NEW YORK STATE OF OPPORTUNITY. | Department of Environmental Conservation

FINAL SUPPLEMENTAL GENERIC ENVIRONMENTAL IMPACT STATEMENT

ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM

Regulatory Program for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs

FINDINGS STATEMENT

June 2015

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Pursuant to Article 8 of the Environmental Conservation Law, the State Environmental Quality Review Act (SEQRA), and its implementing regulations set forth at 6 NYCRR Part 617, the New York State Department of Environmental Conservation makes the following findings:

Lead Agency:	New York State Department of Environmental Conservation
Address:	Central Office, 625 Broadway, Albany, NY 12233
Name of Action:	Regulatory Program for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs
Description of Action:	High-volume hydraulic fracturing, which is often used in conjunction with horizontal drilling and multi-well pad development, is an approach to extracting natural gas that raises new and significant adverse impacts not studied in 1992 in the NYSDEC's previous Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program (GEIS). DEC prepared a Supplemental Generic Environmental Impact Statement (SGEIS) to satisfy the requirements of SEQRA by studying the high-volume hydraulic fracturing technique, identifying significant adverse impacts for these anticipated operations that were not identified in the GEIS, and identifying mitigation measures to minimize adverse environmental impacts. The SGEIS was therefore used in considering if and under what conditions high-volume hydraulic fracturing should be allowed in New York State.
Location:	Statewide
Date SGEIS filed:	May 13, 2015

I. INTRODUCTION

Pursuant to the State Environmental Quality Review Act (SEQRA) and its implementing regulations, and as mandated by Executive Order 41, this Findings Statement constitutes the findings of the New York State Department of Environmental Conservation (Department or DEC) with respect to whether permits to drill, deepen, plug back or convert wells that use high-volume hydraulic fracturing to develop natural gas resources in the Marcellus Shale and other low-permeability gas reservoirs should be authorized in New York State. This Findings Statement draws upon information in the Supplemental Generic Environmental Impact Statement (SGEIS or Final SGEIS) issued by the Department on May 13, 2015, and documents encompassed in the FSGEIS, including the extensive public comments and the Department's Response to Comments, the revised draft SGEIS prepared in September 2011 (rdSGEIS), the draft SGEIS prepared in September 2009 (dSGEIS), and the 1992 Generic Environmental Impact Statement (1992 GEIS) on the Department's Oil, Gas, and Solution Mining Regulatory Program.

A. Background and Description of Action

High-volume hydraulic fracturing utilizes a well stimulation technique that has greatly increased the ability to extract natural gas from very tight rock.[1] There are several distinct phases associated with well development that uses high-volume hydraulic fracturing. They are: 1) the construction phase, which consists of land disturbance and clearing of trees and other lands to

[1] High-volume hydraulic fracturing is defined as the stimulation of a well using 300,000 or more gallons of water as the base fluid for hydraulic fracturing for all stages in a well completion, regardless of whether the well is vertical or directional, including horizontal. The 300,000-gallon threshold is the sum of all water, fresh and recycled, used for all stages in a well completion. Well stimulation requiring less than 300,000 gallons of water as the base fluid for hydraulic fracturing for all stages in a well completion is not considered high-volume, and will continue to be reviewed and permitted pursuant to the 1992 GEIS, and 1992 and 1993 Findings Statements. Wells using less than 300,000 gallons of water for hydraulic fracturing per completion do not have the same magnitude of impacts. Indeed, wells hydraulically fractured with less water are generally associated with smaller well pads and many fewer truck trips, and do not trigger the same potential water sourcing and disposal impacts as high-volume hydraulically fractured wells. The 300,000-gallon threshold also applies if a re-completion of an existing well involves hydraulic fracturing using 300,000 gallons or more of water for the re-completion. The 300,000-gallon threshold is calculated based on all stages per well completion or well re-completion, not cumulative use for separate completions or re-completions.

construct well pads, access roads, and other supporting infrastructure; 2) the drilling phase, which consists of the operation of heavy machinery to drill wells typically 4,000 feet in length, producing significant quantities of drill cuttings; 3) the hydraulic fracturing and completion phase, which consists of a well stimulation technique involving the pumping of a mixture of water and chemical additives, some of which potentially pose hazards to public health and the environment, down a well bore at high pressure, followed by the "flowback" of fluids and natural gas; 4) the production phase, which consists of removal of drilling and well completion equipment, partial reclamation of the well pad, and installation of equipment at the wellhead to capture natural gas and transmit the gas to compressor stations, gathering lines, and ultimately the end user; and 5) the reclamation phase, which occurs when the well or wells at the pad are no longer producing natural gas, the well is plugged and closed, and restoration of the disturbed area is implemented.

High-volume hydraulic fracturing, which is often used in conjunction with horizontal drilling and multi-well pad development, raises new, potentially significant, adverse impacts that were not studied in the 1992 GEIS.[2] High-volume hydraulic fracturing is distinct from other methods of well completion that have been allowed in the State under the 1992 GEIS and Department permits due to the much larger volumes of water used to conduct hydraulic fracturing operations. When using high-volume hydraulic fracturing with horizontal well drilling, a number of wells are drilled from a single well pad (a multi-well pad). Although horizontal drilling has the potential to result in fewer well pads than traditional vertical well drilling, pads where high-volume hydraulic fracturing would be employed are larger and the industrial activity associated with high-volume hydraulic fracturing on the pads would be more intense. Indeed, 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, compared to the average disturbance associated with a well pad for a single vertical well during the drilling and fracturing stage, which is estimated at 4.8 acres. Horizontal drilling also facilitates natural gas extraction from many areas where conventional natural gas extraction had been commercially unprofitable. Therefore, drilling, well construction and well operation would likely be widespread in certain

[2] The 1992 GEIS is posted on the Department's website at http://www.dec.ny.gov/energy/45912.html. The 1992 GEIS includes an analysis of impacts from well drilling as well as hydraulic fracturing. Since 1992 the Department has used the 1992 GEIS as the basis of its SEQRA review for permit applications for gas drilling in New York State.

regions of the State and would impact areas that have previously not been subject to significant oil and gas development. Also, high-volume hydraulic fracturing requires significantly more water, and chemical additives, which may pose public health hazards through potential exposure. The high volumes of fracturing liquids associated with this type of well completion raise concerns about potential significant adverse impacts to water supplies, wastewater treatment and disposal and truck traffic. Horizontal wells also generate greater volumes of drilling waste (cuttings) than vertical wells drilled to the same target formation. In addition, development of low-permeability reservoirs using high-volume hydraulic fracturing has the potential to industrialize rural areas of New York. Industry projections of the level of drilling, as reflected in the intense development activity in neighboring Pennsylvania, have raised additional concerns relating to air quality, truck traffic, noise, habitat, cultural, historic and natural resources, agriculture, community character and socioeconomics.

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. Additional low-permeability reservoirs may be considered in the future by project sponsors for development by high-volume hydraulic fracturing.

The purpose of the SGEIS process for high-volume hydraulic fracturing was to assess the potential environmental impacts created by this process of extracting natural gas. Once the potential impacts are assessed, the Department also must evaluate whether mitigation measures can eliminate or reduce significant adverse environmental impacts to the maximum extent practicable, and if so, whether measures should be imposed consistent with SEQRA and the Environmental Conservation Law (ECL).[3] The Department must conclude that a high-volume hydraulic fracturing permitting program is consistent with the Department's mission as laid out in Article 1 of the ECL to "conserve, improve, and protect its natural resources and environment and to prevent, abate and control water, land and air pollution, in order to enhance the health, safety and welfare of the people of the state and their overall economic and social well being."[4] Additionally, the Department's regulatory role related to mineral resources is described in

[3] See Article 8 of the ECL and 6 NYCRR Part 617

[4] ECL § 1-0101(1)

Article 23 of the Environmental Conservation Law where the legislature declared it "to be in the public interest to regulate the development, production, and utilization of natural resources of oil and gas in this state in such a manner as will prevent waste…."[5]

As explained in detail below, the Department has determined that there are potential significant adverse environmental and public health impacts associated with high-volume hydraulic fracturing operations. Even with the implementation of an extensive suite of mitigation measures considered by the Department and described in these findings, the significant adverse public health and environmental impacts from allowing high-volume hydraulic fracturing to proceed under any scenario cannot be adequately avoided or minimized to the maximum extent practicable in accordance with SEQRA. In addition, as further described below, significant uncertainty remains regarding the level of risk to public health and the environment that would result from permitting high-volume hydraulic fracturing in New York, and regarding the degree of effectiveness of proposed mitigation measures. Consequently, and due to the limited economic and social benefits that would be derived from high-volume hydraulic fracturing, the No-Action alternative is the only reasonable alternative consistent with social, economic and other essential considerations. The Department is therefore selecting the No-Action alternative. These findings will apply statewide.

B. Procedural History

In 2008, the Department determined that some aspects of the current and anticipated application of high-volume hydraulic fracturing warranted further review under SEQRA. The Department commenced a public process to develop the SGEIS with public scoping sessions in the autumn of 2008.

February 2009 Final Scope - The Department released a draft Scope for public review in October 2008, and held public scoping sessions at six venues in the Southern Tier and Catskills in November and December, 2008. A total of 188 verbal comments were received at these sessions. In addition, over 3,770 written comments were received (via e-mail, mail, or written

[5] ECL § 23-0301

comment card). The Department completed the Final Scope in February 2009, which outlined the analysis required for a thorough understanding of the potentially significant adverse environmental impacts of high-volume hydraulic fracturing in low-permeability reservoirs.

2009 Draft SGEIS - The Department released the 2009 draft SGEIS for public review on September 30, 2009 and held public hearings at four venues in New York City (NYC), the Catskills and the Southern Tier in October and November, 2009. Comments were accepted at the hearings verbally and in writing, by postal mail, by e-mail and through a web-based application developed specifically for that purpose. More than 2,500 people attended the Department hearings, and more than 200 verbal comments were delivered by individuals, local government officials, representatives of environmental groups and other organizations and members of the oil and gas industry. The Department also received over 13,000 comments via e-mail, postal mail and the web-based comment system. In addition, transcripts from hearings held by the New York State Assembly, the City of Oneonta, and the Tompkins County Council of Governments on the 2009 draft SGEIS also provided the Department with numerous comments.

Executive Order 41- On December 13, 2010, former Governor David Paterson issued Executive Order No. 41 (EO 41), which directed the Department to publish a revised draft SGEIS and to accept public comment on the revisions. EO 41 is commonly referred to as a "moratorium" on high-volume hydraulic fracturing because it recognizes that under SEQRA, permits to drill wells using this method cannot be issued until completion of the SGEIS process. On January 1, 2011, Governor Andrew Cuomo continued EO 41.

2011 Revised Draft SGEIS - The 2011 revised draft SGEIS was released for public comment on September 7, 2011 and the comment period was continued until January 11, 2012. Hearings were held in four locations throughout the state in November 2011. In response to the public comment period and public hearings, the Department received approximately 67,000 comments and public hearing statements on the revised draft.

2011 Draft Regulations – In October of 2011, following release of the 2011 revised draft SGEIS, the Department proposed draft regulations to be considered as part of a comprehensive regulatory program described in the draft SGEIS. The Department received 180,000 comments

on the draft regulations. On February 27, 2013, the proposed regulations expired under provisions of the State Administrative Procedure Act.[6]

2014 DOH Public Health Review - In September of 2012, the Department requested that the New York State Department of Health (DOH) review and assess the Department's analysis of potential health impacts contained in the revised Draft SGEIS. DOH published that review in December 2014.

2015 Final SGEIS – The Final SGEIS includes a consolidated summary of the substantive comments received on both the 2009 dSGEIS and the 2011 rdSGEIS, along with responses to substantive comments. The Final SGEIS was publically released on May 13, 2015.

C. Interested Agencies

The Department, as the only agency with jurisdiction to fund, approve, or undertake the Action, is the lead agency for the Action and there are no other involved agencies in the Action. Nevertheless, the Department coordinated and consulted with many interested agencies during the SGEIS process. The following agencies have participated in the SGEIS process because of specific expertise or concerns related to it:

- The New York State Office of General Services (OGS)
- The New York State Public Service Commission (PSC)
- The New York State Department of Health (DOH)
- The New York State Department of Transportation (DOT)
- The New York State Department of Agriculture and Markets (Ag & Mrkts)
- The New York State Office of Parks, Recreation and Historic Preservation (OPRHP)

[6] See SAPA § 202(2) and (3)

- The New York State Energy Research and Development Authority (NYSERDA)
- The New York State Department of Financial Services (DFS)
- The New York State Department of Law (DOL)
- The United States Department of Transportation (USDOT)
- The United States Environmental Protection Agency (USEPA)
- The New York City Department of Environmental Protection (NYCDEP)
- The Susquehanna River Basin Commission (SRBC)
- The Delaware River Basin Commission (DRBC)

D. Purpose and Need for the Action

Article 23 of the ECL confers upon the Department jurisdiction to, among other things, regulate oil and natural gas development in New York State. Consequently, any person seeking to drill and extract oil or natural gas must obtain a permit from the Department pursuant to Title 5 of Article 23 of the ECL.

The exploration and development of natural gas resources provides one method of serving the public's need for energy. Natural gas consumption comprises approximately 23 percent of the total energy consumption in the United States. Natural gas is used for many purposes: home space and water heating; cooking; commercial and industrial space heating; commercial and industrial processes; as a raw material for the manufacture of fertilizer, plastics, and petrochemicals; as vehicle fuel; and for electric generation.

The Marcellus Shale formation has attracted attention as a significant source of natural gas production. The Marcellus Shale extends from Ohio and West Virginia into Pennsylvania and New York. In New York, the Marcellus Shale is located in much of the Southern Tier and

adjoining areas, stretching from Chautauqua and Erie Counties in the west to the counties of Sullivan, Ulster, Greene and Albany in the east.

The Department recognizes that energy created from natural gas has had a relatively beneficial environmental impact in reducing the amount of energy derived from oil and coal-based sources The Department acknowledges the need for, and will continue to foster, the transition from fossil fuels to non-emitting clean energy sources in order to reduce greenhouse gas (GHG) emissions overall. However, increased availability of low-cost natural gas has the potential to reduce the implementation of various types of renewable energy and energy efficiencies.

While natural gas may serve as a "bridge" or "transitional fuel" towards greater utilization of non-emitting clean energy sources, increased natural gas development could extend the use of fossil fuels, or delay the necessary deployment of clean energy. Consequently, the reliance on natural gas resources for the State's energy needs should be balanced with the use of non-emitting sources into the future.

II. POTENTIAL ENVIRONMENTAL IMPACTS

High-volume hydraulic fracturing is a well stimulation technique which consists of pumping large volumes of water, chemical additives, and a proppant, such as sand, down the wellbore under high pressure to create fractures in the hydrocarbon-bearing rock. This process then releases natural gas into the well bore where it can be captured at the surface and moved through pipelines to end users of the gas.

The construction, drilling, hydraulic fracturing, production, and reclamation phases can result in adverse environmental impacts which can range in duration from acute impacts during only one phase, to more permanent impacts that could be present for years or decades after a well is reclaimed. In addition to the direct impacts from each phase of well development, the authorization of high-volume hydraulic fracturing would also induce growth in the natural gas industry. This growth would in turn generate the construction of natural gas pipelines, gathering lines, compressor stations and other associated infrastructure beyond the well pad. This ancillary activity has the potential to create adverse impacts to state-owned lands, freshwater wetlands, forests and other habitat due to fragmentation, streams where pipelines cross, air resources (from

compressor stations), visual resources, agricultural lands, threatened and endangered species, and the spread of invasive species.

As explained in detail below, the drilling, hydraulic fracturing, and production phases involve other potential environmental impacts in areas such as spills, cuttings disposal, waste disposal, air emissions, and community character.

A. Water Resources, Floodplains and Wetlands

Potential significant environmental impacts to surface water and groundwater, floodplains, and wetlands from high-volume hydraulic fracturing include impacts resulting from water withdrawals needed for the fracturing stage; stormwater runoff during construction and operation of a well pad; surface spills; groundwater impacts associated with well drilling and construction; waste disposal and spills during the storage and transport of wastes; impacts to New York City's and Syracuse's unfiltered surface water supply and subsurface water supply infrastructure; impacts to other surface drinking water supplies; loss of habitat associated with construction; and potential groundwater contamination from the hydraulic fracturing procedure itself.

i. Water withdrawals

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 well. This water 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.

At peak activity, the total amount of water necessary for hydraulic fracturing statewide would result in increased demand for fresh water of approximately 0.25% annually. However, the cumulative impact of such water withdrawals, if temporally proximate and from the same water resource, could be significant.

ii. Stormwater runoff

All phases of natural gas well construction and development, from initial land clearing for access roads, equipment staging areas and well pads, drilling and fracturing operations, to production and final reclamation, have the potential to cause water resource impacts during rain and snow melt events if stormwater is not properly managed. Initial land clearing exposes soil to erosion and more rapid runoff. Equipment and any materials that are spilled, including chemical additives and fuel, when exposed to rainfall, could convey contaminants off-site and into water resources during rain events if they are not properly contained. A natural gas production site, including access roads, is also a potential source of stormwater runoff impacts because its hydrologic characteristics, sediment, nutrient, contaminant, and water volumes may be substantially different from the pre-developed condition. The cumulative water resource impacts of all of these construction and development activities could be significant.

iii. Floodplains

High-volume hydraulic fracturing operations within floodplain areas would create serious and significant environmental risks to water and other resources. The 1992 GEIS summarizes the potential significant adverse impacts of 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. For high-volume hydraulic fracturing, potential significant adverse impacts are magnified given the potential geographic scope of hydraulic fracturing. Severe flooding is described as one of the ways that bulk supplies such as fracturing additives might accidentally enter the environment in large quantities and result in significant potential environmental and public health impacts.

iv. Wetlands

The 1992 GEIS broadly summarized the potential significant adverse impacts to wetlands associated with interruption of natural drainage, flooding, erosion and sedimentation, brush disposal, increased access and pit location. For high-volume hydraulic fracturing, potential impacts are magnified based on the potential scope of high-volume hydraulic fracturing and the larger well pad size required for these operations. Impacts to state- and federally-regulated

wetlands can disrupt healthy ecosystems by jeopardizing essential breeding grounds for fish, birds, and other wildlife and by disrupting the flood control functions healthy wetlands provide.

v. Spills

The Department concludes that spills or releases in connection with high-volume hydraulic fracturing could have significant adverse impacts on water resources. The SGEIS identifies a significant number of contaminants contained in additives used in fracturing fluids and present in vehicle or machine fuels, and contaminants otherwise associated with high-volume hydraulic fracturing operations.

These additives and contaminants could result in significant adverse public health and environmental impacts if spilled or released taking into account potential exposure pathways. With the assistance of NYSDOH, Chapter 5 of the SGEIS described potential adverse health impacts from exposure to classes of chemicals such as petroleum distillate products, aromatic hydrocarbons, glycols, alcohols, aldehydes, microbiocides and other constituents.

Spills or releases of these contaminants can occur as a result of tank ruptures, equipment or surface impoundment failures, overfills, vandalism, accidents (including vehicle collisions), ground fires, improper operations and other incidents. Spilled, leaked or released fluids could flow overland to a surface water body or infiltrate the ground, reaching subsurface soils, aquifers, and drinking water sources. These types of environmental impacts could lead to significant and adverse public health outcomes.

vi. Well-drilling and fracturing fluid migration

Additional potential significant adverse impacts on groundwater and surface water resources could result from well drilling and construction associated with high-volume hydraulic fracturing. Those potential significant adverse impacts include impacts from turbidity, fluids pumped into or flowing from rock formations penetrated by the drilling of the well, and contamination from natural gas present in the rock formations, above the target shale deposits, that are penetrated by the drilling of the well.

Typically, the 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 shale deposits.

High-volume hydraulic fracturing is engineered to target the prospective hydrocarbon-producing zone. The induced fractures create a pathway to the intended wellbore, but typically do not create a discharge mechanism or pathway beyond the fractured zone where none existed before.

While there is little likelihood of vertical migration of hydraulic fracturing fluids based on the nature of the activity and geological characteristics of the formation being targeted, uncertainty remains as to migration risks from wellbore failures or connectivity to nearby abandoned wells or faults. The location and depth of abandoned wells and existing faults in the Marcellus Shale region is not fully catalogued or understood. Therefore, it will be difficult in some cases to ensure that all abandoned wells and existing faults have been identified, and a failure to understand these geologic conditions prior to high-volume hydraulic fracturing activities has the potential to cause significant adverse environmental and health impacts.

Gas migration can potentially occur as a result of poor well construction (i.e., casing and cement problems), or through existing abandoned wells or faults. There are circumstances in which the casing and wellbore can be compromised from engineering control failures in the construction process. Thus, in the event that wellbores are compromised, there is an increased risk of unintended natural gas and fluid migration. The NYSDOH Public Health Review notes that: "Studies have found evidence for underground migration of methane associated with faulty well construction." In addition to these studies, there was a reported incident in 1996, in the Town of Freedom, during the drilling of a conventional oil and gas well. There, an underground blowout of natural gas occurred when the well bore became pressurized by a strong gas flow. This underground blowout caused methane migration that affected properties approximately one and a half miles away. In addition, methane detected in the shallow subsurface after the event, including in residential water wells and a pond, resulted in the evacuation of 12 families from their homes.

In sum, when local geologic conditions are fully understood, properly-constructed wells and properly-conducted fracturing operations would be expected to avoid potential fracturing fluid and methane migration into groundwater and surface water resources. However, there is a risk that well integrity can fail, especially over time, and questions have arisen about whether high-volume hydraulic fracturing can cause seismic changes which could potentially result in fracturing fluid migration through abandoned wells or existing fissures and faults. Thus, high-volume hydraulic fracturing could result in significant adverse impacts to water resources from well construction and fracturing fluid migration.

vii. Waste disposal

After the hydraulic fracturing procedure is completed and pressure is released, the direction of fluid flow reverses up the wellbore. The well is "cleaned up" by allowing water, chemical additives, and excess proppant (typically sand) to flow up through the wellbore to the surface. Both the process and the returned water (which also contains brine and other naturally occurring material from the shale zone) are commonly referred to as "flowback." The SGEIS estimates flowback water volume to range 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.

The disposal of flowback water and production brine could cause a significant adverse impact if the wastewater is not properly stored and treated prior to disposal. Residual fracturing chemicals and/or naturally-occurring constituents from the rock formation could be present in production brine 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 which are not designed to remove pollutants of this nature.

The 1992 GEIS findings determined that any proposed disposal wells require an individual site-specific determination under SEQRA. With respect to the use of disposal wells for waste disposal, the Department is not proposing to alter this finding. Any such proposal 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.

Gamma ray logs from deep wells drilled in New York over the past several decades show the Marcellus Shale to be higher in naturally-occurring radioactive material (NORM) than other bedrock formations including other potential reservoirs that could be developed by high-volume hydraulic fracturing. As explained in Chapter 5 of the SGEIS, the total volume of drill cuttings produced from drilling a horizontal well may be about 40% greater than that for a well drilled vertically to the same depth below the ground surface. For multi-well pads, cuttings volume would be multiplied by the number of wells on the pad. Consequently, there is the potential for significant adverse environmental impacts associated with improper waste disposal.[7]

B. Ecosystems and Wildlife

Land disturbance directly associated with high-volume hydraulic fracturing would consist primarily of constructed gravel access roads, well pads and utility corridors. As previously indicated, the average total disturbance associated with a multi-well pad, including incremental portions of access roads and utility corridors is estimated at 7.4 acres.

The primary impacts of land disturbance and other high-volume hydraulic fracturing operations on ecosystems and wildlife are: (1) loss of habitat and habitat fragmentation; (2) potential introduction and spreading of invasive species; and (3) loss of endangered and threatened species. These impacts primarily occur as a result of the construction phases for access roads and well pads. However, significant adverse impacts to ecosystems and wildlife would occur during the construction and operation of associated infrastructure such as utility corridors, gas pipelines,

[7] While not part of the Final SGEIS, USEPA issued a draft report entitled "Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources" (June 2015), that identifies "potential mechanisms by which hydraulic fracturing could affect drinking water resources." Specifically, the report found that "[a]bove ground mechanisms can affect surface and ground water resources and include water withdrawals at times or in locations of low water availability, spills of hydraulic fracturing fluid and chemicals or produced water, and inadequate treatment and discharge of hydraulic fracturing wastewater. Below ground mechanisms include movement of liquids and gases via the production well into underground drinking water resources and movement of liquids and gases from the fracture zone to these resources via pathways in subsurface rock formations." While the report did not find "widespread [or] systemic impacts on drinking water resources" it did confirm a number of specific instances where some of these potential mechanisms led to impacts on water resources. Specifically, the report found that "spills of hydraulic fracturing fluid and produced water in certain cases have reached drinking water resources, both surface and ground water" and that the "[d]ischarge of treated hydraulic fracturing wastewater has increased contaminant concentrations in receiving surface waters." The report further found that "[b]elow ground movement of fluids, including gas … have contaminated drinking water resources." Of the total spills, 300 reached an environmental receptor such as surface water, groundwater and/or soil. USEPA also acknowledged that factors limited the certainty of the draft report, including insufficient pre- and post-fracturing drinking water data and a lack of long-term systematic studies.

and compressor stations. Operations at a well pad can also create such impacts, including the noise generated during the hydraulic fracturing phase.

High-volume hydraulic fracturing operations have the potential to industrialize rural areas of New York, which would result in serious and unavoidable impacts to habitats (e.g., fragmentation, loss of connectivity, degradation, nighttime lighting and noise), 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. Impacts to wildlife, habitats and biodiversity would be more severe in unique habitat areas including Forest Focus Areas and Grassland Focus Areas, which are areas that contain greater biodiversity and more productive habitat for birds and other wildlife. There are also potential impacts on fish and wildlife from the potential release of chemicals used in high-volume hydraulic fracturing into the environment.

Numerous vehicle trips associated with high-volume hydraulic fracturing, particularly at multi-well pads, have been identified as an activity which presents an 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 could have a significant adverse impact on the environment.

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 and associated regulations.[8] 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, and the brook floater and green floater). Certain actions, such as clearing of vegetation or alteration of stream beds, can also result in the loss of nesting and spawning areas.

[8] See ECL § 11-0535 and 6 NYCRR Part 182.

Accordingly, significant adverse impacts to ecosystems and wildlife would result from high-volume hydraulic fracturing.

C. Air Resources and Greenhouse Gas Emissions

High-volume hydraulic fracturing operations result in air emissions from several different types of sources. The fracturing phase in particular results in emissions from mobile sources (trucks carrying water) and from the equipment necessary for completing fracturing operations. After fracturing and into production, fugitive methane and other contaminant releases into air occur. Part of the Department's effort to assess the potential air quality impacts of high-volume hydraulic fracturing activities in the Marcellus Shale and other low-permeability gas reservoirs includes the performance of an air quality modeling analysis. The analysis identifies the emission sources involved in well drilling, completion and production, and the analysis of source operations for purposes of assessing compliance with applicable air quality standards. The air quality modeling analysis also assumed the maximum build-out projections of high-volume hydraulic fracturing wells.

Chapter 6 of the SGEIS provides a comprehensive list of federal and New York State regulations that 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) of the wells. The total operations associated with well drilling can be assigned to three "types" of potential sources of air emissions: 1) combustion from engines, compressors, line heaters, and flares; 2) short-term venting of gas constituents which are not flared; and 3) emissions from truck activities near the well pad. Each of these source categories have limitations in terms of the size and number of the needed equipment, their possible simultaneous operations over a short-term period (e.g., 24-hour), and the time frames over which these equipment or activities could occur over a period of one year, which affects the corresponding annual impacts. The Department's modeling took all of these factors into account. The Department performed supplemental modeling specifically for short-term particulate matter (PM10/PM2.5) and nitrogen dioxide (NO_2) impacts, which were found to exceed the corresponding standards in the absence of mitigation measures. In addition, regional ozone modeling indicated that emissions of nitrogen oxides (NOx) from high-volume hydraulic

fracturing development could contribute to increased ozone levels, including in the New York City metropolitan area, which is currently designated nonattainment for ozone. Other downwind areas, such as Albany-Schenectady-Troy, Poughkeepsie-Newburgh and Greater Connecticut (Hartford), are projected to be at or near the proposed ozone standard once finalized. Accordingly, high-volume hydraulic fracturing development could impact the ability of these areas to maintain air quality that meets the ozone standard. As discussed below, there are potential significant adverse health impacts associated with increased levels of particulate matter, ozone, diesel exhaust, and volatile organic compounds.

Additionally, all operational phases of proposed well pad activities were considered, and resulting greenhouse gas (GHG) emissions determined in the SGEIS. Emission estimates of carbon dioxide (CO_2) and methane (CH_4) are included as both short tons and as carbon dioxide equivalents (CO_2e) for proposed activities, where relevant and quantifiable. The Department not only estimated potential GHG emissions from activities, but also identified and characterized major sources of CO_2 and CH_4 during anticipated operations so that key contributors of GHGs could be addressed and mitigated, with particular emphasis placed on mitigating CH_4, with its greater Global Warming Potential (GWP). With respect to cumulative and macro-impacts of high-volume hydraulic fracturing, the Intergovernmental Panel on Climate Change considers the decarbonization of the energy system to be key to reducing and stabilizing GHGs in the atmosphere and avoiding the worst effects of climate change.[9] The State's overall goal is to reduce GHG emissions 80 percent by 2050, as discussed in the draft State Energy Plan (2014). The Department notes that, regardless of the magnitude of methane emissions from natural gas infrastructure, the consumption of fossil fuel, including natural gas, to produce energy contributes to climate change.[10] Additionally, the increased availability of low-cost natural gas has the potential to undermine the deployment of various types of renewable energy and energy efficiencies, thereby suppressing investment in and use of these clean energy technologies.

[9] IPCC AR5 WG3 Chapter 7 Energy Sources. IN IPCC, 2014. Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Edenhofer et al. (eds)] Cambridge University Press, Cambridge

[10] e.g., Zhang, Xiaochun et al. 2014. "Key factors for assessing climate benefits of natural gas versus coal electricity generation." Environmental Research Letters 9: 114022

D. Geologic Resources: Naturally Occurring Radioactive Material (NORM) and Seismicity

Well drilling and high-volume hydraulic fracturing activities can bring NORM to the surface in the cuttings, flowback water and production brine, and NORM can accumulate in pipes and tanks (pipe scale and sludge). Based upon currently available information, it is anticipated that late-phase flowback water and production brine may contain elevated NORM levels. Although the highest concentrations of NORM are in production brine, it does not present a risk to workers because the external radiation levels for those handling the brine are very low. However, the build-up of NORM in pipes and equipment has the potential to cause a significant adverse impact because it could expose workers handling pipes, for cleaning or maintenance, to increased radiation levels. Disposal of this equipment also may cause significant adverse impacts. Finally, wastes from the treatment of flowback water and production brine may contain concentrated NORM.

The Department recognizes that there is increasing uncertainty about whether high-volume hydraulic fracturing can cause earthquakes and the potential magnitude of those earthquakes, even though much of the Marcellus and Utica Shales underlies portions of the state with the lowest seismic hazard class rating in New York. As discussed in the SGEIS, the smallest measurable seismic events are typically between 1.0 and 2.0 magnitude on the Richter scale. In contrast, seismic events with magnitude 3.0 are typically large enough to be felt by people. Fluid injection of any kind, including fluid injected during high-volume hydraulic fracturing operations, can trigger felt seismic events if the fluid reaches a geologic fault. While induced seismic events from this process are more typically associated with waste disposal or other long-term injections, there have been several instances where seismic events have been linked to hydraulic fracturing operations in the United Kingdom and Canada, and in the United States including Ohio, Oklahoma and Texas. Recent earthquakes observed in Poland, Ohio, which were linked to hydraulic fracturing, occurred in an area with the same seismic hazard class rating as those portions of New York with the lowest seismic hazard class rating in the State.

Potential seismic events from high-volume hydraulic fracturing could have more significant environmental impacts if they were to take place near subsurface water supply infrastructure

(tunnels and aqueducts) associated with the New York City drinking water system, or if they were to take place in proximity to other subsurface water supply infrastructure in New York State.

E. Noise & Visual Resources

The construction of well pads and wells associated with high-volume hydraulic fracturing involves heavy machinery required to fell trees and move earth. The hydraulic fracturing phase results in significant truck traffic and the use of large diesel-powered pumps. The use of this equipment would result in adverse noise and visual impacts during those phases, which could be unavoidable.

Specific identified adverse impacts related to visual impacts include: temporary new landscape features at well pads, construction of new off-site facilities necessary for the high-volume hydraulic fracturing process, the congested appearance of staging areas and the increase in truck and other specialized vehicle traffic in certain areas. These visual impacts would be most problematic in areas that contain important viewsheds, as identified in the Department's Visual Impact Analysis policy.

Construction activity would result in temporary visual and noise impacts. There would be noise and visual impacts during drilling, and the noise impacts from drilling and hydraulic fracturing would be of longer duration for multi-well pad drilling. Any significant noise impacts at a well pad would cease after completion of the hydraulic fracturing stage, but there would continue to be noise impacts beyond the well pad related to the construction and operation of ancillary infrastructure. Additionally, there would be some longer-term visual impacts during the production phase.

Specific identified adverse impacts related to noise include: a potential 37-42 decibel increase over the quietest background areas measured at 2,000 feet during the drilling and hydraulic fracturing stage and increased traffic noise near well pads and on specific trucking routes.

F. Transportation

The introduction of high-volume hydraulic fracturing has the potential to generate significant truck traffic during the construction and hydraulic fracturing phases of the well. Estimates of early well pad development predict that there could be nearly 2,000 one-way heavy and light duty truck trips per well pad.[11]

The cumulative impact of this substantial amount of 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. It is not feasible to conduct a detailed traffic assessment given that the precise location of well pads is unknown at this time. However, such traffic has the potential to damage roads. In addition to road damage, increased truck traffic proportionally increases the number of vehicle breakdowns and vehicle accidents, and increases the risk of spills of potentially hazardous materials. These increased risks correspondingly increase the risk of and frequency of public health impacts. Increased truck traffic also creates potential adverse impacts related to noise and air emissions, discussed above. Finally, as discussed below, increased truck traffic could have direct impacts on community character in the municipality in which the well pad is located, but it could also have ancillary community character impacts on surrounding communities, some of which may have decided to limit or ban high-volume hydraulic fracturing operations through local law.

The potential adverse environmental impacts from transportation associated with high-volume hydraulic fracturing operations would be significant, and some of these adverse impacts would be unavoidable.

G. Socioeconomics & Community Character

As required by SEQRA, the Department considered the economic benefits and growth-inducing aspects of authorizing high-volume hydraulic fracturing.[12] As detailed in the SGEIS, the Department selected three representative regions to analyze the socioeconomic impacts of high-volume hydraulic fracturing. The Department utilized this approach as a way to assess the regional implications of high-volume hydraulic fracturing operations. The three representative

[11] SGEIS Table 6.60

[12] ECL § 8-0109(2)

regions were selected to provide a range of the scale of impacts that may occur. Since the actual location of the natural gas drilling had not been determined, it was impossible to assess the impacts at specific locations. The SGEIS notes that there could be significant variations in impacts at a town/municipal level across the state and within the same representative region.

The SGEIS considered a low and average rate of development based on industry estimates to predict the economic effects where high-volume hydraulic fracturing is expected to take place. However, for all of the reasons discussed below, projections of the expected employment, income, and tax generation impacts that would result from the approval of high-volume hydraulic fracturing in New York State have been reduced by the Department since the release of the 2011 revised draft SGEIS.

In light of changing development patterns in the natural gas industry, the Department considered revised projections in which the 20-year peak construction period (the previous assumption in the 2011 rdSGEIS) would be reduced to 10 years to more realistically reflect the development that could be expected, which would then be followed by a 10-year gradual decline in production. As detailed in the Department's response to comments, a 10-year peak construction period followed by a 10-year gradual decline in production would reduce employment projections, projected employee earnings and property tax receipts.

The potential economic benefits from high-volume hydraulic fracturing would also likely be further reduced by the New York Court of Appeals recent decision in the matter of *Wallach v. Town of Dryden* and *Cooperstown Holstein Corp. v. Town of Middlefield*, which found the ECL[13] does not preempt communities with adopted zoning laws from prohibiting high-volume hydraulic fracturing. As a result of this ruling, high-volume hydraulic fracturing could be prohibited in particular communities throughout the state.

Additionally, numerous mitigation measures proposed in the SGEIS and further considered by the Department (outlined in further detail in Section III below) would have limited where high-volume hydraulic fracturing could occur in New York State. Based on these limiting factors, the Department concluded that the number of wells that would be drilled would have been

[13] ECL § 23-0303(2)

substantially reduced. Consequently, the Department must consider the reduced forecast of economic benefits from a high-volume hydraulic fracturing permitting program when deciding on the appropriate alternative to select in this Findings Statement.

High-volume hydraulic fracturing would have negative socioeconomic and community character impacts. For example, some of the negative impacts associated with high-volume hydraulic fracturing operations, including increased traffic, noise, and visual impacts, may adversely affect visitors' experience of certain traditional tourist destinations. As a result, tourist destination enterprises that are more geared to traditional tourists may experience a loss in visitors, sales, and employment. In addition to negatively impacting the tourism experience, increased truck traffic may also lead to additional demands for expanded road infrastructure and related improvements.

Depending upon the level of development, some agricultural land could be lost due to high-volume hydraulic fracturing activities, as well as adverse impacts to organic agriculture. The potential significant adverse environmental impacts relating to agricultural land must be considered within the framework of the goals of Article 14, Section 4 of the New York State Constitution, which specifically states that the policy of the state is to "encourage the development and improvement of its agricultural lands for the production of food and other agricultural products [which]…shall include the protection of agricultural lands."

An increase in natural gas development and related truck traffic by permitting high-volume hydraulic fracturing activities in New York State would change the economic, demographic, and social characteristics of some of the affected communities, which would be viewed as negative impacts by some and as positive impacts by others. The degree of change in community character that would occur from high-volume hydraulic fracturing activities would be primarily dependent on the manner in which the community identifies itself, as well as the community's natural physical features, history, demographics and socioeconomics, and culture. The severity of impacts on community character in rural communities would be greater for those areas where development is focused in a particular location or region.

Some of the most significant negative impacts on the local communities would result from the expected increases in the transient and permanent populations. As described in the SGEIS, population would increase in local communities affected by the proposed high-volume hydraulic fracturing operations. Thus, the demand for locally provided services and facilities, such as school, fire, police, and health care, would expand, thereby increasing both the need for one-time capital expenditures as well as increasing recurring annual operating costs, as more residents would need to be served.

H. Special and Unique Places

There are several places within New York State that, because of their special or unique character, have been afforded additional protection to ensure their availability for public use, enjoyment, and appreciation. These areas include state-owned lands and state parks, federal lands and federal parks, the Adirondack and Catskill Park, historical districts, and other places containing important historical, archeological or cultural resources.

State-owned lands, including state-owned forests, reforestation areas, wildlife management areas and state parks, 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. Surface disturbance associated with high-volume hydraulic fracturing could have negative impacts on habitats on state-owned lands, and recreational use of those lands, especially in large contiguous forest patches that are valuable because they sustain wide-ranging forest species and provide important habitat for forest interior species.

The noise, visual and truck traffic impacts from high-volume hydraulic fracturing activities on state-owned lands could adversely affect the public's recreational use and overall experience on state-owned lands. Furthermore, truck traffic coming to and from private parcels conducting high-volume hydraulic fracturing embedded within state-owned lands could create similar adverse impacts to the public's use of the surrounding state-owned land.

A similar potential adverse impact would be created by high-volume hydraulic fracturing on privately owned lands in the Catskill Park. A significant increase of visual, noise, and traffic

impacts on private parcels in the Catskill Park could result in greater significant site-specific and cumulative impacts to constitutionally protected Forest Preserve land, adversely impacting its mandated "forever wild" forest land character and preventing the public from having a Forest Preserve experience characterized by peace and quiet as envisioned by those who framed the Forest Preserve's constitutional protection.

The potential impacts from high-volume hydraulic fracturing in state and federally-designated historical districts are similar, as these districts may be vulnerable to visual and noise impacts associated with such operations and related truck traffic. The Department recognizes the potential for the character of these historic districts to be significantly adversely impacted over many years as a consequence of activities associated with high-volume hydraulic fracturing.

High-volume hydraulic fracturing operations would result in significant adverse impacts to special places and cultural resources, but the degree of impact would be highly dependent on site-specific conditions.

I. Public Health

As described in the NYSDOH Public Health Review from December of 2014, there are several potential adverse environmental impacts that could result from high-volume hydraulic fracturing. These impacts may be associated with adverse public health outcomes and include: 1) air impacts that could affect respiratory health due to increased levels of particulate matter, ozone, diesel exhaust, or volatile organic compounds; 2) drinking water impacts from underground migration of methane and/or fracturing fluid chemicals associated with faulty well construction or seismic activity; 3) surface spills from use, transport or storage of chemicals or wastewater potentially resulting in soil, groundwater, and surface water contamination; 4) surface water contamination resulting from inadequate wastewater treatment; 5) earthquakes and creation of fissures; 6) community character impacts such as increased vehicle traffic, road damage, noise, odor complaints, and increased demand for housing and medical care; and 7) climate change impacts due to methane and other volatile organic compound releases to the atmosphere and their resulting public health impacts.

Several recently published reports cited in the NYSDOH Public Health Review present data from surveys of health complaints among residents living near high-volume hydraulic fracturing activities. Commonly reported symptoms include skin rash or irritation, nausea or vomiting, abdominal pain, breathing difficulties or cough, nosebleeds, anxiety/stress, headache, dizziness, eye irritation, and throat irritation in populations within close proximity to high-volume hydraulic fracturing natural gas development. Additionally, ongoing studies by the National Institutes of Health, the National Science Foundation, the Environmental Protection Agency, and several different state and academic institutions continue to explore the relationship between high-volume hydraulic fracturing and public health risks and outcomes.[14] Many of these studies are several years from completion.

Linking health complaints and outcomes to specific chemicals or substances emitted from a high-volume hydraulic fracturing operation is difficult, and the NYSDOH concluded "that significant gaps exist in the knowledge of potential public health impacts from HVHF [high-volume hydraulic fracturing]." Any assessment of health risks from a given chemical is highly dependent on understanding the route (ingestion, inhalation, or skin contact), degree, extent, and timing of human exposure (if any) to that chemical. In the absence of data from a specific exposure incident, the NYSDOH stated that this assessment would entail making many assumptions and extrapolations regarding the exposure conditions under which risks are estimated.

The NYSDOH, recognizing the current uncertainty and identified risk with respect to the correlation between high-volume hydraulic fracturing and public health impacts, found that there are continuing and unfinished studies to amass more scientific information to better understand likely public health risks and outcomes. Until completion of ongoing studies by the National Institutes of Health, the National Science Foundation, the Environmental Protection Agency, and others regarding public health impacts from high-volume hydraulic fracturing, the Department will adhere to the NYSDOH recommendation in its public health review that "until the science provides sufficient information to determine the level of risk to public health from HVHF [high-

[14] NYSDOH, Public Health Review, December 2014, pp. 7-11

volume hydraulic fracturing] to all New Yorkers and whether the risks can be adequately managed … HVHF should not proceed in New York State."

J. Pipelines

The Public Service Commission (PSC) would be the principal regulatory entity in overseeing the construction of intrastate pipelines. Gas pipeline and compressor station siting actions undertaken pursuant to Public Service Law (PSL) Article VII are designated Type II SEQRA actions.[15] In addition, Section 130 of the PSL overrides the Department's State permitting authority, so that the Public Service Commission is the single State authority empowered to grant or deny applications to these site pipelines. However, in considering site-specific impacts of pipelines, PSC and the Department have historically coordinated and would continue to coordinate their reviews within the PSC proceedings. The PSC's Article VII proceedings are an analogue of the SEQRA process. The Department is a statutory party to such proceedings and additionally retains Federally delegated or authorized separate jurisdiction over any required air pollution control permits and registrations (usually for associated compressor stations and dehydrators) as well as under the State Pollution Discharge Elimination System (SPDES) for stormwater runoff. Consequently, significant site-specific adverse impacts would be addressed through the Article VII proceeding. However, on a generic level authorization of high-volume hydraulic fracturing would result in the construction and operation of pipelines and associated infrastructure and equipment that have the potential to result in significant adverse impacts.

The construction of natural gas pipelines, compressor stations and other associated infrastructure has the potential to create adverse impacts to state-owned lands, freshwater wetlands, forests and other habitat due to fragmentation, streams where pipelines cross, air resources (from compressor stations), visual resources, agricultural lands, and threatened and endangered species, and to contribute to the spread of invasive species.

Additionally, there is the potential for cumulative adverse impacts from gathering lines necessary to support high-volume hydraulic fracturing operations and these cumulative impacts could affect community character and wildlife habitat from the network of pipelines needed to

[15] See 6 NYCRR 617.5(c)(35)

facilitate high-volume hydraulic fracturing activities. Consequently, because the SGEIS is a generic SEQRA review of an activity that would be widespread across certain regions and would induce the construction of gathering lines, pipelines and compressor stations, the Department considered the general potential impacts associated with these ancillary activities. The Department recognizes that these considerations are limited where the Department is preempted by federal law (e.g., Surface Transportation Act, Natural Gas Act).

K. Cumulative Impacts

A generic environmental impact analysis is intended to consider the common impacts of an activity that will be performed using a standard process in various locations.[16] With respect to high-volume hydraulic fracturing, regardless of where a well is drilled, there would be impacts common to all well pads and wells. In many sections of Chapter 6, the SGEIS analyzes the combined, or cumulative, impacts of drilling more than one high-volume hydraulically fractured well or multi-well pad because the Department had sufficient information to conduct such analysis on a generic basis (e.g., air impacts). In certain instances there is insufficient information regarding the actual number of wells to be drilled in a town or county, the distribution of such wells statewide, and the timing of drilling, to conduct a cumulative analysis of the impacts of several wells or well pads. However, even with the significant uncertainty surrounding the scope and siting of high-volume hydraulic fracturing, the Department anticipates that high-volume hydraulic fracturing would impact many areas, including some that previously have not been widely exposed to oil and gas development. Moreover, beyond directly impacting those areas where the activity would be allowed, the ancillary activities associated with high-volume hydraulic fracturing and their corresponding significant adverse impacts would likely spread to those areas of the State where high-volume hydraulic fracturing is prohibited and would lead to significant adverse cumulative impacts.

Indeed, as NYSDOH stated in its Public Health Review, "[t]he number of well pads and associated high-volume hydraulic fracturing activities could be vast and spread out over wide geographic areas where environmental conditions and populations vary. The dispersed nature of

[16] 6 NYCRR 617.10

the activity magnifies the possibility of process and equipment failures, leading to the potential for cumulative risks for exposures and associated adverse health outcomes."

The cumulative effects caused by the aggregate of past development patterns, present expectations concerning high-volume hydraulic fracturing development, and reasonably foreseeable future development would, taken together, result in significant adverse impacts to some resources, particularly community character and wildlife from habitat fragmentation. For example, the cumulative impacts of high-volume hydraulic fracturing and its associated truck traffic could have adverse impacts on the community character of specific areas, including special and unique places, state-owned lands, the Catskill Park, and state and federally-designated historic districts.

There would be cumulative impacts to surface water bodies from erosion and sedimentation resulting from the construction of well pads. Sediment loading from disturbed soils on construction sites is a significant problem. EPA estimates that one un-stabilized acre subject to construction activity releases 1,000 to 2,000 times the sediment during a rain event that an acre of forest or natural meadow does. Such eroded sediments often carry adsorbed contaminants and nutrients to nearby streams and water bodies. Eroded sediments can fill wetlands and silt in the rock cobble that serves as spawning beds for trout. Sediment may impair drinking water quality by contributing to the transport of pathogens and interfering with the effectiveness of disinfection. Furthermore, in terms of the impact on the quality of waters in the State, phosphorus is one of the more significant water pollutants. Erosion and sediment loads from the construction of high-volume hydraulic fracturing wells, well pads, and associated infrastructure would introduce phosphorus and other pollutants into surface waters, accelerating their eutrophication.

III. MITIGATION MEASURES

SEQRA requires that the lead agency preparing an environmental impact statement set forth the mitigation measures that would minimize identified significant adverse environmental impacts.[17]

[17] ECL § 8-0109(2)(f)

In the SGEIS, the Department identified numerous mitigation measures intended to avoid and reduce adverse environmental and public health impacts.

Following the issuance of the 2011 revised draft SGEIS and faced with ever-increasing information and scientific studies detailing the risks and uncertainties regarding the environmental and public health impacts that could result from high-volume hydraulic fracturing development, the Department considered significant additional mitigation measures beyond those originally proposed in the SGEIS that could further reduce or avoid the impacts to water and other natural resources, wildlife, air, transportation, and community character.

The Department considered extensive mitigation measures, including measures to: heighten protections for water resources and provide for enhanced monitoring, reduce air pollution and greenhouse gas emissions, further protect habitat and wetlands, ban any high-volume hydraulic fracturing development in state-owned lands and in the Catskill Park, and provide for greater disclosure of fracturing additives and create opportunities for public comment in a permitting process.

The SGEIS outlined a potential program that would in some instances effectively mitigate potential significant adverse impacts. As discussed more fully below, the Department considered additional measures where the proposed mitigation measures were regarded as either ineffective in avoiding or adequately minimizing significant adverse impacts. However, in many instances the potential for significant adverse environmental impacts remains notwithstanding the mitigation measures the Department considered.

A. Water Resources

With respect to water resources, the Department considered mitigation measures that would heavily rely on setbacks and buffers, which would have prohibited high-volume hydraulic fracturing within:

- The New York City and Syracuse drinking water supply watersheds and within 4000’ of related water tunnels or supply infrastructure;

- 500’ of, and including, Primary Aquifers;
- 2000’ of public drinking water supply wells and intakes;
- 1000’ of each side of the main flowing water body and any tributary to that water body, both for a distance of 1 mile upstream from a public drinking water supply intake;
- 500’ of private water wells;
- 100-year floodplains;

Additionally, the Department considered mitigation measures that would have required a site-specific environmental review for high-volume hydraulic fracturing within

- 500’ of, and including, Principal Aquifers; and
- 300’ of a perennial or intermittent stream, storm drain, lake, pond and freshwater wetlands.

In addition to setbacks, the Department considered requiring operators to develop and implement a groundwater monitoring program to detect potential spills and releases around the well pad and to detect potential contamination in groundwater drawn by nearby drinking water wells before they are impacted. The Department also considered extending buffer zones on tributaries to public drinking water supplies. The Department determined that beneficial use determinations (BUDs) for the road spreading of brine produced from wells stimulated by high-volume hydraulic fracturing in the Marcellus Shale or other low-permeability formations will not be issued until additional data on its chemical content is available and evaluated by the Department and NYSDOH.

To further protect drinking water sources, the Department considered requiring specific methodologies for determining the depth to the base of fresh potable water and confirming that all potable freshwater zones are above the depth of the surface casing, including use of geophysical logs in either the uncased surface hole or the drilled intermediate hole up to and including the surface casing seat for the first well on a pad. The Department also considered

requiring use of external casing packers on the intermediate string or other means approved by the Department to permanently isolate any potable freshwater zone found below the surface casing seat from deeper, poor-quality water and/or gas-bearing zones.

Furthermore, to address concerns about flooding beyond the 100-year floodplain and in recognition of the increasing frequency and intensity of recent and potentially future flood events, the Department considered requiring that well pads be elevated two feet above the 500-year floodplain elevation or the known elevation of the flood of record, if such data are available.

In response to concerns raised about infrastructure associated with the Syracuse and New York City watersheds, the Department considered extending its initial 4,000-foot setback for surface disturbance to additionally apply to the water supply infrastructure, including tunnels that transport drinking water supplies. Beyond the setback, the placement of any portion of a wellbore less than 2,000 feet from any water tunnel or underneath a tunnel would be prohibited, and enhanced site-specific review plus consultation with the municipality would be required for any wellbore located within two miles of any water supply infrastructure for the Syracuse and NYC drinking water supplies. This measure recognizes the existence of uncertainty regarding high-volume hydraulic fracturing-induced earthquakes, both as to their probability and magnitude.

In further recognition that spills or engineering control failures could result in exposure to the harmful elements of high-volume hydraulic fracturing, and the potential for noise and lighting impacts, the Department considered establishing a 500-foot or greater setback from the edge of the well pad to inhabited private dwellings and places of assembly, such as schools and hospitals, unless the Department issues a variance from the requirement with the consent of the owner and any tenants.

B. Ecosystems and Wildlife

In response to concerns raised about impacts to wildlife habitat and wetlands, the Department considered requiring the applicant to address potential impacts to habitat connectivity in cases where a well permit application for high-volume hydraulic fracturing proposes a new access road within the 100-year floodplain or within 50 feet of surface water.

C. Air Resources and Greenhouse Gases

To reduce the air quality impacts, the Department proposed requiring the use of cleaner engines and retrofits in the drilling and fracturing equipment. Some comments from the public, however, argued that this mitigation measure would be considered a federally preempted regulation of emissions and emission-control technology for non-road engines. If a court were to agree with this argument, then additional air quality impacts could occur due to the use of dirtier engines. Additionally, to reduce GHG emissions, the Department considered requiring that a Reduced Emission Completion (REC) with minimal venting and flaring be performed whenever a commercial sales line, interconnecting gathering line and operating compressor station, if necessary, are available. The Department also proposed requiring a GHG emissions mitigation plan.

D. Public Disclosure

Based upon comments from the public with respect to chemicals used in the high-volume hydraulic fracturing process, the Department considered expanding the fracturing fluid chemical disclosure requirements to ensure that each chemical, and not merely each product, would be disclosed both before drilling and after completion of each well. The Department also considered requiring that every ECL Article 23 well application proposing high-volume hydraulic fracturing on a new well pad be subject to a fifteen-day public notice period, limited to site-specific issues on the subject application not addressed in the 1992 GEIS or this SGEIS. Similarly, the Department considered requiring operators to produce semiannual forecasts of high-volume hydraulic fracturing and related activities expected to occur within the ensuing three years, revising the forecast every six months. This measure recognizes that local governments, including emergency responders and local and state health workers, could be significantly impacted if high-volume hydraulic fracturing were allowed to proceed.

E. Community Character & Socioeconomics

The Department has also recognized that high-volume hydraulic fracturing activities could have a profound impact on community character, especially on those areas that have unique, historic and “special” identities. In this respect the Department considered prohibiting high-volume

hydraulic fracturing development in the Catskill Park (outside the NYC drinking water supply watershed) and requiring a site-specific review in state and federally designated historic districts.

To mitigate the possibility that adverse socioeconomic impacts would result from concentrated well construction activity in a short period of time within a given area, the so-called "boomtown" phenomenon, the Department considered consulting with local governments and placing limits on the number of wells and/or well pads that could be constructed in a specific area at a single time.

As more fully explained below, collectively these mitigation measures would reduce, but not eliminate, impacts to ecosystems and wildlife, air and water resources, community character and public health. Indeed, this ever-increasing collection of proposed mitigation measures demonstrates three essential facets of the proposed program: (1) the effectiveness of the mitigation is uncertain; (2) the potential risk and impact from high-volume hydraulic fracturing to the environment and public health cannot be quantified at this time, and (3) there are some impacts that are simply unavoidable.

IV. FINDINGS & SELECTED ALTERNATIVE

Before embarking on one of the most unique and environmentally-challenging activities confronting New York State, the Department, as required by SEQRA, must select the alternative that will avoid or minimize significant adverse environmental and public health impacts to the maximum extent practicable consistent with social, economic and other essential considerations. Here, the No-Action alternative is the only alternative that meets the SEQRA legal mandate because authorizing high-volume hydraulic fracturing under any scenario would not adequately mitigate adverse impacts to ecosystems and wildlife, air and water resources, community character and public health and would likely have diminished economic and social benefits.[18] This selected alternative is consistent with the Department's mission, which charges the agency

[19] See 6 NYCRR 617.11(d)[19] See ECL § 1-0101(1)

with conserving, improving, and protecting natural resources to enhance the health, safety, and welfare of the people of the state and their overall economic and social well-being.[19]

High-volume hydraulic fracturing presents significant environmental impacts and challenges to New York State, including multiple wells drilled on a single pad and well pads constructed throughout numerous counties of the State, some of which have not previously been exposed to this type of intense industrial activity. Some of the engineering controls and management practices that would be required for this activity are untested in New York and consequently, it remains uncertain whether they would be adequate to prevent spills and other unplanned events resulting in the discharge of pollutants associated with high-volume hydraulic fracturing. In addition, the risk of environmental impacts from human error and mechanical failure could result in significant adverse impacts. In the event of a spill or emergency, available mitigation measures, such as setbacks and buffers, may fail to adequately minimize adverse impacts to water resources. Compounding this risk is the current uncertainty identified by NYSDOH as to level of risk high-volume hydraulic fracturing activities pose to public health.

Setbacks or buffers are used as a measure to reduce risk because, even with engineering controls and best management practices in place, spills or engineering control failures occur during activities related to high-volume hydraulic fracturing, such as drilling, chemical storage, and truck transportation. When compared to conventionally drilled wells, high-volume hydraulically fractured horizontal wells produce and use significantly more drilling and fracturing fluids, cuttings, flowback water and production brine for wells drilled to the same vertical depth below the ground surface and in the same geological formation. Consequently, wells stimulated by high-volume hydraulic fracturing create larger waste disposal impacts, such as an increased likelihood of spills from accidents occurring during the storage and transportation of this waste. Setbacks are traditionally used as one tool to protect a resource from being impacted from such a spill. However, determining the sufficiency of a setbacks for this particular activity is extremely difficult. In this regard, the adequacy of a buffer for high-volume hydraulic fracturing is complicated by a number of factors, including the effectiveness of control measures, the potential for spills and the uncertainty of the risk posed from those spills, the potential risks

[19] See ECL § 1-0101(1)

posed by ancillary activities, and the risks posed from the subsurface access to natural gas resources below water resources. Furthermore, the proposal to monitor groundwater around well pads, while providing some level of comfort for the public and the regulator, does not prevent impacts of a spill from affecting water resources or public health. These concerns led NYSDOH to acknowledge uncertainties regarding the "kinds of adverse health outcomes that may be associated with HVHF."

Waste disposal, as a general matter, also presents risks because of the uncertainty as to how and where high-volume hydraulic fracturing-generated-waste could be properly disposed. Overall, the absence of existing facilities with recognized capacity to accept large volumes of wastewater raises the potential of significant impacts, including improper or illegal disposal. Specifically, there are no publicly owned treatment works (POTWs) permitted to accepted high-volume hydraulic fracturing wastewater in New York State, and the Department has yet to receive any requests from any POTW in the State to accept this source of wastewater.

The Department also recognizes that there remains some level of uncertainty as to the potential impact of earthquakes induced by high-volume hydraulic fracturing. A recent study ascribed a series of earthquakes in Poland, Ohio to high-volume hydraulic fracturing operations.[20] Between March 4 and March 12, 2014, 77 earthquakes, ranging between 1.0 and 3.0 in magnitude, were identified and found to be closely related spatially and temporally to hydraulic fracturing operations at a nearby well. After the Ohio Department of Natural Resources ordered the high-volume hydraulic fracturing well to be shut down on March 10, 2014 the rate of incidence decreased until the earthquakes stopped. Moreover, the likely presence of unknown faults in New York raises concern as to the effectiveness of evaluating and monitoring mapped fault lines and other proposed safeguards. Consequently, it is unclear whether the operators or the Department could adequately identify these faults prior to the drilling and hydraulic fracturing phases of well development.

Some identified mitigation measures would inevitably fail to fully address the impacts that they are intended to address. For example, in trying to protect "special places" from impacts

[20] Skoumal, R., Brudzinski, M.R., and Currie, B.S. January 2015. Earthquakes induced by hydraulic fracturing in Poland Township, Ohio. *Bulletin of the Seismological Society*

associated with high-volume hydraulic fracturing, the Department considered prohibiting the activity on private lands in the Catskill Park (the Forest Preserve is constitutionally protected and needs no additional protections). By limiting this prohibition to one unique part of the State, the measure excludes many other communities and regions that also have unique features that would be susceptible to impacts from the extensive changes to the landscape that high-volume hydraulic fracturing could cause. Moreover, the prohibition of high-volume hydraulic fracturing on State-owned lands would not address impacts from truck traffic coming to and from private parcels where high-volume hydraulic fracturing might be conducted that are surrounded by or adjacent to state-owned lands.

Further, the Department concludes that identified mitigation measures to protect forest and grassland focus areas would reduce impacts to the precise location of a well pad and associated infrastructure. However, these measures would not address the cumulative impacts of future construction of well pads and infrastructure within focus areas, which could result in habitat fragmentation that would adversely impact these areas. Furthermore, beyond focus areas, there are countless smaller forests and grasslands that provide important habitat for declining species that would be negatively impacted both individually and collectively if high-volume hydraulic fracturing were allowed to proceed. Thus, while the proposed mitigation measures, including reclamation requirements, would reduce impacts from high-volume hydraulic fracturing activities, significant unavoidable and unmitigated adverse environmental impacts would still remain.

High-volume hydraulic fracturing development could also increase ozone levels by 1 to 3 parts per billion (ppb) in areas downwind of the areas of development, including the New York City metropolitan area, which currently measures above the current National Ambient Air Quality Standard (NAAQS) for ozone of 75 ppb and is projected to be at or around that level in 2018. Based on methodology that EPA uses to characterize the impact of emissions in one state on ozone levels in downwind states, EPA has determined that any contribution to ozone nonattainment in excess of 1 % of the standard (0.75 ppb) is significant, as well as contributions that would interfere with maintenance of the standard in excess of 1 % of the standard. The significance of the contribution of high-volume hydraulic fracturing development to ozone

nonattainment in New York could increase in the future if EPA finalizes its regulatory proposal to reduce the ozone NAAQS to the range of 65-70 ppb.

Establishing a high-volume hydraulic fracturing permitting program in New York State would have significant impacts on community character in light of the anticipated pervasive nature of the activity, as well as the induced growth that extends far beyond the well pads. The Department recognizes that taken alone, the impacts of high-volume hydraulic fracturing on individual resource areas may be reduced or mitigated, but that community character is defined as a combination of several environmental factors. While the Department acknowledges that some communities may experience some positive benefits, and that various mitigation measures could be required to address or reduce adverse impacts on individual resource areas that contribute to community character, these measures would not adequately mitigate the transformation of various localities from high-volume hydraulic fracturing. In this respect, it is far less certain that specific mitigation measures can address potential cumulative impacts beyond a well pad or pads to a particular area, especially where the activity is clearly inconsistent with the area's previous history of development or experience with intense industrial activity.

Local government entities, through the use of zoning and municipal development tools, can define and influence community character. The recent New York Court of Appeals decision in the matters of *Wallach v. Town of Dryden* and *Cooperstown Holstein Corp. v. Town of Middlefield* found that ECL Section 23-0303(2) does not preempt communities with adopted zoning laws from prohibiting the use of land for high-volume hydraulic fracturing drilling. As a result of this ruling, high-volume hydraulic fracturing is expected to be prohibited by numerous municipalities throughout the state.

Both the recent New York Court of Appeals rulings and the extensive proposed mitigation measures considered by the Department all have the effect of reducing the amount of land in New York State available for the high-volume hydraulic fracturing development. By the Department's estimates, based on municipal bans and the imposition of the mitigation measures the Department would impose on the activity, more than 63% of land area of New York over the Marcellus Shale would not be available for high-volume hydraulic fracturing development.

These restrictions on the amount of available land would, in turn, reduce the number of wells that could be permitted and any projected economic benefits associated with this activity.

In addition, the Department acknowledges that the *Dryden* and *Middlefield* decision, as well as the consideration of several mitigation measures and site-specific review requirements, would increase the costs of developing New York State's shale gas reserves, which would slow the pace of development of the natural gas industry even if a high-volume hydraulic fracturing permitting program were established. It is understood that the costs to industry associated with the court decisions and implementation of the proposed mitigation measures may make it financially impractical to recover certain natural gas reserves in the state, particularly given the current and uncertain future price of natural gas.

In light of the Court's decision and the proposed mitigation measures, the expected positive socioeconomic impacts on employment, income, and tax generation associated with high-volume hydraulic fracturing would be substantially less (in the tens to hundreds of millions of dollars) than originally projected in the SGEIS and as projected under the revised development scenarios discussed above. Even with these reduced and uncertain economic prospects, it remains likely that because of the evolution of the technology that facilitates extraction of natural gas from deep low-permeability shale formations where it was previously not feasible, high-volume hydraulic fracturing would impact areas that previously have not been exposed to intense oil and gas development. As discussed above, if high-volume hydraulic fracturing were authorized, the proposed restrictions and prohibitions in certain areas would likely lead to intensified development in those areas where high-volume hydraulic volume would be permissible and where the shale was productive. Moreover, as discussed below, beyond directly impacting areas where high-volume hydraulic fracturing would be permissible, the ancillary and transport activities associated with a regulatory program and its corresponding significant adverse impacts would likely affect other areas of the State where high-volume hydraulic fracturing is prohibited. Consequently, the footprint on certain regions of the State and the associated impacts would be greater than for traditional methods of extraction.

In addition to the diminished economic benefits to the private sector from high-volume hydraulic fracturing, there would be substantial administrative and technical oversight costs to the

Department, other state agencies, and local municipal entities associated with ensuring compliance with implementation of stringent mitigation measures. The complexity and multiplicity of reviews and permits required would necessitate that state and local government entities dedicate a substantial amount of resources to the oversight of high-volume hydraulic fracturing operations. The Department estimates that its cost of administering this program under the average development scenario would grow from approximately $14 million in the first year to nearly $25 million in the fifth year. These projected costs do not consider other substantial costs that would be incurred by other state and local agencies. The cost of additional regulatory oversight costs would further reduce the fiscal benefits associated with authorizing high-volume hydraulic fracturing in New York.

Considering all of the impacts described above as well as the increased administrative costs and the reduced and uncertain economic benefits, the Department would need to be highly confident that the extensive and wide-ranging environmental impacts described in Section II above would be mitigated to the maximum extent practicable and that the risks to sensitive environmental and public health receptors would be adequately minimized. Unlike any other activity regulated by the Department, there is a potential for significant adverse impacts to be wide-ranging and widespread, including impacts to water resources, forests, and ecosystems and wildlife across a substantial portion of the State.

The Department adopts the NYSDOH statement in the Public Health Review that "[w]hile a guarantee of absolute safety is not possible, an assessment of the risk to public health must be supported by adequate scientific information to determine with confidence that the overall risk is sufficiently low to justify proceeding with HVHF in New York. The current scientific information is insufficient. Furthermore, it is clear from existing literature and experience that HVHF activity has resulted in environmental impacts that are potentially adverse to public health."

The Department concludes that while the mitigation measures in some instances would likely be effective in reducing the risk of impacts, in other instances impacts would only be partially mitigated, and in some instances the Department recognizes that there is insufficient information, or too much uncertainty as to the effectiveness of the mitigation, to determine if the impacts

could be adequately mitigated at all. The Department concludes that there would be unavoidable cumulative impacts to community character and wildlife habitat.

Based on unavoidable adverse environmental impacts and uncertainty regarding the science surrounding high-volume hydraulic fracturing and its potential impacts to public health and the environment, the Department finds that the best course of action is to select the No Action alternative. Selection of the No Action alternative means that the Department will not establish a high-volume hydraulic fracturing permitting program; that no individual or site-specific permit applications for wells using high-volume hydraulic fracturing will be processed; and that high-volume hydraulic fracturing will be prohibited in New York State.

The Department rejects the other available alternatives (the "phased-permitting approach," the "environmentally-friendly chemical approach," and the "Special Places" alternative) because they all fail to limit unavoidable adverse environmental impacts and fail to address the risks and uncertainties of high-volume hydraulic fracturing.

The phased permitting alternative could limit and/or restrict resource development in designated areas to reduce certain unavoidable adverse environmental impacts identified in the SGEIS, such as identified impacts on community character, and visual, noise and transportation impacts that are anticipated to occur as a result of the development. However, the phased permitting alternative would not address the risks and uncertainties arising from accidents, spills and unforeseen events as effectively as the No Action alternative would succeed in addressing those concerns. Additionally, a phased permitting approach would further reduce the potential economic benefits from high-volume hydraulic fracturing development and could reduce the economic viability of these operations in New York.

The "environmentally-friendly chemical alternative" and "Special Places" alternatives address potential environmental impacts for only certain resources, namely water resources and community character, and do not comprehensively address all of the potential adverse environmental impacts from the activity.

V. CONCLUSION AND CERTIFICATION

The prospect of high-volume hydraulic fracturing development in the State of New York has generated immense levels of public interest and concern. The over 80,000 public comments on the draft and revised draft SGEIS constitute the most comments, by far, that the Department has received on an environmental impact statement which it has prepared. Additionally, the 180,000 public comments the Department received on the draft regulations (which have since expired) were similarly unprecedented. The vast majority of the over 260,000 comments received urged the Department to severely restrict the practice of high-volume hydraulic fracturing or to prohibit it altogether.

These findings are the culmination of a nearly seven-year process to fully and exhaustively evaluate the environmental impacts of this activity, determine the measures and controls that would minimize such impacts, review and understand the science and experiences observed in other parts of the country, and understand the risks and uncertainties arising from the activity.

In the end, there are no feasible or prudent alternatives that would adequately avoid or minimize adverse environmental impacts and that address the scientific uncertainties and risks to public health from this activity. The Department's chosen alternative to prohibit high-volume hydraulic fracturing is the best alternative based on the balance between protection of the environment and public health and economic and social considerations.

Having considered the 1992 GEIS, the 2009 dSGEIS, the 2011 rdSGEIS and the Final SGEIS, and having considered the preceding facts and conclusions relied upon to meet the requirements of 6 NYCRR 617.9, this Statement of Findings certifies that:

1. The requirements of 6 NYCRR Part 617 have been met;

2. Consistent with the social, economic and other essential considerations from among the reasonable alternatives available, the No-Action alternative avoids adverse environmental impacts to the maximum extent practicable; including impacts disclosed in the supplemental environmental impact statement (and in Section II of this Findings Statement), and;

3. Consistent with the applicable policies of Article 42 of the Executive Law, as implemented by 19 NYCRR Part 600.5, approval of the No-Action alternative will achieve the appropriate balance between the protection of the environment and the need to accommodate social and economic considerations.

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Joseph J. Martens
Commissioner
Dated: JUN 29 2015