

New York's Prescription for Hydraulic Fracturing

New York State Department of Environmental Conservation

INTRODUCTION

The Department of Environmental Conservation is responsible for the regulation of oil and gas resources production in New York. With recent advances in technology, namely the introduction of a new natural gas extraction technique, high-volume hydraulic fracturing (HVHF), the previously unreachable natural gas reservoir of the Marcellus Shale¹ is now a target for industry prospectors. However, under New York's Environmental Quality Review Act, significant review of the technique is needed before permits can be issued in the state.

The final scope of topics necessary for review relative to permit issuance for HVHF was issued by the state in February 2009. By September 2009, a Draft Supplemental Generic Environmental Impact Statement (dSGEIS) was released for public review and

comment. Over 13,000 comments were received. In December 2010, Governor Paterson issued Executive Order No. 41, ordering the Department of Environmental Conservation to conduct further environmental review to "ensure that all environmental and public health impacts are mitigated or avoided."

As part of this review, NYSDEC supplemented its analysis by including HVHF experiences and data from the state of Pennsylvania. The department examined widely publicized incidents including gas migration, fracturing fluid releases, uncontrolled release of flowback water and brine, and high total dissolved solids (TDS) discharges within several counties and bodies of water in the state. These incidents have caused public concern about the safety and potential adverse impacts associated with HVHF in Pennsylvania and elsewhere.

A revised dSGEIS was released for public review in July 2011. This draft received over 60,000 comments before the comment period was closed

in January 2012. New York has yet to lift a statewide moratorium on fracking. Most recently, the approval process has been suspended to allow New York State Commissioner of Health, Dr. Nirav Shah, time to review the dSGEIS and assess whether the potential impacts to public health have been adequately addressed.

The dSGEIS reviews these and other potential impacts of several aspects of HVHF activity including water withdrawal, transportation, the use of additives in water, facility requirements, and waste disposal. It also outlines the regulations and restrictions that should be imposed on the activity to safety and sustainably develop shale gas resources.

These risks and proposed regulations represent important considerations for any state or locality contemplating the initiation of hydraulic fracturing on their land. The dSGEIS should be required reading for any jurisdiction contemplating the implementation of HVHF. Eds.

¹ The Marcellus Shale is a black shale formation extending from Ohio and West Virginia northeast into Pennsylvania and Southern New York.

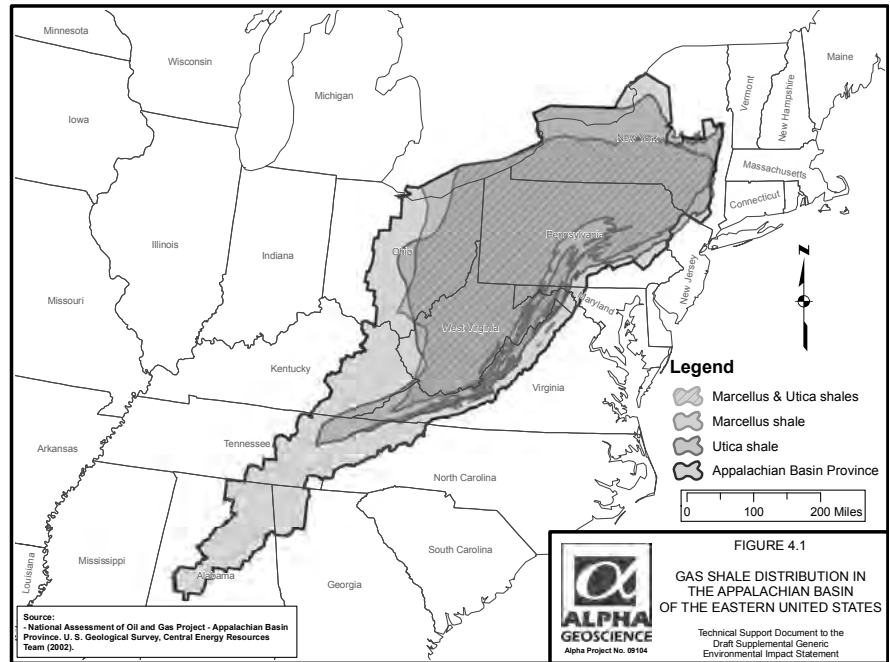
This article is a series of excerpts from the revised draft of the Supplemental Generic Environmental Impact Statement on the Oil, Gas, and Solution Mining Regulatory Program regarding Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs dated September 7, 2011 and prepared by the New York State Department of Environmental Conservation with Assistance from Alpha Environmental, Inc., Ecology and Environmental Engineering, P.C., ICF International, URS Corp, NTC Consultants and Sammons/Dutton LLC. For complete information on current and proposed NYSDEC regulations, please refer to the full 2011 draft SGEIS and 1992 GEIS available via the NYSDEC website at www.dec.ny.gov.

High-volume hydraulic fracturing is a well stimulation technique that has greatly increased the ability to extract natural gas from very tight rock. HVHF, which is often used in conjunction with horizontal drilling and multi-well pad development, is an approach to extracting natural gas in New York that raises new, potentially significant, adverse impacts not previously studied. Increased production of domestic natural gas resources from deep underground shale deposits in other parts of the country has dramatically altered future energy supply projections and has the promise of lowering costs for users and purchasers of this energy commodity.

HVHF is distinct from other types of well completion that have been allowed in the state due to the much larger volumes of water and additives used to conduct hydraulic fracturing operations. The use of HVHF with horizontal well drilling technology provides for a number of wells to be drilled from a single well pad (multi-pad wells). Although horizontal drilling results in fewer well pads than traditional vertical well drilling, the pads are larger and the industrial activity taking place on the pads is more intense. Also, hydraulic fracturing requires chemical additives, some of which may pose hazards when highly concentrated. The extra water associated with such drilling may also result in significant adverse impacts relating to water supplies, wastewater treatment and disposal and truck traffic. Horizontal wells also generate greater volumes of drilling waste (cuttings). The industry projections of the level of drilling, as reflected in the intense development activity in neighboring Pennsylvania, has raised additional concerns relating to community character and socioeconomics.

General Background

In 2011, the USGS estimated a mean of 84.2 Tcf of technically recoverable undiscovered natural gas reserves in



the Marcellus Shale in the Appalachian Basin, more than a 40-fold increase from a previous 2002 estimate of 1.9 Tcf. In New York, the primary target for shale-gas development is currently the Marcellus Shale, with the deeper Utica Shale also identified as a potential resource. Gas has been produced from the Marcellus Shale in New York since 1880 when the first well was completed in Ontario County. As of September 2011, all gas wells completed in New York’s Marcellus Shale have been vertical wells.

The New York State Department of Environmental Conservation (NYS-DEC) prepared a revised draft Supplemental Generic Environmental Impact Statement (dSGEIS) to satisfy the requirements of the State Environmental Quality Review Act (SEQRA) by studying the new technique and identifying potential new significant adverse impacts for these anticipated operations. In reviewing and processing permit applications for HVHF in these deep, low-permeability formations, NYSDEC would apply the requirements contained within existing regulations, as well as with the final SGEIS and the findings drawn from it.

Based on industry projections, NYS-DEC has determined that it may receive applications to drill approximately 1,700 - 2,500 horizontal and vertical wells for development of the Marcellus Shale by HVHF during a “peak development” year. An average year may see 1,600 or more applications. Development of the Marcellus Shale in New York may occur over a 30-year period. Those peak and average levels of development are the assumptions upon which the analyses contained in the dSGEIS are based.

The final SGEIS will apply statewide, except in areas that NYSDEC proposes should be off-limits to surface drilling for natural gas using HVHF technology, as discussed below. Forest Preserve land in the Adirondacks and Catskills is already off-limits to natural gas development pursuant to the New York State Constitution.

Natural Gas Development Activities & HVHF

The average disturbance associated with a multi-well pad, access road and proportionate infrastructure during the drilling and fracturing stage is estimated

at 7.4 acres. The average disturbance associated with a well pad for a single vertical well during the drilling and fracturing stage is estimated at 4.8 acres in comparison. As a result of required partial reclamation, the average well pad would generally be reduced to averages of about 5.5 acres and 4.5 acres, respectively, during the production phase.

Because most shale gas development would consist of several wells on a multi-well pad, more than one well would be serviced by a single access road instead of one well per access road as was typically the case historically. Therefore, in areas developed by horizontal drilling using multi-well pads, it is expected that fewer access roads as a function of the number of wells would be constructed. Industry estimates that 90% of the wells used to develop the Marcellus Shale would be horizontal wells located on multi-well pads. This method provides the most flexibility to avoid environmentally sensitive locations within the acreage to be developed.

With respect to overall land disturbance from horizontal drilling, there would be a larger surface area used for an individual multi-well pad. This would be more than offset, however, by the fewer total number of well pads required within a given area and the need for only a single access road and gas gathering system to service multiple wells on a single pad.

The HVHF process involves the controlled use of water and chemical additives, pumped under pressure into the cased and cemented wellbore. To protect fresh water zones and isolate the target hydrocarbon-bearing zone, hydraulic fracturing does not occur until after the well is cased and cemented, and typically after the drilling rig and its associated equipment are removed from the well pad. NYSDEC would generally require at least three strings of cemented casing in the well during fracturing operations. The outer string (i.e., surface casing) would extend below fresh ground water and would

be cemented to the surface before the well was drilled deeper. The intermediate casing string, also called protective string, is installed between the surface and production strings. The innermost casing string (i.e., production casing) typically extends from the ground surface to the toe of the horizontal well.

The fluid used for HVHF is typically comprised of more than 98% fresh water and sand, with chemical additives comprising 2% or less of the fluid. Additives include acids, breakers, bactericide/biocides, corrosion inhibitors, friction reducers, gelling agents, iron controls, scale inhibitors, and surfactant. (A list of specific chemical constituents is included in Chapter 5 of the dSGEIS available online.²) It is estimated that 2.4 million to 7.8 million gallons of water may be used for a multi-stage hydraulic fracturing procedure in a typical 4,000-foot lateral wellbore. Water may be delivered by truck or pipeline directly from the source to the well pad, or may be delivered by trucks or pipeline from centralized water storage or staging facilities consisting of tanks or engineered impoundments.

After the hydraulic fracturing procedure is completed and pressure is released, the direction of fluid flow reverses. The well is “cleaned up” by allowing water and excess proppant (typically sand) to flow up through the wellbore to the surface. Both the process and the returned water are commonly re-

ferred to as “flowback.” Estimated flowback water volume ranges from 216,000 gallons to 2.7 million gallons per well, based on a pumped fluid estimate of 2.4 million to 7.8 million gallons.

Estimates of potential gas production from HVHF operations in the New York Marcellus Shale per well are as follows:

High Estimate

Year 1 – initial rate of 8.72 MMcf/d declining to 3.49 MMcf/d.
Years 2 to 4 – 3.49 MMcf/d declining to 1.25 MMcf/d.
Years 5 to 10 – 1.25 MMcf/d declining to 0.55 MMcf/d.
Years 11 and after – 0.55 MMcf/d declining at 5% per annum.
The associated estimate ultimate recovery (EUR) is approximately 9.86 Bcf.

Low Estimate

Year 1 – initial rate of 3.26 MMcf/d declining to 1.14 MMcf/d.
Years 2 to 4 – 1.14 MMcf/d declining to 0.49 MMcf/d.
Years 5 to 10 – 0.49 MMcf/d declining to 0.29 MMcf/d.
Years 11 and after – 0.29 MMcf/d declining at 5% per annum.
The associated EUR is approximately 2.28 Bcf

Water Resources Impacts

Potential significant adverse impacts on water resources exist with regard to water withdrawals for hydraulic fracturing; storm water runoff; surface spills, leaks and pit or surface impoundment failures; groundwater impacts associated with well drilling and construction; waste disposal and New York City’s subsurface water supply infrastructure. Additional concerns have been raised relating to the potential degradation of New York City’s surface drinking water supply and potential groundwater contamination from the hydraulic fracturing procedure itself.

2 A list of all fracturing additive products disclosed to NYSDEC with complete chemical information, including complete product composition disclosures and MSDSs, is presented in Table 5.4 in Chapter 5 of the 2011 draft SGEIS. Table 5.5 is a list of products for which only partial chemical composition information was provided to NYSDEC. Chapter 5 is available for download at http://www.dec.ny.gov/docs/materials_minerals_pdf/rdsgeisch50911.pdf.

Water Withdrawal

Water for hydraulic fracturing may be obtained by withdrawing it from surface water bodies away from the well site or through new or existing water-supply wells drilled into aquifers. Without proper controls on the rate, timing and location of such water withdrawals, the cumulative impacts of such withdrawals could cause modifications to groundwater levels, surface water levels, and stream flow that could result in significant adverse impacts, including but not limited to impacts to the aquatic ecosystem, downstream river channel and riparian resources, wetlands, and aquifer supplies.

Applicants would not only have to follow Susquehanna River Basin Commission (SRBC) and Delaware River Basin Commission (DRBC) protocols for water withdrawal where applicable, but would also be required to adhere to a more stringent and protective passby flow requirement in regards to water withdrawal plans – whether inside or outside of the Susquehanna or Delaware river basins.

Storm Water Runoff and Surface Releases

All phases of natural gas well development, from initial land clearing for access roads, equipment staging areas and well pads, to drilling and fracturing operations, production and final reclamation, have the potential to cause water resource impacts during rain and snow melt events if storm water is not properly managed. Proposed mitigation measures to prevent significant adverse impacts from storm water runoff include erosion prevention and sediment control measures through state permitting programs, the prohibition of drilling within a certain radius of surface waters, drinking water supplies, and structures.

Spills or releases in connection with HVHF could have significant adverse impacts on water resources. A significant number of contaminants are contained in fracturing additives, or

otherwise associated with HVHF operations. Spills or releases can occur as a result of tank ruptures, equipment or surface impoundment failures, overfills, vandalism, accidents (including vehicle collisions), ground fires, or improper operations. Spilled, leaked or released fluids could flow to a surface water body or infiltrate the ground, reaching subsurface soils and aquifers.

Groundwater Contamination

Well drilling and construction associated with HVHF can have significant adverse impacts on groundwater resources. These potential impacts

... concerns have been raised relating to the potential degradation of New York City's surface drinking water supply and potential groundwater contamination ...

include impacts from turbidity, fluids pumped into or flowing from rock formations penetrated by the well, and contamination from natural gas present in the rock formations penetrated by the well. These potential impacts are not unique to horizontal wells or HVHF. The concentrated nature of the activity on multi-well pads and the larger fluid volumes and pressures associated with HVHF require enhanced procedures and mitigation measures.

It is highly unlikely that groundwater contamination would occur by fluids escaping from the wellbore for hydraulic fracturing. In 2009, regulatory officials from 15 states testified that groundwater contamination as a result of the hydraulic fracturing process in the

tight formation itself had not occurred. Regardless, prior to drilling, operators would be required to test private wells within 1,000 feet of the drill site to provide baseline information and allow for ongoing monitoring. If there are no wells within 1,000 feet, the survey area is extended to 2,000 feet.

The potential migration of natural gas to a water well presents a safety hazard because of its combustible and asphyxiant nature, especially if the natural gas builds up in an enclosed space such as a well shed, house or garage. Well construction associated with HVHF presents no new significant adverse impacts with regard to potential gas migration. Gas migration is a result of poor well construction (i.e., casing and cement problems). As with all gas drilling, well construction practices mandated in New York are designed to prevent gas migration. Such practices would also minimize the risk of migration of other formation fluids such as oil or brine.

No significant adverse impact to water resources is likely to occur due to underground vertical migration of fracturing fluids through the shale formations. Developable shale formations are vertically separated from potential freshwater aquifers by at least 1,000 feet of sandstones and shales of moderate to low permeability. In fact, most of the bedrock formations above the Marcellus Shale are other shales. That shales must be hydraulically fractured to produce fluids is evidence that these types of rock formations do not readily transmit fluids. The high salinity of native water in the Marcellus and other Devonian shales is evidence that fluid has been trapped in the pore spaces for hundreds of millions of years, implying that there is no mechanism for discharge of fluids to other formations.

Hydraulic fracturing is engineered to target the prospective hydrocarbon-producing zone. The induced fractures create a pathway to the intended wellbore, but do not create a discharge mechanism or pathway beyond the fractured zone

where none existed before. The pressure differential that pushes fracturing fluid into the formation is diminished once the rock has fractured, and is reversed toward the wellbore during the flowback and production phases. Accordingly, there is no likelihood of significant adverse impacts from the underground migration of fracturing fluids.

Waste Disposal

No significant adverse impacts are identified with regard to the disposal of liquid wastes. Drilling and fracturing fluids, mud-drilled cuttings, pit liners, flowback water and produced brine, although classified as non-hazardous industrial waste, must be hauled under a waste transporter permit issued by NYS-DEC. Any environmental risk posed by the improper discharge of liquid wastes would be addressed through the institution of a waste tracking procedure similar to that which is required for medical waste, even though the hazards are not equivalent.

The disposal of flowback water could cause a significant adverse impact if the wastewater was not properly treated prior to disposal. Residual fracturing chemicals and naturally-occurring constituents from the rock formation could be present in flowback water and could result in treatment, sludge disposal, and receiving-water impacts. Salts and dissolved solids may not be sufficiently treated by municipal biological treatment and/or other treatment technologies that are not designed to remove pollutants of this nature. Mitigation measures have been identified that would eliminate any potential significant adverse impact from flowback water or treatment of other liquid wastes associated with HVHF.

Proposed disposal wells require individual site-specific review under SEQRA. Therefore, the potential for significant adverse environmental impacts from any proposal to inject flowback water from HVHF into a disposal well would be reviewed on a site-specific

basis with consideration to local geology (including faults and seismicity), hydrogeology, nearby wellbores or other potential conduits for fluid migration and other pertinent site-specific factors.

Exposure Mechanisms

Potential flood damage relative to mud or reserve pits, brine and oil tanks, other fluid tanks, brush debris, erosion and topsoil, bulk supplies (including additives) and accidents (including trucking accidents) is one of the few ways that bulk supplies such as additives “might accidentally enter the environment in large quantities.”

Impacts on Ecosystems and Wildlife

Fragmentation of Habitat

HVHF operations would have a significant impact on the environment because such operations have the potential to draw substantial development into New York, which would result in unavoidable impacts to habitats (fragmentation, loss of connectivity, degradation, etc.), species distributions and populations, and overall natural resource biodiversity. Habitat loss, conversion, and fragmentation (both short-term and long-term) would result from land grading and clearing, and the construction of well pads, roads, pipelines, and other infrastructure associated with gas drilling.

Measures to mitigate habitat fragmentation include required site-specific ecological assessments conducted by the permit applicant and implementation of measures identified as part of such ecological assessment.

Potential Transfer of Invasive Species

The number of vehicle trips associated with HVHF, particularly at multi-well sites, has been identified as an activity that presents the opportunity to transfer invasive terrestrial species. Surface water withdrawals also have the potential to transfer invasive aquatic species. The

introduction of terrestrial and aquatic invasive species would have a significant adverse impact on the environment.

Use of State-Owned Lands

State-owned lands play a unique role in New York’s landscape because they are managed under public ownership to allow for sustainable use of natural resources, provide recreational opportunities for all New Yorkers, and provide important wildlife habitat and open space. Given the level of development expected for multi-pad horizontal drilling, there would be additional pressure for surface disturbance on state lands. Surface disturbance associated with gas extraction could have an impact on habitats on state lands, and recreational use of those lands, especially large contiguous forest patches that are valuable because they sustain wide-ranging forest species, and provide more habitat for forest interior species.

Impact on Endangered and Threatened Species

The area underlain by the Marcellus Shale includes both terrestrial and aquatic habitat for 18 animal species listed as endangered or threatened in New York State that are protected under the State Endangered Species Law (ECL 11-0535) and associated regulations (6 NYCRR Part 182). Endangered and threatened wildlife may be adversely impacted through project actions such as clearing, grading and road building that occur within the habitats that they occupy. Certain species are unable to avoid direct impact due to their inherent poor mobility (e.g., Blanding’s turtle, club shell mussel). Certain actions, such as clearing of vegetation or alteration of streambeds, can also result in the loss of nesting and spawning areas.

Impacts on Air Resources

Federal and New York State regulations apply to potential air emissions and air quality impacts associated with

the drilling, completion (hydraulic fracturing and flowback) and production phases (processing, transmission and storage).

Since September 2009 industry has provided information that: (1) simultaneous drilling and completion operations at a single pad would not occur; (2) the maximum number of wells to be drilled at a pad in a year would be four in a 12-month period; and (3) centralized flowback impoundments, which are large volume, lined ponds that function as fluid collection points for multiple wells, are not contemplated. Control measures for nitrogen dioxide and particulate matter, restrictions reflecting industry's proposed operations, and recommended mitigation measures would be included in well permits. NYSDEC also developed an air monitoring program to fully address potential for adverse air quality impacts beyond those analyzed in the dSGEIS, which

are either not fully known at this time or not verifiable by the assessments to date. The air monitoring plan would help determine and distinguish both the background and drilling related concentrations of pertinent pollutants in the ambient air.

Air quality impact mitigation measures include pollution control techniques, various operational scenarios and equipment that can be used to achieve regulatory compliance, as well as mitigation measures for well pad operations. In addition, measures to reduce benzene emissions from glycol dehydrators and formaldehyde emissions from off-site compressor stations are needed.

Greenhouse Gas Emission Impacts

All operational phases of proposed well pad activities would result in greenhouse gas (GHG) emissions. The primary GHGs emitted from oil and gas

operations are carbon dioxide (CO₂) and methane (CH₄). Table 1 summarizes estimated GHG emissions in various drilling scenarios.

Socioeconomic Impacts

To assess the potential socioeconomic impacts of HVHF, including the potential impacts on population, employment and housing, representative regions were selected to evaluate how HVHF might impact areas with different production potential, different land use patterns, and different levels of experience with natural gas well development. Using a low and average rate of development based on industry estimates, HVHF would have a significant positive economic effect where the activity takes place. An increased availability of jobs is predicted to result both directly and indirectly from the introduction of

Table 1: Summary of Estimated Greenhouse Gas Emissions (Revised July 2011)

| | CO ₂ (tons) | CH ₄ (tons) | CH ₄ Expressed as CO ₂ e (tons) | Total Emissions from Proposed Activity CO ₂ e (tons) |
|---|------------------------|------------------------|---|---|
| Estimated First-Year Green House Gas Emissions from Single Vertical Well | 8,660 | 246 | 6,150 | 14,810 |
| Estimated First-Year Green House Gas Emissions from Single Horizontal Well | 8,761 | 240 | 6,000 | 14,761 |
| Estimated First-Year Green House Gas Emissions from Four-Well Pad | 13,901 | 402 | 10,050 | 23,951 |
| | | | | |
| Estimated Post First-Year Annual Green House Gas Emissions from Single Vertical or Single Horizontal Well | 6,164 | 244 | 6,100 | 12,264 |
| Estimated Post First-Year Annual Green House Gas Emissions from Four-Well Project | 6,183 | 565 | 14,125 | 20,300 |

HVHF statewide. Income levels would also see positive impacts.

While providing positive impacts in the areas of employment and income, HVHF could cause adverse impacts on the availability of housing, especially temporary housing such as hotels and motels. HVHF would also bring both positive and negative impacts on state and local government spending. Increased activity would result in large increases in local tax revenues and increases in the receipt of production royalties but would also result in an increased demand for local services, including emergency response services.

Visual, Noise and Community Character Impacts

The construction of well pads and wells associated with HVHF would result in temporary, but adverse impacts relating to noise. In certain areas the construction activity would also result in temporary visual impacts. The cumulative impact of well construction activity and related truck traffic would cause impacts on the character of the rural communities where much of this activity would take place.

Transportation Impacts

The introduction of HVHF has the potential to generate significant truck traffic during the construction and development phases of the well. These impacts would be temporary, but the cumulative impact of this truck traffic has the potential to result in significant adverse impacts on local roads and, to a lesser extent, state roads where truck traffic from this activity is concentrated. Applicants may be required to develop a transportation plan that sets forth proposed truck routes, surveys road conditions along those routes and requires local road use agreements to address any impacts on local roads.

Naturally Occurring Radioactive Material (NORM) Concerns

Based upon currently available information, production brine could contain elevated NORM levels. Although the highest concentrations of NORM are in produced waters, it does not present a risk to workers because the external radiation levels are very low. However, the build-up of NORM in pipes and equipment could expose workers handling the pipe to increased radiation levels. Wastes from the treatment of production waters may contain concentrated NORM. If so, controls would be required to limit radiation exposure to workers handling this material as well as to ensure that it is disposed of in accordance with applicable regulatory requirements.

Seismicity

There is a reasonable base of knowledge and experience related to seismicity induced by hydraulic fracturing. Information reviewed indicates that there is essentially no increased risk to the public, infrastructure, or natural resources in New York from induced seismicity related to hydraulic fracturing. The microseisms created by hydraulic fracturing are too small to be felt, or to cause damage at the ground surface or to nearby wells. Accordingly, no significant adverse impacts from induced seismicity are expected to result from HVHF operations.

Proposed Mitigation Measures

NYSDEC has identified the following measures that, if implemented, would eliminate or mitigate potentially significant adverse impacts from HVHF operations.

No HVHF Operations in the New York City and Syracuse Watersheds

Site disturbance relating to HVHF operations will not be permitted in the Syracuse and New York City watersheds or in a protective 4,000-foot buffer area around those watersheds. These areas are unfiltered water supplies that depend on strict land use and development controls to ensure that water quality is protected. The proposed HVHF activity is not consistent with the preservation of these watersheds as an unfiltered drinking water supply.

No HVHF Operations on Primary Aquifers

Eighteen other aquifers in the State of New York are highly productive aquifers presently utilized as sources of water supply by major municipal water supply systems and are designated as "primary aquifers." Because these aquifers are the primary source of drinking water for many public drinking water supplies, site disturbance relating to HVHF operations would be prohibited in these aquifers and in a protective 500-foot buffer area around them. This provision would be subject to reconsideration two years after issuance of the first permit for HVHF.

No HVHF Operations on Principal Aquifers Without Site-Specific Environmental Review

Principal Aquifers are aquifers known to be highly productive or whose geology suggests abundant potential water supply, but which are not intensively used as sources of water supply by major municipal systems at the present time. Surface discharges from HVHF well pads could cause significant adverse impacts on these important water resources. To mitigate this risk, applications for HVHF operations at any surface location within the boundaries of principal aquifers, or outside but within 500 feet of the boundaries of principal aquifers, would require (1) site-specific SEQRA

determinations of significance and (2) individual State Pollution Discharge Elimination System (SPDES) permits for storm water discharges. NYSDEC would re-evaluate the necessity of this restriction after two years of experience issuing permits in areas outside of the 500-foot boundary.

No HVHF Operations within 2,000 feet of Public Drinking Water Supplies

Surface discharges from HVHF well pads could cause significant adverse impacts on water resources. To mitigate the risk of such events, HVHF operations at any surface location within 2,000 feet of public water supply wells, river or stream intakes and reservoirs would not be permitted. NYSDEC would re-evaluate the necessity of this approach after three years of experience issuing permits in areas outside of this setback.

No HVHF Operations in Floodplains or Within 500 Feet of Private Water Wells

NYSDEC would not issue permits for HVHF operations at any well pad that is wholly or partially within a 100-year floodplain in order to address potential significant adverse impacts due to flooding. In order to ensure that there are no impacts on drinking water supplies from HVHF operations, no permits would be issued for any well pad located within 500 feet of a private water well or domestic use spring, unless waived by the landowner.

Mandatory Disclosure of Hydraulic Fracturing Additives and Alternatives Analysis

NYSDEC's hydraulic fracturing chemical disclosure requirements are among the most stringent in the country. Chapter 5 of the dSGEIS lists the chemical name and Chemical Abstract Services (CAS) number, 322 chemicals proposed for use for HVHF in New York. Chemical usage was reviewed by the New York State Department of Health (NYSDOH), which provided health

hazard information that is presented in the document. Additives include acids, breakers, bactericide/biocides, corrosion inhibitors, friction reducers, gelling agents, iron controls, scale inhibitors, and surfactant. In response to public concerns relating to the use of hydraulic fracturing additives and their potential impact on water resources, the dSGEIS adds a new requirement that operators evaluate the use of alternative hydraulic fracturing additive products that pose less potential risk to water resources. In addition, a project sponsor must disclose all additive products it proposes to use, and provide Material Safety Data Sheets (MSDS) for those products, so that the appropriate remedial measures can be imposed if a spill occurs. NYSDEC will publicly disclose the identities of hydraulic fracturing fluid additive products and their MSDS, provided that information which meets the confidential business information exception to NYSDEC's records access program will not be subject to public disclosure.

Enhanced Well Casing

In order to mitigate the risk of significant adverse impacts to water resources from the migration of gas or pollutants in connection with HVHF operations, a third cemented "string" of well casing around the gas production wells is required in most situations. This enhanced casing specification is designed to specifically address concerns over migration of gas into aquifers.

Required Secondary Containment and Stormwater Controls

In order to mitigate the risk of a significant adverse impact to water resources from spills of chemical additives, hydraulic fracturing fluid or liquid wastes associated with HVHF, secondary containment, spill prevention and storm water pollution prevention are comprehensively addressed for all stages of well pad development. NYSDEC has proposed a new storm water general permit for gas drilling opera-

tions that would address potential storm water impacts associated with HVHF operations.

Conditions Related to Disposal of Wastewater and Solid Waste

To ensure that wastewater from HVHF operation is properly disposed, NYSDEC proposes to require that before any permit is issued the operator have department-approved plans in place for disposing of flowback water and production brine. In addition, NYSDEC proposes to require a tracking system, similar to what is in place for medical waste, for all liquid and solid wastes generated in connection with HVHF operations. A proposed requirement for closed-loop drilling would be expanded in order to ensure that no significant adverse impacts occur related to the disposal of pyrite-rich Marcellus Shale cuttings on-site.

No HVHF Operations on Certain State Lands

Surface disturbance associated with HVHF operations would not be allowed on State-owned lands administered by NYSDEC, including but not limited to state forests and state wildlife management areas, because it is inconsistent with the suite of purposes for which those lands have been acquired. Current Office of Parks, Recreation and Historic Preservation (OPRHP) policy would impose similar restrictions on state parks. Further, precluding site disturbance on certain state lands would partially mitigate the significant adverse impacts from habitat fragmentation on forestlands due to HVHF activity. It would prevent the loss of such habitat in protected state land areas representing some of the largest contiguous forest patches where HVHF activity could occur.

Mitigation for Loss of Habitat and Impacts on Wildlife

In order to further mitigate significant adverse impacts on wildlife habitat

caused by fragmentation of forest and grasslands on private land, NYSDEC proposes to require that surface disturbance in contiguous forest patches of 150 acres or more and contiguous grassland patches of 30 acres or more within specified Forest and Grassland Focus areas, respectively, be contingent upon site-specific ecological assessments conducted by the permit applicant and implementation of best management practices identified through such assessments.

Air Quality Control Measures and Mitigation for Greenhouse Gas Emissions

Additional mitigation measures are designed to ensure that emissions associated with HVHF operations do not result in the exceedance of any National Ambient Air Quality Standards (NAAQS). In addition, NYSDEC has committed to implement local and regional level air quality monitoring at well pads and surrounding areas.

Mitigation measures required through permit conditions and possibly new regulations could ensure that HVHF operations do not result in significant adverse impacts relating to climate change. A greenhouse gas emission impacts mitigation plan would be required. This plan must include: a list of best management practices for GHG emission sources for implementation at the permitted well site; a leak detection and repair program; use of EPA's Natural Gas Star best management practices for any pertinent equipment; use of reduced emission completions that provide for the recovery of methane instead of flaring whenever a gas sales line and interconnecting gathering line are available; and a statement that the operator would provide NYSDEC with a copy of the report filed with EPA to meet the GHG Reporting Rule.

Other Control Measures

Other important existing and anticipated regulatory requirements and/or permit conditions that would be imposed to ensure that HVHF operations do not cause significant impacts on the environment in New York include, but are not limited to the following:

- Before a permit is issued, department staff would review the proposed layout of the well site based on analysis of application materials and a site visit. Risky site plans would either not be approved or would be subject to enhanced site-specific construction requirements.
 - NYSDEC's staff reviews the proposed casing and cementing plan for each well prior to permit issuance. Permits are not issued for improperly designed wells, and in the case of HVHF, the as-built wellbore construction would be verified before the operation is allowed to proceed.
 - Require in most cases fully cemented intermediate casing, with the setting depths of both surface and intermediate casing determined by site-specific conditions.
 - Fracturing equipment components would be pressure tested with fresh water, mud or brine prior to the introduction of chemical additives.
 - Require pressure testing of blowout prevention equipment, the use of at least two mechanical barriers that can be tested, the use of specialized equipment designed for entering the wellbore when pressure is anticipated, and the on-site presence of a certified well control specialist.
 - Flowback water stored on-site must use covered watertight tanks within secondary containment and the fluid contained in the tanks must be removed from the site within certain time periods.
- NYSDEC has a robust permitting and approval process in place to address any proposals to discharge flowback water or production brine to wastewater treatment plants. NYSDEC would require that before any permit is issued the operator have department-approved plans in place for disposing of flowback water and production brine. Permission to treat such wastewater at a treatment plant in New York State would not be granted without a demonstrable showing that such wastewater can be properly treated at the plant. Additionally, NYSDEC anticipates that operators would favor reusing flowback water for subsequent fracturing operations as they are now doing in Pennsylvania, so that disposal of flowback would be minimized.
 - NYSDEC would require that a transportation plan be developed and included with any permit application. That plan would include proposed truck routes and an assessment of road conditions along such routes. Any local road use agreement(s) would have to be disclosed and the applicant would have to demonstrate that the roads to be used are sufficient to accommodate the proposed truck traffic.
 - NYSDEC would consult with local governments and, where appropriate, place limits on the number of wells and/or well pads that can be constructed in a specific area at a single time in order to mitigate potential adverse impacts on community character, tourism and other potential socioeconomic impacts that could result from a concentration of well construction activity in a short period of time within a confined area.
 - NYSDEC would also impose measures designed to reduce adverse noise or visual impacts from well construction.

Permit Process and Regulatory Coordination

Local governments will be given notice in writing of all HVHF applications in the locality. A continuously updated database of local government officials and an electronic notification system would be developed for this purpose.

The project sponsor will be required to identify whether the proposed location of the well pad, or any other activity under the jurisdiction of NYSDEC, conflicts with local land use laws or regulations, plans or policies. The project sponsor would also be required to identify whether the well pad is located in an area where the affected community has adopted a comprehensive plan or other local land use plan and whether the proposed action is inconsistent with such plan(s).

Alternative Actions

Alternatives to well permit issuance were reviewed and considered by NYSDEC, including both its prohibition and the removal of oil and gas industry regulation. Regulation as described by the GEIS was found to be the best alternative.

The alternatives analysis considers the use of a phased-permitting approach to developing the Marcellus Shale and other low permeability gas reservoirs, including consideration of limiting and/or restricting resource development in designated areas. NYSDEC proposes

to partially adopt this alternative by restricting resource development in the New York City and Syracuse watersheds (plus buffer), public water supplies, primary aquifers and certain state lands. In addition, restrictions and setbacks relating to development in other areas near public water supplies, principal aquifers and other resources as outlined above are recommended.

NYSDEC does not believe that resource development should be further limited by imposing an annual limit on permits issued for HVHF operations. NYSDEC believes any such annual limit would be arbitrary. Rather, NYSDEC proposes to limit permit issuance to match NYSDEC resources that are made available to review and approve permit applications, and to adequately inspect well pads and enforce permit conditions and regulations.

Although it is not possible to predict the number of permit applications that will be submitted in any given area, and therefore proscribe the level of activity that any one operator may undertake in those areas, NYSDEC has the ability to respond and adjust to conditions in the field. If it is demonstrated, for example, that the measures in place to mitigate noise impacts do not adequately address the impact of HVHF on a host community, NYSDEC retains the option through the permitting process to impose additional conditions on operations, such as phasing of drilling operations on adjacent well pads, to prevent or mitigate cumulative or simultaneous operations from impacting nearby residents.

Review of Selected Non-Routine Incidents in Pennsylvania

A number of widely publicized incidents involving HVHF operations in Pennsylvania have caused public concern about the safety and potential adverse impacts associated with HVHF operations. The events and their likely causes were studied; protective measures currently in place and/or identified as a proposed mitigation measure by NYSDEC would further minimize the risk of such events occurring should HVHF operations be permitted in New York.

Next Steps

Following the public comment period for the revised dSGEIS and the draft regulations, NYSDEC will produce a final SGEIS. The final SGEIS will include summaries of the substantive comments received on both the 2009 dSGEIS and the revised dSGEIS, along with NYSDEC's responses to such comments. The final SGEIS will also incorporate by reference all volumes of the 1992 GEIS.

Endnotes

- 1 ALL Consulting. 2011 June 30. SGEIS Supplementary Information—Production Rates. Letter to Brad Gill, Executive Director, Independent Oil & Gas Association of New York. p.2.