a drilling application was defined as the individual well.

The Marcellus Shale development area in New York covers 29 counties and approximately 18,700 square miles. Although active development of the Marcellus Shale is occurring nearby in the northern tier of Pennsylvania, limited development has occurred in New York to date. The emerging understanding of the productive potential of the Marcellus Shale, based on drilling and production experience in Pennsylvania and other states, has given rise to estimates of economically recoverable reserves sufficient to support extended large-scale development in New York, given supportive gas prices. However, the productive potential likely differs substantially across the New York development area, as will the cost for drilling and well completion and for production and gas transmission infrastructure development. Differences in productivity, along with other factors influencing the spatial distribution of gas service companies and other support activities make it unlikely that all communities in the New York portion of the Marcellus development area will experience development or the effects of development; certainly all will not experience such effects equally.

The vast majority of development will occur on privately owned land, in a land ownership pattern generally characterized by numerous owners, few of whom own large tracts. Operators must secure leases with individual landowners or consortiums of landowners in order to develop the resource. This ownership pattern can give rise to the involvement of multiple operators in developing the resource and to substantial variability in development levels and timing for any one development sub-area. Consequently, the number of operators that will develop the resource in New York is currently unknown, as are the development strategies and schedules of those operators.

Although hypothetical quantitative gas development scenarios could be prepared using the currently known extent of Marcellus Shale and other low-permeability gas resources in New York, in this instance the parameters chosen to estimate the location, pace, timing and ultimate extent of development would be speculative as would the designation of affected communities and assumptions about how and when these communities would be affected.

While we believe it is currently premature to prepare forecasts that would be of value for development sub-areas and individual communities, it is possible to qualitatively describe the types of socioeconomic effects that have accompanied natural gas development in other parts of the country. A description of the socioeconomic and community character effects that have accompanied natural gas development in other states could help achieve meaningful disclosure and inform future monitoring, forecasting and community and industry planning efforts.

The following table characterizes selected beneficial and adverse socioeconomic effects associated with natural gas development. The potential effects are differentiated by three general categories of communities and four different stages or levels of exploration, development and production, with the objective of providing the reader with examples of how effects may vary by stage of development and type of community. The three general categories of communities include Rural Communities, Small Towns/Villages and Cities/Urban Areas. The four stages or levels considered include Exploration/Early Development, Moderate Development, Large/Full Scale Development and Post-Development/Production. By definition, a summary requires simplification; therefore this table does not address every possible combination of development influences and community characteristics that would result in socioeconomic impacts or changes in community character but, it does illustrate the general types of beneficial and adverse socioeconomic effects that accompany natural gas development.

SUMMARY CHARACTERIZATION OF SOCIOECONOMIC EFFECTS OF NATURAL GAS DEVELOPMENT²⁸

		<u>Exploration/Early Development</u>	<u>Moderate Development</u>	<u>Large/Full-Scale Development</u>	<u>Post-Development Production</u>
		Dispersed pattern of few well pads	Multiple well pads, simultaneously in localized area, some production begins	Many well pads, multiple operators, regional area, service centers emerge, production begins	Overlaps with Moderate and Full-Scale, but also continues post Development
Rural Communities	ECN	Limited, primarily indirect effects on jobs, spending and business revenues for other sectors of local economies. Landowners benefit from leasing revenue	Short-term direct and subcontracting job opportunities. Some landowners receive royalties. May see support infrastructure construction begin.	Investment stimulated in local retail and services. Landowners receive royalties. Active ancillary support infrastructure. Potential conflicts with agriculture & tourism/recreation/ resort economies.	Long-term, primarily indirect effects on jobs, spending and business revenues. Royalty revenues continue.
	POP	Limited and temporary	Potentially moderate, temporary increases, particularly in communities with temporary housing. Limited production-related population begins to increase.	Moderate to major, short-term, especially in communities with existing or new temp. housing. Migrants mostly single-status at first, but can more households if development is sustained over the long-term.	Limited, long-term during life of the field.
	H	Limited demand for existing temporary housing (motels & RV parks)	Demand for existing temporary housing; may see investment in new temp. housing, e.g., RV parks. Limited demand for production-related conventional housing.	Depending on proximity to major population centers, demand for housing may stimulate construction of RV parks and multifamily rentals. Localized demand for production-related conventional housing.	Demand for temporary housing abates as development ends. Communities where temporary and rental housing supply expanded could experience excess capacity. Long-term demand is for conventional housing.
	SVC	Limited, primarily to law enforcement, emergency response/medical and road maintenance	Potentially moderate increases for all services. Some communities see demand on utilities.	Moderate to major. Demands on utilities, building departments. Some increase in school enrollment related to production employment build up.	Demand abates. Communities that have expanded infrastructure and service capacity to accommodate development could experience excess capacity.
	FISC	Limited - primarily sales tax on consumer-type purchases	Minor to moderate increases in sales taxes; direct and indirect property taxes, utility revenues & intergovernmental revenues. Production-related tax revenues begin to accrue, but jurisdictional mismatches may occur.	Minor to major increases in sales taxes; direct and indirect property taxes, utility revenues & intergovernmental revenues. Production-related taxes build over time.	Sales taxes, utility revenue and intergovernmental revenues decline, but remain higher than pre-development. For jurisdictions hosting development, production-related taxes peak, then decline but continue for many years. Aggregate production-related taxes are significant. Property taxes fluctuate in response to price changes.
	A&V	Limited but may simultaneously raise hopes for supporters and raise concern for expanded development among some residents and interested parties	Attitudes and values become more pronounced as concerns and hopes for expanded development become more well defined and are supported by local/regional examples of beneficial and adverse effects	Attitudes and values are solidified and polarized, based on local experience and interests in development.	Development related effects abate but lingering divisiveness may occur.
	QOL	Limited, temporary and localized effects. May provide employment opportunities and increased income for some but noise, traffic and industrial activity may affect perceived quality of life for others.	Scale of localized effects on noise, traffic and industrial activity increases, affecting perceived quality of life for more residents.	Potentially major and geographically widespread effects on quality of life. Disparities in distribution of benefits and adverse effects.	Some long-term effects on QOL continue, some new long-term residents in community, migrant population reduced.
	CC	Limited and generally temporary, but placement of wells in sensitive areas could affect community character	Character of rural communities at the center of development affected by moderate traffic, industrial activity, noise, land use changes.	Character of rural communities at the center of development affected by substantial and sustained traffic, industrial activity, noise, land use changes. Migrant population can affect established social structures.	For some communities, return to near pre-development rural setting could occur. For others, change in setting related to development-related residential, commercial and public investment would persist. For some, perceptions that adverse change in community character have occurred may remain after development ceases.

²⁸ Table created in partnership with NTC, Sammons/Dutton, LLC and Blankenship Consulting, LLC

Small Towns / Villages	ECN	Limited local job opportunities, limited local spending, Limited effects on other sectors of local economies	Short-term, moderate scale direct job opportunities. Effects from ancillary infrastructure begin. Moderate scale indirect effects on jobs, spending and business revenues. Some field offices develop and production-related jobs begin to become available.	Many direct, indirect and induced job. Production-related jobs build over time. Investment stimulated in local retail and services. Indirect effects benefit un/underemployed residents. Labor force competition results in higher wages. Labor shortages possible. Potential conflicts with tourism/ recreation/resort economies. More field offices and service firms develop. Community income rises, in some cases substantially.	Long-term, direct and indirect effects on jobs, spending and business revenues. Some shrinkage of retail and service sector compared to the development peak. Royalty revenues continue. Community income rises.
	POP	Limited, short term and temporary	Potentially moderate, temporary increases in communities with existing temporary housing, including those within reasonable commuting distance of development.	Moderate to major, short and long-term, especially in communities with existing or new temporary housing. Many single-status migrants, but also families associated with field offices, service centers and expanding production employment. Population increase peaks.	Some communities will experience substantial declines in population. Others will lose population but still be larger than predevelopment. Long-term population will have more families.
	H	Limited demand for temporary housing (motels & RV parks)	Demand for existing temporary housing; may see investment in new temp. housing, e.g., RV parks. Temporary housing costs may escalate. Limited demand for production-related conventional housing.	For communities distant from major population centers, demand expands for both temporary and conventional housing, potentially stimulating real estate subdivision and construction of RV parks, motels, and conventional housing for both rental and sales. Housing costs escalate.	Housing demand and costs abate. Some communities may have excess capacity in temporary and rental housing. Improvements in housing stock persist.
	SVC	Limited primarily to law enforcement, emergency response and health care and road maintenance.	Up to moderate increases. Some communities see demand on utilities and building departments. Potential infrastructure expansion in some communities.	Moderate to major demands on full spectrum of local government facilities and services including planning/building departments. Infrastructure expansion likely. Some increase in school enrollments, particularly if development is sustained and production-related employment increases.	Demands on community infrastructure and services abates. Long term demand associated with production likely greater than pre-development demand, but resembles pre-development demand in nature. Development-related infrastructure improvements continue to benefit communities.
	FISC	Limited, primarily sales tax on purchases and lodging	Up to moderate increases in sales tax, building and tap fees, intergovernmental revenues. Indirect effects on property taxes. Production-related tax revenues begin to flow. Some communities face infrastructure expansion costs. Potential for jurisdictional mismatches.	Moderate to major increases in sales tax, building and tap fees, intergovernmental revenues. Indirect effects on property taxes. More communities face cost to expand infrastructure and services. In some cases costs exceed development-related revenues in early years. Production-related revenues tend to climb throughout the development period, but are sensitive to gas prices.	Substantial declines from peak sales tax, building fees and intergovernmental revenues. Indirect effects on property taxes. Property taxes peak but continue. Some towns and districts that incurred debt to fund improvements may have unretired long-term debt. For jurisdictions that host development, production-related taxes persist for years, but typically begin to decline, based on declining production volumes and gas prices. Total development and production-related taxes would be significant. Post-development revenues generally higher than predevelopment levels.
	A&V	Limited but may arouse concern for expanded development	Attitudes and values become more pronounced as concerns about and hopes for expanded development become more well defined and are supported by local/regional examples of beneficial and adverse effects	Attitudes and values are solidified and polarized, based on local experience and interests in development.	Development related effects abate but lingering divisiveness may occur.
	QOL	Limited, temporary and localized effects. May result in increased job opportunities and income for some but noise, traffic and industrial activity may affect perceived quality of life for others	Employment and income benefits increase and become more long-term. Scale of localized noise, traffic and industrial activity increases, affecting perceived quality of life for more residents. Some communities on periphery of development also affected.	Potentially major and geographically widespread effects on quality of life. Elevated levels of traffic, noise and industrial activity and changes in the environmental and aesthetic setting. Disparities in distribution of benefits and adverse effects. Expansion of goods and services and investments in residential, commercial and public infrastructure enhance QOL for some. Higher costs adversely affect low and fixed income populations.	Some beneficial effects on QOL such as production-related employment and income, and improvements in residential, commercial and public infrastructure. Reductions in economic activity associated with development may adversely affect some residents and business owners. Quality of life effects associated with traffic, noise and industrial activity and change in the environmental and aesthetic setting would be substantially reduced and combined with interim reclamation may result in a return to near pre-development levels for some. Others may perceive ongoing levels of these effects to be detrimental.
	CC	Limited and generally temporary, but placement of wells in sensitive areas could affect community character	Community character of small towns at the center of development affected by traffic, industrial activity, noise and changes in land use and environmental, visual and social settings.	Community character of towns at the center of development affected by traffic, industrial activity, noise, and changes in environmental and social setting. For some a sense of vibrancy exists. For others the presence of many newcomers is unwelcome. The degree of change in community setting can range from negligible to dramatic and be seen as mildly beneficial to substantially adverse, depending on the predevelopment character of the community, the level of development that occurs, and the attitudes of residents toward development.	Depending on the level of development that occurs, and the predevelopment nature of the community, the cessation of development and the corresponding reductions in traffic, noise and industrial activity and the gradual reduction in environmental and aesthetic effects associated with interim reclamation, could result in a return to near predevelopment character for some communities. For others, the changes long-term changes would still be seen as adverse. Communities in economic decline that have experienced development-related revitalization may see the long-term change as beneficial.

Cities / Urban Areas	ECN	Increase in economic activity commensurate with level of exploration and early development occurring in surrounding areas. Increase in employment in non-skilled direct and indirect and induced jobs	Short-term, minor to moderate scale direct job opportunities, including effects from ancillary infrastructure. Moderate scale indirect economic effects. Some field offices develop.	Investment stimulated in local retail and services. Indirect impacts benefit un/underemployed residents. Conflicts with tourism/recreation economies less pronounced due to larger/more diverse economy. More field offices and service firms develop. Community income rises.	Long-term, primarily indirect effects on jobs, spending and business revenues. Some shrinkage of retail and service sector compared to the peak, but typically higher than predevelopment. Result is higher community income.
	POP	Potential for minor, temporary increase in population, primarily transient workers.	Potentially moderate, temporary increases in communities with existing temporary housing, including those within reasonable commuting distance of development.	Moderate scale, short and long-term, especially in communities with existing temp. housing. Many single-status migrants, but more families associated with field offices, service centers and indirect changes. Population increase peaks.	Some cities see substantial population decreases, others will lose population but still be larger than predevelopment. Long-term population will have more families.
	H	Increase in demand for primarily temporary housing resources.	Demand for existing temporary housing; may see investment in new temp. housing, e.g., RV parks. Cost of temporary housing may escalate, depending on the size of the city, but would be less pronounced than in smaller town.	Depending on the predevelopment available housing stock, housing demand may stimulate real estate subdivision and construction of motels and conventional housing for both rental and sales. Housing costs may escalate, but less pronounced than in smaller towns.	Housing demand and costs abate. Some communities may have excess capacity in temporary housing and moderate excess capacity in conventional housing, but improvements in housing stock persist.
	SVC	Limited, primarily law enforcement, emergency response/ health care and road maintenance services	Up to moderate increases. Some communities see demand on utilities and building departments. Potential infrastructure improvement in some cities.	Moderate to major, depending on the size of the city. Demands on utilities, and full range of community services including building departments. Infrastructure expansion possible for cities central to several development areas. In some cases, needs predate development. Communities benefit from enhanced fiscal capacity. Increase in school enrollments likely, depending on location in relation to development areas.	Development-related infrastructure and service demand eases, but improvements continue to benefit communities. Demand from production-related population resembles typical population demand. Communities that expanded infrastructure and service capacity to accommodate development experience excess capacity.
	FISC	Limited, primarily increases in sales tax and lodging revenues.	Up to moderate increases in sales tax, building and tap fees, intergovernmental revenues. Indirect effects on property taxes. Some communities face infrastructure expansion costs. Some costs could precede revenues.	Moderate to major increases in sales tax, building and tap fees, intergovernmental revenues. Indirect effects on property taxes. Some cities could face cost to expand infrastructure and services. Some costs could precede revenues.	Substantial decline over peak sales tax, building fees and intergovernmental revenues. Indirect effects on property taxes. Development and production-related tax revenues would be significant. Post-development revenues generally higher than predevelopment levels. For communities that have financed development-related infrastructure expansion, some long-term debt obligations could remain.
	A&V	Effects likely to be modest depending on proximity to exploration/development activities and pre-existing attitudes towards development	Attitudes and values become more pronounced as concerns about and hopes for expanded development become more well defined and are supported by local/regional examples of beneficial and adverse effects	Attitudes and values are solidified and polarized, based on personal attitudes toward development and interests in development. Local and regional experiences with development and the city's proximity to development also help inform and solidify attitudes and opinions.	Development related effects abate but lingering divisiveness may occur.
	QOL	Increased employment, income and economic activity could improve living conditions for some.	Improvements in QOL for some due to improved economic climate, particularly if current economy is depressed or stagnant. Few likely to be directly affected by increased traffic, noise and industrial activity.	Economic QOL improvements possible for many people. Development-related, residential, commercial and public infrastructure improvements could improve QOL for many residents. Residents with interests outside the city and in areas where development occurs could perceive deterioration in QOL in changes in recreation settings or places with special meaning.	Development-related employment, income and other economic effects cease, potentially diminishing QOL for many residents. Those that previously perceived development as diminishing their QOL may now experience a return to near pre-development levels.
	CC	In most cases, changes in community character would not be anticipated, depending on the proximity of exploration and early development to the city.	For most cities, changes in community character are likely to be limited depending on the city's proximity to development and capacity to accommodate moderate increases in employment with existing infrastructure.	Economic aspects of community character typically more vibrant, signs of growth, development and investment can be apparent, depending on the communities predevelopment economic climate. Some smaller cities centrally located in large scale development areas may experience changes in their social setting which can be perceived as both beneficial and adverse.	Depending on the size of the city and its proximity to development, a wide range of long-term effects in community character is possible. Some cities may revert to near predevelopment character, with modest improvements in infrastructure. Others may leverage infrastructure improvements to develop or attract new industries. Still others may experience economic decline.

ECN Economics - Employment and Economic Activity
POP Population
H Housing
SVC Services: Community Infrastructure, Facilities and Services
FISC Fiscal: State and Local Government Fiscal Conditions
A&V Attitudes and Values
QOL Quality of Life and Social Conditions
CC Community Character

Cumulative Impact Summary Table

Cumulative Issue	Address in 1992 GEIS	Process Enhancements	Additional Mitigation
Multi-Well Pads	No		Review previous well drilling activity on pad for subsequent wells
Regional Impacts	Yes		Examine any negative issues that have occurred on adjacent spacing units
Trucking	Yes		Require trucking plan and encourage road use agreement between applicant and municipality.
Positive Impacts	Yes		None required

8 Appendix A

Examples of Best Management Practices for Site Development

The following list of items relates to the various aspects of site development and is intended to help guide the review of applications. Not all the elements will be required for each application. After an application is submitted and the site visit has been completed, the Department can determine the amount of information it will require from the list below. In selecting items for review, the Department should keep in mind that the applicants will also have to prepare a Stormwater Pollution Prevention Plan (SWPPP) to obtain coverage under the applicable general SPDES permit for stormwater discharges.

- (1) Proposed New Conditions
 - (a) Grading and drainage plan showing proposed topography at appropriate contour intervals. This information shall be combined as an overlay with the map of existing topography.
 - (b) Location, proposed height and use of buildings and other structures, such as retaining walls, fences, outdoor storage tanks, etc.
 - (c) Location, proposed use, design and construction materials of improvements not requiring structures, such as parking, loading and outdoor storage areas.
 - (d) Location and arrangement of site access and egress, including all paths for vehicular travel within the site. Information should include profiles and cross sections of roadways showing grades and widths.
 - (e) Location and size of water lines and appurtenances.
 - (f) Location and design of outdoor lighting fixtures and a lighting plan if proposed.
 - (g) General reclamation plan and schedule, including areas of natural vegetation to remain, the treatment of buffer areas and the location and type of trees to be planted.
 - (h) Estimated project construction schedule showing a phasing plan within the required 3 year time frame.
 - (i) Additional specifications for materials and colors.

- (j) Any other requirements which the Department might deem necessary, including but not limited to a licensed survey and as-built drawings.
- (2) All applicants shall refer to the NYS DEC “Guide to Best Management Practices” manual prior to submitting a site plan. The BMP manual will serve as a guide to locating well pads so as to minimize impacts on the landscape. Although these are not intended to be mandatory regulations, they can serve as a basic guide to the proper siting of well pads.

The Department should keep in mind that the applicants will also have to prepare a Stormwater Pollution Prevention Plan (SWPPP) to obtain coverage under the applicable general SPDES permit for stormwater discharges

NOTE: until the Best Management Practices manual is developed, the following can serve as a general guideline:

- (a) Location of Project and Proposed Site Features
 - i. Avoid locating rigs and structures so that they will interrupt or obscure views of the crestlines or ridgelines.
 - ii. In addition to siting the structures sensitively, consider how the building design (height, massing, etc.) will affect the visual impact of the site.
 - iii. Locate structures to have the least impact on the views of surrounding properties.
 - iv. Grading and development should preserve salient natural features such as natural terrain, waterways and other similar resources, keep cut and fill operations to a minimum and ensure conformity to existing topography so as to create the least erosion potential and adequately accommodate the volume and rate of velocity of surface runoff.
 - v. The development should be fitted to the topography and soils to create the least erosion potential.
- (b) Vegetation and Wildlife
 - i. Minimize the fragmentation of existing ecosystems such as wetlands or forests. Extensive clearing of established vegetation can increase the risk of erosion, as well as significant disruption of important ecosystems.
 - ii. The preferred well-pad should be within areas which have previously been disturbed. These areas require the least vegetative clearing, and pose less impact on the function of existing ecosystems.
 - iii. Avoid any disturbance of wildlife habitat, especially riparian corridors and wetlands.

- iv. Grading and development should preserve salient natural features such as trees and groves so as to create the least erosion potential and adequately accommodate the volume and rate of velocity of surface runoff.
- (c) Lighting
- i. Avoid “uplights” and wall-washes, as well as lighting where the bulb is visible from the fixture.
 - ii. Light fixtures should not cast light on to the neighboring properties to the maximum extent practicable.
- (d) Stormwater
- i. Refer to New York State Department of Environmental Conservation Stormwater Management Design Manual when designing stormwater facilities for well-pads

9 Appendix B – Socioeconomic Effects of Natural Gas Development

Socioeconomic Effects of Natural Gas Development

Prepared to support

NTC Consultants
Saratoga Springs, NY

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Denver, CO Denver, CO

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Sammons/Dutton LLC, working in conjunction with Blankenship Consulting, LLC, entered into a contract with the New York State Energy Research and Development Authority (hereafter NYSERDA) to review and provide technical assistance related to public comment received to the draft Supplemental Generic Environmental Impact Statement (dSGEIS) issued by the New York State Department of Environmental Quality (NYSDEC). To complete this assignment, Sammons/Dutton LLC and Blankenship Consulting, LLC met with NYSDEC, NYSERDA and NTC on several occasions and toured portions of the Marcellus Shale area in New York and Pennsylvania. We also communicated via telephone with NYSERDA and NTC during the preparation of this report. We appreciate the assistance provided. However, Sammons/Dutton LLC and Blankenship Consulting LLC are responsible for the report's content. Furthermore, the views, conclusions, and opinions expressed herein do not necessarily reflect those of NYSDEC, NYSERDA, the State of New York, or NTC Consultants.

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1 Introduction

This paper has been prepared to support NTC Consultants in their review of and response to comments received regarding potential socioeconomic and community character impacts described in the *draft Supplemental Generic Environmental Impact Statement (dSGEIS) for On the Oil, Gas and Solution Mining Regulatory Program – Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs*. NTC Consultants has been retained by the New York State Energy Research & Development Authority (NYSERDA) “to research, review, compile, and provide to NYSERDA a report that addresses issues identified in the final scope for the dSGEIS to “complete a review and analysis of the cumulative impact and community character issues surrounding the use of horizontal drilling and high-volume hydraulic fracturing of tight formations, particularly of shale resources.”

The intent of this paper is not to assess specific socioeconomic effects of natural gas development in the Marcellus Shale area of New York. Rather, the paper provides a review of the general types of socioeconomic effects – beneficial and adverse – that have accompanied natural gas development, including development that involves multi-well pad drilling and high volume hydraulic fracturing, in some areas of the intermountain region of the western United States. We are mindful of differences between the development context in the western U.S. and New York, including the fact that much of the development in the western U.S. occurs on public land and minerals, and in areas less densely populated than the area of New York covered by the SGEIS. But we believe that some of these effects, particularly those described for rural areas and small communities without previous natural gas development experience and infrastructure, have the potential to occur regardless of the location. In any case, an understanding of the types of socioeconomic effects that have occurred elsewhere can inform the consideration of potential effects in New York.

The paper is based on the authors’ 30-plus year’s experience in assessing and monitoring the socioeconomic effects of natural gas and other types of industrial and natural resource development on public, private, state and tribal lands in the western United States under the provisions of NEPA and other regulatory and voluntary assessment initiatives. The authors are familiar with the extensive body of research concerning the socioeconomic impacts of industrial and natural resource development, which has helped inform this paper, although not explicitly referenced in all cases.

The types of potential cumulative socioeconomic effects discussed in this paper are not specifically identified as topics to be addressed in GEISs under SEQRA. Rather, the discussion reflects potential effects that the authors believe could arise over time, particularly if development evolves into large scale development. The discussion also reflects recent and continuing evolution of socioeconomic impact assessment practice with respect to identifying and disclosing potential cumulative socioeconomic effects and acknowledges the considerable uncertainties associated with long-term, geographically

dispersed activities involving multiple independent operators and multiple private landowners.

Several recent studies address aspects of natural gas development in the western U.S.; these studies illustrate the types of effects discussed in this paper. They include the *Northwest Colorado Socioeconomic Analysis and Forecasts* prepared for the Associated Governments of Northwest Colorado²⁹ and the *Sublette County Socioeconomic Impact Study: Phase I Final Report and Phase II Final Report*, prepared for the Sublette County, Wyoming Board of County Commissioners.³⁰ A third report, the *ExxonMobil Piceance Development Project Environmental Assessment - Socioeconomic Technical Report*,³¹ prepared by the authors for the U.S. Bureau of Land Management White River Field Office, assesses potential effects of a specific natural gas project in the context of ongoing large scale natural gas development in northeastern Colorado. A more recent journal article, *Energy Boomtowns & Natural Gas: Implications for Marcellus Shale Local Governments & Rural Communities*, published by the Northeast Regional Center for Rural Development,³² describes a model for impact assessment, presents a case study describing Sublette County's experience with large scale natural gas development and discusses some possible implications for Marcellus Shale Development.

Although NYSDEC can indirectly influence the occurrence and magnitude of some socioeconomic effects through its permitting and siting authority, the economic, employment and population-related aspects of natural gas development are not regulated, managed, or monitored by New York State agencies, or by local governments, although municipalities retain jurisdiction over local roads. This situation is not unique to New York State. Economic, employment and population-related effects of natural resource development are typically not regulated by federal agencies that disclose such impacts in NEPA documents nor by the states or communities that host development, although counties and communities can control the location and some aspects of growth with land use planning and zoning mechanisms. Additionally, some states have developed laws and regulations to regulate socioeconomic effects of certain types of projects,³³ although to our knowledge, none specifically address natural gas drilling.

2 Definition of “Cumulative”

A number of comments from the public and outside agencies on the dSGEIS concerned potential cumulative effects on community character and socioeconomic conditions within areas potentially affected by natural gas development. It is our perspective that

²⁹ Available at: http://www.agnc.org/reports/08-socioeconomic/agnc_final_mail_report_4-07-08.pdf

³⁰ Available at <http://www.sublettewyo.com/DocumentView.aspx?DID=355> and <http://www.sublettewyo.com/DocumentView.aspx?DID=392>

³¹ Available at: http://www.blm.gov/pgdata/etc/medialib/blm/co/information/nepa/white_river_field/completed_2007_documents.Par.59795.File.dat/PDPEASocioTechRep05-06V4.pdf

³² Available at: <http://nercrd.psu.edu/publications/rdppapers/rdp43.pdf>

³³ For example, the Wyoming Industrial Development Information and Siting Act, the Montana Hard Rock Mining Impact Act and the Montana Major Facility Siting Act.

fundamental differences in terminology and meaning exist between the use of the word “cumulative” in many of those comments and the term “cumulative” as it is used in the New York State Environmental Quality Review Act (“SEQRA”). We believe that most comments use the term “cumulative” as it has evolved under the National Environmental Policy Act (NEPA), as defined by the U.S. Council on Environmental Quality. The differences in meaning are explored below.

2.1 U.S. Council on Environmental Quality

The Executive Office of the President’s Council on Environmental Quality issued *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act*. (40 CFR Parts 1500-1508, July 1, 1986). Section 1508.7 defines cumulative impact.

“Cumulative impact” is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.”

NEPA requires general consideration of socioeconomic effects, but does not explicitly address effects on community character.³⁴

2.2 New York State Environmental Quality Review Act (SEQRA)

Although found repeatedly in 617: *State Environmental Quality Review*, the term “cumulative” is not specifically defined. References to the word include the following:

617.7(c) (2)

(2) For the purpose of determining whether an action may cause one of the consequences listed in paragraph (1) of this subdivision, the lead agency must consider reasonably related long-term, short-term, direct, indirect and cumulative impacts, including other simultaneous or subsequent actions which are:

- (i) included in any long-range plan of which the action under consideration is a part;
- (ii) likely to be undertaken as a result thereof; or
- (iii) dependent thereon.

617.9(b)(5)

(iii) a statement and evaluation of the potential significant adverse environmental impacts at a level of detail that reflects the severity of the impacts and the reasonable likelihood of

³⁴ Section 102(A) of NEPA requires federal agencies to “utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decision-making which may have an impact on man's environment.”

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their occurrence. The draft EIS should identify and discuss the following only where applicable and significant:

- (a) reasonably related short-term and long-term impacts, cumulative impacts and other associated environmental impacts;

and,

617.10

(e) In connection with projects that are to be developed in phases or stages, agencies should address not only the site specific impacts of the individual project under consideration, but also, in more general or conceptual terms, the cumulative impacts on the environment and the existing natural resource base of subsequent phases of a larger project or series of projects that may be developed in the future. In these cases, this part of the generic EIS must discuss the important elements and constraints present in the natural and cultural environment that may bear on the conditions of an agency decision on the immediate project.

The context for cumulative that emerges from SEQRA is one of impacts of related/dependent projects whereas the NEPA definition focuses on projects that may be independent but occur within the same, prior or subsequent timeframes and in close enough proximity/location to interact with the impacts of other projects. In practical terms, the NEPA definition is more encompassing than SEQRA. Many of the public comments on the dSGEIS appear to adopt the more broad NEPA perspective. Acknowledging and understanding the difference is central to the consideration of responses to those comments.

2.3 Social and Economic Considerations

There are also differences in the treatment of social and economic considerations between NEPA and SEQRA. NEPA implementing guidelines include social and economic effects among the types of effects that should be considered (40 CFR 1508.8). But, the implementing regulations also say that "...economic or social effects are not intended by themselves to require preparation of an environmental impact statement. When an environmental impact statement is prepared and economic or social and natural or physical environmental effects are interrelated, then the environmental impact statement will discuss all of these effects on the human environment" (40CFR 1508.14).

Under SEQRA, social and economic considerations are a subset of overall public need and benefits of a proposed action, which are to be balanced against environmental harm.³⁵ Purely economic arguments are also not considered appropriate for agency

³⁵ See SEQRA regulations at 6 NYCRR 617.9(b)(5), which provides that an EIS must contain (i) a concise description of the proposed action, its purpose, public needs and benefits, including social and economic considerations. This is consistent with the answers to question 8 (Why are social and economic considerations required in an EIS?) in Section 5.C of the SEQRA Handbook (page 117), and with questions

conclusions in a SEQR review, and some social considerations may be considered too arbitrary, discriminatory or speculative to include in an EIS.³⁶

3 Cumulative Socioeconomic Assessment

In the Marcellus Shale and other low-permeability gas reservoir development areas of New York, cumulative socioeconomic effects (both adverse and beneficial) could occur as a result of concurrent natural gas development (multiple rigs operating at the same time within the same development area and potentially in multiple development areas), coupled with secondary development of production and transmission infrastructure. Given a productive and geographically extensive resource, such development could occur over an extended period of time, which could also contribute to cumulative socioeconomic effects. As the natural gas resource is developed, produced and transported to markets, production activities will begin, overlapping with the development phase and creating additional potential for cumulative socioeconomic effects. In addition, natural gas development may occur simultaneously with other types of development again resulting in cumulative effects under the NEPA definition.

A number of comments on the dSGEIS suggest that NYSDEC should prepare quantitative forecasts of development based on hypothetical scenarios formulated on assumptions regarding the pace, location and ultimate scale of development for the Marcellus Shale resource. Some of these comments reference the cumulative and programmatic assessments completed under NEPA for proposed development on federal lands in the western U.S. as examples of quantitative cumulative forecasts that could be developed for the SGEIS. The comments suggest that this type of quantitative assessment is necessary for disclosing the effects of development and for enabling communities to plan for development.

In response, it would be our contention that when adequate information becomes available, quantitative development scenarios would be useful not as specific predictions of activity and the effects thereof, but to foster an understanding of the cumulative socioeconomic and community character impacts of development. But absent the necessary information to adequately inform realistic development scenarios, it is premature to prepare forecasts that would be of value for communities and other interested parties.

To be useful for affected communities, agencies and other interested parties, quantitative cumulative analysis of development for a given geography requires a reasonable understanding of the timing, pace, magnitude and location of development and other factors. The less actual experience in a particular area with the type of development under consideration and the wider the geographic region covered, the higher the degree of

14 and 15 in 5.I of the handbook (page 152). The SEQRA Handbook is online at: http://www.dec.ny.gov/docs/permits_ej_operations_pdf/seqrhandbook.pdf.

³⁶ See SEQRA Handbook at 5.C, question 9 (page 118).

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uncertainty associated with the parameters chosen for those factors and the less useful forecasts based on the factors will be.

Across the western United States, natural gas development typically occurs on land in public ownership or on lands having a mix of public and private ownership on which one or a relatively small number of operators have proposed the majority of development. Although analysis may occur at a programmatic level in some cases, operators typically must file a Plan of Development (POD) outlining the pace, timing and general location in which development will occur for an assessment for National Environmental Policy Act compliance. Because the POD identifies proposed development within a relatively large area, the ensuing NEPA assessment addresses potential impacts in a regional context over a period of time, commonly 15 years or more. No comparable analysis occurs under SEQRA because the individual well is the unit of analysis. Subsequent to the completion of the NEPA assessment, individual wells are still subject to individual siting review associated with an Application for Permit to Drill (APD).

The Marcellus Shale development area in New York covers 29 counties and approximately 18,700 square miles. Although active development of the Marcellus Shale is occurring nearby in the northern tier of Pennsylvania, limited development has occurred in New York to date. The emerging understanding of the productive potential of the Marcellus Shale, based on drilling and production experience in Pennsylvania and other states, has given rise to estimates of economically recoverable reserves sufficient to support extended large-scale development in New York, given supportive gas prices. However, the productive potential likely differs substantially across the New York development area, as will the cost for drilling and well completion and for production and gas transmission infrastructure development. Differences in productivity, along with other factors influencing the spatial distribution of gas service companies and other support activities make it unlikely that all communities in the New York portion of the Marcellus development area will experience development or the effects of development; certainly all will not experience such effects equally.

The vast majority of development will occur on privately owned land, in a land ownership pattern generally characterized by numerous owners, few of whom own large tracts. Operators must secure leases with individual landowners or consortiums of landowners in order to develop the resource. This ownership pattern can give rise to the involvement of multiple operators in developing the resource and to substantial variability in development levels and timing for any one development sub-area. Consequently, the number of operators that will develop the resource in New York is currently unknown, as are the development strategies and schedules of those operators.

Although hypothetical quantitative gas development scenarios could be prepared using the currently known extent of Marcellus Shale and other low-permeability gas resources in New York, in this instance the parameters chosen to estimate the location, pace, timing and ultimate extent of development would be speculative as would the designation of affected communities and assumptions about how and when these communities would be affected.

While we believe it is currently premature to prepare forecasts that would be of value for development sub-areas and individual communities, it is possible to qualitatively describe the types of socioeconomic effects that have accompanied natural gas development in other parts of the country. A description of the socioeconomic and community character effects that have accompanied natural gas development in other states could help achieve meaningful disclosure and inform future monitoring, forecasting and community and industry planning efforts.

The remainder of this paper describes socioeconomic effects that have accompanied natural gas development in the western U.S.,³⁷ and in some cases suggests how these effects might accrue to communities in the affected areas of New York. The paper also outlines a process for monitoring and forecasting the pace, timing and magnitude of development for individual communities and the region as a whole. The authors believe that such a process could promote the enhancement of the beneficial effects of natural gas development and facilitate avoidance, management and mitigation of potential adverse effects.

4 Socioeconomic Effects of Natural Gas Development

The types of socioeconomic effects (both beneficial and adverse) that can accompany natural gas development are generally well known. The following discussion summarizes these effects and is intended to be illustrative rather than exhaustive.

There are several characteristics of the natural gas industry that shape the socioeconomic effects of development.

- The natural gas development and production industry is decentralized.
- Unlike many industries, the natural gas production phase typically begins soon after development is initiated, typically as further development is ongoing.
- The industry is subject to a variety of influences that often result in cyclical patterns of development.

The decentralized nature of the natural gas industry results from the fact that development is performed by many companies of different types and sizes. Although exploration and production companies are the prime movers in natural gas development, the vast majority of the work is performed by contractors. These range from large, international contractors such as Halliburton and Schlumberger to very small local companies contracted to perform a variety of relatively non-specialized tasks such as surveying, transportation and excavation, to name but a few. An individual natural gas service company may work for a number of exploration and production companies within a development area. The decentralized nature of activity during the development phase can complicate the assessment and management of social and economic effects of natural gas development, because it is difficult to know in advance which contractors will be

³⁷The current development experience in Pennsylvania may eventually yield useful information for New York, but we have not yet encountered studies that assess the full range of socioeconomic topics.

used for development in a particular area and where those contractors will be located, which in turn complicates efforts to forecast employment levels and community effects.

Unlike most mines and industrial facilities, the production phase of natural gas development typically begins soon after development is initiated as wells are brought on line and gas is transported to markets. Consequently, the production phase overlaps the development phase. Production activities, infrastructure and employment increases until an area is completely developed. Correspondingly, economic activity, royalties and federal, state and local tax and royalty revenues associated with production begin to accrue during development.

Finally, the experience in the western U.S. has been that natural gas development can be volatile – although it is certainly not unique in that respect – manufacturing, technology, real estate and other sectors all typically experience periods of advance and decline. The pace, timing and perhaps even ultimate extent of natural gas development are affected by natural gas sales prices, by the cost of development and production in a particular area compared to other areas, by the availability of adequate transmission capacity or the lack thereof and by regulatory and policy incentives or impediments. The experience in the western U.S. has been that development levels have waxed and waned as prices have varied and technological advances have facilitated exploration, development and production of new gas resources. In part because of this decentralization, gas development levels can diminish rapidly as individual drilling and completion contractors and associated well service contractors are idled. In contrast, increasing the level of drilling and development can take more time, particularly if driven by major increases in gas prices. In such cases there is typically wide-spread competition for rigs and for experienced drilling, completion and well service employees both within and between development areas. Finally, even though development levels sometimes slow dramatically, gas production continues, generating ongoing employment and economic activity and ongoing, albeit, reduced levels of federal, state and local government tax and royalty revenues and leasing and royalty revenues to landowners.

4.1 STAGES OF NATURAL GAS DEVELOPMENT

The stages of development of a natural gas play can be grouped into five general categories: Exploration/Early Development, Moderate Development, Large Scale Development, Post-Development Production, and Closure and Reclamation, although not every natural gas play progresses to the Large Scale Development stage. Each stage of development can result in differing socioeconomic and community character effects, depending on the characteristics of an area and its communities. It is important to note that these stages are not discrete. For example, initial production begins during development and wells may be closed and reclaimed as production continues elsewhere in a field.

4.1.1 Exploration and Early Development

Exploration is the process of locating and defining natural gas deposits. During exploration companies use a variety of techniques including seismology and exploratory

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drilling to locate, define and explore the economics of gas deposits. Operators may initially drill a one or several wells in an area to help define the resource or to secure a lease, possibly returning to the well pad or elsewhere within the lease at a later date to drill multiple wells to fully develop the lease.

If exploration and early development activities do not identify economically productive natural gas resources, the Exploration and Early Development stage may be the only phase of development experienced in an area. Conversely, increases in gas prices or advances in technology may result in operators developing an area some time after initial exploration has occurred.

Identification of commercially viable resources typically triggers efforts to plan and develop supporting infrastructure to gather, treat, and deliver gas from the field to markets.

4.1.2 Moderate Development

Moderate Development is defined as a small number of rigs operating simultaneously in any one development area, with associated development of gathering systems and other support facilities. Moderate Development could include one operator employing several rigs or several operators developing leases in the same area.

Although some of the facilities associated with high volume hydraulic fracturing such as water withdrawal, drilling water impoundments, water reinjection wells and some gathering, compression, and transmission systems and other support facilities are developed during moderate levels of development, these facilities often do not achieve the highly consolidated and centralized nature that occurs during a Large Scale stage of development.

Moderate levels of development may occur for extended periods in some areas and for some areas may be the highest level of development that occurs, depending on gas prices, the extent and economic potential of the resource, the extent of leases held by individual operators in the area, and other factors.

4.1.3 Large Scale Development

Large Scale development involves multiple rigs operating in a local development area, with development occurring simultaneously in several development areas over a period of multiple years, and possibly decades. One industry official has suggested that Marcellus shale development in New York could potentially reach 2,000 wells per year. Based on the current drilling experience in the Marcellus Shale, achieving that level of activity would imply as many as 100 to 125 drilling rigs deployed across the region, along with other supporting activity.

Large Scale Development would involve concurrent installation of drilling and completion support facilities, including those necessary to support high volume hydraulic fracturing, such as water withdrawal and storage facilities, centralized water/flowback storage facilities, and water treatment and transportation facilities. During this stage,

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access road construction, development of gas gathering systems, construction of offsite production facilities, construction of gas transmission facilities (pipelines) and other activities necessary to bring the gas resource into production are likely to occur on a more consolidated and centralized basis because of the overall vision for development and the potential for achieving economies of scale.

Large scale development typically occurs as a result of a well defined resource base, sustained high gas sales prices to support economic recovery, adequate pipeline capacity to transport gas to local and regional markets, and the absence of large, significantly lower cost natural gas production areas elsewhere in the region or nation.

The potential that large scale natural gas development will occur in the Marcellus Shale development area of New York is substantial. The geographic extent and productive potential of the resource, the proximity of the resource to markets and the development success in the Marcellus Shale in other states indicate that development could ramp up rapidly, once drilling resumes.

4.1.4 Post-Development Production

As noted in the beginning of this section, natural gas production typically begins early in the development phase as wells are brought on line and gathering systems are connected to pipelines so that the gas can be transported to markets. Consequently production infrastructure is developed and production employment builds gradually as development proceeds. Typically the Post-Development Production phase extends many years beyond the completion of the development phase, with the volume of production declining over time. It is not uncommon for natural gas fields to be in production for decades, particularly if they are amenable to enhanced recovery techniques.

The Post-Development Production phase is also characterized by dramatic decreases in industrial activity and employment as compared to development, and, as interim reclamation occurs, a return to a landscape that begins to resemble the area's pre-development character.

4.1.5 Closure and Reclamation

As noted at the beginning of this section, closure and reclamation often begins during the production Phase as individual wells cease to be economically productive. However, gas prices and the economics of each field could result in wholesale closure of a field. Closure involves the decommissioning of wells and production facilities and the reclamation of well pads, production facilities and, if dictated by the leaseholder, reclamation of roads.

5 Standard Elements of Socioeconomic Assessment

Although different agencies, organizations and researchers may categorize them differently, socioeconomic impact assessment generally includes the following elements:

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- Employment and Economic Activity
- Population and Housing³⁸
- Community Infrastructure and Services
- Local and State Government Fiscal Conditions
- Attitudes and Values
- Social Conditions and Quality of Life
- Community Character

Community character is not always identified as a distinct element of socioeconomic assessment in the western U.S., perhaps because many of the aspects of community character are often included in the other socioeconomic elements. The following sections describe briefly the types of effects that natural gas development can have on each of these socioeconomic elements, drawing on the socioeconomic effects that have accompanied natural gas development in the western U.S. The discussions focus on the development and production stages, which are most likely to generate substantial socioeconomic effects.

5.1 Employment and Economic Activity

Natural gas development and production generates three types of employment.

1. Direct employment includes workers in natural gas service occupations, construction or other sectors involved in some aspect of natural gas-related drilling, field development or production.
2. Indirect employment includes jobs and portions of jobs created in other supply and service industries by natural gas industry purchases.
3. Induced employment includes jobs and portions of jobs created by direct, indirect and induced employee spending of natural gas-related income for goods and services. Induced employment, income and economic activity associated with natural gas development and production occurs across most economic sectors.

5.1.1 Development Phase Employment

Reduced to its most simple form, natural gas development phase employment levels are a function of the number of new wells drilled and completed each year, the labor component associated with each new well drilled and completed and the labor components associated with secondary facilities required to produce and transport the gas to markets. As noted, the potential number of new wells in the New York portion of the Marcellus Shale is substantial. Consequently, it is foreseeable that the number of

³⁸ Population and housing are typically treated as separate subjects in socioeconomic assessment. The topics have been combined here because the availability and location of housing is often the major driver of population effects of natural gas development.

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development phase jobs could rapidly increase over a number of years after drilling is authorized but then begin to stabilize over time.

Natural gas development is multifaceted and requires a wide mix of employment skills. Many of the required skills (e.g. earthmoving, truck driving, construction, mechanics, surveying and a variety of administrative skills) may be available in local labor force. In many cases, development companies will hire contractors and workers from the local labor pool, providing employment and economic benefits for the workers and new economic activity for local communities and the region.

However, a substantial portion of development work is performed by non-local workers because the specialized skills required for certain aspects of development are typically not available locally. Many non-local direct workers are transient in the early stages of development, relocating from development sub-area to sub-area temporarily, while maintaining their permanent residence and perhaps a family outside of the development area. If the natural gas development appears to be of sufficiently long duration, with sustained job opportunities and not subject to recurring and protracted seasonal shut-downs, some non-local workers may relocate, establishing residences and moving their households to communities within or near the development area.

Generally, moderate stage development is characterized by increased employment opportunities for local residents, moderate levels of spending by operators and contractors for goods and services, including increased contracting opportunities for non-specialized local businesses such as trucking, earthmoving and construction companies.

Large scale natural gas development correspondingly generates large numbers of jobs and increases in personal income and economic activity. These effects can be beneficial for many workers and companies, but can also present challenges for some local business and communities. The prospect of new, relatively high paying natural gas jobs is often seen as a beneficial effect of resource development, particularly in areas experiencing depressed economic conditions and substantial unemployment or underemployment. But in sparsely populated rural areas and small communities without a labor surplus, the available local labor force can quickly be exhausted by the labor requirements of large scale natural gas development. The labor demand often draws contractors and employers from surrounding communities or other parts of the region or state, but when the commute requires overnight stays, such employees become “non-local” from the perspective of communities in the development area.

The magnitude of development phase employment is often easy to observe, but difficult to monitor and track using secondary data sources because many workers’ employers and residences are located outside the development area.

In cases where gas development labor demand outstrips local supply, local employers often experience upward pressure on wages. From an employee’s perspective, higher wages are seen as beneficial. Businesses that share in the expanded economic activity

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associated with gas development may be able to increase wages sufficient to retain employees, but those who do not benefit from the increased economic activity may not.

Although the long hours, hard work and sometimes difficult working conditions typically associated with many aspects of natural gas development may not appeal to all workers, the relatively high wages typically entice some employees of local businesses and governments to seek jobs in development-related work. When this occurs, local businesses and governments may experience problems with employee retention and recruiting. If communities are within reasonable daily commuting distance of a larger community, local businesses and governments may be able to replace workers from the regional labor pool, thereby extending the employment and economic benefits of development to other communities. But for communities that are not within reasonable commuting distance of a larger labor pool, such difficulties can be compounded in instances where natural gas development workers have absorbed available affordable housing and housing prices escalate, limiting the ability to attract new workers from outside the development area. In these cases, some local businesses may have difficulty in profiting from the increased economic activity associated with natural gas development, because they cannot adequately staff their operations. Some retail and service businesses in large scale development areas have reportedly reduced services and hours of operations because of labor shortages. In addition to labor shortages, the increase in demand also leads to higher costs for goods and services in large scale development areas. As with higher wages, higher prices can pose hardships for businesses and individuals that do not share in the increased economic activity associated with development.

As noted above, during exploration and moderate stage development, local and regional contractors are likely to perform a portion of the development work. But specialized contractors, who at the early stages of development are likely to be non-local, typically relocate to the area on a temporary basis and specialized natural gas industry suppliers typically service the development from existing service centers in other areas and states. As development intensifies, contractors and suppliers establish new field offices in communities that are central to development areas with access to interstate highway and rail access. Such regional service centers typically serve development activities within a 100 to 200 mile radius. Given the geographic extent of the Marcellus Shale resource in New York, some initial development in the southern tier of New York is likely to be supported by companies presently located in northern Pennsylvania, but one or more regional service centers could emerge in New York over time. Continued development over time also provides expanded opportunities for local residents to become engaged in the industry through on-the-job work experience and advancement and training programs that are often established through local trade schools, colleges, and state employment agencies.

Finally, because labor markets are imperfect, and the availability of a relatively large number of jobs may result in an influx of job-seekers, some of whom lack necessary skills and qualifications and may be relatively indigent. To the extent that indigent job seekers are unable to find jobs or do not have resources to secure housing and

transportation to work; they can become a burden for local human service agencies. This situation can be exacerbated by weak economic conditions in other parts of the state or country.

5.1.2 Production Phase Employment

Producing natural gas fields require substantially fewer workers than gas-field development, with the number of production jobs essentially a function of the number and productivity of producing wells. Many of the jobs will be with gas production companies, but others will be with well service firms, pipeline companies, and other associated support businesses. Because these jobs begin to come online even as development continues, the total employment in the industry continues to increase over time, but is then subject to contraction as the pace of development wanes.

Production-related field operation and maintenance jobs are typically long-term, relatively high paying full-time jobs with benefits that require a mixture of technical, administrative and routine maintenance skills. Over time, the majority of the workers filling these jobs typically establish residence in communities near the gas fields.

Similar to direct development jobs, direct production-related jobs support additional indirect and induced employment, income and economic activity in the surrounding economy, again on a long-term basis. These benefits arise as gas companies procure a range of goods and services, often from a variety of vendors including some local companies, generating additional employment, income and economic activity. Because production-phase gas company and service firm employees typically live near production facilities, they spend a substantial portion of their income locally.

5.1.3 Potential effects of development on other sectors of local economies

Some comments on the dSGEIS expressed concern for the effects of natural gas development on other sectors of local economies including agriculture, outdoor recreation and tourism, second/retirement home development, local government, and in one instance, higher education. The potential for development to exert upward pressure on wages and the resultant effects on local businesses and governments is discussed above. Natural gas development also has the potential to affect other sectors of local economies, through changes in land use, visual and noise effects, changes in perceived aesthetics of an area, and increases in industrial activity and traffic in communities and rural areas where little such activity currently exists. However, while some of the potential effects could be viewed as adverse, others could also be viewed as beneficial.

The Marcellus Shale resource is overlain by large agricultural areas in New York. Development can affect agriculture adversely through surface disturbance and reductions in pasture and crop lands and through conflicts between industrial and agricultural activities. In cases where the agricultural operator owns the affected surface and mineral rights, the owner is likely to have factored the direct cost of these effects into a lease bonus and royalty agreement. Agricultural land-owners may also negotiate improvements such as water features, road improvements and fencing in lease agreements. Indirect effects may occur as businesses that purchase and process agricultural products and

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supply goods and services to the agriculture industry see reductions in economic activity related to removal of agricultural lands from production, although the percentage of agricultural lands permanently removed from production in any one development sub-area is likely to be relatively small. Lease and royalty income may encourage some agricultural operators to cease operations; conversely such income may allow other operators to weather the effects of fluctuating commodity prices and make equipment purchases, capital investments and improvements that they would not otherwise be able to afford. Development-related demand for industrial, commercial and residential development may also result in conversion of agricultural lands to these uses.

Natural gas development may affect tourism and outdoor recreation uses on land under development, on adjacent lands, and in some instances, at a more regional scale. The economic significance of these uses and associated activity varies across the development area, but is widely recognized as an important element of the local economic base. Surface disturbance, industrial activity, traffic, noise, changes in access, and visual effects can remove some lands from tourism and recreation use during development and alter the tourism and recreation setting on adjacent lands, potentially making them less desirable for many users. As with the agricultural lands, owners of land used for tourism and outdoor recreation purposes that secure leases with natural gas companies are likely to have factored the cost of these effects into their compensation for the lease agreement. Adjacent landowners who do not have leases and whose land is not involved through compulsory integration would not receive offsetting benefits. Tourism and recreational users of lands and resources affected directly and indirectly by traffic, changes in views, and access would also not receive direct benefits. At the same time, some tourism and recreation oriented establishments and venues may see increases in demand and activity due to development-related population growth and higher income among residents.

Areas undergoing development that have traditionally been used for hunting, bird watching and wildlife watching may experience reductions in wildlife and game during development. In many cases these reductions are likely to be temporary and associated primarily with the development phase. As with agriculture, businesses that provide goods and services exclusively to tourists and outdoor recreationists could experience reductions in economic activity during the development phase if tourists and outdoor recreationists are displaced to areas outside a particular business's service area. Reductions in economic activity associated with tourism and outdoor recreation visitors for many business that also serve the general public (e.g., motels, restaurants, convenience stores) could be offset by increases in business associated with natural gas development activity.

The effects of natural gas development on second home and retirement home populations and migration can be associated with development-related industrial activity, traffic, noise and visual effects, which could adversely change the aesthetic setting for some current and potential future second/retirement home owners within that area. The extent of the change would be dependent on a number of factors, including the extent and proximity of natural gas development relative to second/retirement homes, the duration of the development phase and the implementation and success of impact avoidance,

management and mitigation measures. Second/retirement homeowners who lease land for natural gas development would likely weigh the change in setting as they develop lease agreements with natural gas operators. Owners of adjacent lands without leases would obviously not receive lease benefits.

5.1.4 Potential effects of production on other sectors of local economies

During the transition from development to production, many of the development-related elements that can generate adverse effects on other sectors of local economies diminish or cease. Employment demand is drastically reduced, correspondingly reducing labor competition for local business and governments. Affected agricultural lands will in most cases be limited to lands leased for development and in most cases the amount of residual disturbance will be minimal.

Industrial activity and traffic is dramatically reduced. Much of the land disturbed for drill pads, pipelines and other secondary facilities is reclaimed. Visual and noise effects are dramatically reduced. In many cases, particularly if reclamation is successful and environmental damage or significant adverse publicity does not occur, affected land uses and economic activities will return to their pre-development conditions. Some tourists, recreationists and current and prospective second/retirement homeowners will view production-related facilities and activities as incompatible with these land uses. It is worth noting that the development phase could extend for years or even decades in any one area, so the period before return to post-development conditions may be likewise extended.

5.2 **Population and Housing**

Population growth associated with the natural gas industry development and production is directly linked to employment levels during these phases. Large scale development of the Marcellus Shale across the southern tier of New York could be expected to trigger population growth over the long-term.

5.2.1 Development Phase Population and Housing Effects

Although direct employment associated with development activity and the location and pace of the activity are primary drivers for population growth, a number of local factors also influence growth. In the Marcellus Shale development area, these factors include the levels of unemployment and underemployment in communities in and near the development area as development proceeds, the capacity of existing nearby industry service centers in Pennsylvania and elsewhere to accommodate development in the southern tier of New York, industry decisions for siting new regional service facilities, and the capacity of communities within and adjacent to development areas to accommodate non-local workers.

As noted in the preceding discussion on employment, many direct development phase workers tend to be transient, at least in the early stages of development. Some supervisory personnel and workers who perceive long-term employment opportunities may purchase homes, particularly near regional service centers, but the vast majority will initially seek temporary accommodations such as motels, recreational vehicle (RV) parks,

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mobile home parks and apartments and rental homes, if available. If housing availability is limited or as housing in these communities is absorbed, workers will travel in search of housing. The rapid increase in housing demand that accompanies large scale development often results in increases in housing costs and absorption of existing vacant housing, including sub-standard units. Over time, development-related demand can stimulate construction of new motels, apartments, and single-family homes. Although such construction expands supply, housing costs often remain high until the pace of development plateaus. Across the Marcellus Shale development area, such effects are most likely to be seen in/near the regional service centers.

Population centers near development areas, particularly those offering available conventional and/or temporary housing resources, are likely to attract development phase workers. Development employers can direct or influence some residency choices by providing transportation to and from communities and work sites and by leasing arrangements or occupancy commitments with temporary housing owners.

If no housing is available within commuting distance, workers may seek unconventional housing resources within or near the development area. It is common in many areas (depending on local zoning ordinances) for drilling workers to live in modular housing at the rig site during drilling. This may be particularly true for multi-well pads where multiple wells are drilled during one continuous period.

In areas where the available housing has been absorbed, well service, completion and pipeline companies may also seek to establish temporary worker housing (modular units or mobile home/RV spaces) at field offices and lay-down yards, again depending on local zoning ordinances. In the western US, temporary RV camps have also been established at local fairgrounds and vacant commercial or industrial facility parking lots. In rural areas where substantial development occurs, it is not uncommon to find large numbers of workers sharing apartments and rental houses, living in RV's in residential areas or camping in both approved and unapproved campsites.

Because many development phase workers tend to live in motels and other temporary housing and in many cases share accommodations, they are not readily recorded in population statistics. This can complicate planning, budgeting and service delivery issues for local governments.

The temporary and transient nature of development phase workers may cause developers and lenders to be cautious in responding to the increased housing demand. The volatility of natural gas prices and the "boom and bust" experiences in other large scale natural gas development areas may add to the uncertainty that developers and lenders have about responding to demand.

Development phase workers can absorb available rental housing under a large scale development scenario. Tight housing markets typically result in escalating rental housing costs, which can in turn price others out of the rental housing market. There is particular concern for people on fixed incomes that may not be able to keep pace with escalating

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housing costs, and for low to moderate-income retail and service workers needed to accommodate increased demand from development. In communities that cater to tourism and recreation visitors, competition for available temporary housing can occur, reducing availability for tourism and recreation visitors. Owners of temporary housing may receive an increase in income because development workers fill units during off seasons, but as noted above, the lack of available units for tourist and recreation visitors could affect businesses that rely on such visitors.

Development phase workers also create demand for new conventional single and multifamily housing units, particularly if the development phase is seen as long-term and sustained. This demand can support local residential development contractors and related industries and add to local property tax bases. Demand can typically be stronger in communities central to a development sub-area or several sub-areas or in communities near regional service centers.

5.2.2 Production Phase Population and Housing Effects

As noted in the preceding section on employment, ongoing natural gas production requires substantially fewer employees than the development phase and, because production phase employment builds during the development phase, most production-related population and housing demand will be in place before development ceases. The character of housing demand will likewise change from temporary to conventional housing (single family, multifamily and mobile homes).

Some production-related activities such as well workovers, recompletions and periodic gas field and pipeline maintenance activities require short-term temporary workers. These workers are relatively specialized and their presence in any one gas field is likely to be infrequent. Although these services will likely be established in the New York development area or perhaps in nearby northern portions of Pennsylvania, they are likely to travel to most parts on the development area and perform their tasks on a temporary and short-term basis. These temporary and short-term surges in employment can usually be accommodated within existing temporary housing resources in most areas.

As development winds down, the outflow of development workers will reduce population in communities where they reside, sometimes relatively quickly. Production-related population levels will be substantially less than development-related population levels, but somewhat higher than pre-development levels, assuming activity in other sectors of the economy remains the same.

If communities have added substantial temporary or short-term housing to accommodate development phase workers, surplus capacity may exist in these types of units after development is completed.

5.3 Community Infrastructure and Services

Natural gas development and production-related activities and the incremental population associated with those activities will generate demand for the full range of local government facilities and services and for some state government services. For example, during exploration and moderate stages of development, demand is usually limited to law enforcement, emergency response, emergency medical and road and highway maintenance and traffic control. Traffic, vehicle and industrial accidents and issues associated with a single-status, predominately working-age male workforce are the primary drivers associated with emergency response and law enforcement increases. Because many workers are temporary, and do not have local general purpose health care providers, they commonly use hospital emergency rooms for what would be otherwise be routine health care visits.

Transportation-related issues are some of the major drivers for local and state government service demand. Traffic and congestion issues in rural areas and communities, and the large number of heavy and at times overweight trucks can result in accelerated deterioration of roads not designed for industrial purposes. In New York, local governments retain jurisdiction over local roads and can require a road agreement, which could include completion of a road system integrity study to potentially assess fees for maintenance and improvements or a trucking plan³⁹ (NTC Consultants 2009).

During exploration and moderate stages of development, demand for local government utility infrastructure is typically minimal, because temporary workers live in existing housing, and local government infrastructure is presumably designed to accommodate populations associated with existing housing. But, local services may not be designed to accommodate year-round occupancy of temporary housing facilities. Solid waste and wastewater disposal facilities can be affected if such facilities are used by the development industry.

When large scale, multi-year development occurs, the full range of local government facilities and services can be affected, particularly for areas that are centrally located or emerge as regional service centers.

For communities that have undergone population decline in recent years, additional demand may be seen as a welcome effect. In these cases, use of excess facility capacity and the associated additional revenue may drive down costs for other residents. But even in cases where underutilized infrastructure capacity exists, equipment may need to be updated and improved and staff levels increased to meet the incremental development-related demand. In most cases staffing levels in communities are typically sized to accommodate existing demand and would need to be expanded to meet the incremental development-related demand.

³⁹ NTC Consultants. *Impacts on Community Character of Horizontal Drilling and High Volume Hydraulic Fracturing in Marcellus Shale and Other Low-Permeability Gas Reservoirs: Final Report*. Prepared for the New York State Energy Research and Development Authority. Albany, NY. September 16, 2009.

Utilities such as water, wastewater, stormwater drainage and solid waste disposal facilities and schools, recreation facilities, and in some cases, general government facilities often need to be expanded in communities that experience substantial growth. In order to be in place in time to accommodate growth, local governments need to be able to anticipate growth and need time to secure funding, and plan and construct facilities and expand programs in advance of growth. Obviously, local governments require revenue to fund needed facilities and services to accommodate growth, and local officials, bond underwriters and, in cases where voter approval is required, the general public seek to gain some level of reassurance that such growth will actually occur and be sustainable.

5.4 Local and State Government Fiscal Conditions

Natural gas development and production generate revenues for local and state governments through a variety of tax, license and fee mechanisms. Not only are public sector revenues derived directly from the activity, but also indirectly from the activities of suppliers and vendors, and local expenditures of wages and other income by employees and by lease and royalty revenues accruing to local leaseholders. Property taxes levied on production could be significant for those local entities from which production occurs, or in which associated development is located. Although the property taxes fluctuate in response to pricing changes for natural gas, any such revenues represent gains that would not otherwise accrue and for which few substitute sources exist. Local trade and service centers would benefit from increased sales tax revenues, and possibly increases in local property taxes based on real estate appreciation and new construction.

The experience in the western U.S. has been that as development proceeds and production levels rise, revenues to state and local government typically exceed the costs of servicing production-related service demand, thereby generating surplus revenue that can fund service enhancements, infrastructure improvements, or general tax relief for affected communities and for the state as a whole. Given the magnitude of the natural gas resource associated with the Marcellus Shale area of New York, the revenue to the state and certain local governments is likely to be substantial.

At the same time, the state and certain local governments will incur substantial costs to accommodate and service development-related activities and population growth. Even considering the substantial revenues generated by natural gas development and production, some local governments are likely to incur development related fiscal shortfalls, as a result of two relatively well recognized development-related fiscal phenomena.

- *Tax lag time* issues occur when a government entity directly affected by development faces a need to respond to development-related service demand before tax revenues from development flow to that entity. For example, some local governments will be required to provide law enforcement, emergency response and other services related to natural gas development before they receive production-related tax revenues. This often results in some combination of unmet

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service demand, decreased service levels for existing users, and higher costs for existing residents to fund the additional service demand. These effects typically are temporary in nature and subside as adequate revenues accrue to offset the costs of service.

- *Jurisdictional mismatch* issues occur when a local government experiences increased service demand but does not receive sufficient tax revenues from development to offset the cost of servicing the demand. This can occur in communities along transportation routes and in communities that host service companies and development employees but no actual development or production and with limited commercial business activity to capture increases in sales tax or property taxes from residential and commercial development. The effects of these issues are similar to tax lag time issues, i.e., unmet service demand, decreased service levels for existing users and higher costs for residents to fund the additional service demand, with the added problem that adequate revenue to address these issues are not forthcoming even in the long term.

Over time the adverse fiscal effects of tax lags tend to ease as production and development related sales taxes increase and the development-related demands stabilize or decline. Production related revenues may increase even more rapidly when rising production coincides with rising gas prices, often outpacing increases in service costs. Rising gas prices also translate into higher royalty receipts for lessors. Jurisdictional mismatch issues may also ease once the pace of development abates reducing demands on indirectly affected local governments and public service providers.

As some localities in the western states can attest, state and local governments also face risks of fiscal hardship if they become too dependent on development and production related revenues and gas prices decline suddenly. Communities can also face fiscal adjustments over time because production rates typically begin declining once the pace of new development slows or ceases; Marcellus Shale wells are projected to produce for 30 years or longer. Declining production triggers reductions in royalty income to owners and production related property and sales taxes for local government (assuming constant prices).

5.5 Attitudes and Values

As might be expected, residents of natural gas development areas in the western U.S. and other people with interest in those areas have a variety of opinions about that development. Similarly, many residents and persons and organizations with an interest in the Marcellus Shale and other low-permeability gas reservoir development areas of New York have already formed attitudes about the desirability and potential effects of natural gas development in these areas. These attitudes can be assumed to be generally reflective of the values of the individuals and organizations that hold them. While both positive and negative attitudes toward development have been expressed during the SGEIS scoping process and in various other forums, it is likely that many residents and interested persons and groups may hold a mixture of positive and negative attitudes and some have yet to

form hard and fast opinions. Attitudes toward development obviously influence the acceptance of development activities or resistance to such activities. Widespread resistance to development activities in the western U.S. have at times resulted in pressure for increased regulation of development.

The manner in which development occurs in New York and the perceived effectiveness of the regulatory structure and state and local agencies in ensuring that development proceeds in an orderly and environmentally safe fashion may help shape the attitudes about development. If environmental damage occurs or it is perceived that social conditions have been adversely affected, some currently uncommitted individuals and organizations and perhaps even some who are supportive could be driven toward an “opposed to development” position. Conversely, many communities across the west are supportive of natural gas development because of the associated economic benefits.

5.6 Social Conditions and Quality of Life

Social and quality of life effects of natural gas development and production have varied from community to community in the western U.S. and have been dependent on community size and pre-existing character and familiarity with development, the level of development that has occurred and the manner in which development has been managed, among other factors. Social effects of development can be both beneficial and adverse and the same activity may be experienced or perceived differently by different organizations, groups and individuals within the same community. Strong support for and opposition to development among different groups within a community can cause division and affect community cohesion.

The increase in economic activity, employment opportunities and royalty income that accompany development can serve to improve the standard of living and quality of life for many local residents and non locals alike.

The introduction of new activities, traffic, workers and residents and changes in the surrounding landscape can alter social conditions and quality of life in affected communities. In communities that experience substantial and sustained development activity and an influx of large numbers of workers relative to their size, these changes can be perceived by some as disruptive and can affect community satisfaction and personal well being. Where large numbers of development workers and their families relocate to a relatively small, previously stable community because of sustained employment opportunities, social integration and community cohesion can be affected.

For some residents of development areas, particularly those that are economically depressed, the opportunity for employment and increased income could result in positive changes in quality of life. The potential that an expanded labor force would accommodate residents not previously able to find work would also be seen as positive. For those local governments that receive revenues from development, the potential for new or improved facilities and services can also positively affect social conditions and quality of life.

But some areas that experience large scale development have reported substantial increases in a variety of crime and social problems including alcohol and drug-related offenses, traffic offenses, disturbances, assaults and domestic conflicts.⁴⁰ Although some increases in crime and social problems would be anticipated to accompany any increase in population, some researchers have also attributed the increased levels of crime and social problems to the temporary and transient nature of the workforce and their living conditions. There has been some debate in the social impact assessment literature about whether or not crime and other adverse social indicators increase at higher rates in communities experiencing large scale development than average rates for all communities.⁴¹ But the implications are clear that increases in crime and social problems are likely with large scale development, even if they are proportionate to the increase in the numbers of people working and living in affected communities.

5.7 Community Character

Natural gas development – particularly large scale development – can affect community character in a variety of ways. The location, timing and magnitude of development relative to a specific community and the particulars of a community’s predevelopment character are all factors that contribute to community character effects.

The availability of new jobs and new economic activity for communities with declining industrial and population bases could add vitality, diversity and renewed investment in commercial, industrial, residential and community infrastructure. Conversely, agricultural, tourism/outdoor recreation and second/retirement home-oriented communities that experience substantial and sustained industrial activity and traffic and large influxes of development employees relative to their predevelopment population could experience adverse changes in community character, particularly as perceived by residents and visitors who value the existing environmental, scenic and social setting of those communities.

Changes in community character would be most dramatic during the development phase, and the potential for extended, multi-year changes in character are substantial given the estimated size of the natural gas reserves and the time it may require to fully develop the resource and construct the required production and transportation facilities in any one development sub-area. Although some communities who place high value on their environmental, scenic and social setting may be able to regain their predevelopment character once development is completed and reclamation occurs, in some cases the sense that community character may have been adversely altered may persist for some residents and visitors after development ceases. It is also true that for some communities the

⁴⁰ For example, see Sublette County Socioeconomic Impact Study Phase I Final Report. Ecosystem Research Group. January 2008. Pages 54 – 58 and Index Crimes, Arrests, and Incidents in Sublette County 1995 to 2004: Trends and Forecasts. Prepared by J. Jacquet. Sublette County, Wyoming. April 2005, available at: <http://www.sublettewyo.com/DocumentView.aspx?DID=351>.

⁴¹ See Local Social Disruption and Western Energy Development: A Critical Review. Wilkinson et.al. Pacific Sociological Review Volume 25. Number , July 1982. Available online at: [http://www.sublettewyo.com/archives/42/Local_Social_Disruption_-_Critical_Review_Response_and_Commentary\[1\].pdf](http://www.sublettewyo.com/archives/42/Local_Social_Disruption_-_Critical_Review_Response_and_Commentary[1].pdf)

change in community infrastructure and housing stock enabled by development may be seen as a lasting improvement over the community's predevelopment character. There are numerous examples of communities in the western US that have used natural resource development revenues to fund construction of new facilities, enhance public services and service delivery, redevelop historic buildings and develop and improve tourism and recreation infrastructure.

For many communities, particularly those that emerge as regional service centers, beneficial economic changes in community character are likely to persist well into the production phase.

6 Summary

Development of natural gas resources in the western U.S. has resulted in substantial economic, community development and other benefits for affected communities and fiscal benefits for federal, state and local governments and has provided an important source of domestic energy. It has also resulted in adverse socioeconomic effects for some affected communities.

Given the extent of Marcellus Shale Reserves, the demand for natural gas and proximity of the Marcellus Shale area to major markets, the potential for large scale development in the New York development area is substantial. As has been the case in the western U.S., large scale development could result in substantial economic and fiscal benefits for the State of New York, affected communities and the nation as a whole. But the potential that some communities within and near development sub-areas could be adversely affected also exists. Although it is premature to prepare quantitative forecasts of potential effects of development, the experience with large scale natural gas development in the western U.S., indicates that potential socioeconomic effects could include labor shortages, workforce competition, housing shortages and escalating housing costs, additional burdens on local government infrastructure and service systems, local government fiscal deficits, congestion and other traffic problems, changes in community social conditions and character and community dissatisfaction. Such impacts are unlikely to occur uniformly across the landscape or in time, but would be foreseeable in some cases.

Perhaps the most important lesson that can be drawn from the natural resource development experience in the western U.S. is that planning for development is essential. Planning can help enhance the benefits of development and avoid, manage and mitigate many of the adverse effects. It is also clear that with proper planning, the investments made to accommodate development can be leveraged to create infrastructure to meet long-term economic and community sustainability objectives.

As noted earlier in this paper, several states have created mechanisms to require proponents of certain types of industrial and natural resource development initiatives to describe their projects in detail and work with affected communities to accommodate the associated workforce and population. To our knowledge, none of these mechanisms

include natural gas development as one of the regulated industries, in part, we suspect, because of the decentralized nature of the industry.

There are also examples of planning initiatives involving federal, state, community and industry stakeholders that have been initiated by agencies of the federal government, such as the Pinedale Anticline Working Group,⁴² which was developed by the U.S. Bureau of Land Management to address the effects of natural gas development in Sublette County, Wyoming.

Finally, there are joint public/private initiatives that have involved industry organizations and local and state governments to identify and address socioeconomic impacts. One such initiative designed to specifically address the effects of large scale natural gas development was the Overthrust Industrial Association (OIA).⁴³ The OIA example is probably the most germane to the New York Marcellus Shale case, because it was a voluntary initiative organized by the natural gas industry with active involvement of state and local government.⁴⁴

The remainder of this paper describes how a similar initiative could function in the Marcellus Shale Development Area of New York. Other models are certainly possible; the model presented here is intended as a vehicle to describe the components of a process that would help affected communities, the state and the natural gas industry monitor development, forecast future development and work collaboratively to enhance the beneficial effects of development and avoid, manage and mitigate potential adverse effects.

7 A Model for a Joint Private/Public Effort to Address Socioeconomic Impacts

The foundation of the model described in the following section is a joint natural gas industry, state and local government initiative. Industry participation could be in the form of a Marcellus Shale natural gas industry association or a similar subdivision of an existing natural gas industry association.⁴⁵

7.1 Ongoing Updates and Monitoring

Local governments need reliable information to plan for development. Communities need to know how much development will occur in and near communities, and when it will occur. They need to know if companies and contractors will locate offices and yards in their communities, the areas likely to undergo development and the major transportation

⁴² See <http://www.sublettewyo.com/DocumentView.aspx?DID=365> and <http://www.sublettewyo.com/DocumentView.aspx?DID=364>

⁴³ See http://www.sublettewyo.com/archives/42/Overthrust_Case_Study_1988%5b1%5d.pdf

⁴⁴ In the interest of disclosure, one of the authors of this paper, George Blankenship, served as Coordinator for the OIA from 1981 through 1984.

⁴⁵ Some individual gas exploration and production companies routinely engage communities in which they operate to provide information about their activities and solicit community input on development. But because of the decentralized nature of gas development, it is preferable to include all exploration and production companies in the development area and as many major service firms as possible.

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routes that will be used to reach well pads and secondary production facilities. While not all information is needed at once, communities need this information sufficiently in advance to allow them to plan and construct the necessary infrastructure and services to accommodate development. Communities also need some certainty that development will actually occur and that they will receive the necessary revenues from development to pay for needed infrastructure and service improvements in a timely fashion. Advance information allows communities to factor in sustainability considerations as they plan for development.

Local and regional economic/community development organizations could benefit from advance information to develop strategies for capitalizing on industry-related investment in infrastructure and demand for goods and services. Industry could in turn benefit from local proposals for such things as industrial parks, workforce housing facilities, workforce training centers and inventories of local vendor capabilities.

Although the benefits of detailed information about gas development plans and possibilities are clear, the decentralized nature of the natural gas industry, the volatility of gas prices and uncertainty about productivity, costs and environmental/regulatory constraints, particularly in relatively new plays such as the Marcellus, limits the availability and certainty of development information. However, after the SGEIS is approved and drilling in the Marcellus Shale development area resumes, it is likely to require some time for companies to achieve elevated drilling levels. This time could be used to put a system in place to monitor development, prepare informed forecasts of future development and begin the process of planning for development.

An effective method for monitoring and forecasting development requires involvement of the natural gas industry as well as state and local governments. State government has information on the extent of the Marcellus Shale resource, applications for drilling permits, secondary production facilities and pipelines. Natural gas operators have development plans and strategies. Typically companies allocate development budgets for several years. Budgets provide a degree of certainty that development plans will actually be accomplished within the budget period. It is true that companies can change development plans quickly based on drilling success, commodity prices and other factors. It is also true that some companies may be reluctant to share their long range plans for competitive reasons. But if monitoring reports and forecasts are updated frequently (we suggest semiannually during the first five years of development) and forecasts are prepared by industry association staff or contractors that aggregate information by sub-area and hold individual operator's data confidential, it is possible to overcome these concerns. It would also be important to preface each forecast with the caveat that the projections are the best available at the time, but subject to change with changing conditions.

Industry monitoring information should include sub-area level information for wells drilled and completed, wells planned for the near term, mid term and long term, again recognizing that mid term and long term projects carry an increasing amount of uncertainty. Monitoring should also include plans for pipelines and secondary production

facilities. Finally, industry staff or contractors could collect and aggregate information about employment for each development activity such as the location of companies and contractors, the number of employers performing each activity and the demographic, housing and residency characteristics of the employees. This information would be useful not only for demonstrating the location of actual economic benefits of development, but for calibrating future forecasts to allow industry and local and state government to more accurately assess population, housing and service demand aspects of future development in sub-areas and for the development area as a whole.

Local governments routinely collect information about changing socioeconomic conditions including population change, housing starts, temporary housing occupancy statistics and other relevant and useful indicators. Correlated with state and industry development information, these indicators would be a powerful element for tracking community growth from development and predicting the future path of growth.

Local and state governments can also track and report resource related tax payments. This information is useful for tracking actual benefits of development and is also important for identifying development related revenues as resources for offsetting development-related costs to local government entities.

As noted above, it is recommended that monitoring reports and projections be prepared semiannually during at least the first five years of development. At the sub-area level, working groups of operators and local and state government officials and staff should meet to review the results of the reports and discuss benefit enhancement measures and strategies to avoid, manage and mitigate identified adverse socioeconomic effects. Having the ability to address issues in a working forum can help defuse controversies and foster a collaborative approach to accommodating development.

The process described above would lead to timely and dynamic quantitative forecasts of future development, which would be updated and informed by industry and community experience. The description of potential socioeconomic and community character effects that would flow from such a process would help achieve meaningful and timely disclosure, and the output of the forecasting process would be a key element of community and industry planning efforts.

7.2 Impact Assessment and Planning

The purpose of development forecasts is to allow communities and industry to plan for development. If forecasts reveal that a sub-area is likely to receive a high level of development, communities and industries can work together to insure that development is accommodated in a manner that benefits both industry and the affected communities.

Industry has some ability to steer certain aspects of development such as field offices and equipment yards to communities that can accommodate such facilities and are desirous of the development. Through housing and transportation incentives, companies can influence where workers live.

Communities that are aware of development potentials can make decisions about whether or not they want to accommodate development and provide incentives for attracting, companies and workers to their communities. With advance information and forecasts, they can factor sustainability considerations into their plans to accommodate development, and use industry investments to leverage the construction of facilities to meet their sustainability objectives. To the extent that communities and lenders become confident in the forecasts, they can be used to support construction financing, and explicit disclosure of the factors and uncertainty that underlie the forecasts would help communities and lenders to factor the potential volatility of the natural gas industry into financing instruments.

Information about the location, pace and magnitude of development would allow communities and companies to collaborate to develop guidelines and policies for development such as industry-wide transportation policies and corporate social responsibility guidelines.

Information about current and anticipated revenues from development would allow communities to contrast anticipated revenues with anticipated costs to accommodate development. The resultant fiscal assessment could be used again to help communities and companies guide certain aspects of development to communities that will receive substantial revenues.

7.3 Strategies to Enhance Positive Effects and Avoid, Manage or Mitigate Adverse Effects

The long-term objectives of impact assessment and planning include enhancing the positive socioeconomic effects of natural resource development while simultaneously working to avoid, manage or mitigate adverse effects. Examples of opportunities to achieve these objectives, which reflect experiences from other natural gas development areas, are highlighted below.

7.3.1 Examples of strategies to address employment, income and other economic effects

The establishment of programs to train local residents in skills needed by the natural gas industry can accomplish several objectives. Such programs allow local residents to obtain skilled development-related jobs, reducing unemployment and underemployment and increasing local incomes. Such programs provide additional employment and revenue for local and regional educational institutions. In some cases, the natural gas industry has supported the development of such programs with grants. The employment of local residents in natural gas development can reduce development-related immigration, which correspondingly reduces initial housing demand and demand on local government infrastructure and services.⁴⁶

⁴⁶ The Pennsylvania College of Technology has developed a Marcellus Shale Education and Training Center. See <http://www.pct.edu/msetc/>. A number of other Pennsylvania educational institutions have also developed programs to train natural gas industry workers, according to a July 4, 2010 associated press story

The highly specialized nature of natural gas activity requires substantial purchases of goods and services from vendors located outside the development area. But other goods such as aggregate, concrete, water and fuel are typically acquired locally, as are many routine hardware, administrative and housekeeping supplies. Local purchase of these goods and services indirectly generates employment and income in a variety of local economic sectors. One method to enhance local purchasing is for gas industry associations to exchange information with local economic development organizations about industry goods and services requirements and local vendor capabilities to provide these goods and services. Local vendors can also determine if it would be profitable to expand their product lines to accommodate natural gas industry demand. These activities will occur with or without industry /community cooperation, but an institutionalized process could streamline the development of local service infrastructure.

As with the development phase, training of local residents for production-related jobs and establishing local business capabilities to provide the requisite goods and services are methods to enhance local benefit.

7.3.2 Examples of strategies to address potential effects on other sectors of the local economy

Some effects on other sectors of the economy are likely unavoidable. Some tourists and outdoor recreation visitors and current and prospective second and retirement homeowners may view natural gas development as incompatible with these activities. Measures to reduce noise and visual effects of development, to locate industrial activity and traffic away from tourism, recreation and second/retirement home land uses, where possible, and to conduct these activities at times where other uses do not occur, where practical, could reduce adverse effects of the conflicts. In many cases, the conflicts will be temporary during development and abate during the production phase depending on the success of reclamation programs, the proximity of well pads and production facilities to these land uses and the specific use and terrain conditions. However for some, the setting may be irreversibly altered.

Strategic siting of drill pads and production facilities and the management of traffic, noise and visual effects are the most effective tools for avoiding and managing production phase effects on other sectors of local economies.

7.3.3 Examples of strategies for addressing housing and population effects

The availability and location of housing are key factors in the generation of socioeconomic effects of large scale development projects, and housing development or stimulation by gas companies and the efficient location of such housing are some of the most effective tools for enhancing benefits of development and avoiding, managing and mitigating adverse effects. Although there may be fairly large communities within the development area that have substantial existing available housing resources, these

titled "*Pa. colleges ramp up training programs for Marcellus Shale work force*," accessed online at: <http://www.pressconnects.com/article/20100704/NEWS01/7040351/Pa.+colleges+ramp+up+training+programs+for+Marcellus+Shale+work+force>

communities may be at some distance from active development sub-areas. In western states where there are a limited number of communities separated by considerable distances, the lack of housing availability has given rise to the development of temporary living facilities – also known as construction camps. These facilities can range from modular dormitory units that host four or more workers and are situated in commercial mobile home or RV parks to large stand-alone facilities that host hundreds of workers with onsite security, dining, housekeeping, fitness/recreation and transportation services.

Other temporary housing strategies could involve joint industry/private developer, industry/community or industry/non-profit ventures, wherein long-term commercial or community housing needs are leveraged by industry investment to meet both temporary worker and long term commercial or community housing needs. Examples include motels and RV parks that house temporary workers during the development phase and are subsequently used to house tourists and recreation visitors. Long-term community and non-profit housing needs could be accommodated by developing facilities to serve temporary development workers that are converted for community purpose such as assisted living facilities, low income housing, or group quarters when no longer needed for development. The key to these strategies is early industry/community collaboration.

Because the production phase gears up during development, long-term direct housing demand is more gradual than short-term demand. But the need to accommodate indirect and induced workers during the development phase may encourage some developers to invest in new housing; conversely, concerns about the duration of demand and volatility may discourage such development. Ongoing information about industry development plans can inform developer's decisions.

8 Conclusion

As noted above, perhaps the most important lesson that can be drawn from the natural resource development experience in the western U.S. is that planning for development is essential. In reality, neither the federal government nor the states have ever done a good job of advance planning for large scale natural gas development, in our opinion. Even the aforementioned Pinedale Anticline Working Group and the Overthrust Industrial Association were initiated after development had resulted in adverse community and local government effects and the affected communities had to play catch up to remedy the socioeconomic impacts of development. The result in those cases was that the substantial economic and fiscal benefits for the states and local governments were at least initially overshadowed by adverse community and social impacts.

It is premature to effectively forecast the location, timing and magnitude of development in the Marcellus Shale development area of New York. But given the size of the resource, the proximity to major markets and the increasing role of natural gas in meeting the nation's energy requirements, large scale development in New York is likely. Large scale development has the potential to generate substantial economic and fiscal benefits but also has the potential to generate substantial adverse economic, social and community character effects for affected communities.

Socioeconomic Effects of Natural Gas Development

New York and the natural gas industry currently have time before the SGEIS is approved and large scale development occurs. That time could be used by industry, the State and local governments to put a monitoring and forecasting mechanism in place, and begin formulating a process and strategies to enhance the benefits of development and avoid, manage and mitigate potential adverse effects.

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