| RESOURCE | IMPACT | dSGEIS section | dSGEIS pp. | GEIS sec. | GEIS pp. | MITIGATING MEASURE | dSGEIS section | dSGEIS pp. | GEIS sec. | GEIS pp. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Requires submission of a fluid disposal plan for flowback water which specifies quality, maintenance, and monitoring of piping and conveyances. | *7.1.6.3* | | | |
| | | | | | | Requires application and pre-approval of POTWs proposing to dispose of flowback and production waters. Specifies application contents (e.g. headworks analysis, waste fluid characterization, regulatory limits) and demonstration that final discharges will fall within regulatory limits. | *7.1.8.1* | | | |
| | | | | | | Requires SPDES coverage of any private wastewater treatment facility proposed to accept waste fluid. | *7.1.8.1* | | | |
| | | | | | | Restates governance of EPA UIC permit over proposed injection well disposal. Notes site-specific SEQRA review for each injection well. | *7.1.8.2* | | | |
| *Water resources (cont.)* | Degradation/contamination of the NYC/unfiltered water supplies. | | | | | No well pads for high-volume hydraulic fracturing in the New York City or Syracuse watersheds or within a 4000' buffer of the watersheds. | *7.1.10* | | | |
| Floodplains | Contamination of surface waters from the release into the environment of chemical pollutants in a flood event. | *6.2* | | | | No well pads or access roads for high-volume hydraulic fracturing permitted within 100-year floodplains. | *7.2* | | | |
| Freshwater Wetlands | Contamination of freshwater wetlands from accidental release of drilling or HF fluids, chemicals, or fuel. | *6.3* | | *16.B.2.d* | *16-7..8* | For Department-regulated wetlands, makes permit approval dependent on site-specific SEQRA review and coverage under any necessary wetlands permits. | *7.3* | | | |
| | | | | | | Specifies setbacks between fuel tanks and wetlands at a mandatory 500 feet. | *7.3* | | | |
| | | | | | | Requires SPOTS 10 secondary containment for any fuel tank. | *7.3* | | | |
| | | | | | | Requires a Wetlands Permit when project is w/in 100' of a freshwater wetland > 12.4 ac. in size or of unique local significance. Authorizes permit conditions on a case-by-case basis regarding location and timing of activities/facilities and replacement of lost wetland acreage. | | | *17.B.1.f* | *17-5* |
| Ecosystems and Wildlife | Degradation of local ecosystem from fragmentation of habitat | *6.4.1* | | | | Requires operator to develop and employ Best Management Practices for surface disturbance to reduce habitat impacts. | *7.4.1* | | | |
| | | | | | | Restricts operations during mating and migration seasons in certain habitats | *7.4.1* | | | |

| RESOURCE | IMPACT | dSGEIS section | dSGEIS pp. | GEIS sec. | GEIS pp. | MITIGATING MEASURE | dSGEIS section | dSGEIS pp. | GEIS sec. | GEIS pp. |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Requires pre-drilling and post-completion animal and plant surveys when well pads are located in 150-acre or larger forest patches within Forest Focus Areas or 30-acre or larger grassland patches within Grassland Focus Areas. | *7.4.1* | | | |
| | Degradation of local ecosystem functions and native biological communities from the introduction of invasive species. | *6.4.1* | | | | Requires operator diligence in exploiting accepted BMPs for removal and preventing introduction of invasive species. | *7.4.2.1* | | | |
| | | | | | | Requires baseline surveying and reporting of project site for existence of invasive species. | *7.4.2.1* | | | |
| | | | | | | Affords DEC the right to apply permit conditions for invasive species management when outside of the DRB and SRB. | *7.4.2.2* | | | |
| | | | | | | Relies upon DRBC and SRBC protocols for aquatic invasive species management in their respective jurisdictions. | *7.4.2.2* | | | |
| *Ecosystems and Wildlife (cont.)* | Harm to local wildlife populations from the loss of habitat | *6.4.3* | | *16.B.2.b* | *16-6..7* | Requires partial and final well pad reclamation. | *7.4.1* | | | |
| | Impacts to State-Owned Lands | *6.4.4* | | | | No surface drilling allowed on specified State-owned lands. | *7.4.4* | | | |
| Air Quality | Degradation of Air Quality | *6.5* | | *16.B.2.f* | *16-9..10* | Specifies minimum exhaust-stack heights, restrictions on public access, and sulfur content of fuel-oil. | *7.5.3.1* | | | |
| | | | | | | Prohibits use of the BTEX class of compounds as additives in HVHF fluid surface impoundments. | *7.5.3.2* | | | |
| | | | | | | Requires reporting of fracturing additives and public access restrictions. | *7.5.3.2* | | | |
| | | | | | | Requires catalytic technology for production equipment. | *7.5.3.3* | | | |
| Greenhouse Gas Emissions | Emission of gases with Global Warming Potential due to natural gas well drilling and production. | *6.6* | | | | Requires development of a GHG emissions impacts mitigation plan, requires development of a leak detection and repair program, and encourages participation in the USEPA's Natural Gas STAR program. Requires reduced emission completions where a pipeline is available. | *7.6.8* | | | |
| Naturally Occuring Radioactive Material (NORM) | Exposure of workers, the public, and the environment to harmful levels of radiation. | *6.8* | | | | Outlines necessary monitoring work. | *7.8.2* | | | |
| | | | | | | Requires NORM testing of discharged waste fluids and material in production tanks. | *7.8.2* | | | |

| RESOURCE | IMPACT | dSGEIS section | dSGEIS pp. | GEIS sec. | GEIS pp. | MITIGATING MEASURE | dSGEIS section | dSGEIS pp. | GEIS sec. | GEIS pp. |
|---|---|---|---|---|---|---|---|---|---|---|
| Visual Impacts | Temporary new landscape features at well pads, new offsite facilities, congested appearance of campsites and staging areas, increase in specialized traffic. | *6.9* | | *16.B.2.e* | *16-8* | Permit conditions would require operation consistent with a visual impacts mitigation plan. Site-specifc assessment could result in additional design and siting requirements. | *7.9* | | | |
| Noise | Temporary impacts but could occur on 24-hour basis. Potential 37-42 dB increase over quietest background at 2,000 feet during drilling and hydraulic fracturing. Increased traffic noise near well pad. Noise along approach and departure corridors from increased airplan service. | *6.10* | | *16.B* | *16-2* | Operator must submit and adhere to a noise impacts mitigation plan. Site-specific assessment could result in specific mitigating permit conditions. | *7.10* | | *17.B.1.b* | *17-4* |
| Transportation | Increased traffic on roadways; damage to local roads, bridges and other infrastructure; damage to state roads, bridges and other infrastructure; increased number of breakdowns and other accidents; risk of potentially hazardous spills; traffic impacts near rail centers. | *6.11* | | | | Potential for road use agreements between operators and municipalities. Requirement to file a transportation plan that includes prposed routes and a road condition assessment. Site-specific assessment could result in additional traffic safety requirements, first responder emergency response training or avoidance of sensitive locations for trucks carrying hazardous materials. | *7.11* | | | |
| Socioeconomic & Community Character | Positive impacts on employment and income; increased economic activity; potential localized housing shortages; positive and negative impacts on state and government spending; increased tax revenues and production royalties; increased demand for local services; potential changes in the economic, demographic and social characteristics of affected communities that could be viewed as negative by some and positive by others. | *6.8 & 6.12* | | *16.B.2.h* | *16-10..11* | This section will be updated after July 31, 2011. | *7.8 & 7.12* | | | |

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New York State

DEC

# Glossary

Updated August 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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| Term | Definition |
|---|---|
| Access Road: | A road constructed to the wellsite that provides access during the drilling and operation of the well. |
| Accumulator: | The storage device for nitrogen pressurized hydraulic fluid, which is used in operating the blowout preventers. |
| AERMOD: | American Meteorological Society's and USEPA's Regulatory Model recommended by EPA for regulatory dispersion modeling. |
| AGC/SGC: | Annual Guideline Concentrations and Short-term Guideline Concentration defined in DAR-1 (Air Guide 1) procedures. |
| ALJ: | Administrative Law Judge. |
| Anaerobic: | Living or active in the absence of free oxygen. |
| Annular Space or Annulus: | Space between casing and the wellbore, or between the tubing and casing or wellbore, or between two strings of casing. |
| ANSS: | USGS's Advanced National Seismic System. |
| Anticline: | A fold with strata sloping downward on both sides from a common crest. |
| API: | American Petroleum Institute. |
| API Number: | A number referencing system designed by the American Petroleum Institute to identify wells; each state and county has a specific number code. |
| Aquifer: | A zone of permeable, water saturated rock material below the surface of the earth capable of producing significant quantities of water. |
| ARD (Acid Rock Drainage): | Refers to the outflow of acidic water from (usually abandoned) metal mines or coal mines. Acid rock drainage occurs naturally within some environments as part of the rock weathering process, usually within rocks containing an abundance of sulfide minerals. |
| AST: | Above-ground storage tank. |
| Bactericides: | Also known as a "Biocide." An additive that kills bacteria. |
| Barrel: | A volumetric unit of measurement equivalent to 42 U.S. gallons. |
| bbl: | Barrel. |
| bbl/yr: | Barrels per year. |
| Bcf: | Billion cubic feet. A unit of measurement for large volumes of gas. |
| Bentonite: | A natural clay, used as a cement or mud additive for its expansive characteristics and/or its tendency to not separate from water. |
| Berm: | A mound or wall of earth or sand. |
| Biocides: | See definition for "Bactericides". |
| Blending Unit or Blender: | The equipment used to prepare the slurries and gels commonly used in stimulation treatments. |
| Blooie Line: | Pipe that diverts fluids from the wellbore to a reserve pit. |
| Blowout: | An uncontrolled flow of gas, oil or water from a well, during drilling when high formation pressure is encountered. |
| BMP: | Best Management Practices. |
| BOD: | Biochemical (or biological) oxygen demand. |

| Term | Definition |
|---|---|
| BOP: | Blowout Preventer. A device attached immediately above the casing which can be closed and shut off the hole should a blowout occur. |
| Borehole: | See wellbore. |
| Breaker: | A chemical used to reduce the viscosity of a fluid (break it down) after the thickened fluid has finished the job it was designed for. |
| Brine Disposal Well: | A well (Class IID) for subsurface injection of associated produced brines from oil, gas and underground gas storage operations, or a well (Class V) for disposal of spent brine from geothermal and solution mining operations. |
| Brine: | A solution containing appreciable amounts of NaCl and/or other salts. Synonymous with salt water. |
| BTEX: | Benzene, Toluene, Ethylbenzene, and Xylene. These are all aromatic hydrocarbons. |
| BUD: | Beneficial Use Determination issued by NYSDEC's Division of Materials Management. |
| Buffer Zone: | An area designed to protect and separate an activity from things around it. |
| C&D: | Construction and demolition. |
| CAA: | Clean Air Act. |
| Cable Tool: | Equipment (rig) for cable-tool drilling consisting of a heavy metal bar sharpened to a chisel-like point and attached to a cable. The gravity impact of the heavy metal bar (bit) pulverizes the rock which is removed with a bailer. |
| Caliper Log: | A log that is used to check for any wellbore irregularities. It is run prior to primary cementing as a means of calculating the amount of cement needed. Also run in conjunction with other open-hole logs for log corrections. |
| Carbonate: | A salt of carbonic acid, $CO_3^{-2}$. |
| Carcinogen: | Cancer causing substance. |
| CAS Number: | Chemicals Abstract Service number, assigned by Chemical Abstracts Service, which is part of the American Chemical Society. The CAS registry is the most authoritative collection of disclosed chemical substance information, containing more than 48 million organic and inorganic substances and 61 million sequences. |
| Casing: | Steel pipe placed in a well. |
| Casing Shoe: | Reinforcing collar screwed onto the bottom of surface casing that guides the casing through the hole while absorbing the brunt of the shock. |
| Cation: | A positively charged ion. |
| CBS: | Chemical Bulk Storage. |
| CEA: | Critical Environmental Area. |
| Cement Bond Log: | A log used to evaluate the effectiveness of a primary cement job based on the different responses of sound waves in metal pipe and cement. It can also be used to locate channels in the cement. |
| Cement Sheath: | A protective covering around the casing, segregates the producing formation and prevents undesirable migration of fluid. |
| CFR: | Code of Federal Regulations. |
| cfs: | Cubic feet per second. |

| Term | Definition |
|---|---|
| $CH_4$: | Methane. |
| Chemical Additive: | A product composed of one or more chemical constituents that is added to a primary carrier fluid to modify its properties in order to form hydraulic fracturing fluid. |
| Chemical Constituent: | A discrete chemical with its own specific name or identity, such as a CAS Number, which is contained within an additive product. |
| Choke: | A device with an orifice installed in a line to restrict the flow of fluids. |
| Choke Manifold: | The arrangement of piping and special valves, called chokes, through which drilling mud is circulated when the blowout preventers are closed to control the pressures encountered during a kick. |
| Circulation: | The round trip made by the well fluids from the surface down the tubing, wellbore or casing, and then back to the surface. |
| Class GSB Water: | The best usage of Class GSB waters is as a receiving water for disposal of wastes. Class GSB waters are saline groundwaters that have a chloride concentration in excess of 1,000 milligrams per liter or a total dissolved solids concentration in excess of 2,000 milligrams per liter. |
| Clastic: | Rock consisting of fragments of rocks that have been transported from other places. |
| Clay Stabilizer/Clay Inhibitor: | A chemical additive used in stimulation treatments to prevent the migration and/or swelling of clay particles. |
| Closed Loop Drilling System: | A pitless drilling system where all drilling fluids and cuttings are contained at the surface within piping, separation equipment and tanks. |
| CO: | Carbon monoxide. |
| $CO_2$: | Carbon Dioxide. |
| $CO_2e$: | Carbon Dioxide equivalents. |
| COGCC: | Colorado Oil and Gas Conservation Commission. |
| Completion: | Preparation of a well for production after it has been drilled to the objective formation and in the case of a dry hole, preparation of a well for plugging and abandonment. |
| Compressive Strength: | Measure of the ability of a substance to withstand compression. |
| Compressor Stations: | Facilities which increase the pressure on natural gas to move it in pipelines or into storage. |
| Compulsory Integration: | New York's Environmental Conservation Law (Article 23, Titles 5 and 9 as amended by Chapter 386 of the Laws of 2005) gives all property owners the opportunity to recover or receive the gas beneath their property. To protect these "correlative rights," the Department of Environmental Conservation may establish spacing units whenever necessary. Compulsory integration is required when any owner in a spacing unit does not voluntarily integrate their interests with those of the unit operator. Compensation to the compulsory integrated interests will be established by a DEC Commissioner's Order after a public hearing. |
| Condensate: | Liquid hydrocarbons that were originally in the reservoir gas and are recovered by surface separation. |
| Conductor Hole: | The hole for conductor pipe or casing. |
| Conductor Pipe or Casing: | Large diameter casing that is usually the first string of casing in a well. Set or driven into the unconsolidated material where the well will be drilled to keep loose material from caving in. Usually relatively short in length. |
| Correlative Rights: | Rights of any mineral owner to recover resources that underlay their property. |

| Term | Definition |
|---|---|
| Corrosion Inhibitor: | A chemical substance that minimizes or prevents corrosion in metal equipment. |
| CRDPF: | Continuously Regenerating Diesel Particulate Filter. |
| Crosslinkers: | A compound, typically a metallic salt, mixed with a base-gel fluid, such as a guar-gel system, to create a viscous gel used in some stimulation or pipeline cleaning treatments. The crosslinker reacts with the multiple-strand polymer to couple the molecules, creating a fluid of high viscosity. |
| CT: | coiled tubing. |
| Cubic Foot: | Unit of measurement of the volume of gas contained in one cubic foot of space at a standard pressure (14.73 psi) and standard temperature (60° F). |
| Cuttings or Samples: | Chips of rock cut by the drill bit and brought to the surface by the drilling fluid. They indicate to the wellsite workers what kind of rocks are being penetrated and can also indicate the presence of oil or gas. |
| CWA: | Clean Water Act. |
| CWF: | Cold-Water Fishery (waters). |
| CWS: | Community water systems. |
| CZM: | Coastal Zone Management. |
| DAR: | Division of Air Resources in the NYS Department of Environmental Conservation. |
| DAR-1 (Air Guide-1): | Division of Air Resources program policy guidelines for the control of toxic air contaminants. |
| Dehydrator: | A device used to remove water and water vapors from gas. |
| Department: | New York State Department of Environmental Conservation. |
| De-sander: | A centrifugal device for removing sand from drilling fluid to prevent abrasion of the pumps. It may be operated mechanically or by a fast-moving stream of fluid inside a special cone-shaped vessel, in which case it is sometimes called a hydrocyclone. |
| De-silter: | A centrifugal device used to remove very fine particles, or silt, from drilling fluid. |
| Devonian Period: | Period of geologic time from 415 to 360 million years ago. |
| Diesel-Based Hydraulic Fracturing: | Hydraulic fracturing using diesel as the primary carrier. |
| Dip: | Angle of inclination from the horizontal. |
| Dipole Sonic Log: | A type of acoustic log that displays travel time of P-waves versus depth. |
| Disconformity: | A surface of erosion between parallel rock strata or a contact between two discordant structures (e.g., a dike emplaced within a layered sedimentary rock unit). |
| Disposal Well: | A well into which waste fluids can be injected deep underground for safe disposal. |
| DMM: | Division of Materials Management in the NYS Department of Environmental Conservation. |
| DMN: | Division of Mineral Resources in the NYS Department of Environmental Conservation. |
| DMR: | Division of Marine Resources in the NYS Department of Environmental Conservation. |
| Doghouse: | A small enclosure on the rig floor used as an office and/or as a storehouse for small objects. Also, any small building used as an office or for storage. |
| DOH: | (New York State) Department of Health. |
| DOW: | Division of Water in the NYS Department of Environmental Conservation. |
| DMV: | (New York State) Department of Motor Vehicles. |

| Term | Definition |
|---|---|
| DPS: | (New York State) Department of Public Service. |
| DRA: | Division of Regulatory Affairs in the NYS Department of Environmental Conservation. |
| DRBC: | Delaware River Basin Commission. |
| Drilling Fluid: | Mud, water, or air pumped down the drill string which acts as a lubricant for the bit and is used to carry rock cuttings back up the wellbore. It is also used for pressure control in the wellbore. |
| Drive Pipe: | See definition for "Conductor Casing". |
| Dry Hole: | Any well that does not produce oil or gas in commercial quantities. |
| DSHM: | Division of Solid and Hazardous Materials in the NYS Department of Environmental Conservation. |
| E&P: | Exploration and Production. |
| EAF: | Environmental Assessment Form. |
| ECL: | Environmental Conservation Law. |
| Ecosystem: | The system composed of interacting organisms and their environments. |
| EDR: | Electrodialysis Reversal. |
| Effluent: | Something that flows out, in particular a waste material such as an industrial discharge. |
| EIS: | Environmental Impact Statement. |
| EM&CP: | Environmental Management and Construction Plan. |
| EM&CS&P: | Environmental Management and Construction Standards and Practices. |
| Entrainment: | The condition of being drawn into something and transported with it, for example, gas bubbles in cement. |
| EO 41: | Executive Order 41. |
| EPA: | (U.S.) Environmental Protection Agency. |
| EPCRA: | Emergency Planning and Community Right to Know Act of 1986. |
| ERP: | Emergency Response Plan. |
| EUR: | Estimated ultimate recovery. |
| EV: | Exceptional Value (waters). |
| Evaporite: | Sedimentary rock or mineral deposits formed from the extensive or total evaporation of seawater. |
| FAA: | (U.S.) Federal Aviation Administration. |
| FAD: | Filtration Avoidance Determination. |
| Fault: | A fracture or fracture zone along which there has been displacement of the sides relative to each other. |
| Field: | The general area underlain by one or more pools. |
| Flare: | The burning of unwanted gas through a pipe. |
| Flocculant: | A chemical added to a fluid to cause unwanted particles, such as clay, to clump together for easier removal. |
| Floodplain: | Level land built up by stream deposition (past floods) that may be subject to future flooding. |
| Flowback Fluids: | Liquids produced following drilling and initial completion and clean-up of the well. |
| Flowmeter: | An instrument that measures fluid flow rates. |
| Flue Gas: | An exhaust gas coming out of a pipe or stack. |
| FMCSA: | Federal Motor Carrier Safety Administration. |

| Term | Definition |
|---|---|
| Foaming Agents: | An additive used to make foam in a drilling fluid. |
| Fold: | A bend in rock strata. |
| Footwall: | The mass of rock beneath a fault plane. |
| Formation: | A rock body distinguishable from other rock bodies and useful for mapping or description. Formations may be combined into groups or subdivided into members. |
| Fossil: | A record of ancient life. |
| Fracing (pronounced “fracking”): | See definition for "Hydraulic Fracturing". |
| Freeboard: | The height above the recorded high-water mark of a structure associated with the water. In the case of pits, the extra depth left unused to prevent any chance of overflow. |
| Friction Reducers/Friction Reducing Agent: | Chemical additives which alter the hydraulic fracturing fluid allowing it to be pumped into the target formation at a higher rate & reduced pressure. |
| FTIR: | Fourier-transform Infrared. |
| Gamma Ray Log: | Log that records natural gamma radiation of the formations. Shales can be identified because of their high natural gamma radiation content. |
| Gas Gathering: | The collection and movement of raw gas from the wellhead to an acceptance point of a transportation pipeline. |
| Gas Meter: | An instrument for measuring and indicating, or recording, the volume of natural gas that has passed through it. |
| Gas-Water Separator: | A device used to separate undesirable water from gas produced from a well. |
| GEIS: | Generic Environmental Impact Statement. |
| Gelling Agents: | Polymers used to thicken fluid so that it can carry a significant amount of proppants into the formation. |
| Geomembrane: | Man-made polymeric membrane (flexible membrane) that is manufactured to be essentially impermeable and is used to build containment pits. |
| Geothermal Well: | A well drilled to explore for or produce heat from the subsurface. |
| GHG: | Greenhouse gas. |
| gpd: | Gallons per day. |
| gpm: | Gallons per minute. |
| GRI: | Gas Research Institute. |
| Groundwater: | Water in the subsurface below the water table. Groundwater is held in the pores of rocks, and can be connate, from meteoric sources, or associated with igneous intrusions. |
| Groundwater Hydrology: | The science of the occurrence, distribution, and movement of water below the surface of the earth. |
| Grout: | A concrete mixture placed into a well annulus from the surface; also, the process of emplacing such mixture. |
| GWP: | Global warming potential. |
| GWPC: | Ground Water Protection Council. |
| $H_2SO_4$: | Sulfuric acid. |
| HAPS: | Hazardous Air Pollutants as defined under the Clean Air Act. |
| Hardpan: | A hard impervious layer of soil composed chiefly of clay cemented by relatively insoluble materials. |
| HDPE: | High-density polyethylene. This plastic is resistant to most chemicals, insoluble in organic solvents, and has high impact and tensile strength. |

| Term | Definition |
|---|---|
| High-Volume Hydraulic Fracturing: | The stimulation of a well using 300,000 gallons or more of water as the base fluid in fracturing fluid. |
| HMTA: | Hazardous Material Transportation Act. |
| HMTUSA: | Hazardous Materials Transportation Uniform Safety Act. |
| Horizontal Drilling: | Deviation of the borehole from vertical so that the borehole penetrates a productive formation in a manner parallel to the formation. |
| Horizontal Leg: | The part of the wellbore that deviates significantly from the vertical; it may or may not be perfectly parallel with formational layering. |
| HQ: | High Quality (waters). |
| Hydraulic Conductivity: | A property of a soil or rock, that describes the ease with which water can move through pore spaces or fractures. It is dependent upon the intrinsic permeability of the material and on the degree of saturation. |
| Hydraulic Fracturing: | The act of pumping hydraulic fracturing fluid into a formation to increase its permeability. |
| Hydraulic Fracturing Fluid: | Fluid used to perform hydraulic fracturing; includes the primary carrier fluid and all applicable additives. |
| Hydrocarbons: | Organic compounds of hydrogen and carbon whose densities, boiling points, and freezing points increase as their molecular weights increase. Although composed of only two elements, hydrocarbons exist in a variety of compounds, because of the strong affinity of the carbon atom for other atoms and for itself. The smallest molecules of hydrocarbons are gaseous; the largest are solids. Petroleum is a mixture of many different hydrocarbons. |
| Hydrocyclone: | A device to classify, separate or sort particles in a liquid suspension based on the densities of the particles. A hydrocyclone may be used to separate solids from liquids or to separate liquids from different density. |
| Hydrogen Sulfide or $H_2S$: | A malodorous, toxic gas with the characteristic odor of rotten eggs. |
| ICE: | Internal Combustion Engines. |
| ICF: | ICF International, a consulting firm. |
| Igneous Rock: | Rock formed by solidification from a molten or partially molten state (magma). |
| Infill Wells: | Wells drilled between known producing wells to better exploit the reservoir. |
| Infrastructure: | The system of public works of a country, state, or region. It can also refer to the resources (as personnel, buildings, or equipment) required for an activity. |
| Injectate: | Injectate is any substance injected down a well. |
| Injection Well: | A well through which fluids are injected into an underground stratum to increase reservoir pressure and to displace oil. Also called an input well. |
| Injection Zone: | A geological formation, group of formations, or part of a formation that receives fluids through a well. |
| Intermediate Casing or String: | Casing set below the surface casing in deep holes where added support or control of the wellbore is needed. It goes between the surface casing and the conductor casing. In very deep wells, more than one string of intermediate casing may be used. |
| IOGA-NY: | Independent Oil and Gas Association of New York. |
| IOGCC: | Interstate Oil and Gas Compact Commission. |
| Iron Inhibitors: | Chemicals used to bind the metal ions and prevent a number of different types of problems that the metal can cause (for example, scaling problems in pipe). |

| Term | Definition |
|---|---|
| ITR: | Injection Timing Retard. |
| Joule-Thompson Effect: | Referring to the change in temperature observed when a gas expands while flowing through a restriction without any heat entering or leaving the system. The change may be positive or negative. The Joule-Thomson effect often causes a temperature decrease as gas flows through pores of a reservoir to the wellbore. |
| km: | Kilometer. |
| KML: | Keyhole Markup Language. |
| LCSN: | Lamont-Doherty Cooperative Seismographic Network. |
| LDAR: | Leak detection and repair. |
| LDCs: | Local Distribution Companies. |
| Limestone: | A sedimentary rock consisting chiefly of calcium carbonate ($CaCO_3$). |
| Lithologic: | Referring to the physical characteristics of rocks or sediment that can be determined with the human eye. |
| Log: | A systematic recording of data, such as a driller's log, mud log, electrical well log, or radioactivity log. Many different logs are run in wells to discern various characteristics of rock formations that the wellbore passes through. |
| Lost Circulation: | The quantities of drilling fluid lost to a formation, usually in cavernous, pressured, or coarsely permeable beds, evidenced by complete or partial failure of the mud to return to the surface as it is being circulated in the hole. |
| Lost Circulation Material: | Material put into fluids to block off the permeability of a lost circulation zone. |
| Lost Circulation Zone: | Formation that is so permeable or soluble that it diverts the flow of fluids from the well. |
| Low-Permeability Gas Reservoirs: | Gas bearing rocks (which may or may not contain natural fractures) which exhibit in-situ gas permeability of less than 0.10 milidarcies. |
| LPG: | Liquefied Petroleum Gas. |
| LWRP: | Local Waterfront Revitalization Program. |
| Manifold: | An arrangement of piping or valves designed to control, distribute and often monitor fluid flow. |
| Marcellus Well: | A well for which the operator designates the Marcellus Shale as the objective formation. |
| Mcf: | Thousand cubic feet. |
| MCL, MCLG: | Maximum Contaminant Level, Maximum Contaminant Level Goal. |
| md: | Millidarcy. |
| Methane: | Methane ($CH_4$) is a greenhouse gas that remains in the atmosphere for approximately 9-15 years. Methane is also a primary constituent of natural gas and an important energy source. |
| Microseisms (or microseismic events): | Small bursts of seismic energy generated by shear slippages along planes of weakness in the reservoir and surrounding layers which are induced by changes in stress and pore pressure around the hydraulic fracture. These microseisms are extremely small, and sensitive receiver systems are required. |
| Micro-annulus (plural is micro-annuli): | A small gap that can form between the casing or liner and the surrounding cement sheath, most commonly formed by variations in temperature or pressure during or after the cementing process. |
| mg/L: | milligrams per liter. |

| Term | Definition |
|---|---|
| Mineral Rights: | The ownership of the minerals under a given surface, with the right to enter and remove them. It may be separated from the surface ownership. |
| MMcf: | Million cubic feet. |
| MMcf/d: | Million cubic feet per day. |
| MOVES: | Motor Vehicle Emission Simulator. |
| mR/hr: | Milliroentgens per hour. |
| MSC: | Marcellus Shale Coalition. |
| MSDS: | Material Safety Data Sheet. A written or printed document which is prepared in accordance with 29 CFR 1910.1200(g). |
| MSGP: | Multi-Sector General Permit. |
| MSW: | Municipal solid waste. |
| Mudlogging (Unit): | Trailer located at the wellsite housing equipment and personnel to progressively analyze wellbore cuttings washed up from the borehole. A portion of the mud is diverted through a gas-detecting device. |
| NAAQS and AAQS: | National or State Ambient Air Quality Standards for criteria pollutants. |
| Native Gas: | Gas originally in place in an underground formation. Term is usually associated with gas storage. |
| NCWS: | Non-community water systems. |
| NESHAPs: | National Emission Standards for Hazardous Air Pollutants. |
| NFRM: | Natural Flow Regime Method. |
| NGPA: | Natural Gas Policy Act of 1978. |
| $NH_3$: | Ammonia. |
| NMHC: | Non-methane hydrocarbons. |
| NNSR: | Nonattainment New Source Review. |
| NOI: | Notice of Intent. |
| Noise Log: | A record of the sound vibrations in the wellbore caused by flowing liquid or gas. Used to determine fluid entry points or flow behind casing. |
| Non-Darcy Flow: | Fluid flow that deviates from Darcy's law, which assumes laminar flow in the formation. Non-Darcy flow is typically observed in high-rate gas wells when the flow converging to the wellbore reaches flow velocities exceeding the Reynolds number for laminar or Darcy flow, and results in turbulent flow. |
| Nonwetting Phase: | The pore space fluid which is not attached to the reservoir rock and thus has the greatest mobility. |
| $N_2O$: | Nitrous Oxide. |
| $NO_2$: | Nitrogen Dioxide. |
| NORM - Naturally Occurring Radioactive Materials: | Low-level radioactivity that can exist naturally in native materials, like some shales and may be present in drill cuttings and other wastes from a well. |
| Non-Indigenous: | Not having originated in and being produced, growing, living, or occurring naturally in a particular region or environment. |
| Normalized Pressure Integral Curve Analysis: | Another type of Decline or Type Curve Analysis (see). |
| NPDES: | National Pollutant Discharge Elimination System. |

| Term | Definition |
|---|---|
| NSCR: | Non-Selective Catalytic Reduction. |
| NSPS: | New Source Performance Standards. |
| NTNC: | Non- transient non-community. |
| NWS: | National Weather Service. |
| NYCDEP: | New York City Department of Environmental Protection. |
| NYCRR: | New York Codes of Rules and Regulations. |
| NYSDAM: | New York State Department of Agriculture and Markets. |
| NYSDOH: | New York State Department of Health. |
| NYSDOT: | New York State Department of Transportation. |
| NYSERDA: | New York State Energy Research and Development Authority. |
| $O_3$: | Ozone. |
| Operator: | Any person or organization in charge of the development of a lease or drilling and operation of a producing well. |
| OPRHP: | (NY State) Office of Parks, Recreation and Historic Preservation. |
| Ordovician Period: | Period of geologic time from 520 to 465 million years ago. |
| PADEP: | Pennsylvania Department of Environmental Protection. |
| Paleozoic Era: | Large block of geologic time from 570 to 225 million years ago; beginning marked by the appearance of abundant fossils. Most of the bedrock in New York State was formed (deposited) during the Paleozoic. |
| Parameter: | A characteristic of a model of a reservoir that may or may not vary with respect to position or with time. (e.g., porosity is a petrophysical parameter (or characteristic) that varies with position). |
| Partial Reclamation: | The reclamation of a well site following completion of a well and in the case of multi-well pad, completion of the last well on the multi-well pad. This includes the reclamation of pits, regarding of lands and the revegetation of lands outside the well pad. |
| Passby Flow Requirement: | A prescribed quantity of flow that must be allowed to pass an intake when withdrawal is occurring. Passby requirements also specify low- flow conditions during which no water can be withdrawn. |
| Pathogens: | A specific causative agent (as a virus or bacterium). |
| PBS: | Petroleum Bulk Storage. |
| PCC: | Pre-ignition Chamber Combustion. |
| Pennsylvanian Period: | Period of geologic time from 310 to 280 million years ago. |
| Percolation Test: | Test to determine at what rate fluids will pass through soil. |
| Perennial Stream: | A stream channel that has continuous flow in parts of its bed all year round during years of normal rainfall. |
| Perforate: | To make holes through the casing to allow the oil or gas to flow into the well or to squeeze cement behind the casing. |
| Perforation: | A hole created in the casing to achieve efficient communication between the reservoir and the wellbore. |
| Permeability: | A measure of a material's ability to allow passage of gas or liquid through pores, fractures, or other openings. The unit of measurement is the millidarcy. |
| Permeable: | Able to transmit gas or liquid through interconnected pores, fractures, or other openings. |

| Term | Definition |
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| Petroleum: | In the broadest sense the term embraces the full spectrum of hydrocarbons (gaseous, liquid, and solid). |
| PHMSA: | Pipeline and Hazardous Materials Safety Administration. |
| PID: | Perforation Inflow Diagnostic. |
| Pipe Racks: | Horizontal supports for storing tubular goods. |
| Plat: | A map of land parcels; a drafted map of a site's location showing boundaries of adjoining parcels. |
| Plug Back: | To place cement in or near the bottom of a well to exclude bottom water, to sidetrack, or to produce from a formation higher in the well. Plugging back can also be accomplished with a mechanical plug set by wireline, tubing, or drill pipe. |
| Plugged and Abandoned: | (plug and abandon) To prepare a well to be closed permanently with cement plugs, usually after either logs determine there is insufficient hydrocarbon potential to complete the well, or after production operations have drained the reservoir. |
| PM10 and PM2.5: | Particulate matter with sizes of less than 10 and 2.5 microns, respectively. |
| Pneumatic: | Run by or using compressed air. |
| POC: | Principal Organic Contaminant. |
| Poisson's ratio: | An elastic constant that is a measure of the compressibility of material perpendicular to applied stress, or the ratio of latitudinal to longitudinal strain. Named for French mathematician Simeon Poisson (1781 to 1840). |
| Polymer: | Chemical compound of unusually high molecular weight composed of numerous repeated, linked molecular units. |
| Pool: | An underground reservoir containing a common accumulation of oil and/or gas. Each zone of a structure which is completely separated from any other zone in the same structure is a pool. |
| Porosity: | Volume of pore space expressed as a percent of the total bulk volume of the rock. |
| Potable Fresh Water: | Suitable for drinking by humans and containing less than 250 ppm of sodium chloride or 1,000 ppm TDS. |
| POTW: | Publicly Owned Treatment Works. |
| ppb: | Parts per billion. |
| ppm: | Parts per million. |
| Precambrian Era: | Very large block of geologic time spanning from Earth's formation to the 4,500 to 570 million years ago. |
| Pressure Buildup Test: | An analysis of data obtained from measurements of the bottomhole pressure in a well that is shut-in after a flow period. The profile created on a plot of pressure against time is used with mathematical reservoir models to assess the extent and characteristics of the reservoir and the near-wellbore area. |
| Primary Aquifer: | A highly productive aquifer presently being utilized as a source of water supply by a major municipal supply system. |
| Primary Carrier Fluid: | The base fluid, such as water, into which additives are mixed to form the hydraulic fracturing fluid which transports proppant. |
| Primary Production: | Production of a reservoir by natural energy in the reservoir. |
| Principal Aquifer: | An aquifer known to be highly productive or whose geology suggests abundant potential water supply, but which is not intensively used as a source of water supply by a major municipal system. |

| Term | Definition |
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| Principal Stresses: | Forces per unit area acting on the external surface of a solid body. |
| Product: | A hydraulic fracturing fluid additive that is manufactured using precise amounts of specific chemical constituents and is assigned a commercial name under which the substance is sold or utilized. |
| Production Casing: | Casing set above or through the producing zone through which the well produces. |
| Production Brine: | Liquids co-produced during oil and gas wells production. |
| Proppant or Propping Agent: | A granular substance (sand grains, aluminum pellets, or other material) that is carried in suspension by the fracturing fluid and that serves to keep the cracks open when fracturing fluid is withdrawn after a fracture treatment. |
| PSC: | Public Service Commission. |
| PSD: | Prevention of Significant Deterioration defined in the Clean Air Act. |
| PSI: | Pounds per square inch. |
| PSIG: | Pounds per Square Inch Gauge. |
| PSL: | Public Service Law. |
| Public Water Supply: | Either a community or non-community well system which provides piped water to the public for human consumption if the system has a minimum of five (5) service connections, or regularly serves a minimum average of 25 individuals per day at least 60 days per year. |
| PTE: | Potential to Emit. |
| Pump and Plug Method: | A technique for placing cement plugs at appropriate intervals. |
| PVC: | Polyvinylchloride; a durable petroleum derived plastic. |
| RACT: | Reasonably Available Control Technology. |
| Radial Cement Bond Log: | A record of sonic amplitudes derived from acoustic signals passing along the well casing. Used to evaluate cement-to-pipe and cement-to-formation bonding. |
| RCRA: | Resource Conservation and Recovery Act. |
| Real Property: | Includes mineral claims, surface and water rights. |
| REC: | Reduced Emissions Completion. |
| Reclaimed: | (Reclamation) Rehabilitation of a disturbed area to make it acceptable for designated uses. This normally involves regrading, replacement of topsoil, re-vegetation, and other work necessary to restore it. |
| Remediation: | The removal of pollution or contaminants from the environmental media such as soil, groundwater, or surface water. |
| Reserve pit: | A mud pit in which a supply of drilling fluid has been stored. Also, a waste pit, usually an excavated, earthen-walled pit. In NY it is required to be lined with plastic to prevent soil contamination. |
| Reservoir (oil or gas): | A subsurface, porous, permeable or naturally fractured rock body in which oil or gas has accumulated. A gas and production is only gas plus fresh water that condenses from the flow stream reservoir. In a gas condensate reservoir, the hydrocarbons may exist as a gas, but, when brought to the surface, some of the heavier hydrocarbons condense and become a liquid. |
| Reservoir (water): | Any man-made structure used to supply fresh water to the public. |
| Reservoir Rock: | A rock that may contain oil or gas in appreciable quantity and through which petroleum may migrate. |

| Term | Definition |
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| RO: | Reverse Osmosis. |
| Rotary Rig: | A derrick equipped with rotary equipment where a well is drilled using rotational movement. |
| Royalty: | The landowner's share of the value of oil and gas produced. |
| Run-Off: | The portion of precipitation on land that ultimately reaches streams sometimes with dissolved or suspended material. |
| Sandstone: | A variously colored sedimentary rock composed chiefly of sandlike quartz grains cemented by lime, silica or other materials. |
| SAPA: | State Administrative Procedures Act. |
| Scale Inhibitor: | A chemical substance which prevents the accumulation of a mineral deposit (for example, calcium carbonate) that precipitates out of water and adheres to the inside of pipes, heaters, and other equipment. |
| SCR: | Selective Catalytic Reduction. |
| SDWA: | Safe Drinking Water Act. |
| SDWIS: | Safe Drinking Water Information System. |
| Sedimentary: | Rocks formed from sediment transported from their source and deposited in water or by precipitation from solution or from secretions of organisms. |
| Sedimentation Control: | (sedimentation) The process of separation of the components of a cement slurry during which the solids settle. Sedimentation is one of the characterizations used to define slurry stability. |
| Seep: | Natural leakage of gas or oil at the earth's surface. |
| SEIS: | Supplemental Environmental Impact Statement. |
| Seismic: | Related to earth vibrations produced naturally or artificially. |
| Separator: | Tank used to physically separate the oil, gas, and water produced simultaneously from a well. |
| SEQR: | Reference to the regulatory program or type of review done under SEQRA. |
| SEQRA: | State Environmental Quality Review Act. |
| Setback: | Minimum distance required between a well operation and other zones, boundaries, or objects such as highways, wetlands, streams, or houses. |
| SGC/AGC: | Short-term Guideline Concentration and Annual Guideline Concentrations defined in DAR-1 (Air Guide 1) procedures. |
| SGEIS: | Supplemental Generic Environmental Impact Statement. |
| Shale: | A thinly laminated claystone, siltstone or mud stone. |
| Shale Shaker: | A series of trays with sieves or screens that vibrate to remove cuttings from circulating fluid in rotary drilling operations. The size of the openings in the sieve is selected to match the size of the solids in the drilling fluid and the anticipated size of cuttings. Also called a shaker. |
| Shear Wave (S-wave): | Elastic body wave in which particles oscillate perpendicular to the direction in which the wave propagates. S-waves, or shear waves, travel more slowly than P-waves and cannot travel through fluids. Interpretation of S-waves can help determine rock properties. |
| Short Ton: | 20 short hundred weight, 2,000 pounds. |

| Term | Definition |
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| Show: | Small quantity of oil or gas, not enough for commercial production. |
| Shut In (Verb): | To close the valves at the wellhead to keep the well from flowing or to stop producing a well. |
| Shut-In (Adjective): | The state of a well which has been shut-in. |
| SI: | Spark Ignition. |
| Significant Habitats: | Areas which provide one or more of the key factors required for survival, variety or abundance of wildlife, and/or for human recreation associated with such wildlife. |
| SILs: | Significant Impact Levels for criteria pollutants. |
| Siltation: | The build-up of silt in a stream or lake as a result of activity that disturbs the streambed, bank, or surrounding land. |
| Siltstone: | Rock in which the constituent particles are predominantly silt size. |
| Silurian Period: | Period of geologic time from 405 to 415 million years ago. |
| SIP | State Implementation Plan |
| Slickwater Fracturing (or slick-water): | A type of hydraulic fracturing which utilizes water-based fracturing fluid mixed with a friction reducing agent & other chemical additives. The fluid is typically 98% fresh water & sand (proppant) & 2% or less chemical additives. |
| Slippage: | The phenomenon in multiphase flow when one phase flows faster than another phase, in other words slips past it. Because of this phenomenon, there is a difference between the holdups and cuts of the phases. |
| $SO_2$: | Sulfur dioxide. |
| $SO_3$ | Sulfur trioxide. |
| Sonic Log: | See "Dipole Sonic Log". |
| Spacing Unit: | A surface area allotted to a well by regulations or field rules issued by a governmental authority having jurisdiction for the drilling and production of a well. |
| Spacing: | Distance separating wells in a field to optimize recovery of oil and gas. |
| SPDES: | State Pollutant Discharge Elimination System. |
| Spring: | A place where groundwater naturally flows from underground onto land or into a body of surface water. |
| Spudding: | The breaking of the earth's surface in the initial stage of drilling a well. |
| Squeeze: | Technique where cement is forced under pressure into the annular space between casing and the wellbore, between two strings of pipe, or into the casing-hole annulus. |
| SRBC: | Susquehanna River Basin Commission. |
| Stage: | Isolation of a specific interval of the wellbore and the associated interval of the formation for the purpose of maintaining sufficient fracturing pressure. |
| Stage Plug: | A device used to mechanically isolate a specific interval of the wellbore and the formation for the purpose of maintaining sufficient fracturing pressure. |
| Standpipe: | A vertical pipe rising along the side of the derrick or mast. It joins the discharge line leading from the mud pump to the rotary hose and through which mud is pumped going into the hole. |
| Stimulation: | The act of increasing a well's productivity by artificial means such as hydraulic fracturing, acidizing, and shooting. |

| Term | Definition |
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| Stratigraphic Test Well: | A hole drilled to gather engineering, geologic or hydrological information including but not limited to lithology, structural, porosity, permeability and geophysical data. |
| Stratigraphy: | The study of rock layering, including the history, composition, relative ages and distribution of different rock units. |
| Stratum (plural strata): | Sedimentary rock layer, typically referred to as a formation, member, or bed. |
| Stream's Designated Best Use: | Each waterbody in NYS has been assigned a classification, which reflects the designated "best uses" of the waterbody. These best uses typically include the ability to support fish and aquatic wildlife, recreational uses (fishing, boating) and, for some waters, public bathing, drinking water use or shellfishing. Water quality is considered to be good if the waters support their best uses. |
| Substructure: | The foundation on which the derrick and drawworks sit. It contains space for storage and well-control equipment. |
| Surface Casing: | Casing extending from the surface through the potable fresh water zone. |
| Surface Impoundment: | A liquid containment facility that can be installed in a natural topographical depression, excavation, or bermed area formed primarily of earthen materials, then lined with a geomembrane or a combination of other geosynthetic materials. |
| Surfactants: | Chemical additives that reduce surface tension; or a surface active substance. Detergent is a surfactant. |
| SWPPP: | Stormwater Pollution Prevention Plan. |
| SWTR: | Surface Water Treatment Rule. |
| Target Formation: | The reservoir that the driller is trying to reach when drilling the well. |
| TCEQ: | Texas Commission on Environmental Quality. |
| Tcf: | Trillion cubic feet. |
| TD: | Total depth. |
| TDS: | Total Dissolved Solids. The dry weight of dissolved material, organic and inorganic, contained in water and usually expressed in mg/L or ppm. |
| TEG: | Triethylene Glycol. |
| Tensile Strength: | The force per unit cross-sectional area required to pull a substance apart. |
| Tight Formation: | Formation with very low permeability. |
| TMD: | Total measured depth. |
| TNC: | Transient non-community (in the context of water systems) or The Nature Conservancy. |
| TOC: | Total Organic Carbon. |
| Total Kjeldahl Nitrogen: | The sum of organic nitrogen; ammonium $NH_3$ and ammonia $NH_4$+ in water and soil analyses. |
| Tote: | A container used in the storage of various solid powder or liquid bulk products. |
| Trap: | Any geological barrier which restricts the migration of oil & gas. |
| TVD: | True vertical depth. |
| Turbidity: | Amount of suspended solids in a liquid. |

| Term | Definition |
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| UA: | Urbanized areas. |
| UC: | Urban clusters. |
| UIC – Underground Injection Control: | A program administered by the Environmental Protection Agency, primacy state, or Indian tribe under the Safe Drinking Water Act to ensure that subsurface emplacement of fluids does not endanger underground sources of drinking water. |
| ULSF: | Ultra-Low Sulfur (Diesel) Fuel. |
| UN: | United Nations. |
| Unfiltered Surface Water Supplies: | Those that the U.S. EPA and NYSDOH have determined meet the requirements of the "Interim Enhanced Surface Water Treatment Rule" (IESWT Rule) for unfiltered water supply systems. The IESWT Rule is a December 16, 1998 amendment to the Surface Water Treatment Rule that was originally promulgated by EPA on June 29, 1989. In New York State, this includes the NYC Drinking Water Supply Watershed and the Skaneateles Drinking Water Supply Watershed. |
| UOC: | Unspecified Organic Contaminant. |
| USCG: | United States Coast Guard. |
| USDOT: | United States Department of Transportation. |
| USDW - Underground Source of Drinking Water: | An aquifer or portion of an aquifer that supplies any public water system or that contains a sufficient quantity of ground water to supply a public water system, and currently supplies drinking water for human consumption, or that contains fewer than 10,000 mg/L total dissolved solids and is not an exempted aquifer. |
| Water Well: | Any residential well used to supply potable water. |
| USEPA: | United States Environmental Protection Agency. |
| USGS: | United States Geological Survey. |
| Viscosity: | A measure of the degree to which a fluid resists flow under an applied force. |
| Vitrinite Reflectance: | A measurement of the maturity of organic matter with respect to whether it has generated hydrocarbons or could be an effective source rock. |
| VMT: | Vehicle Miles per Trip. |
| VOC: | Volatile Organic Compound. |
| Watershed: | The region drained by, or contributing water to, a stream, lake, or other body of water. |
| Well Location Plat: | A map of parcels of land with the proposed well and other features, particularly adjoining parcel boundaries. |
| Well Pad: | The area directly disturbed during drilling and operation of a gas well. |
| Wellbore: | A borehole; the hole drilled by the bit. A wellbore may have casing in it or it may be open (uncased); or part of it may be cased, and part of it may be open. |
| Wellhead: | The equipment installed at the surface of the wellbore. A wellhead includes such equipment as the casinghead and tubing head. |
| Well site: | Includes the well pad and access roads, equipment storage and staging areas, vehicle turnarounds, and any other areas directly or indirectly impacted by activities involving a well. |
| Wetland: | Any area regulated pursuant to Part 663. |
| Wildcat: | Well drilled to discover a previously unknown oil or gas pool or a well drilled one mile or more from a producing |

| Term | Definition |
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| | well. |
| Wireline: | A general term used to describe well-intervention operations conducted using single-strand or multistrand wire or cable for intervention in oil or gas wells. Although applied inconsistently, the term commonly is used in association with electric logging and cables incorporating electrical conductors. |
| WMA: | Wildlife Management Area. |
| WOC Time: | "Waiting on cement" time. Pertaining to the time when drilling or completion operations are suspended so that the cement in a well can harden sufficiently. |
| Workover: | Repair operations on a producing well to restore or increase production. |
| ZLD: | Zero liquid discharge. |
| Zonal Isolation: | The state of keeping fluids in one zone separate from the fluids in another zone. In the case of a well, isolation is maintained by appropriate use of casing, cement, plugs and packers. |
| Zone: | A rock stratum of different character or fluid content from other strata. |

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New York State

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Revised Draft
Supplemental Generic Environmental Impact Statement

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New York State

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# Appendices

# REVISED DRAFT
# Supplemental Generic Environmental Impact Statement on the Oil, Gas and Solution Mining Regulatory Program

Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-Permeability Gas Reservoirs

New York State Department of Environmental Conservation

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[1] Updated/revised July 2011
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[3] Appendix 22 from the September 2009 dSGEIS has been replaced with a new Appendix 22.

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New York State

DEC

# Appendix 1

## FEMA
## Flood Insurance Rate Map
## Availability

Excerpted from Alpha Environmental, 2009
Updated by NYSDEC

Updated July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ALBANY COUNTY | ALBANY, CITY OF | 04/15/1980 |
| ALBANY COUNTY | ALTAMONT, VILLAGE OF | 08/15/1983 |
| ALBANY COUNTY | BERNE,TOWN OF | 08/01/1987 (L) |
| ALBANY COUNTY | BETHLEHEM, TOWN OF | 04/17/1984 |
| ALBANY COUNTY | COEYMANS, TOWN OF | 08/03/1989 |
| ALBANY COUNTY | COHOES, CITY OF | 12/4/1979 |
| ALBANY COUNTY | COLONIE, TOWN OF | 09/05/1979 |
| ALBANY COUNTY | GREEN ISLAND, VILLAGE OF | 06/04/1980 |
| ALBANY COUNTY | GUILDERLAND, TOWN OF | 01/06/1983 |
| ALBANY COUNTY | KNOX, TOWNSHIP OF | 08/13/1982 (M) |
| ALBANY COUNTY | MENANDS, VILLAGE OF | 03/18/1980 |
| ALBANY COUNTY | NEW SCOTLAND, TOWN OF | 12/1/1982 |
| ALBANY COUNTY | RAVENA, VILLAGE OF | 04/02/1982 (M) |
| ALBANY COUNTY | RENSSELAERVILLE, TOWN OF | 08/27/1982 (M) |
| ALBANY COUNTY | VOORHEESVILLE, VILLAGE OF | 12/1/1982 |
| ALBANY COUNTY | WATERVLIET, CITY OF | 01/02/1980 |
| ALBANY COUNTY | WESTERLO, TOWN OF | 08/03/1989 |
| ALLEGANY COUNTY | ALFRED, TOWN OF | 10/07/1983 (M) |
| ALLEGANY COUNTY | ALFRED, VILLAGE OF | 02/15/1980 |
| ALLEGANY COUNTY | ALLEN, TOWN OF | 07/16/1982 (M) |
| ALLEGANY COUNTY | ALMA, TOWN OF | 10/07/1983 (M) |
| ALLEGANY COUNTY | ALMOND, VILLAGE OF | 02/15/1980 |
| ALLEGANY COUNTY | AMITY, TOWN OF | 12/18/1984 |
| ALLEGANY COUNTY | ANDOVER, TOWN OF | 03/02/1998 |
| ALLEGANY COUNTY | ANDOVER, VILLAGE OF | 04/02/1979 |
| ALLEGANY COUNTY | ANGELICA, TOWN OF | 12/31/1982 (M) |
| ALLEGANY COUNTY | ANGELICA, VILLAGE OF | 02/01/1984 |
| ALLEGANY COUNTY | BELFAST, TOWN OF | 08/06/1982 (M) |
| ALLEGANY COUNTY | BELMONT, VILLAGE OF | 12/18/1984 |
| ALLEGANY COUNTY | BIRDSALL, TOWN OF | 07/16/1982 (M) |
| ALLEGANY COUNTY | BOLIVAR, TOWN OF | 07/30/1982 (M) |
| ALLEGANY COUNTY | BOLIVAR, VILLAGE OF | 01/19/1996 |
| ALLEGANY COUNTY | BURNS, TOWN OF | 07/16/1982 (M) |
| ALLEGANY COUNTY | CANASERAGA, VILLAGE OF | 12/02/1983 (M) |
| ALLEGANY COUNTY | CANEADEA, TOWN OF | 08/20/1982 (M) |
| ALLEGANY COUNTY | CLARKSVILLE, TOWN OF | 11/12/1982 (M) |
| ALLEGANY COUNTY | CUBA, TOWN OF | 07/30/1982 (M) |
| ALLEGANY COUNTY | CUBA, VILLAGE OF | 04/17/1978 |
| ALLEGANY COUNTY | FRIENDSHIP, TOWN OF | 12/18/1984 |
| ALLEGANY COUNTY | GENESEE, TOWN OF | 07/30/1982 (M) |
| ALLEGANY COUNTY | GRANGER, TOWN OF | 10/07/1983 (M) |
| ALLEGANY COUNTY | GROVE, TOWN OF | 11/6/1991 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ALLEGANY COUNTY | HUME, TOWN OF | 10/2/1997 |
| ALLEGANY COUNTY | INDEPENDENCE, TOWN OF | 07/09/1982 (M) |
| ALLEGANY COUNTY | NEW HUDSON, TOWN OF | 08/20/1982 (M) |
| ALLEGANY COUNTY | RICHBURG, VILLAGE OF | 01/05/1978 |
| ALLEGANY COUNTY | RUSHFORD, TOWN OF | 12/23/1983 (M) |
| ALLEGANY COUNTY | SCIO, TOWN OF | 03/18/1985 |
| ALLEGANY COUNTY | WARD,TOWN OF | (NSFHA) |
| ALLEGANY COUNTY | WELLSVILLE, TOWN OF | 03/18/1985 |
| ALLEGANY COUNTY | WELLSVILLE, VILLAGE OF | 07/17/1978 |
| ALLEGANY COUNTY | WEST ALMOND, TOWN OF | (NSFHA) |
| ALLEGANY COUNTY | WILLING, TOWN OF | 12/24/1982 (M) |
| ALLEGANY COUNTY | WIRT, TOWN OF | 06/25/1982 (M) |
| BROOME COUNTY | BARKER, TOWN OF | 02/05/1992 |
| BROOME COUNTY | BINGHAMTON, CITY OF | 06/01/1977 |
| BROOME COUNTY | BINGHAMTON, TOWN OF | 01/06/1984 (M) |
| BROOME COUNTY | CHENANGO, TOWN OF | 08/17/1981 |
| BROOME COUNTY | COLESVILLE, TOWN OF | 01/20/1993 |
| BROOME COUNTY | CONKLIN, TOWN OF | 07/17/1981 |
| BROOME COUNTY | DICKINSON, TOWN OF | 04/15/1977 |
| BROOME COUNTY | ENDICOTT, VILLAGE OF | 09/07/1998 |
| BROOME COUNTY | FENTON, TOWN OF | 08/03/1981 |
| BROOME COUNTY | JOHNSON CITY, VILLAGE OF | 09/30/1977 |
| BROOME COUNTY | KIRKWOOD, TOWN OF | 06/01/1977 |
| BROOME COUNTY | LISLE, TOWN OF | 08/20/2002 |
| BROOME COUNTY | LISLE, VILLAGE OF | 01/06/1984 (M) |
| BROOME COUNTY | MAINE, TOWN OF | 02/05/1992 |
| BROOME COUNTY | NANTICOKE, TOWN OF | 12/18/1985 |
| BROOME COUNTY | PORT DICKINSON, VILLAGE OF | 05/02/1977 |
| BROOME COUNTY | SANFORD, TOWN OF | 06/04/1980 |
| BROOME COUNTY | TRIANGLE, TOWN OF | 07/20/1984 (M) |
| BROOME COUNTY | UNION, TOWN OF | 09/30/1988 |
| BROOME COUNTY | VESTAL, TOWN OF | 03/02/1998 |
| BROOME COUNTY | WHITNEY POINT, VILLAGE OF | 01/06/1984 (M) |
| BROOME COUNTY | WINDSOR, TOWN OF | 09/30/1992 |
| BROOME COUNTY | WINDSOR, VILLAGE OF | 05/18/1992 |
| CATTARAUGUS COUNTY | ALLEGANY, TOWN OF | 11/15/1978 |
| CATTARAUGUS COUNTY | ALLEGANY, VILLAGE OF | 12/17/1991 |
| CATTARAUGUS COUNTY | ASHFORD, TOWNSHIP OF | 05/25/1984 |
| CATTARAUGUS COUNTY | CARROLLTON, TOWN OF | 03/18/1983 (M) |
| CATTARAUGUS COUNTY | CATTARAUGUS, VILLAGE OF | 04/20/1984 (M) |
| CATTARAUGUS COUNTY | COLD SPRING, TOWN OF | 03/01/1978 |
| CATTARAUGUS COUNTY | CONEWANGO, TOWN OF | 07/30/1982 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| CATTARAUGUS COUNTY | DAYTON, TOWN OF | 05/25/1984 (M) |
| CATTARAUGUS COUNTY | DELEVAN, VILLAGE OF | 01/20/1984 (M) |
| CATTARAUGUS COUNTY | EAST OTTO, TOWN OF | 04/20/1984 (M) |
| CATTARAUGUS COUNTY | EAST RANDOLPH, VILLAGE OF | 02/01/1978 |
| CATTARAUGUS COUNTY | ELLICOTTVILLE, TOWN OF | 01/19/2000 |
| CATTARAUGUS COUNTY | ELLICOTTVILLE, VILLAGE OF | 05/02/1994 |
| CATTARAUGUS COUNTY | FARMERSVILLE, TOWN OF | 07/23/1982 (M) |
| CATTARAUGUS COUNTY | FRANKLINVILLE, TOWN OF | 07/17/1978 |
| CATTARAUGUS COUNTY | FRANKLINVILLE, VILLAGE OF | 07/03/1978 |
| CATTARAUGUS COUNTY | FREEDOM, TOWN OF | 08/19/1991 |
| CATTARAUGUS COUNTY | GREAT VALLEY, TOWN OF | 07/17/1978 |
| CATTARAUGUS COUNTY | HINSDALE, TOWN OF | 01/17/1979 |
| CATTARAUGUS COUNTY | HUMPHREY, TOWN OF | 08/13/1982 (M) |
| CATTARAUGUS COUNTY | ISCHUA, TOWN OF | 08/15/1978 |
| CATTARAUGUS COUNTY | LEON, TOWN OF | 08/13/1982 (M) |
| CATTARAUGUS COUNTY | LIMESTONE, VILLAGE OF | 04/17/1978 |
| CATTARAUGUS COUNTY | LITTLE VALLEY, TOWN OF | 06/22/1984 (M) |
| CATTARAUGUS COUNTY | LITTLE VALLEY, VILLAGE OF | 02/01/1978 |
| CATTARAUGUS COUNTY | LYNDON, TOWN OF | 07/16/1982 (M) |
| CATTARAUGUS COUNTY | MACHIAS, TOWN OF | 08/20/1982 (M) |
| CATTARAUGUS COUNTY | MANSFIELD, TOWN OF | 05/25/1984 (M) |
| CATTARAUGUS COUNTY | NAPOLI, TOWN OF | 07/02/1982 (M) |
| CATTARAUGUS COUNTY | NEW ALBION, TOWN OF | 12/03/1982 (M) |
| CATTARAUGUS COUNTY | OLEAN, CITY OF | 05/09/1980 |
| CATTARAUGUS COUNTY | OLEAN, TOWN OF | 02/01/1979 |
| CATTARAUGUS COUNTY | OTTO, TOWN OF | 04/20/1984 (M) |
| CATTARAUGUS COUNTY | PERRYSBURG, TOWN OF | 04/20/1984 (M) |
| CATTARAUGUS COUNTY | PERSIA, TOWN OF | 04/20/1984 (M) |
| CATTARAUGUS COUNTY | PORTVILLE, TOWN OF | 07/18/1983 |
| CATTARAUGUS COUNTY | PORTVILLE, VILLAGE OF | 04/17/1978 |
| CATTARAUGUS COUNTY | RANDOLPH, TOWN OF | 11/05/1982 (M) |
| CATTARAUGUS COUNTY | RANDOLPH, VILLAGE OF | 08/01/1978 |
| CATTARAUGUS COUNTY | SALAMANCA, CITY OF | 04/17/1978 |
| CATTARAUGUS COUNTY | SALAMANCA, TOWN OF | 11/1/1979 |
| CATTARAUGUS COUNTY | SOUTH DAYTON, VILLAGE OF | 01/05/1978 |
| CATTARAUGUS COUNTY | SOUTH VALLEY, TOWN OF | 12/02/1983 (M) |
| CATTARAUGUS COUNTY | YORKSHIRE, TOWN OF | 05/25/1984 (M) |
| CATTARAUGUS COUNTY/ERIE COUNTY/CHAUTAUQUA COUNTY/ALLEGANY COUNTY | SENECA NATION OF INDIANS | 09/30/1988 |
| CAYUGA COUNTY | AUBURN, CITY OF | 08/02/2007 |
| CAYUGA COUNTY | AURELIUS, TOWN OF | 08/02/2007 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| CAYUGA COUNTY | AURORA, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | BRUTUS, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | CATO, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | CATO, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | CAYUGA, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | CONQUEST, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | FAIR HAVEN, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | FLEMING, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | GENOA,TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | IRA, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | LEDYARD, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | LOCKE, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | MENTZ, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | MERIDIAN, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | MONTEZUMA, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | MORAVIA, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | MORAVIA, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | NILES, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | OWASCO, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | PORT BYRON, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | SCIPIO, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | SEMPRONIUS, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | SENNETT, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | SPRINGPORT, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | STERLING, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | SUMMER HILL, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | THROOP, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | UNION SPRINGS, VILLAGE OF | 08/02/2007 |
| CAYUGA COUNTY | VENICE, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | VICTORY, TOWN OF | 08/02/2007 |
| CAYUGA COUNTY | WEEDSPORT, VILLAGE OF | 08/02/2007 |
| CHAUTAUQUA COUNTY | ARKWRIGHT, TOWN OF | 04/08/1983 (M) |
| CHAUTAUQUA COUNTY | BEMUS POINT, VILLAGE OF | 11/2/1977 |
| CHAUTAUQUA COUNTY | BROCTON, VILLAGE OF | (NSFHA) |
| CHAUTAUQUA COUNTY | BUSTI, TOWN OF | 01/20/1993 |
| CHAUTAUQUA COUNTY | CARROLL, TOWN OF | 10/29/1982 (M) |
| CHAUTAUQUA COUNTY | CASSADAGA, VILLAGE OF | 12/1/1977 |
| CHAUTAUQUA COUNTY | CELORON, VILLAGE OF | 03/18/1980 |
| CHAUTAUQUA COUNTY | CHARLOTTE, TOWN OF | 03/23/1984 (M) |
| CHAUTAUQUA COUNTY | CHAUTAUQUA, TOWN OF | 06/15/1984 |
| CHAUTAUQUA COUNTY | CHERRY CREEK, TOWN OF | 07/02/1982 (M) |
| CHAUTAUQUA COUNTY | CHERRY CREEK, VILLAGE OF | 02/15/1978 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| CHAUTAUQUA COUNTY | CLYMER, TOWN OF | 10/07/1983 (M) |
| CHAUTAUQUA COUNTY | DUNKIRK, CITY OF | 02/04/1981 |
| CHAUTAUQUA COUNTY | DUNKIRK, TOWN OF | 08/06/1982 (M) |
| CHAUTAUQUA COUNTY | ELLERY, TOWN OF | 03/18/1980 |
| CHAUTAUQUA COUNTY | ELLICOTT, TOWN OF | 08/01/1984 |
| CHAUTAUQUA COUNTY | ELLINGTON, TOWN OF | 10/07/1983(M) |
| CHAUTAUQUA COUNTY | FALCONER, VILLAGE OF | 01/05/1978 |
| CHAUTAUQUA COUNTY | FORESTVILLE, VILLAGE OF | 03/18/1983(M) |
| CHAUTAUQUA COUNTY | FREDONIA, VILLAGE OF | 11/15/1989 |
| CHAUTAUQUA COUNTY | FRENCH CREEK, TOWN OF | 06/08/1984 (M) |
| CHAUTAUQUA COUNTY | GERRY, TOWN OF | 01/06/1984 (M) |
| CHAUTAUQUA COUNTY | HANOVER, TOWN OF | 12/18/1984 |
| CHAUTAUQUA COUNTY | HARMONY, TOWNSHIP OF | 12/01/1986 (L) |
| CHAUTAUQUA COUNTY | JAMESTOWN, CITY OF | 06/01/1978 |
| CHAUTAUQUA COUNTY | KIANTONE, TOWN OF | 02/02/1996 |
| CHAUTAUQUA COUNTY | LAKEWOOD, VILLAGE OF | 11/2/1977 |
| CHAUTAUQUA COUNTY | MAYVILLE, VILLAGE OF | 01/05/1978 |
| CHAUTAUQUA COUNTY | MINA, TOWN OF | 01/02/2003 |
| CHAUTAUQUA COUNTY | NORTH HARMONY, TOWN OF | 02/15/1980 |
| CHAUTAUQUA COUNTY | PANAMA, VILLAGE OF | 03/01/1978 |
| CHAUTAUQUA COUNTY | POLAND, TOWN OF | 03/11/1983 (M) |
| CHAUTAUQUA COUNTY | POMFRET, TOWN OF | 12/18/1984 |
| CHAUTAUQUA COUNTY | PORTLAND, TOWN OF | 10/07/1983 (M) |
| CHAUTAUQUA COUNTY | RIPLEY,TOWN OF | (NSFHA) |
| CHAUTAUQUA COUNTY | SHERIDAN, TOWN OF | 10/07/1983 (M) |
| CHAUTAUQUA COUNTY | SHERMAN, VILLAGE OF | 03/01/1978 |
| CHAUTAUQUA COUNTY | SHERMAN,TOWN OF | 01/06/1984 (M) |
| CHAUTAUQUA COUNTY | SILVER CREEK, VILLAGE OF | 08/01/1983 |
| CHAUTAUQUA COUNTY | SINCLAIRVILLE, VILLAGE OF | 12/1/1977 |
| CHAUTAUQUA COUNTY | STOCKTON, TOWN OF | 10/21/1983 (M) |
| CHAUTAUQUA COUNTY | VILLENOVA, TOWN OF | 05/21/1982 (M) |
| CHAUTAUQUA COUNTY | WESTFIELD, TOWN OF | 06/08/1984 (M) |
| CHAUTAUQUA COUNTY | WESTFIELD, VILLAGE OF | 10/07/1983 (M) |
| CHEMUNG COUNTY | ASHLAND, TOWN OF | 01/16/1980 |
| CHEMUNG COUNTY | BALDWIN, TOWN OF | 07/23/1982 (M) |
| CHEMUNG COUNTY | BIG FLATS, TOWN OF | 08/18/1992 |
| CHEMUNG COUNTY | CATLIN, TOWN OF | 06/22/1984 (M) |
| CHEMUNG COUNTY | CHEMUNG, TOWN OF | 09/03/1980 |
| CHEMUNG COUNTY | ELMIRA HEIGHTS, VILLAGE OF | 09/29/1996 |
| CHEMUNG COUNTY | ELMIRA, CITY OF | 04/02/1997 |
| CHEMUNG COUNTY | ELMIRA, TOWN OF | 09/29/1996 |
| CHEMUNG COUNTY | ERIN, TOWN OF | 08/13/1982 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| CHEMUNG COUNTY | HORSEHEADS, TOWN OF | 09/29/1996 |
| CHEMUNG COUNTY | HORSEHEADS, VILLAGE OF | 09/29/1996 |
| CHEMUNG COUNTY | MILLPORT, VILLAGE OF | 06/15/1988 (M) |
| CHEMUNG COUNTY | SOUTHPORT, TOWN OF | 08/05/1991 |
| CHEMUNG COUNTY | VAN ETTEN, TOWN OF | 09/28/1979 (M) |
| CHEMUNG COUNTY | VAN ETTEN, VILLAGE OF | 07/01/1988 (L) |
| CHEMUNG COUNTY | VETERAN, TOWN OF | 02/18/1983 (M) |
| CHEMUNG COUNTY | WELLSBURG, VILLAGE OF | 06/15/1981 |
| CHENANGO COUNTY | AFTON, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | AFTON, VILLAGE OF | 11/26/2010 |
| CHENANGO COUNTY | BAINBRIDGE, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | BAINBRIDGE, VILLAGE OF | 11/26/2010 |
| CHENANGO COUNTY | COLUMBUS, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | COVENTRY, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | EARLVILLE, VILLAGE OF | 11/26/2010 (M) |
| CHENANGO COUNTY | GERMAN, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | GREENE, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | GREENE, VILLAGE OF | 11/26/2010 |
| CHENANGO COUNTY | GUILFORD, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | LINCKLAEN, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | MC DONOUGH, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | NEW BERLIN, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | NEW BERLIN, VILLAGE OF | 11/26/2010 |
| CHENANGO COUNTY | NORTH NORWICH, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | NORWICH, CITY OF | 11/26/2010 |
| CHENANGO COUNTY | NORWICH, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | OTSELIC, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | OXFORD, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | OXFORD, VILLAGE OF | 11/26/2010 |
| CHENANGO COUNTY | PHARSALIA, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | PITCHER, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | PLYMOUTH, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | PRESTON, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | SHERBURNE, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | SHERBURNE, VILLAGE OF | 11/26/2010 |
| CHENANGO COUNTY | SMITHVILLE, TOWN OF | 11/26/2010 (M) |
| CHENANGO COUNTY | SMYRNA, TOWN OF | 11/26/2010 |
| CHENANGO COUNTY | SMYRNA, VILLAGE OF | 11/26/2010 (M) |
| CLINTON COUNTY | ALTONA, TOWN OF | 09/28/2007 (M) |
| CLINTON COUNTY | AUSABLE, TOWN OF | 09/28/2007 (M) |
| CLINTON COUNTY | BEEKMANTOWN, TOWN OF | 09/28/2007 |
| CLINTON COUNTY | BLACK BROOK, TOWN OF | 09/28/2007 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| CLINTON COUNTY | CHAMPLAIN, TOWN OF | 09/28/2007 |
| CLINTON COUNTY | CHAMPLAIN, VILLAGE OF | 09/28/2007 |
| CLINTON COUNTY | CHAZY, TOWN OF | 09/28/2007 |
| CLINTON COUNTY | CLINTON, TOWN OF | 09/28/2007 (M) |
| CLINTON COUNTY | ELLENBURG, TOWN OF | 09/28/2007 (M) |
| CLINTON COUNTY | MOOERS, TOWN OF | 09/28/2007 (M) |
| CLINTON COUNTY | PERU,TOWN OF | 09/28/2007 |
| CLINTON COUNTY | PLATTSBURGH, CITY OF | 09/28/2007 |
| CLINTON COUNTY | PLATTSBURGH, TOWN OF | 09/28/2007 |
| CLINTON COUNTY | ROUSES POINT, VILLAGE OF | 09/28/2007 |
| CLINTON COUNTY | SARANAC, TOWN OF | 09/28/2007 |
| CLINTON COUNTY | SCHUYLER FALLS, TOWN OF | 09/28/2007 |
| COLUMBIA COUNTY | ANCRAM, TOWN OF | 06/05/1985 (M) |
| COLUMBIA COUNTY | AUSTERLITZ, TOWN OF | 06/05/1985 (M) |
| COLUMBIA COUNTY | CANAAN, TOWN OF | 07/03/1985 (M) |
| COLUMBIA COUNTY | CHATHAM, TOWN OF | 09/15/1993 |
| COLUMBIA COUNTY | CHATHAM, VILLAGE OF | 12/15/1982 |
| COLUMBIA COUNTY | CLAVERACK, TOWN OF | 09/06/1989 |
| COLUMBIA COUNTY | CLERMONT, TOWNSHIP OF | 09/05/1984 |
| COLUMBIA COUNTY | COPAKE, TOWN OF | 06/19/1985 (M) |
| COLUMBIA COUNTY | GALLATIN, TOWN OF | 10/16/1984 |
| COLUMBIA COUNTY | GERMANTOWN, TOWN OF | 05/11/1979 (M) |
| COLUMBIA COUNTY | GHENT, TOWN OF | 01/01/1988 (L) |
| COLUMBIA COUNTY | GREENPORT, TOWN OF | 11/15/1989 |
| COLUMBIA COUNTY | HILLSDALE, TOWN OF | 05/15/1985 (M) |
| COLUMBIA COUNTY | HUDSON, CITY OF | 09/29/1989 |
| COLUMBIA COUNTY | KINDERHOOK, TOWN OF | 12/1/1982 |
| COLUMBIA COUNTY | KINDERHOOK, VILLAGE OF | 12/1/1982 |
| COLUMBIA COUNTY | LIVINGSTON, TOWN OF | 05/11/1979 (M) |
| COLUMBIA COUNTY | NEW LEBANON, TOWN OF | 06/05/1985 (M) |
| COLUMBIA COUNTY | STOCKPORT, TOWN OF | 01/19/1983 |
| COLUMBIA COUNTY | STUYVESANT, TOWN OF | 09/14/1979 (M) |
| COLUMBIA COUNTY | TAGHKANIC, TOWN OF | 01/03/1986 (M) |
| COLUMBIA COUNTY | VALATIE, VILLAGE OF | 12/1/1982 |
| CORTLAND COUNTY | CINCINNATUS, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | CORTLAND, CITY OF | 03/02/2010 |
| CORTLAND COUNTY | CORTLANDVILLE, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | CUYLER, TOWN OF | 03/02/2010 (M) |
| CORTLAND COUNTY | FREETOWN, TOWN OF | 03/02/2010 (M) |
| CORTLAND COUNTY | HARFORD, TOWN OF | 03/02/2010 (M) |
| CORTLAND COUNTY | HOMER, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | HOMER, VILLAGE OF | 03/02/2010 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| CORTLAND COUNTY | LAPEER, TOWN OF | 03/02/2010 (M) |
| CORTLAND COUNTY | MARATHON, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | MARATHON, VILLAGE OF | 03/02/2010 |
| CORTLAND COUNTY | MCGRAW, VILLAGE OF | 03/02/2010 |
| CORTLAND COUNTY | PREBLE, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | SCOTT, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | SOLON, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | TAYLOR, TOWN OF | 03/02/2010 (M) |
| CORTLAND COUNTY | TRUXTON, TOWN OF | 03/02/2010 (M) |
| CORTLAND COUNTY | VIRGIL, TOWN OF | 03/02/2010 |
| CORTLAND COUNTY | WILLET, TOWN OF | 03/02/2010 (M) |
| DELAWARE COUNTY | ANDES, TOWN OF | 05/01/1985 (M) |
| DELAWARE COUNTY | ANDES, VILLAGE OF | 04/01/1986 (L) |
| DELAWARE COUNTY | BOVINA, TOWN OF | 05/01/1985 (M) |
| DELAWARE COUNTY | COLCHESTER,TOWN OF | 02/04/1987 |
| DELAWARE COUNTY | DAVENPORT, TOWN OF | 02/02/2002 |
| DELAWARE COUNTY | DELHI, TOWN OF | 07/18/1985 |
| DELAWARE COUNTY | DELHI, VILLAGE OF | 07/18/1985 |
| DELAWARE COUNTY | DEPOSIT, TOWN OF | 03/18/1986 (M) |
| DELAWARE COUNTY | FLEISCHMANNS, VILLAGE OF | 01/17/1986 (M) |
| DELAWARE COUNTY | FRANKLIN, TOWN OF | 04/01/1988 (L) |
| DELAWARE COUNTY | FRANKLIN, VILLAGE OF | 08/01/1987 (L) |
| DELAWARE COUNTY | HAMDEN,TOWN OF | 03/04/1986 (M) |
| DELAWARE COUNTY | HANCOCK, TOWN OF | 09/28/1990 |
| DELAWARE COUNTY | HANCOCK, VILLAGE OF | 09/28/1990 |
| DELAWARE COUNTY | HARPERSFIELD, TOWN OF | 06/05/1985 (M) |
| DELAWARE COUNTY | HOBART, VILLAGE OF | 05/15/1985 (M) |
| DELAWARE COUNTY | KORTRIGHT, TOWN OF | 05/15/1985 (M) |
| DELAWARE COUNTY | MARGARETVILLE, VILLAGE OF | 06/04/1990 |
| DELAWARE COUNTY | MASONVILLE, TOWN OF | 11/01/1985 (M) |
| DELAWARE COUNTY | MEREDITH, TOWN OF | 05/15/1985 (M) |
| DELAWARE COUNTY | MIDDLETOWN, TOWN OF | 08/02/1993 |
| DELAWARE COUNTY | ROXBURY, TOWN OF | 05/15/1985 (M) |
| DELAWARE COUNTY | SIDNEY, TOWN OF | 09/30/1987 |
| DELAWARE COUNTY | SIDNEY, VILLAGE OF | 09/30/1987 |
| DELAWARE COUNTY | STAMFORD, TOWN OF | 10/01/1986 (L) |
| DELAWARE COUNTY | STAMFORD, VILLAGE OF | 08/01/1987 (L) |
| DELAWARE COUNTY | TOMPKINS, TOWN OF | 11/15/1985 (M) |
| DELAWARE COUNTY | WALTON, TOWN OF | 09/02/1988 |
| DELAWARE COUNTY | WALTON, VILLAGE OF | 04/02/1991 |
| DELAWARE COUNTY/BROOME COUNTY | DEPOSIT, VILLAGE OF | 02/01/1979 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| DUTCHESS COUNTY | AMENIA, TOWN OF | 11/15/1989 |
| DUTCHESS COUNTY | BEACON, CITY OF | 03/01/1984 |
| DUTCHESS COUNTY | BEEKMAN, TOWN OF | 09/05/1984 |
| DUTCHESS COUNTY | CLINTON, TOWN OF | 07/05/1984 |
| DUTCHESS COUNTY | DOVER, TOWN OF | 07/04/1988 |
| DUTCHESS COUNTY | EAST FISHKILL, TOWN OF | 06/15/1984 |
| DUTCHESS COUNTY | FISHKILL, TOWN OF | 06/01/1984 |
| DUTCHESS COUNTY | FISHKILL, VILLAGE OF | 03/15/1984 |
| DUTCHESS COUNTY | HYDE PARK, TOWN OF | 06/15/1984 |
| DUTCHESS COUNTY | LAGRANGE, TOWN OF | 09/08/1999 |
| DUTCHESS COUNTY | MILAN, TOWN OF | 08/10/1979 (M) |
| DUTCHESS COUNTY | MILLBROOK, VILLAGE OF | 02/27/1984 (M) |
| DUTCHESS COUNTY | MILLERTON, VILLAGE OF | 01/03/1985 |
| DUTCHESS COUNTY | NORTH EAST, TOWN OF | 09/05/1984 |
| DUTCHESS COUNTY | PAWLING, TOWN OF | 01/03/1985 |
| DUTCHESS COUNTY | PAWLING, VILLAGE OF | 08/01/1984 |
| DUTCHESS COUNTY | PINE PLAINS, TOWN OF | 10/05/1984 (M) |
| DUTCHESS COUNTY | PLEASANT VALLEY, TOWN OF | 01/16/1980 |
| DUTCHESS COUNTY | POUGHKEEPSIE, CITY OF | 01/05/1984 |
| DUTCHESS COUNTY | POUGHKEEPSIE, TOWN OF | 09/08/1999 |
| DUTCHESS COUNTY | RED HOOK, TOWN OF | 10/16/1984 |
| DUTCHESS COUNTY | RED HOOK, VILLAGE OF | (NSFHA) |
| DUTCHESS COUNTY | RHINEBECK, TOWN OF | 09/05/1984 |
| DUTCHESS COUNTY | RHINEBECK, VILLAGE OF | 02/01/1985 |
| DUTCHESS COUNTY | STANFORD, TOWN OF | 12/17/1991 |
| DUTCHESS COUNTY | TIVOLI, VILLAGE OF | 08/01/1984 |
| DUTCHESS COUNTY | UNION VALE, TOWN OF | 09/02/1988 |
| DUTCHESS COUNTY | WAPPINGER, TOWN OF | 09/22/1999 |
| DUTCHESS COUNTY | WAPPINGERS FALLS, VILLAGE OF | 09/22/1999 |
| DUTCHESS COUNTY | WASHINGTON, TOWN OF | 08/17/1979 (M) |
| ERIE COUNTY | AKRON, VILLAGE OF | 11/19/1980 |
| ERIE COUNTY | ALDEN, TOWN OF | 02/06/1991 |
| ERIE COUNTY | ALDEN, VILLAGE OF | 01/06/1984 (M) |
| ERIE COUNTY | AMHERST, TOWN OF | 10/16/1992 |
| ERIE COUNTY | ANGOLA, VILLAGE OF | 08/06/2002 |
| ERIE COUNTY | AURORA, TOWN OF | 04/16/1979 |
| ERIE COUNTY | BLASDELL, VILLAGE OF | 06/25/1976 (M) |
| ERIE COUNTY | BOSTON, TOWN OF | 09/30/1981 |
| ERIE COUNTY | BRANT, TOWN OF | 01/06/1984 (M) |
| ERIE COUNTY | BUFFALO, CITY OF | 09/26/2008 |
| ERIE COUNTY | CHEEKTOWAGA, TOWN OF | 03/15/1984 |
| ERIE COUNTY | CLARENCE, TOWN OF | 03/05/1996 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ERIE COUNTY | COLDEN, TOWN OF | 07/02/1979 |
| ERIE COUNTY | COLLINS,TOWN OF | 09/26/2008 |
| ERIE COUNTY | CONCORD, TOWN OF | 09/04/1986 |
| ERIE COUNTY | DEPEW, VILLAGE OF | 08/03/1981 |
| ERIE COUNTY | EAST AURORA, VILLAGE OF | 08/06/2002 |
| ERIE COUNTY | EDEN, TOWN OF | 08/24/1979 (M) |
| ERIE COUNTY | ELMA,TOWN OF | 06/22/1998 |
| ERIE COUNTY | EVANS, TOWN OF | 02/02/2002 |
| ERIE COUNTY | FARNHAM, VILLAGE OF | (NSFHA) |
| ERIE COUNTY | GRAND ISLAND, TOWN OF | 09/26/2008 |
| ERIE COUNTY | HAMBURG, TOWN OF | 12/20/2001 |
| ERIE COUNTY | HAMBURG, VILLAGE OF | 01/20/1982 |
| ERIE COUNTY | HOLLAND, TOWN OF | 09/26/2008 |
| ERIE COUNTY | KENMORE,VILLAGE OF | (NSFHA) |
| ERIE COUNTY | LACKAWANNA, CITY OF | 07/02/1980 |
| ERIE COUNTY | LANCASTER, TOWN OF | 02/23/2001 |
| ERIE COUNTY | LANCASTER, VILLAGE OF | 07/02/1979 |
| ERIE COUNTY | MARILLA, TOWN OF | 09/29/1978 |
| ERIE COUNTY | NEWSTEAD, TOWN OF | 05/04/1992 |
| ERIE COUNTY | ORCHARD PARK, TOWN OF | 03/16/1983 |
| ERIE COUNTY | ORCHARD PARK, VILLAGE OF | (NSFHA) |
| ERIE COUNTY | SARDINIA, TOWN OF | 01/16/2003 |
| ERIE COUNTY | SLOAN, VILLAGE OF | (NSFHA) |
| ERIE COUNTY | SPRINGVILLE, VILLAGE OF | 07/17/1986 |
| ERIE COUNTY | TONAWANDA, CITY OF | 09/26/2008 |
| ERIE COUNTY | TONAWANDA, TOWN OF | 11/12/1982 |
| ERIE COUNTY | WALES, TOWN OF | 09/26/2008 |
| ERIE COUNTY | WEST SENECA, TOWN OF | 09/30/1992 |
| ERIE COUNTY | WILLIAMSVILLE, VILLAGE OF | 09/26/2008 |
| ERIE COUNTY/CATTARAUGUS COUNTY | GOWANDA, VILLAGE OF | 09/26/2008 |
| ESSEX COUNTY | CHESTERFIELD, TOWN OF | 05/04/1987 |
| ESSEX COUNTY | CROWN POINT,TOWN OF | 07/16/1987 |
| ESSEX COUNTY | ELIZABETHTOWN, TOWN OF | 01/20/1993 |
| ESSEX COUNTY | ESSEX, TOWN OF | 04/03/1987 |
| ESSEX COUNTY | JAY, TOWN OF | 06/17/2002 |
| ESSEX COUNTY | KEENE, TOWN OF | 06/05/1985 (M) |
| ESSEX COUNTY | KEESEVILLE, VILLAGE OF | 09/28/2007 (M) |
| ESSEX COUNTY | LAKE PLACID, VILLAGE OF | (NSFHA) |
| ESSEX COUNTY | LEWIS, TOWN OF | 05/15/1985 (M) |
| ESSEX COUNTY | MINERVA, TOWN OF | 10/05/1984 (M) |
| ESSEX COUNTY | MORIAH, TOWN OF | 09/24/1984 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ESSEX COUNTY | NEWCOMB, TOWN OF | 06/05/1985 (M) |
| ESSEX COUNTY | NORTH ELBA, TOWN OF | 08/23/2001 |
| ESSEX COUNTY | NORTH HUDSON, TOWN OF | 05/15/1985 (M) |
| ESSEX COUNTY | PORT HENRY, VILLAGE OF | 07/16/1987 |
| ESSEX COUNTY | SCHROON, TOWN OF | 11/16/1995 |
| ESSEX COUNTY | ST. ARMAND, TOWN OF | 02/05/1986 |
| ESSEX COUNTY | TICONDEROGA, TOWN OF | 09/06/1996 |
| ESSEX COUNTY | WESTPORT, TOWN OF | 09/04/1987 |
| ESSEX COUNTY | WILLSBORO, TOWN OF | 05/18/1992 |
| ESSEX COUNTY | WILMINGTON, TOWN OF | 11/16/1995 |
| FRANKLIN COUNTY | BANGOR, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | BELLMONT, TOWN OF | 08/05/1985 (M) |
| FRANKLIN COUNTY | BOMBAY, TOWN OF | 02/15/1985 (M) |
| FRANKLIN COUNTY | BRANDON, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | BRIGHTON, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | BRUSHTON, VILLAGE OF | 02/19/1986 (M) |
| FRANKLIN COUNTY | BURKE, TOWN OF | 02/19/1986 (M) |
| FRANKLIN COUNTY | BURKE, VILLAGE OF | (NSFHA) |
| FRANKLIN COUNTY | CHATEAUGAY, VILLAGE OF | (NSFHA) |
| FRANKLIN COUNTY | CONSTABLE, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | DICKINSON, TOWN OF | 03/18/1986 (M) |
| FRANKLIN COUNTY | DUANE, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | FORT COVINGTON, TOWN OF | 12/23/1983 (M) |
| FRANKLIN COUNTY | FRANKLIN, TOWN OF | 09/24/1984 (M) |
| FRANKLIN COUNTY | HARRIETSTOWN, TOWN OF | 01/03/1985 |
| FRANKLIN COUNTY | MALONE, TOWN OF | 09/04/1985 (M) |
| FRANKLIN COUNTY | MALONE, VILLAGE OF | 04/03/1978 |
| FRANKLIN COUNTY | MOIRA, TOWN OF | 04/15/1986 (M) |
| FRANKLIN COUNTY | SANTA CLARA, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | SARANAC LAKE, VILLAGE OF | 01/02/1992 |
| FRANKLIN COUNTY | TUPPER LAKE, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | TUPPER LAKE,VILLAGE OF | 03/01/1987 (L) |
| FRANKLIN COUNTY | WAVERLY, TOWN OF | (NSFHA) |
| FRANKLIN COUNTY | WESTVILLE, TOWN OF | 02/15/1985 (M) |
| FULTON COUNTY | BLEECKER,TOWN OF | 07/18/1985 (M) |
| FULTON COUNTY | BROADALBIN, TOWN OF | 01/03/1985 (M) |
| FULTON COUNTY | BROADALBIN, VILLAGE OF | 04/15/1986 (M) |
| FULTON COUNTY | CAROGA, TOWN OF | 07/18/1985 (M) |
| FULTON COUNTY | EPHRATAH, TOWN OF | 07/03/1985 (M) |
| FULTON COUNTY | GLOVERSVILLE, CITY OF | 09/30/1983 |
| FULTON COUNTY | JOHNSTOWN, CITY OF | 07/18/1983 |
| FULTON COUNTY | JOHNSTOWN, TOWN OF | 07/03/1985 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| FULTON COUNTY | MAYFIELD, TOWN OF | 08/05/1985 (M) |
| FULTON COUNTY | NORTHAMPTON, TOWN OF | 08/19/1985 (M) |
| FULTON COUNTY | NORTHVILLE, VILLAGE OF | (NSFHA) |
| FULTON COUNTY | OPPENHEIM, TOWN OF | 06/18/1976 |
| FULTON COUNTY | PERTH, TOWN OF | 02/15/1985 (M) |
| FULTON COUNTY | STRATFORD, TOWN OF | 01/03/1985 (M) |
| GENESEE COUNTY | ALABAMA, TOWN OF | 11/18/1983 (M) |
| GENESEE COUNTY | ALEXANDER, VILLAGE OF | 05/04/1987 |
| GENESEE COUNTY | ALEXANDER,TOWN OF | 05/04/1987 |
| GENESEE COUNTY | BATAVIA, CITY OF | 09/16/1982 |
| GENESEE COUNTY | BATAVIA, TOWN OF | 01/17/1985 |
| GENESEE COUNTY | BERGEN, TOWN OF | 07/06/1984 (M) |
| GENESEE COUNTY | BERGEN, VILLAGE OF | 06/08/1979 (M) |
| GENESEE COUNTY | BETHANY, TOWN OF | 09/24/1984 (M) |
| GENESEE COUNTY | BYRON, TOWN OF | 02/01/1988 (L) |
| GENESEE COUNTY | CORFU, VILLAGE OF | 10/15/1985 (M) |
| GENESEE COUNTY | DARIEN, TOWN OF | 07/06/1984 (M) |
| GENESEE COUNTY | ELBA, TOWN OF | 10/05/1984 (M) |
| GENESEE COUNTY | ELBA, VILLAGE OF | 01/20/1984 (M) |
| GENESEE COUNTY | LE ROY, TOWN OF | 09/14/1979 (M) |
| GENESEE COUNTY | LE ROY, VILLAGE OF | 08/03/1981 |
| GENESEE COUNTY | OAKFIELD, TOWN OF | 05/25/1984 (M) |
| GENESEE COUNTY | OAKFIELD, VILLAGE OF | 03/23/1984 (M) |
| GENESEE COUNTY | PAVILION, TOWN OF | 02/27/1984 (M) |
| GENESEE COUNTY | PEMBROKE, TOWN OF | 01/20/1984 (M) |
| GENESEE COUNTY | STAFFORD,TOWN OF | 07/16/1982 |
| GENESEE COUNTY/WYOMING COUNTY | ATTICA, VILLAGE OF | 07/03/1986 |
| GREENE COUNTY | ASHLAND, TOWN OF | 05/16/2008 |
| GREENE COUNTY | ATHENS, TOWN OF | 05/16/2008 |
| GREENE COUNTY | ATHENS, VILLAGE OF | 05/16/2008 |
| GREENE COUNTY | CAIRO, TOWN OF | 05/16/2008 |
| GREENE COUNTY | CATSKILL, TOWN OF | 05/16/2008 |
| GREENE COUNTY | CATSKILL, VILLAGE OF | 05/16/2008 |
| GREENE COUNTY | COXSACKIE, TOWN OF | 05/16/2008 |
| GREENE COUNTY | COXSACKIE, VILLAGE OF | 05/16/2008 |
| GREENE COUNTY | DURHAM, TOWN OF | 05/16/2008 (M) |
| GREENE COUNTY | GREENVILLE, TOWN OF | 05/16/2008 (M) |
| GREENE COUNTY | HALCOTT, TOWN OF | 05/16/2008 (M) |
| GREENE COUNTY | HUNTER, TOWN OF | 05/16/2008 |
| GREENE COUNTY | HUNTER, VILLAGE OF | 05/16/2008 |
| GREENE COUNTY | JEWETT, TOWN OF | 05/16/2008 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| GREENE COUNTY | LEXINGTON, TOWN OF | 05/16/2008 |
| GREENE COUNTY | NEW BALTIMORE, TOWN OF | 05/16/2008 (M) |
| GREENE COUNTY | PRATTSVILLE, TOWN OF | 05/16/2008 |
| GREENE COUNTY | TANNERSVILLE, VILLAGE OF | 05/16/2008 |
| GREENE COUNTY | WINDHAM, TOWN OF | 05/16/2008 |
| HAMILTON COUNTY | ARIETTA, TOWN OF | (NSFHA) |
| HAMILTON COUNTY | BENSON, TOWN OF | (NSFHA) |
| HAMILTON COUNTY | HOPE, TOWN OF | 04/30/86(M) |
| HAMILTON COUNTY | INDIAN LAKE, TOWN OF | 12/04/85(M) |
| HAMILTON COUNTY | INLET, TOWN OF | (NSFHA) |
| HAMILTON COUNTY | LAKE PLEASANT, TOWN OF | (NSFHA) |
| HAMILTON COUNTY | LONG LAKE, TOWN OF | 09/24/1984 (M) |
| HAMILTON COUNTY | MOREHOUSE, TOWN OF | (NSFHA) |
| HAMILTON COUNTY | SPECULATOR, VILLAGE OF | 02/06/1984 (M) |
| HAMILTON COUNTY | WELLS, TOWN OF | 06/03/1986 (M) |
| HERKIMER COUNTY | COLD BROOK, VILLAGE OF | 12/20/2000 |
| HERKIMER COUNTY | COLUMBIA, TOWN OF | 07/16/1982 (M) |
| HERKIMER COUNTY | DANUBE, TOWN OF | 05/12/1999 (M) |
| HERKIMER COUNTY | DOLGEVILLE, VILLAGE OF | 03/16/1983 |
| HERKIMER COUNTY | FAIRFIELD, TOWN OF | 10/18/1988 |
| HERKIMER COUNTY | FRANKFORT, TOWN OF | 12/20/2000 |
| HERKIMER COUNTY | FRANKFORT, VILLAGE OF | 03/07/2001 |
| HERKIMER COUNTY | GERMAN FLATTS, TOWN OF | 05/15/1985 (M) |
| HERKIMER COUNTY | HERKIMER, TOWN OF | 04/17/1985 (M) |
| HERKIMER COUNTY | HERKIMER, VILLAGE OF | 06/17/2002 |
| HERKIMER COUNTY | ILION, VILLAGE OF | 09/08/1999 |
| HERKIMER COUNTY | LITCHFIELD, TOWN OF | 05/07/2001 |
| HERKIMER COUNTY | LITTLE FALLS, CITY OF | 04/04/1983 |
| HERKIMER COUNTY | LITTLE FALLS, TOWN OF | 03/28/1980 (M) |
| HERKIMER COUNTY | MANHEIM, TOWN OF | 05/01/1985 (M) |
| HERKIMER COUNTY | MIDDLEVILLE, VILLAGE OF | 07/03/1985 (M) |
| HERKIMER COUNTY | MOHAWK, VILLAGE OF | 09/08/1999 |
| HERKIMER COUNTY | NEWPORT, TOWN OF | 06/02/1999 |
| HERKIMER COUNTY | NEWPORT, VILLAGE OF | 04/02/1991 |
| HERKIMER COUNTY | NORWAY, TOWN OF | 07/03/1985 (M) |
| HERKIMER COUNTY | OHIO, TOWN OF | 09/24/1984 (M) |
| HERKIMER COUNTY | POLAND, VILLAGE OF | 06/02/1999 (M) |
| HERKIMER COUNTY | RUSSIA, TOWN OF | 06/02/1999 |
| HERKIMER COUNTY | SALISBURY, TOWN OF | 07/03/1985 (M) |
| HERKIMER COUNTY | SCHUYLER, TOWN OF | 06/20/2001 |
| HERKIMER COUNTY | STARK, TOWN OF | 05/15/1985 (M) |
| HERKIMER COUNTY | WARREN, TOWN OF | (NSFHA) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| HERKIMER COUNTY | WEBB, TOWN OF | 07/30/1982 (M) |
| HERKIMER COUNTY | WEST WINFIELD, VILLAGE OF | 07/30/1982 (M) |
| HERKIMER COUNTY | WINFIELD, TOWN OF | 07/30/1982 (M) |
| JEFFERSON COUNTY | ADAMS, TOWN OF | 06/05/1985 (M) |
| JEFFERSON COUNTY | ADAMS, VILLAGE OF | 06/19/1985 (M) |
| JEFFERSON COUNTY | ALEXANDRIA BAY, VILLAGE OF | 04/03/1978 |
| JEFFERSON COUNTY | ALEXANDRIA, TOWN OF | 10/15/1985 (M) |
| JEFFERSON COUNTY | ANTWERP, TOWN OF | 04/15/1986 (M) |
| JEFFERSON COUNTY | ANTWERP, VILLAGE OF | (NSFHA) |
| JEFFERSON COUNTY | BLACK RIVER, VILLAGE OF | 06/05/1989 (M) |
| JEFFERSON COUNTY | BROWNVILLE, TOWN OF | 06/02/1992 |
| JEFFERSON COUNTY | BROWNVILLE, VILLAGE OF | 03/18/1986 (M) |
| JEFFERSON COUNTY | CAPE VINCENT, TOWN OF | 06/02/1992 |
| JEFFERSON COUNTY | CAPE VINCENT, VILLAGE OF | 04/17/1985 (M) |
| JEFFERSON COUNTY | CARTHAGE, VILLAGE OF | 06/17/1991 |
| JEFFERSON COUNTY | CHAMPION, TOWN OF | 06/02/1993 |
| JEFFERSON COUNTY | CHAUMONT, VILLAGE OF | 09/08/1999 |
| JEFFERSON COUNTY | CLAYTON, TOWN OF | 04/02/1986 |
| JEFFERSON COUNTY | CLAYTON, VILLAGE OF | 12/1/1977 |
| JEFFERSON COUNTY | DEFERIET, VILLAGE OF | (NSFHA) |
| JEFFERSON COUNTY | DEXTER, VILLAGE OF | 06/15/1994 |
| JEFFERSON COUNTY | ELLISBURG, TOWN OF | 05/18/1992 |
| JEFFERSON COUNTY | ELLISBURG, VILLAGE OF | 06/19/1985 (M) |
| JEFFERSON COUNTY | EVANS MILLS, VILLAGE OF | 01/02/1992 |
| JEFFERSON COUNTY | GLEN PARK, VILLAGE OF | (NSFHA) |
| JEFFERSON COUNTY | HENDERSON, TOWN OF | 05/18/1992 |
| JEFFERSON COUNTY | HERRINGS, VILLAGE OF | 12/18/1985 |
| JEFFERSON COUNTY | HOUNSFIELD, TOWN OF | 05/18/1992 |
| JEFFERSON COUNTY | LERAY, TOWN OF | 02/02/1902 |
| JEFFERSON COUNTY | LYME, TOWN OF | 09/02/1993 |
| JEFFERSON COUNTY | ORLEANS, TOWN OF | 03/01/1978 |
| JEFFERSON COUNTY | PAMELIA, TOWN OF | 01/02/1992 |
| JEFFERSON COUNTY | PHILADELPHIA, TOWN OF | 06/05/89(M) |
| JEFFERSON COUNTY | PHILADELPHIA, VILLAGE OF | 09/15/1993 |
| JEFFERSON COUNTY | RODMAN, TOWN OF | 07/03/1985 (M) |
| JEFFERSON COUNTY | RUTLAND, TOWN OF | 08/18/1992 |
| JEFFERSON COUNTY | SACKETS HARBOR, VILLAGE OF | 05/02/1994 |
| JEFFERSON COUNTY | THERESA, TOWN OF | 10/15/1985 (M) |
| JEFFERSON COUNTY | THERESA, VILLAGE OF | 10/15/1985 (M) |
| JEFFERSON COUNTY | WATERTOWN, CITY OF | 08/02/1993 |
| JEFFERSON COUNTY | WATERTOWN, TOWN OF | 08/02/1993 |
| JEFFERSON COUNTY | WEST CARTHAGE, VILLAGE OF | 09/28/1990 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| JEFFERSON COUNTY | WILNA, TOWN OF | 01/16/1992 |
| JEFFERSON COUNTY | WORTH, TOWN OF | (NSFHA) |
| LEWIS COUNTY | CASTORLAND, VILLAGE OF | (NSFHA) |
| LEWIS COUNTY | CONSTABLEVILLE, VILLAGE OF | 07/16/1982 (M) |
| LEWIS COUNTY | COPENHAGEN, VILLAGE OF | (NSFHA) |
| LEWIS COUNTY | CROGHAM, VILLAGE OF | 05/15/1985 (M) |
| LEWIS COUNTY | CROGHAN, TOWN OF | 05/15/1985 (M) |
| LEWIS COUNTY | DENMARK, TOWN OF | 05/15/1985 (M) |
| LEWIS COUNTY | DIANA, TOWN OF | 09/24/1984 (M) |
| LEWIS COUNTY | GREIG, TOWN OF | 05/15/1985 (M) |
| LEWIS COUNTY | HARRISBURG, TOWN OF | (NSFHA) |
| LEWIS COUNTY | HARRISVILLE, VILLAGE OF | 09/24/1984 (M) |
| LEWIS COUNTY | LEWIS, TOWN OF | 09/29/1996 |
| LEWIS COUNTY | LEYDEN, TOWN OF | 06/19/1985 (M) |
| LEWIS COUNTY | LOWVILLE, TOWN OF | 06/20/2000 |
| LEWIS COUNTY | LOWVILLE, VILLAGE OF | 06/20/2000 |
| LEWIS COUNTY | LYONS FALLS, VILLAGE OF | 06/19/1985 (M) |
| LEWIS COUNTY | LYONSDALE, TOWN OF | 06/19/1985 (M) |
| LEWIS COUNTY | MARTINSBURG, TOWN OF | 06/19/1985 (M) |
| LEWIS COUNTY | NEW BREMEN, TOWN OF | 05/04/2000 |
| LEWIS COUNTY | OSCEOLA, TOWN OF | 06/30/1976 (M) |
| LEWIS COUNTY | PINCKNEY, TOWN OF | (NSFHA) |
| LEWIS COUNTY | PORT LEYDEN, VILLAGE OF | 06/19/1985 (M) |
| LEWIS COUNTY | TURIN, TOWN OF | 08/02/1994 |
| LEWIS COUNTY | TURIN, VILLAGE OF | 07/01/1977 (M) |
| LEWIS COUNTY | WATSON, TOWN OF | 07/19/2000 |
| LEWIS COUNTY | WEST TURIN, TOWN OF | (NSFHA) |
| LIVINGSTON COUNTY | AVON, TOWN OF | 08/15/1978 |
| LIVINGSTON COUNTY | AVON, VILLAGE OF | 08/01/1978 |
| LIVINGSTON COUNTY | CALEDONIA, TOWN OF | 06/01/1981 |
| LIVINGSTON COUNTY | CALEDONIA, VILLAGE OF | 06/01/1981 |
| LIVINGSTON COUNTY | CONESUS, TOWN OF | 02/15/1991 |
| LIVINGSTON COUNTY | DANSVILLE, VILLAGE OF | 04/05/2010 |
| LIVINGSTON COUNTY | GENESEO, TOWN OF | 09/29/1996 |
| LIVINGSTON COUNTY | GENESEO, VILLAGE OF | 09/29/1996 |
| LIVINGSTON COUNTY | GROVELAND, TOWN OF | 02/15/1991 |
| LIVINGSTON COUNTY | LEICESTER, TOWN OF | 01/20/1982 |
| LIVINGSTON COUNTY | LEICESTER, VILLAGE OF | 08/27/1982 (M) |
| LIVINGSTON COUNTY | LIMA, TOWN OF | 12/23/1983 (M) |
| LIVINGSTON COUNTY | LIMA, VILLAGE OF | 07/23/1982 (M) |
| LIVINGSTON COUNTY | LIVONIA, TOWN OF | 02/19/1992 |
| LIVINGSTON COUNTY | LIVONIA, VILLAGE OF | 06/01/1988 (L) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| LIVINGSTON COUNTY | MOUNT MORRIS, TOWN OF | (NSFHA) |
| LIVINGSTON COUNTY | MOUNT MORRIS, VILLAGE OF | 08/01/1978 |
| LIVINGSTON COUNTY | NORTH DANSVILLE, TOWN OF | 04/05/2010 |
| LIVINGSTON COUNTY | NUNDA, TOWN OF | 07/03/1985 (M) |
| LIVINGSTON COUNTY | NUNDA, VILLAGE OF | 03/23/1984 (M) |
| LIVINGSTON COUNTY | OSSIAN, TOWN OF | 06/08/1984 (M) |
| LIVINGSTON COUNTY | PORTAGE,TOWN OF | 12/18/1984 |
| LIVINGSTON COUNTY | SPARTA, TOWN OF | 04/05/2010 |
| LIVINGSTON COUNTY | SPRINGWATER, TOWN OF | 08/24/1984 (M) |
| LIVINGSTON COUNTY | WEST SPARTA, TOWN OF | 04/05/2010 |
| LIVINGSTON COUNTY | YORK, TOWN OF | 01/20/1982 |
| MADISON COUNTY | BROOKFIELD, TOWN OF | 04/17/1985 (M) |
| MADISON COUNTY | CANASTOTA , VILLAGE OF | 04/15/1988 |
| MADISON COUNTY | CAZENOVIA, TOWN OF | 06/19/1985 |
| MADISON COUNTY | CAZENOVIA, VILLAGE OF | 06/19/1985 |
| MADISON COUNTY | CHITTENANGO, VILLAGE OF | 02/01/1985 (M) |
| MADISON COUNTY | DE RUYTER, TOWN OF | 06/08/1984 |
| MADISON COUNTY | DE RUYTER, VILLAGE OF | 08/24/1984 (M) |
| MADISON COUNTY | EATON, TOWN OF | 09/10/1984 (M) |
| MADISON COUNTY | FENNER, TOWNSHIP OF | 02/05/1986 |
| MADISON COUNTY | GEORGETOWN, TOWN OF | 11/02/1984 (M) |
| MADISON COUNTY | HAMILTON, TOWN OF | 09/27/2002 |
| MADISON COUNTY | HAMILTON,VILLAGE | 09/27/2002 |
| MADISON COUNTY | LEBANON, TOWN OF | 04/17/1985 (M) |
| MADISON COUNTY | LENOX, TOWN OF | 06/03/1988 |
| MADISON COUNTY | LINCOLN, TOWN OF | 09/04/1985 (M) |
| MADISON COUNTY | MADISON, TOWN OF | 01/19/1983 |
| MADISON COUNTY | MORRISVILLE, VILLAGE OF | 04/15/1982 |
| MADISON COUNTY | MUNNSVILLE, VILLAGE OF | 09/15/1983 |
| MADISON COUNTY | NELSON, TOWN OF | 10/05/1984 (M) |
| MADISON COUNTY | ONEIDA, CITY OF | 02/23/2001 |
| MADISON COUNTY | SMITHFIELD, TOWN OF | 04/17/1985 (M) |
| MADISON COUNTY | STOCKBRIDGE, TOWN OF | (NSFHA) |
| MADISON COUNTY | SULLIVAN, TOWN OF | 05/15/1986 |
| MADISON COUNTY | WAMPSVILLE, VILLAGE OF | (NSFHA) |
| MONROE COUNTY | BRIGHTON, TOWN OF | 08/28/2008 |
| MONROE COUNTY | BROCKPORT, VILLAGE OF | 08/28/2008 (M) |
| MONROE COUNTY | CHILI, TOWN OF | 08/28/2008 |
| MONROE COUNTY | CHURCHVILLE, VILLAGE OF | 08/28/2008 |
| MONROE COUNTY | CLARKSON, TOWN OF | 08/28/2008 |
| MONROE COUNTY | EAST ROCHESTER, VILLAGE OF | 08/28/2008 (M) |
| MONROE COUNTY | FAIRPORT, VILLAGE OF | 08/28/2008 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| MONROE COUNTY | GATES, TOWN OF | 08/28/2008 |
| MONROE COUNTY | GREECE, TOWN OF | 08/28/2008 |
| MONROE COUNTY | HAMLIN, TOWN OF | 08/28/2008 |
| MONROE COUNTY | HENRIETTA, TOWN OF | 08/28/2008 |
| MONROE COUNTY | HILTON, VILLAGE OF | 08/28/2008 |
| MONROE COUNTY | HONEOYE FALLS, VILLAGE OF | 08/28/2008 |
| MONROE COUNTY | IRONDEQUOIT, TOWN OF | 08/28/2008 |
| MONROE COUNTY | MENDON, TOWN OF | 08/28/2008 |
| MONROE COUNTY | OGDEN, TOWN OF | 08/28/2008 |
| MONROE COUNTY | PARMA, TOWN OF | 08/28/2008 |
| MONROE COUNTY | PENFIELD, TOWN OF | 08/28/2008 |
| MONROE COUNTY | PERINTON, TOWN OF | 08/28/2008 |
| MONROE COUNTY | PITTSFORD, TOWN OF | 08/28/2008 |
| MONROE COUNTY | PITTSFORD, VILLAGE OF | 08/28/2008 (M) |
| MONROE COUNTY | RIGA, TOWN OF | 08/28/2008 |
| MONROE COUNTY | ROCHESTER, CITY OF | 08/28/2008 |
| MONROE COUNTY | RUSH, TOWN OF | 08/28/2008 |
| MONROE COUNTY | SCOTTSVILLE, VILLAGE OF | 08/28/2008 |
| MONROE COUNTY | SPENCERPORT, VILLAGE OF | 08/28/2008 |
| MONROE COUNTY | SWEDEN, TOWN OF | 08/28/2008 (M) |
| MONROE COUNTY | WEBSTER, TOWN OF | 08/28/2008 |
| MONROE COUNTY | WEBSTER, VILLAGE OF | 08/28/2008 |
| MONROE COUNTY | WHEATLAND, TOWN OF | 08/28/2008 |
| MONTGOMERY COUNTY | AMES, VILLAGE OF | 12/4/1985 |
| MONTGOMERY COUNTY | AMSTERDAM, CITY OF | 06/19/1985 |
| MONTGOMERY COUNTY | AMSTERDAM, TOWN OF | 12/01/1987 (L) |
| MONTGOMERY COUNTY | CANAJOHARIE, TOWN OF | 01/06/1983 |
| MONTGOMERY COUNTY | CANAJOHARIE, VILLAGE OF | 11/3/1982 |
| MONTGOMERY COUNTY | CHARLESTON, TOWN OF | 10/15/1985 (M) |
| MONTGOMERY COUNTY | FLORIDA, TOWN OF | 12/01/1987 (L) |
| MONTGOMERY COUNTY | FONDA, VILLAGE OF | 07/06/1983 |
| MONTGOMERY COUNTY | FORT JOHNSON, VILLAGE OF | 01/19/1983 |
| MONTGOMERY COUNTY | FORT PLAIN, VILLAGE OF | 06/17/2002 |
| MONTGOMERY COUNTY | FULTONVILLE, VILLAGE OF | 10/15/1982 |
| MONTGOMERY COUNTY | GLEN, TOWN OF | 02/19/1986 (M) |
| MONTGOMERY COUNTY | HAGAMAN, VILLAGE OF | 03/18/1986 (M) |
| MONTGOMERY COUNTY | MINDEN, TOWN OF | 01/19/1983 |
| MONTGOMERY COUNTY | MOHAWK, TOWN OF | 08/05/1985 (M) |
| MONTGOMERY COUNTY | NELLISTON, VILLAGE OF | 11/3/1982 |
| MONTGOMERY COUNTY | PALATINE BRIDGE, VILLAGE OF | 11/17/1982 |
| MONTGOMERY COUNTY | PALATINE, TOWN OF | 05/04/1987 |
| MONTGOMERY COUNTY | ROOT, TOWN OF | 04/01/1988 (L) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| MONTGOMERY COUNTY | ST. JOHNSVILLE, TOWN OF | 03/16/1983 |
| MONTGOMERY COUNTY | ST. JOHNSVILLE, VILLAGE OF | 09/29/1989 |
| NASSAU COUNTY | ATLANTIC BEACH, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | BAXTER ESTATES, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | BAYVILLE, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | CEDARHURST, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | CENTRE ISLAND, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | COVE NECK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | EAST HILLS, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | EAST ROCKAWAY, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | EAST WILLISTON, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | FLORAL PARK, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | FLOWER HILL, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | FREEPORT, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | GARDEN CITY, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | GLEN COVE, CITY OF | 09/11/2009 |
| NASSAU COUNTY | GREAT NECK ESTATES, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | GREAT NECK PLAZA, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | GREAT NECK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | HEMPSTEAD, TOWN OF | 09/11/2009 |
| NASSAU COUNTY | HEMPSTEAD, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | HEWLETT BAY PARK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | HEWLETT HARBOR, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | HEWLETT NECK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | ISLAND PARK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | KENSINGTON, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | KINGS POINT, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | LAKE SUCCESS, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | LATTINGTOWN, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | LAUREL HOLLOW, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | LAWRENCE, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | LONG BEACH, CITY OF | 09/11/2009 |
| NASSAU COUNTY | LYNBROOK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | MALVERNE, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | MANORHAVEN, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | MASSAPEQUA PARK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | MILL NECK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | MINEOLA, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | MUNSEY PARK, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | NEW HYDE PARK, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | NORTH HEMPSTEAD, TOWN OF | 09/11/2009 |
| NASSAU COUNTY | NORTH HILLS, VILLAGE OF | (NSFHA) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| NASSAU COUNTY | OYSTER BAY COVE, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | OYSTER BAY, TOWN OF | 09/11/2009 |
| NASSAU COUNTY | PLANDOME HEIGHTS, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | PLANDOME MANOR, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | PLANDOME, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | PORT WASHINGTON NORTH, VILLAG | 09/11/2009 |
| NASSAU COUNTY | ROCKVILLE CENTRE, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | ROSLYN ESTATES, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | ROSLYN HARBOR, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | ROSLYN, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | RUSSELL GARDENS, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | SADDLE ROCK, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | SANDS POINT, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | SEA CLIFF, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | STEWART MANOR, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | THOMASTON, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | VALLEY STREAM, VILLAGE OF | 09/11/2009 |
| NASSAU COUNTY | WESTBURY, VILLAGE OF | (NSFHA) |
| NASSAU COUNTY | WOODSBURGH, VILLAGE OF | 09/11/2009 |
| NIAGARA COUNTY | BARKER, VILLAGE OF | 09/17/2010 |
| NIAGARA COUNTY | CAMBRIA, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | HARTLAND, TOWN OF | 09/17/2010 (M) |
| NIAGARA COUNTY | LEWISTON, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | LEWISTON, VILLAGE OF | (NSFHA) |
| NIAGARA COUNTY | LOCKPORT, CITY OF | 09/17/2010 |
| NIAGARA COUNTY | LOCKPORT, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | MIDDLEPORT, VILLAGE OF | 09/17/2010 |
| NIAGARA COUNTY | NEWFANE, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | NIAGARA FALLS, CITY OF | 09/17/2010 |
| NIAGARA COUNTY | NIAGARA, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | NORTH TONAWANDA, CITY OF | 09/17/2010 |
| NIAGARA COUNTY | PENDLETON, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | PORTER, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | ROYALTON, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | SOMERSET, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | WHEATFIELD, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | WILSON, TOWN OF | 09/17/2010 |
| NIAGARA COUNTY | WILSON, VILLAGE OF | 09/17/2010 |
| NIAGARA COUNTY | YOUNGSTOWN, VILLAGE OF | 09/17/2010 |
| ONEIDA COUNTY | ANNSVILLE, TOWN OF | 04/05/1988 |
| ONEIDA COUNTY | AUGUSTA, TOWN OF | 05/01/1985 (M) |
| ONEIDA COUNTY | AVA, TOWN OF | 02/01/1985 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ONEIDA COUNTY | BARNEVELD, VILLAGE OF | 03/23/1999 |
| ONEIDA COUNTY | BOONVILLE, TOWN OF | 07/03/1985 (M) |
| ONEIDA COUNTY | BOONVILLE, VILLAGE OF | 04/17/1985 (M) |
| ONEIDA COUNTY | BRIDGEWATER, TOWN OF | (NSFHA) |
| ONEIDA COUNTY | BRIDGEWATER, VILLAGE OF | 04/15/1982 |
| ONEIDA COUNTY | CAMDEN, TOWN OF | 09/07/1998 |
| ONEIDA COUNTY | CAMDEN, VILLAGE OF | 08/16/1988 |
| ONEIDA COUNTY | CLAYVILLE, VILLAGE OF | 07/05/1983 |
| ONEIDA COUNTY | CLINTON, VILLAGE OF | 05/01/1985 |
| ONEIDA COUNTY | DEERFIELD, TOWN OF | 06/02/1999 |
| ONEIDA COUNTY | FLORENCE, TOWN OF | 04/17/1985 (M) |
| ONEIDA COUNTY | FLOYD, TOWN OF | 03/15/1984 |
| ONEIDA COUNTY | FORESTPORT, TOWN OF | 04/17/1985 (M) |
| ONEIDA COUNTY | HOLLAND PATENT, VILLAGE OF | 05/21/2001 |
| ONEIDA COUNTY | KIRKLAND, TOWN OF | 04/03/1985 |
| ONEIDA COUNTY | LEE, TOWN OF | 08/03/1998 |
| ONEIDA COUNTY | MARCY, TOWN OF | 06/01/1984 |
| ONEIDA COUNTY | MARSHALL, TOWN OF | 09/30/1982 |
| ONEIDA COUNTY | NEW HARTFORD, TOWN OF | 04/18/1983 |
| ONEIDA COUNTY | NEW HARTFORD, VILLAGE OF | 07/05/1983 |
| ONEIDA COUNTY | NEW YORK MILLS, VILLAGE OF | 05/04/2000 |
| ONEIDA COUNTY | ONEIDA CASTLE, VILLAGE OF | 07/04/1989 |
| ONEIDA COUNTY | ORISKANY FALLS, VILLAGE OF | 01/19/1983 |
| ONEIDA COUNTY | ORISKANY, VILLAGE OF | 09/15/1983 |
| ONEIDA COUNTY | PARIS, TOWN OF | 09/15/1983 |
| ONEIDA COUNTY | PROSPECT, VILLAGE OF | 11/20/2000 |
| ONEIDA COUNTY | REMSEN, TOWN OF | 05/01/1985 (M) |
| ONEIDA COUNTY | REMSEN, VILLAGE OF | 09/24/1984 (M) |
| ONEIDA COUNTY | ROME, CITY OF | 09/21/1998 |
| ONEIDA COUNTY | SANGERFIELD, TOWN OF | 06/05/1985 |
| ONEIDA COUNTY | SHERRILL, CITY OF | 09/15/1983 |
| ONEIDA COUNTY | STEUBEN, TOWN OF | 09/24/1984 (M) |
| ONEIDA COUNTY | SYLVAN BEACH, VILLAGE OF | 06/02/1999 |
| ONEIDA COUNTY | TRENTON, TOWN OF | 09/07/1998 |
| ONEIDA COUNTY | UTICA, CITY OF | 02/01/1984 |
| ONEIDA COUNTY | VERNON, TOWN OF | 08/16/1988 |
| ONEIDA COUNTY | VERNON, VILLAGE OF | 04/15/1988 |
| ONEIDA COUNTY | VERONA, TOWN OF | 10/20/1999 |
| ONEIDA COUNTY | VIENNA, TOWN OF | 10/20/1999 |
| ONEIDA COUNTY | WATERVILLE, VILLAGE OF | 08/02/1982 |
| ONEIDA COUNTY | WESTERN, TOWN OF | 05/04/1989 |
| ONEIDA COUNTY | WESTMORELAND, TOWN OF | 03/02/1983 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ONEIDA COUNTY | WHITESBORO, VILLAGE OF | 05/04/2000 |
| ONEIDA COUNTY | WHITESTOWN, TOWN OF | 05/04/2000 |
| ONEIDA COUNTY | YORKVILLE, VILLAGE OF | 05/04/2000 |
| ONONDAGA COUNTY | BALDWINSVILLE, VILLAGE OF | 03/01/1984 |
| ONONDAGA COUNTY | CAMILLUS, TOWN OF | 05/18/1999 |
| ONONDAGA COUNTY | CAMILLUS, VILLAGE OF | 05/18/1999 |
| ONONDAGA COUNTY | CICERO, TOWN OF | 09/15/1994 |
| ONONDAGA COUNTY | CLAY, TOWN OF | 03/16/1992 |
| ONONDAGA COUNTY | DEWITT, TOWN OF | 03/01/1979 |
| ONONDAGA COUNTY | EAST SYRACUSE, VILLAGE OF | 08/03/1981 |
| ONONDAGA COUNTY | ELBRIDGE, TOWN OF | 08/16/1982 |
| ONONDAGA COUNTY | ELBRIDGE, VILLAGE OF | 08/16/1982 |
| ONONDAGA COUNTY | FABIUS, TOWN OF | 04/30/1986 (M) |
| ONONDAGA COUNTY | FAYETTEVILLE, VILLAGE OF | 04/17/1985 |
| ONONDAGA COUNTY | GEDDES, TOWN OF | 02/17/1982 |
| ONONDAGA COUNTY | JORDAN, VILLAGE OF | 08/16/1982 |
| ONONDAGA COUNTY | LAFAYETTE, TOWN OF | 04/03/1985 |
| ONONDAGA COUNTY | LIVERPOOL, VILLAGE OF | 02/04/1981 |
| ONONDAGA COUNTY | LYSANDER, TOWN OF | 02/04/1983 |
| ONONDAGA COUNTY | MANLIUS, TOWN OF | 09/17/1992 |
| ONONDAGA COUNTY | MANLIUS, VILLAGE OF | 08/01/1984 |
| ONONDAGA COUNTY | MARCELLUS, TOWN OF | 08/16/1982 |
| ONONDAGA COUNTY | MARCELLUS, VILLAGE OF | 06/01/1982 |
| ONONDAGA COUNTY | MINOA, VILLAGE OF | 09/02/1982 |
| ONONDAGA COUNTY | NORTH SYRACUSE, VILLAGE OF | (NSFHA) |
| ONONDAGA COUNTY | ONONDAGA, TOWN OF | 06/17/1991 |
| ONONDAGA COUNTY | OTISCO, TOWN OF | 06/03/1986 (M) |
| ONONDAGA COUNTY | POMPEY, TOWN OF | 10/8/1982 |
| ONONDAGA COUNTY | SALINA, TOWN OF | 08/16/1982 |
| ONONDAGA COUNTY | SKANEATELES, TOWN OF | 06/01/1982 |
| ONONDAGA COUNTY | SKANEATELES, VILLAGE OF | 02/17/1982 |
| ONONDAGA COUNTY | SOLVAY, VILLAGE OF | (NSFHA) |
| ONONDAGA COUNTY | SPAFFORD, TOWN OF | 04/30/1986 (M) |
| ONONDAGA COUNTY | SYRACUSE, CITY OF | 05/15/1986 |
| ONONDAGA COUNTY | TULLY, TOWN OF | 04/30/1986 (M) |
| ONONDAGA COUNTY | TULLY, VILLAGE OF | 01/19/1983 |
| ONONDAGA COUNTY | VAN BUREN, TOWN OF | 03/01/1984 |
| ONTARIO COUNTY | BLOOMFIELD, VILLAGE OF | 8/15/1983 |
| ONTARIO COUNTY | BRISTOL, TOWN OF | 01/20/1984 (M) |
| ONTARIO COUNTY | CANADICE, TOWN OF | 05/15/1984 |
| ONTARIO COUNTY | CANANDAIGUA, CITY OF | 09/24/1982 |
| ONTARIO COUNTY | CANANDAIGUA, TOWN OF | 03/03/1997 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ONTARIO COUNTY | CLIFTON SPRINGS, VILLAGE OF | 07/23/1982 (M) |
| ONTARIO COUNTY | EAST BLOOMFIELD, TOWN OF | 08/15/1983 |
| ONTARIO COUNTY | FARMINGTON, TOWN OF | 09/30/1983 |
| ONTARIO COUNTY | GENEVA, CITY OF | 04/15/1982 |
| ONTARIO COUNTY | GENEVA, TOWN OF | 02/15/1978 |
| ONTARIO COUNTY | GORHAM, TOWN OF | 12/5/1996 |
| ONTARIO COUNTY | HOPEWELL, TOWN OF | 02/27/1984 (M) |
| ONTARIO COUNTY | MANCHESTER, TOWN OF | 03/09/1984 (M) |
| ONTARIO COUNTY | MANCHESTER, VILLAGE OF | 01/20/1984 (M) |
| ONTARIO COUNTY | NAPLES, TOWN OF | 06/08/1984 (M) |
| ONTARIO COUNTY | NAPLES, VILLAGE OF | 09/30/1977 |
| ONTARIO COUNTY | PHELPS, TOWN OF | 12/03/1982 (M) |
| ONTARIO COUNTY | PHELPS, VILLAGE OF | 01/20/1984 (M) |
| ONTARIO COUNTY | RICHMOND, TOWN OF | 12/18/1984 |
| ONTARIO COUNTY | SENECA, TOWN OF | 06/22/1984(M) |
| ONTARIO COUNTY | SHORTSVILLE, VILLAGE OF | 09/24/1984 (M) |
| ONTARIO COUNTY | SOUTH BRISTOL, TOWN OF | 05/18/1998 |
| ONTARIO COUNTY | VICTOR, TOWN OF | 09/30/1983 |
| ONTARIO COUNTY | VICTOR, VILLAGE OF | 05/17/2004 |
| ONTARIO COUNTY | WEST BLOOMFIELD, TOWN OF | 06/01/1978 |
| ORANGE COUNTY | BLOOMING GROVE, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | CHESTER, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | CHESTER, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | CORNWALL ON THE HUDSON, VILLA | 08/03/2009 |
| ORANGE COUNTY | CORNWALL, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | CRAWFORD, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | DEER PARK, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | FLORIDA, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | GOSHEN, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | GOSHEN, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | GREENVILLE, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | GREENWOOD LAKE, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | HAMPTONBURGH, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | HARRIMAN, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | HIGHLAND FALLS, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | HIGHLANDS, TOWNSHIP OF | 08/03/2009 |
| ORANGE COUNTY | KIRYAS JOEL, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | MAYBROOK, VILLAGE OF | 08/03/2009 (M) |
| ORANGE COUNTY | MIDDLETOWN, CITY OF | 08/03/2009 |
| ORANGE COUNTY | MINISINK, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | MONROE, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | MONROE, VILLAGE OF | 08/03/2009 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ORANGE COUNTY | MONTGOMERY, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | MONTGOMERY, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | MOUNT HOPE, TOWN OF | 08/03/2009 (M) |
| ORANGE COUNTY | NEW WINDSOR, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | NEWBURGH, CITY OF | 08/03/2009 |
| ORANGE COUNTY | NEWBURGH, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | PORT JERVIS, CITY OF | 08/03/2009 |
| ORANGE COUNTY | SOUTH BLOOMING GROVE, VILLAGE | 08/03/2009 |
| ORANGE COUNTY | TUXEDO PARK, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | TUXEDO, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | UNIONVILLE, VILLAGE OF | 08/03/2009 (M) |
| ORANGE COUNTY | WALDEN, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | WALLKILL, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | WARWICK, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | WARWICK, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | WASHINGTONVILLE, VILLAGE OF | 08/03/2009 |
| ORANGE COUNTY | WAWAYANDA, TOWN OF | 08/03/2009 |
| ORANGE COUNTY | WOODBURY, VILLAGE OF | 08/03/2009 |
| ORLEANS COUNTY | ALBION, TOWN OF | 08/08/1980 (M) |
| ORLEANS COUNTY | ALBION, VILLAGE OF | 11/30/1979 (M) |
| ORLEANS COUNTY | BARRE, TOWN OF | 10/15/1981 (M) |
| ORLEANS COUNTY | CARLTON, TOWN OF | 11/1/1978 |
| ORLEANS COUNTY | CLARENDON,TOWN OF | (NSFHA) |
| ORLEANS COUNTY | GAINES, TOWN OF | 06/08/1984 (M) |
| ORLEANS COUNTY | HOLLEY, VILLAGE OF | 11/30/1979 (M) |
| ORLEANS COUNTY | KENDALL, TOWN OF | 05/01/1978 |
| ORLEANS COUNTY | LYNDONVILLE, VILLAGE OF | 09/16/1981 |
| ORLEANS COUNTY | MEDINA, VILLAGE OF | 03/28/1980 (M) |
| ORLEANS COUNTY | MURRAY, TOWN OF | 03/21/1980 (M) |
| ORLEANS COUNTY | RIDGEWAY,TOWN OF | 09/14/1979 (M) |
| ORLEANS COUNTY | SHELBY,TOWN OF | 12/23/1983 (M) |
| ORLEANS COUNTY | YATES, TOWN OF | 09/29/1978 |
| OSWEGO COUNTY | ALBION, TOWN OF | 04/15/1986 (M) |
| OSWEGO COUNTY | ALTMAR, VILLAGE OF | 02/05/1986 (M) |
| OSWEGO COUNTY | AMBOY, TOWN OF | 03/01/1988 (L) |
| OSWEGO COUNTY | BOYLSTON, TOWN OF | (NSFHA) |
| OSWEGO COUNTY | CENTRAL SQUARE,VILLAGE OF | (NSFHA) |
| OSWEGO COUNTY | CLEVELAND, VILLAGE OF | 06/01/1982 |
| OSWEGO COUNTY | CONSTANTIA, TOWN OF | 11/3/1982 |
| OSWEGO COUNTY | FULTON, CITY OF | 04/15/1982 |
| OSWEGO COUNTY | GRANBY, TOWN OF | 09/16/1982 |
| OSWEGO COUNTY | HANNIBAL, TOWN OF | 02/01/1988 (L) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| OSWEGO COUNTY | HANNIBAL, VILLAGE OF | 04/01/1987 (L) |
| OSWEGO COUNTY | HASTINGS, TOWN OF | 01/19/1983 |
| OSWEGO COUNTY | LACONA, VILLAGE OF | 05/11/1979 (M) |
| OSWEGO COUNTY | MEXICO, TOWN OF | 10/15/1981 |
| OSWEGO COUNTY | MEXICO, VILLAGE OF | 10/15/1981 |
| OSWEGO COUNTY | MINETTO, TOWN OF | 09/30/1981 |
| OSWEGO COUNTY | NEW HAVEN, TOWN OF | 11/2/1995 |
| OSWEGO COUNTY | ORWELL, TOWN OF | 02/19/1986 |
| OSWEGO COUNTY | OSWEGO, CITY OF | 11/22/1999 |
| OSWEGO COUNTY | OSWEGO, TOWN OF | 06/20/2001 |
| OSWEGO COUNTY | PALERMO, TOWN OF | 03/01/1988 |
| OSWEGO COUNTY | PARISH, TOWN OF | 04/15/1986 (M) |
| OSWEGO COUNTY | PARISH, VILLAGE OF | 02/19/1986 (M) |
| OSWEGO COUNTY | PHOENIX, VILLAGE OF | 02/17/1982 |
| OSWEGO COUNTY | PULASKI, VILLAGE OF | 09/02/1982 |
| OSWEGO COUNTY | REDFIELD, TOWN OF | 04/01/1991 (L) |
| OSWEGO COUNTY | RICHLAND, TOWN OF | 07/17/1995 |
| OSWEGO COUNTY | SANDY CREEK, TOWN OF | 07/17/1995 |
| OSWEGO COUNTY | SANDY CREEK, VILLAGE OF | 05/11/1979 (M) |
| OSWEGO COUNTY | SCHROEPPEL, TOWN OF | 08/02/1982 |
| OSWEGO COUNTY | SCRIBA, TOWN OF | 06/06/2001 |
| OSWEGO COUNTY | VOLNEY, TOWN OF | 04/15/1982 |
| OSWEGO COUNTY | WEST MONROE, TOWN OF | 01/20/1982 |
| OSWEGO COUNTY | WILLIAMSTOWN, TOWN OF | 03/01/1988 |
| OTSEGO COUNTY | BURLINGTON, TOWN OF | 10/21/1983 (M) |
| OTSEGO COUNTY | BUTTERNUTS, TOWN OF | 12/23/1983 (M) |
| OTSEGO COUNTY | CHERRY VALLEY, TOWN OF | 02/01/1988 (L) |
| OTSEGO COUNTY | CHERRY VALLEY, VILLAGE OF | 01/03/1986 (M) |
| OTSEGO COUNTY | COOPERSTOWN, VILLAGE OF | 05/04/2000 |
| OTSEGO COUNTY | DECATUR, TOWN OF | 06/18/1987 |
| OTSEGO COUNTY | EDMESTON, TOWN OF | 06/01/1987 (L) |
| OTSEGO COUNTY | EXETER, TOWN OF | 11/18/1983 (M) |
| OTSEGO COUNTY | GILBERTSVILLE, VILLAGE OF | 11/01/1985 (M) |
| OTSEGO COUNTY | HARTWICK, TOWN OF | 11/04/1983 (M) |
| OTSEGO COUNTY | LAURENS, TOWN OF | 05/15/1985 (M) |
| OTSEGO COUNTY | LAURENS, VILLAGE OF | 04/17/1987 (M) |
| OTSEGO COUNTY | MARYLAND, TOWN OF | 06/03/1986 (M) |
| OTSEGO COUNTY | MIDDLEFIELD, TOWN OF | 06/01/1988 (L) |
| OTSEGO COUNTY | MILFORD, TOWN OF | 05/19/1987 (M) |
| OTSEGO COUNTY | MILFORD, VILLAGE OF | 11/18/1983 |
| OTSEGO COUNTY | MORRIS, TOWN OF | 01/03/1986 (M) |
| OTSEGO COUNTY | MORRIS, VILLAGE OF | 12/04/1985 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| OTSEGO COUNTY | NEW LISBON, TOWN OF | 11/18/1983 (M) |
| OTSEGO COUNTY | ONEONTA, CITY OF | 09/29/1978 |
| OTSEGO COUNTY | ONEONTA, TOWN OF | 10/17/1986 |
| OTSEGO COUNTY | OTEGO, TOWN OF | 02/04/1987 |
| OTSEGO COUNTY | OTEGO, VILLAGE OF | 11/5/1986 |
| OTSEGO COUNTY | OTSEGO, TOWN OF | 06/01/1987 (L) |
| OTSEGO COUNTY | PITTSFIELD, TOWN OF | 11/04/1983 (M) |
| OTSEGO COUNTY | PLAINFIELD, TOWN OF | 11/04/1983 (M) |
| OTSEGO COUNTY | RICHFIELD SPRINGS, VILLAGE OF | 01/03/1986 (M) |
| OTSEGO COUNTY | RICHFIELD, TOWN OF | 04/15/1986 (M) |
| OTSEGO COUNTY | ROSEBOOM, TOWN OF | 06/01/1988 |
| OTSEGO COUNTY | SPRINGFIELD, TOWN OF | 06/01/1987 (L) |
| OTSEGO COUNTY | UNADILLA, TOWN OF | 09/30/1987 |
| OTSEGO COUNTY | UNADILLA, VILLAGE OF | 09/30/1987 |
| OTSEGO COUNTY | WESTFORD, TOWN OF | 06/01/1987 (L) |
| OTSEGO COUNTY | WORCESTER, TOWN OF | 06/01/1987 (L) |
| PUTNAM COUNTY | BREWSTER, VILLAGE OF | 09/18/1986 |
| PUTNAM COUNTY | CARMEL,TOWN OF | 10/19/2001 |
| PUTNAM COUNTY | COLD SPRING, VILLAGE OF | 03/15/1984 |
| PUTNAM COUNTY | KENT, TOWN OF | 09/04/1986 |
| PUTNAM COUNTY | NELSONVILLE, VILLAGE OF | 09/10/1984 (M) |
| PUTNAM COUNTY | PATTERSON, TOWN OF | 07/03/1986 |
| PUTNAM COUNTY | PHILIPSTOWN,TOWN OF | 06/18/1987 |
| PUTNAM COUNTY | PUTNAM VALLEY, TOWN OF | 06/20/2001 |
| PUTNAM COUNTY | SOUTHEAST, TOWN OF | 09/04/1986 |
| RENSSELAER COUNTY | BERLIN, TOWN OF | 08/17/1979 (M) |
| RENSSELAER COUNTY | BRUNSWICK, TOWN OF | 12/6/2000 |
| RENSSELAER COUNTY | CASTLETON-ON-HUDSON, VILLAGE O | 11/15/1984 |
| RENSSELAER COUNTY | EAST GREENBUSH, TOWN OF | 03/18/1980 |
| RENSSELAER COUNTY | EAST NASSAU, VILLAGE OF | 09/05/1984 |
| RENSSELAER COUNTY | GRAFTON, TOWN OF | 10/13/1978 (M) |
| RENSSELAER COUNTY | HOOSICK FALLS, VILLAGE OF | 02/04/2005 |
| RENSSELAER COUNTY | HOOSICK, TOWN OF | 08/01/1987 (L) |
| RENSSELAER COUNTY | NASSAU, TOWN OF | 09/05/1984 |
| RENSSELAER COUNTY | NASSAU, VILLAGE OF | 05/18/1979 (M) |
| RENSSELAER COUNTY | NORTH GREENBUSH,TOWN OF | 06/18/1980 |
| RENSSELAER COUNTY | PETERSBURG, TOWN OF | 09/01/1978 (M) |
| RENSSELAER COUNTY | PITTSTOWN, TOWN OF | 09/05/1990 |
| RENSSELAER COUNTY | POESTENKILL, TOWN OF | 09/02/1981 |
| RENSSELAER COUNTY | RENSSELAER, CITY OF | 03/18/1980 |
| RENSSELAER COUNTY | SAND LAKE, TOWN OF | 05/15/1980 |
| RENSSELAER COUNTY | SCHAGHTICOKE, TOWN OF | 07/16/1984 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| RENSSELAER COUNTY | SCHAGHTICOKE, VILLAGE OF | 06/05/1985 |
| RENSSELAER COUNTY | SCHODACK, TOWN OF | 08/15/1984 |
| RENSSELAER COUNTY | STEPHENTOWN, TOWN OF | 08/03/1981 |
| RENSSELAER COUNTY | TROY, CITY OF | 03/18/1980 |
| RENSSELAER COUNTY | VALLEY FALLS, VILLAGE OF | 06/05/1985 |
| RICHMOND COUNTY/QUEENS COUNTY/NEW YORK COUNTY/KINGS COUNTY/BRONX COUNTY | NEW YORK, CITY OF | 09/05/2007 |
| ROCKLAND COUNTY | CHESTNUT RIDGE, VILLAGE OF | 09/16/1988 |
| ROCKLAND COUNTY | CLARKSTOWN, TOWN OF | 05/21/2001 |
| ROCKLAND COUNTY | GRAND VIEW-ON-HUDSON, VILLAGE | 10/15/1981 |
| ROCKLAND COUNTY | HAVERSTRAW, TOWN OF | 01/06/1982 |
| ROCKLAND COUNTY | HAVERSTRAW, VILLAGE OF | 09/02/1981 |
| ROCKLAND COUNTY | HILLBURN, VILLAGE OF | 09/20/1996 |
| ROCKLAND COUNTY | KASER, VILLAGE OF | 01/01/2050 |
| ROCKLAND COUNTY | MONTEBELLO, VILLAGE OF | 01/18/1989 |
| ROCKLAND COUNTY | NEW HEMPSTEAD, VILLAGE OF | 12/16/1988 |
| ROCKLAND COUNTY | NEW SQUARE, VILLAGE OF | (NSFHA) |
| ROCKLAND COUNTY | NYACK, VILLAGE OF | 12/4/1985 |
| ROCKLAND COUNTY | ORANGETOWN, TOWN OF | 08/02/1982 |
| ROCKLAND COUNTY | PIERMONT, VILLAGE OF | 11/17/1982 |
| ROCKLAND COUNTY | POMONA, VILLAGE OF | 04/15/1982 |
| ROCKLAND COUNTY | RAMAPO, TOWN OF | 02/02/1989 |
| ROCKLAND COUNTY | SLOATSBURG, VILLAGE OF | 01/06/1982 |
| ROCKLAND COUNTY | SOUTH NYACK, VILLAGE OF | 11/4/1981 |
| ROCKLAND COUNTY | SPRING VALLEY, VILLAGE OF | 08/16/1988 |
| ROCKLAND COUNTY | STONY POINT, TOWN OF | 09/30/1981 |
| ROCKLAND COUNTY | SUFFERN, VILLAGE OF | 03/28/1980 |
| ROCKLAND COUNTY | UPPER NYACK, VILLAGE OF | (NSFHA) |
| ROCKLAND COUNTY | WESLEY HILLS, VILLAGE OF | 09/16/1988 |
| ROCKLAND COUNTY | WEST HAVERSTRAW, VILLAGE OF | 09/30/1981 |
| SARATOGA COUNTY | BALLSTON SPA, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | BALLSTON, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | CHARLTON, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | CLIFTON PARK, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | CORINTH, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | CORINTH, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | DAY, TOWN OF | (NSFHA) |
| SARATOGA COUNTY | GALWAY, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | GREENFIELD, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | HADLEY, TOWN OF | 08/16/1995 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| SARATOGA COUNTY | HALFMOON, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | MALTA, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | MECHANICVILLE, CITY OF | 08/16/1995 |
| SARATOGA COUNTY | MILTON, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | MOREAU, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | NORTHUMBERLAND, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | PROVIDENCE, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | ROUND LAKE, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | SARATOGA SPRINGS, CITY OF | 08/16/1995 |
| SARATOGA COUNTY | SARATOGA, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | SCHUYLERVILLE, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | SOUTH GLENS FALLS, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | STILLWATER, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | STILLWATER, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | VICTORY, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | WATERFORD, TOWN OF | 08/16/1995 |
| SARATOGA COUNTY | WATERFORD, VILLAGE OF | 08/16/1995 |
| SARATOGA COUNTY | WILTON,TOWN OF | (NSFHA) |
| SCHENECTADY COUNTY | DELANSON, VILLAGE OF | 05/25/1984 (M) |
| SCHENECTADY COUNTY | DUANESBURG, TOWN OF | 02/17/1989 |
| SCHENECTADY COUNTY | GLENVILLE,TOWN OF | 05/04/1987 |
| SCHENECTADY COUNTY | NISKAYUNA, TOWN OF | 03/01/1978 |
| SCHENECTADY COUNTY | PRINCETOWN, TOWN OF | 07/01/1988 (L) |
| SCHENECTADY COUNTY | ROTTERDAM, TOWN OF | 06/15/1984 |
| SCHENECTADY COUNTY | SCHENECTADY, CITY OF | 09/30/1983 |
| SCHENECTADY COUNTY | SCOTIA, VILLAGE OF | 06/01/1984 |
| SCHOHARIE COUNTY | BLENHEIM, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | BROOME, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | CARLISLE, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | COBLESKILL, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | COBLESKILL, VILLAGE OF | 04/02/2004 |
| SCHOHARIE COUNTY | CONESVILLE, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | ESPERANCE, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | ESPERANCE, VILLAGE OF | 04/02/2004 |
| SCHOHARIE COUNTY | FULTON, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | GILBOA, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | JEFFERSON, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | MIDDLEBURGH, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | MIDDLEBURGH, VILLAGE OF | 04/02/2004 |
| SCHOHARIE COUNTY | RICHMONDVILLE, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | RICHMONDVILLE, VILLAGE OF | 04/02/2004 |
| SCHOHARIE COUNTY | SCHOHARIE, TOWN OF | 04/02/2004 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| SCHOHARIE COUNTY | SCHOHARIE, VILLAGE OF | 04/02/2004 |
| SCHOHARIE COUNTY | SEWARD, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | SHARON SPRING, VILLAGE OF | 04/02/2004 (M) |
| SCHOHARIE COUNTY | SHARON, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | SUMMIT, TOWN OF | 04/02/2004 |
| SCHOHARIE COUNTY | WRIGHT, TOWN OF | 04/02/2004 |
| SCHUYLER COUNTY | BURDETT, VILLAGE OF | 06/01/1988 (L) |
| SCHUYLER COUNTY | CATHARINE, TOWN OF | 04/20/1984 (M) |
| SCHUYLER COUNTY | CAYUTA, TOWN OF | 09/24/1984 (M) |
| SCHUYLER COUNTY | DIX, TOWN OF | 10/29/1982 (M) |
| SCHUYLER COUNTY | HECTOR, TOWN OF | 07/20/1984 (M) |
| SCHUYLER COUNTY | MONTOUR FALLS, VILLAGE OF | 09/15/1983 |
| SCHUYLER COUNTY | MONTOUR, TOWN OF | 03/01/1988 (L) |
| SCHUYLER COUNTY | ODESSA, VILLAGE OF | 04/20/1984 (M) |
| SCHUYLER COUNTY | ORANGE, TOWN OF | 04/20/1984 (M) |
| SCHUYLER COUNTY | READING, TOWN OF | (NSFHA) |
| SCHUYLER COUNTY | TYRONE, TOWN OF | 07/06/1984 (M) |
| SCHUYLER COUNTY | WATKINS GLEN, VILLAGE OF | 07/17/1978 |
| SENECA COUNTY | COVERT, TOWN OF | 06/08/1984 (M) |
| SENECA COUNTY | FAYETTE, TOWN OF | 01/15/1988 |
| SENECA COUNTY | LODI, TOWN OF | 01/15/1988 |
| SENECA COUNTY | LODI, VILLAGE OF | (NSFHA) |
| SENECA COUNTY | OVID, TOWN OF | 01/15/1988 |
| SENECA COUNTY | ROMULUS, TOWN OF | 06/05/1985 (M) |
| SENECA COUNTY | SENECA FALLS, TOWN OF | 08/03/1981 |
| SENECA COUNTY | SENECA FALLS, VILLAGE OF | 08/03/1981 |
| SENECA COUNTY | TYRE, TOWN OF | 08/31/1979 (M) |
| SENECA COUNTY | VARICK, TOWN OF | 12/17/1987 |
| SENECA COUNTY | WATERLOO, TOWN OF | 09/16/1981 |
| SENECA COUNTY | WATERLOO, VILLAGE OF | 08/03/1981 |
| ST. LAWRENCE COUNTY | BRASHER, TOWN OF | 01/03/1986 (M) |
| ST. LAWRENCE COUNTY | CANTON, TOWN OF | 08/17/1998 |
| ST. LAWRENCE COUNTY | CANTON, VILLAGE OF | 05/02/1994 |
| ST. LAWRENCE COUNTY | CLARE, TOWN OF | 07/16/1982 (M) |
| ST. LAWRENCE COUNTY | CLIFTON, CITY OF | 05/15/1986 (M) |
| ST. LAWRENCE COUNTY | COLTON, TOWN OF | 05/01/1985 (M) |
| ST. LAWRENCE COUNTY | DE KALB, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | DE PEYSTER, TOWN OF | 07/23/1982 (M) |
| ST. LAWRENCE COUNTY | EDWARDS, TOWN OF | 07/30/1982 (M) |
| ST. LAWRENCE COUNTY | EDWARDS, VILLAGE OF | 07/23/1982 (M) |
| ST. LAWRENCE COUNTY | FINE, TOWN OF | 05/01/1985 (M) |
| ST. LAWRENCE COUNTY | FOWLER, TOWN OF | 06/05/1989 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| ST. LAWRENCE COUNTY | GOUVERNEUR, TOWN OF | 08/06/1982 (M) |
| ST. LAWRENCE COUNTY | GOUVERNEUR, VILLAGE OF | 03/03/1997 |
| ST. LAWRENCE COUNTY | HAMMOND, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | HERMON, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | HERMON, VILLAGE OF | 08/03/1998 |
| ST. LAWRENCE COUNTY | HEUVELTON, VILLAGE OF | 04/30/1986 (M) |
| ST. LAWRENCE COUNTY | HOPKINTON, TOWN OF | 11/12/1982 (M) |
| ST. LAWRENCE COUNTY | LAWRENCE, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | LISBON, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | LOUISVILLE, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | MACOMB, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | MADRID, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | MASSENA, TOWN OF | 06/17/1986 (M) |
| ST. LAWRENCE COUNTY | MASSENA, VILLAGE OF | 11/5/1980 |
| ST. LAWRENCE COUNTY | MORRISTOWN, TOWN OF | 08/06/1982 (M) |
| ST. LAWRENCE COUNTY | MORRISTOWN, VILLAGE OF | 12/02/1980 (M) |
| ST. LAWRENCE COUNTY | NORFOLK, TOWN OF | 04/15/1986 (M) |
| ST. LAWRENCE COUNTY | NORWOOD, VILLAGE OF | 04/30/1986 (M) |
| ST. LAWRENCE COUNTY | OGDENSBURG, CITY OF | 11/5/1980 |
| ST. LAWRENCE COUNTY | OSWEGATCHIE, TOWN OF | 05/01/1985 (M) |
| ST. LAWRENCE COUNTY | PARISHVILLE, TOWN OF | 07/30/1982 (M) |
| ST. LAWRENCE COUNTY | PIERCEFIELD, TOWN OF | 01/06/1984 (M) |
| ST. LAWRENCE COUNTY | PIERREPONT, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | PITCAIRN, TOWN OF | 08/13/1982 (M) |
| ST. LAWRENCE COUNTY | POTSDAM, VILLAGE OF | 01/05/1996 |
| ST. LAWRENCE COUNTY | POTSDAM,TOWN OF | 03/04/1986 (M) |
| ST. LAWRENCE COUNTY | RENSSELAER FALLS, VILLAGE OF | 01/06/1984 (M) |
| ST. LAWRENCE COUNTY | RICHVILLE, VILLAGE OF | 01/06/1984 (M) |
| ST. LAWRENCE COUNTY | ROSSIE, TOWN OF | 07/30/1982 (M) |
| ST. LAWRENCE COUNTY | RUSSELL, TOWN OF | (NSFHA) |
| ST. LAWRENCE COUNTY | STOCKHOLM, TOWN OF | 04/15/1986 (M) |
| ST. LAWRENCE COUNTY | WADDINGTON, TOWN OF | 04/15/1986 (M) |
| ST. LAWRENCE COUNTY | WADDINGTON, VILLAGE OF | 05/11/1979 (M) |
| STEUBEN COUNTY | ADDISON, TOWN OF | 12/18/1984 |
| STEUBEN COUNTY | ADDISON, VILLAGE OF | 06/15/1981 |
| STEUBEN COUNTY | ARKPORT, VILLAGE OF | 03/04/1980 |
| STEUBEN COUNTY | AVOCA, TOWN OF | 02/05/1992 |
| STEUBEN COUNTY | AVOCA, VILLAGE OF | 05/16/1983 |
| STEUBEN COUNTY | BATH, TOWN OF | 05/02/1983 |
| STEUBEN COUNTY | BATH, VILLAGE OF | 03/16/1983 |
| STEUBEN COUNTY | BRADFORD, TOWN OF | 09/24/1984 (M) |
| STEUBEN COUNTY | CAMERON, TOWN OF | 05/15/1991 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| STEUBEN COUNTY | CAMPBELL, TOWN OF | 06/11/1982 |
| STEUBEN COUNTY | CANISTEO, TOWN OF | 12/18/1984 |
| STEUBEN COUNTY | CANISTEO, VILLAGE OF | 05/18/1979 (M) |
| STEUBEN COUNTY | CATON, TOWN OF | 03/23/1984 (M) |
| STEUBEN COUNTY | COHOCTON, TOWN OF | 05/16/1983 |
| STEUBEN COUNTY | COHOCTON, VILLAGE OF | 05/16/1983 |
| STEUBEN COUNTY | CORNING, CITY OF | 09/27/2002 |
| STEUBEN COUNTY | CORNING, TOWN OF | 09/27/2002 |
| STEUBEN COUNTY | DANSVILLE, TOWN OF | 03/09/84(M) |
| STEUBEN COUNTY | ERWIN, TOWN OF | 07/02/1980 |
| STEUBEN COUNTY | FREMONT, TOWN OF | 10/29/1982 (M) |
| STEUBEN COUNTY | GREENWOOD, TOWN OF | 09/03/1982 (M) |
| STEUBEN COUNTY | HAMMONDSPORT, VILLAGE OF | 04/17/1978 |
| STEUBEN COUNTY | HARTSVILLE, TOWN OF | 09/17/1982 (M) |
| STEUBEN COUNTY | HORNBY, TOWN OF | 04/15/1986 |
| STEUBEN COUNTY | HORNELL, CITY OF | 03/18/1980 |
| STEUBEN COUNTY | HORNELLSVILLE, TOWN OF | 07/16/1980 |
| STEUBEN COUNTY | HOWARD, TOWN OF | 09/03/1982 (M) |
| STEUBEN COUNTY | JASPER, TOWN OF | 07/23/1982 (M) |
| STEUBEN COUNTY | LINDLEY, TOWN OF | 08/01/1980 |
| STEUBEN COUNTY | NORTH HORNELL, VILLAGE OF | 01/17/1986 |
| STEUBEN COUNTY | PAINTED POST, VILLAGE OF | 05/18/2000 |
| STEUBEN COUNTY | PRATTSBURG, TOWN OF | 01/20/1984 (M) |
| STEUBEN COUNTY | PULTENEY, TOWN OF | 09/30/1977 |
| STEUBEN COUNTY | RATHBONE, TOWN OF | 12/03/1982 (M) |
| STEUBEN COUNTY | RIVERSIDE, VILLAGE OF | 05/15/1980 |
| STEUBEN COUNTY | SAVONA, VILLAGE OF | 08/15/1980 |
| STEUBEN COUNTY | SOUTH CORNING, VILLAGE OF | 10/15/1981 |
| STEUBEN COUNTY | THURSTON, TOWN OF | 02/11/1983 (M) |
| STEUBEN COUNTY | TROUPSBURG, TOWN OF | 09/24/1982 (M) |
| STEUBEN COUNTY | TUSCARORA, TOWN OF | 03/01/1988 (L) |
| STEUBEN COUNTY | URBANA, TOWN OF | 01/19/1978 |
| STEUBEN COUNTY | WAYLAND, TOWN OF | 06/08/1984 (M) |
| STEUBEN COUNTY | WAYLAND, VILLAGE OF | 08/01/1988 (L) |
| STEUBEN COUNTY | WAYNE, TOWN OF | 11/2/1977 |
| STEUBEN COUNTY | WEST UNION, TOWN OF | 07/01/1988 (L) |
| STEUBEN COUNTY | WHEELER, TOWN OF | 07/25/1980 (M) |
| STEUBEN COUNTY | WOODHULL, TOWN OF | 04/02/1991 |
| STEUBEN COUNTY/ALLEGANY COUNTY | ALMOND, TOWN OF | 03/04/1980 |
| SUFFOLK COUNTY | AMITYVILLE, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | ASHAROKEN, VILLAGE OF | 09/25/2009 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| SUFFOLK COUNTY | BABYLON, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | BABYLON,TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | BELLE TERRE, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | BELLPORT, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | BRIGHTWATERS, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | BROOKHAVEN,TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | DERING HARBOR, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | EAST HAMPTON,TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | EAST HAMPTON,VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | GREENPORT, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | HEAD OF THE HARBOR, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | HUNTINGTON BAY, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | HUNTINGTON, TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | ISLANDIA, VILLAGE OF | 09/25/2009 (M) |
| SUFFOLK COUNTY | ISLIP,TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | LAKE GROVE, VILLAGE OF | (NSFHA) |
| SUFFOLK COUNTY | LINDENHURST, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | LLOYD HARBOR, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | NISSEQUOGUE, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | NORTH HAVEN, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | NORTHPORT, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | OCEAN BEACH, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | OLD FIELD, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | PATCHOGUE, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | POQUOTT, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | PORT JEFFERSON, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | QUOGUE, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | RIVERHEAD, TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | SAG HARBOR, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | SAGAPONACK, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | SALTAIRE,VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | SHELTER ISLAND, TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | SHOREHAM, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | SMITHTOWN, TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | SOUTHAMPTON, TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | SOUTHAMPTON, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | SOUTHOLD,TOWN OF | 09/25/2009 |
| SUFFOLK COUNTY | THE BRANCH, VILLAGE OF | 09/25/2009 |
| SUFFOLK COUNTY | WEST HAMPTON DUNES, VILLAGE O | 09/25/2009 |
| SUFFOLK COUNTY | WESTHAMPTON BEACH, VILLAGE OF | 09/25/2009 |
| SULLIVAN COUNTY | BETHEL, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | BLOOMINGBURG, VILLAGE OF | 02/18/2011 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| SULLIVAN COUNTY | CALLICOON, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | COCHECTON, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | DELAWARE, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | FALLSBURG, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | FORESTBURGH, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | FREMONT, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | HIGHLAND, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | JEFFERSONVILLE, VILLAGE OF | 02/18/2011 |
| SULLIVAN COUNTY | LIBERTY, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | LIBERTY, VILLAGE OF | 02/18/2011 |
| SULLIVAN COUNTY | LUMBERLAND, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | MAMAKATING, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | MONTICELLO, VILLAGE OF | 02/18/2011 |
| SULLIVAN COUNTY | NEVERSINK, TOWN OF | 02/18/2011 (M) |
| SULLIVAN COUNTY | ROCKLAND, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | THOMPSON, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | TUSTEN, TOWN OF | 02/18/2011 |
| SULLIVAN COUNTY | WOODRIDGE, VILLAGE OF | 02/18/2011 (M) |
| SULLIVAN COUNTY | WURTSBORO, VILLAGE OF | 02/18/2011 |
| TIOGA COUNTY | BARTON, TOWN OF | 05/15/1991 |
| TIOGA COUNTY | BERKSHIRE, TOWN OF | 05/15/1985 (M) |
| TIOGA COUNTY | CANDOR, TOWN OF | 08/19/1986 |
| TIOGA COUNTY | CANDOR, VILLAGE OF | 10/01/1991 (L) |
| TIOGA COUNTY | NEWARK VALLEY, TOWN OF | 02/03/1982 |
| TIOGA COUNTY | NEWARK VALLEY, VILLAGE OF | 02/03/1982 |
| TIOGA COUNTY | NICHOLS, TOWN OF | 02/17/1982 |
| TIOGA COUNTY | NICHOLS, VILLAGE OF | 09/29/1986 |
| TIOGA COUNTY | OWEGO, TOWN OF | 01/17/1997 |
| TIOGA COUNTY | OWEGO, VILLAGE OF | 04/02/1982 |
| TIOGA COUNTY | RICHFORD, TOWN OF | 05/15/1985 (M) |
| TIOGA COUNTY | SPENCER, TOWN OF | 05/15/1985 (M) |
| TIOGA COUNTY | SPENCER, VILLAGE OF | 05/15/1985 (M) |
| TIOGA COUNTY | TIOGA, TOWN OF | 05/17/1982 |
| TIOGA COUNTY | WAVERLY, VILLAGE OF | 03/16/1983 |
| TOMPKINS COUNTY | CAROLINE, TOWN OF | 06/19/1985 (M) |
| TOMPKINS COUNTY | CAYUGA HEIGHTS, VILLAGE OF | (NSFHA) |
| TOMPKINS COUNTY | DANBY, TOWN OF | 05/15/1985 (M) |
| TOMPKINS COUNTY | DRYDEN, TOWN OF | 05/15/1985 (M) |
| TOMPKINS COUNTY | DRYDEN, VILLAGE OF | 01/03/1979 |
| TOMPKINS COUNTY | FREEVILLE, VILLAGE OF | 05/01/88(L) |
| TOMPKINS COUNTY | GROTON, TOWN OF | 10/05/1984 (M) |
| TOMPKINS COUNTY | GROTON, VILLAGE OF | 11/5/1986 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| TOMPKINS COUNTY | ITHACA, CITY OF | 09/30/1981 |
| TOMPKINS COUNTY | ITHACA, TOWN OF | 06/19/1985 |
| TOMPKINS COUNTY | LANSING, TOWN OF | 10/15/1985 |
| TOMPKINS COUNTY | LANSING, VILLAGE OF | 11/19/1987 |
| TOMPKINS COUNTY | NEWFIELD, TOWN OF | 10/15/1985 (M) |
| TOMPKINS COUNTY | TRUMANSBURG, VILLAGE OF | 04/01/1988 (L) |
| TOMPKINS COUNTY | ULYSSES, TOWN OF | 02/19/1987 |
| ULSTER COUNTY | DENNING, TOWN OF | 05/25/1984 (M) |
| ULSTER COUNTY | ELLENVILLE, VILLAGE OF | 09/25/2009 |
| ULSTER COUNTY | ESOPUS, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | GARDINER, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | HARDENBURGH, TOWN OF | 03/16/2089 |
| ULSTER COUNTY | HURLEY, TOWN OF | 08/18/2092 |
| ULSTER COUNTY | KINGSTON, CITY OF | 09/25/2009 |
| ULSTER COUNTY | KINGSTON,TOWN OF | 09/25/2009 |
| ULSTER COUNTY | LLOYD, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | MARBLETOWN, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | MARLBOROUGH, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | NEW PALTZ, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | NEW PALTZ, VILLAGE OF | 09/25/2009 |
| ULSTER COUNTY | OLIVE, TOWN OF | 11/1/1984 |
| ULSTER COUNTY | PLATTEKILL, TOWN OF | (NSFHA) |
| ULSTER COUNTY | ROCHESTER, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | ROSENDALE, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | SAUGERTIES, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | SAUGERTIES, VILLAGE OF | 09/25/2009 (M) |
| ULSTER COUNTY | SHANDAKEN, TOWN OF | 02/17/1989 |
| ULSTER COUNTY | SHAWANGUNK, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | ULSTER, TOWN OF | 09/25/2009 |
| ULSTER COUNTY | WAWARSING, TOWN OF | 09/15/1983 |
| ULSTER COUNTY | WOODSTOCK, TOWN OF | 09/27/1991 |
| WARREN COUNTY | BOLTON, TOWN OF | 08/16/1996 |
| WARREN COUNTY | CHESTER, TOWN OF | 06/05/1985 (M) |
| WARREN COUNTY | GLENS FALLS, CITY OF | 06/05/1985 |
| WARREN COUNTY | HAGUE, TOWN OF | 09/29/1996 |
| WARREN COUNTY | HORICON, TOWN OF | 02/15/1985 (M) |
| WARREN COUNTY | JOHNSBURG, TOWN OF | 05/01/1985 (M) |
| WARREN COUNTY | LAKE GEORGE, TOWN OF | 08/16/1996 |
| WARREN COUNTY | LAKE GEORGE, VILLAGE OF | 09/29/1996 |
| WARREN COUNTY | LAKE LUZERNE, TOWN OF | 05/01/1984 |
| WARREN COUNTY | QUEENSBURY, TOWN OF | 08/16/1996 |
| WARREN COUNTY | STONY CREEK, TOWN OF | 08/24/1984 (M) |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| WARREN COUNTY | THURMAN, TOWN OF | 08/19/1986 |
| WARREN COUNTY | WARRENSBURG, TOWN OF | 03/01/1984 |
| WASHINGTON COUNTY | ARGYLE, TOWN OF | 08/24/1984 (M) |
| WASHINGTON COUNTY | ARGYLE, VILLAGE OF | 05/18/1979 (M) |
| WASHINGTON COUNTY | CAMBRIDGE, TOWN OF | 09/04/1985 (M) |
| WASHINGTON COUNTY | CAMBRIDGE, VILLAGE OF | 01/02/2008 |
| WASHINGTON COUNTY | DRESDEN, TOWN OF | 09/20/1996 |
| WASHINGTON COUNTY | EASTON, TOWN OF | 11/20/1991 |
| WASHINGTON COUNTY | FORT ANN, TOWN OF | 11/5/1997 |
| WASHINGTON COUNTY | FORT ANN, VILLAGE OF | (NSFHA) |
| WASHINGTON COUNTY | FORT EDWARD, TOWN OF | 12/15/1982 |
| WASHINGTON COUNTY | FORT EDWARD, VILLAGE OF | 02/15/1984 |
| WASHINGTON COUNTY | GRANVILLE, TOWN OF | 08/05/1985 (M) |
| WASHINGTON COUNTY | GRANVILLE, VILLAGE OF | 04/17/1985 (M) |
| WASHINGTON COUNTY | GREENWICH, VILLAGE OF | 05/04/2000 |
| WASHINGTON COUNTY | GREENWICH,TOWN OF | 03/16/1992 |
| WASHINGTON COUNTY | HAMPTON, TOWN OF | 04/17/1985 (M) |
| WASHINGTON COUNTY | HARTFORD, TOWN OF | 11/01/1985 (M) |
| WASHINGTON COUNTY | HEBRON, TOWN OF | 06/15/1994 |
| WASHINGTON COUNTY | HUDSON FALLS, VILLAGE OF | (NSFHA) |
| WASHINGTON COUNTY | JACKSON, TOWN OF | 03/16/1992 |
| WASHINGTON COUNTY | KINGSBURY, TOWN OF | 09/07/1979 (M) |
| WASHINGTON COUNTY | PUTNAM, TOWN OF | 11/20/1996 |
| WASHINGTON COUNTY | SALEM, VILLAGE OF | 04/17/1985 (M) |
| WASHINGTON COUNTY | SALEM,TOWN OF | 04/17/1985 (M) |
| WASHINGTON COUNTY | WHITE CREEK, TOWN OF | 04/17/1985 (M) |
| WASHINGTON COUNTY | WHITEHALL, TOWN OF | 07/03/1986 |
| WASHINGTON COUNTY | WHITEHALL, VILLAGE OF | 06/03/1985 (M) |
| WAYNE COUNTY | ARCADIA, TOWN OF | 11/2/1977 |
| WAYNE COUNTY | BUTLER, TOWN OF | 07/09/1982 (M) |
| WAYNE COUNTY | CLYDE, VILLAGE OF | 12/18/1984 |
| WAYNE COUNTY | GALEN, TOWN OF | 05/16/1983 |
| WAYNE COUNTY | HURON, TOWN OF | 01/19/1996 |
| WAYNE COUNTY | LYONS, TOWN OF | 09/07/1979 (M) |
| WAYNE COUNTY | LYONS, VILLAGE OF | 03/16/1983 |
| WAYNE COUNTY | MACEDON, TOWN OF | 01/05/1984 |
| WAYNE COUNTY | MACEDON, VILLAGE OF | 09/30/1983 |
| WAYNE COUNTY | MARION, TOWN OF | 07/01/1988 (L) |
| WAYNE COUNTY | NEWARK, VILLAGE OF | 07/15/1988 |
| WAYNE COUNTY | ONTARIO, TOWN OF | 06/01/1978 |
| WAYNE COUNTY | PALMYRA, TOWN OF | 03/01/1978 |
| WAYNE COUNTY | PALMYRA, VILLAGE OF | 07/15/1988 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| WAYNE COUNTY | RED CREEK, VILLAGE OF | 04/08/1983 (M) |
| WAYNE COUNTY | ROSE, TOWN OF | 03/09/1984 (M) |
| WAYNE COUNTY | SAVANNAH, TOWN OF | 08/06/1982 (M) |
| WAYNE COUNTY | SODUS POINT, VILLAGE OF | 11/2/1977 |
| WAYNE COUNTY | SODUS, TOWN OF | 06/02/1992 |
| WAYNE COUNTY | WALWORTH, TOWN OF | 03/16/1983 |
| WAYNE COUNTY | WILLIAMSON TOWN | 10/17/1978 |
| WAYNE COUNTY | WOLCOTT, TOWN OF | 06/02/1992 |
| WAYNE COUNTY | WOLCOTT, VILLAGE OF | 07/06/1984 (M) |
| WESTCHESTER COUNTY | ARDSLEY, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | BEDFORD, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | BRIARCLIFF MANOR, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | BRONXVILLE, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | BUCHANAN, VILLAGE OF | 09/28/2007 (M) |
| WESTCHESTER COUNTY | CORTLANDT, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | CROTON-ON-HUDSON, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | DOBBS FERRY, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | EASTCHESTER, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | ELMSFORD, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | GREENBURGH,TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | HARRISON, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | HASTINGS-ON-HUDSON, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | IRVINGTON, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | LARCHMONT, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | LEWISBORO, TOWN OF | 09/28/2007 (M) |
| WESTCHESTER COUNTY | MAMARONECK, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | MAMARONECK, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | MOUNT KISCO, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | MOUNT PLEASANT, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | MOUNT VERNON, CITY OF | 09/28/2007 |
| WESTCHESTER COUNTY | NEW CASTLE, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | NEW ROCHELLE, CITY OF | 09/28/2007 |
| WESTCHESTER COUNTY | NORTH CASTLE, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | NORTH SALEM, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | OSSINING, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | OSSINING, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | PEEKSKILL, CITY OF | 09/28/2007 |
| WESTCHESTER COUNTY | PELHAM MANOR, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | PELHAM, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | PLEASANTVILLE, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | PORT CHESTER, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | POUND RIDGE, TOWN OF | 09/28/2007 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| WESTCHESTER COUNTY | RYE BROOK, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | RYE, CITY OF | 09/28/2007 |
| WESTCHESTER COUNTY | SCARSDALE, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | SLEEPY HOLLOW, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | SOMERS, TOWN OF | 09/28/2007 |
| WESTCHESTER COUNTY | TARRYTOWN, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | TUCKAHOE, VILLAGE OF | 09/28/2007 |
| WESTCHESTER COUNTY | WHITE PLAINS, CITY OF | 09/28/2007 |
| WESTCHESTER COUNTY | YONKERS, CITY OF | 09/28/2007 |
| WESTCHESTER COUNTY | YORKTOWN, TOWN OF | 09/28/2007 |
| WYOMING COUNTY | ARCADE, TOWN OF | 03/03/1992 |
| WYOMING COUNTY | ARCADE, VILLAGE OF | 03/03/1992 |
| WYOMING COUNTY | ATTICA, TOWN OF | 04/30/1986 |
| WYOMING COUNTY | BENNINGTON, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | CASTILE, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | CASTILE, VILLAGE OF | 05/28/1982 (M) |
| WYOMING COUNTY | COVINGTON, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | EAGLE, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | GAINESVILLE, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | GAINESVILLE, VILLAGE OF | 02/15/1985 (M) |
| WYOMING COUNTY | GENESEE FALLS, TOWN OF | 05/01/1984 |
| WYOMING COUNTY | JAVA, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | ORANGEVILLE, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | PERRY, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | PERRY, VILLAGE OF | 07/29/1977 (M) |
| WYOMING COUNTY | PIKE, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | PIKE, VILLAGE OF | 06/18/1982 (M) |
| WYOMING COUNTY | SHELDON, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | SILVER SPRINGS, VILLAGE OF | 01/20/1984 (M) |
| WYOMING COUNTY | WARSAW, TOWN OF | 12/23/1983 (M) |
| WYOMING COUNTY | WARSAW, VILLAGE OF | 11/18/1981 |
| WYOMING COUNTY | WETHERSFIELD, TOWN OF | 07/16/1982 |
| WYOMING COUNTY | WYOMING, VILLAGE OF | 08/03/1981 |
| YATES COUNTY | BARRINGTON, TOWN OF | 03/09/1984 (M) |
| YATES COUNTY | BENTON, TOWN OF | 01/20/1984 (M) |
| YATES COUNTY | DRESDEN, VILLAGE OF | 06/15/1981 |
| YATES COUNTY | DUNDEE, VILLAGE OF | 03/01/1988 (L) |
| YATES COUNTY | ITALY, TOWN OF | 03/07/2001 |
| YATES COUNTY | JERUSALEM, TOWN OF | 01/20/1984 (M) |
| YATES COUNTY | MIDDLESEX, TOWN OF | 09/29/1989 |
| YATES COUNTY | MILO, TOWN OF | 07/18/1985 (M) |
| YATES COUNTY | PENN YAN, VILLAGE OF | 06/15/1981 |

**TABLE 3.4**

**Summary of FEMA Flood Insurance Rate Map (FIRM) Availability**

| County | Community Name | Current FIRM Effective Date |
|---|---|---|
| YATES COUNTY | POTTER, TOWN OF | 03/23/1984 (M) |
| YATES COUNTY | RUSHVILLE, VILLAGE OF | 06/05/1985 (M) |
| YATES COUNTY | STARKEY, TOWN OF | 12/3/1987 |
| YATES COUNTY | TORREY, TOWN OF | 12/3/1987 |

Notes:
(NSFHA) - No special flood hazard area - All Zone "C"
(M) No elevation determined - All Zone "A", "C", and "X"
(L) Original FIRM by letter - All Zone "A", "C", and "X"
(S) Suspended community, not in the National Flood Program.
(X) Community not in National Flood Program
(>) Date of current effective map is after the date of this report.
Source: FEMA "Community Status Book Report – June 29, 2011."
(http://www.fema.gov/fema/csb.shtm)

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New York State

DEC

# Appendix 2

## 1992 SEQRA Findings Statement on the GEIS on the Oil, Gas and Solution Mining Regulatory Program

Revised Draft
Supplemental Generic Environmental Impact Statement

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September 1, 1992

# Findings Statement

Pursuant to the State Environmental Quality Review Act (SEQR) of the Environmental Conservation Law (ECL) and the SEQR Regulations 6NYCRR Part 617, the New York State Department of Environmental Conservation makes the following findings.

## Name of Action

Adoption of the Final Generic Environmental Impact Statement (GEIS) on the Oil, Gas and Solution Mining Regulatory Program.

## Description and Background

In early 1988, the Department of Environmental Conservation released the Draft GEIS on the Oil, Gas and Solution Mining Regulatory Program. The Draft GEIS comprehensively reviewed the environmental impacts of the Department's program for regulating the siting, drilling, production and plugging and abandonment of oil, gas, underground gas storage, solution mining, brine disposal, geothermal and stratigraphic test wells. Six public hearings were held on the Draft GEIS in June 1988.

The Final GEIS was released in July 1992. It contains individual responses to the hundreds of comments received on the Draft GEIS. The Final GEIS also includes more detailed topical responses addressing several controversial issues that frequently appeared in the comments on the draft document.

Together, the Draft and Final GEIS and this Findings Statement will provide the groundwork for revisions to the Oil, Gas and Solution Mining Regulations (6NYCRR Parts 550-559). These regulations are being updated to more accurately reflect and effectively implement the current Oil, Gas and Solution Mining Law (ECL Article 23).

The Draft GEIS included suggested changes to the regulations in bold print throughout the document. In the interests of environmental protection and public safety, a significant

number of the suggested regulatory changes are already put in effect as standard conditions routinely applied to permits. All formal regulation changes, however, must be promulgated in accordance with the State Administrative Procedure Act (SAPA) requiring separate review, public hearings and approval. Further public input during the rulemaking process may cause some of the new regulations, when they are eventually adopted, to differ from those discussed in the GEIS. Any regulations adopted that differ significantly from those discussed in the GEIS will undergo an additional SEQR Review and Determination.

**Location**

Statewide.

**DEC Jurisdiction**

Jurisdiction is provided by the Oil, Gas and Solution Mining Law (ECL Article 23).

**Date Final GEIS Filed**

The Final GEIS was filed June 25, 1992/#PO-009900-00046. The Notice of Completion was published in the Environmental Notice Bulletin July 8, 1992.

**Facts and Conclusions Relied Upon to Support the SEQR Findings**

The record of facts established in the Draft and Final GEIS upholds the following conclusions:

1. The **unregulated** siting, drilling, production, and plugging and abandonment of oil, gas, solution mining, underground gas storage, brine disposal, geothermal and stratigraphic test wells could have potential negative impacts on every aspect of the environment. The potential negative impacts range from very minor to significant. Potential impacts of **unregulated** activities on ground and surface waters are a particularly serious concern. The potential negative impacts on all environmental resources are described in detail in Chapters 8 through 14 and summarized in Chapter 16 of the Draft GEIS.

2. Under **existing regulations and permit conditions**, the potential environmental impacts of the above wells are **greatly reduced** and most are reduced to non-significant levels. The extensive mitigation measures required under the existing regulatory program are described in detail in Chapters 8 through 14 and summarized in Chapter 17 of the Draft GEIS.

3. The potential environmental impacts associated with the activities covered by the Oil, Gas and Solution Mining Regulatory Program also have economic and social implications. For example, it is less expensive to prevent pollution than pay for remediation of environmental problems, health care costs, and lawsuit expenses. The State also receives significant economic benefits from the activities covered by the regulatory program. The regulated industries provide jobs and economic stimulus through the purchase of goods and services, and the payment of taxes, royalties and leasing bonuses. Additional information on the potential economic impacts associated with the activities covered by the regulatory program is provided in Chapter 18 of the Draft GEIS.

4. The Department's routine requirement of: 1) a program-specific Environmental Assessment Form (EAF) with <u>every</u> well drilling permit application, 2) a plat (map) showing the proposed well location, and 3) a pre-drilling site inspection, allows the Department to:

   - reliably determine potential environmental problems, and
   - select appropriate permit conditions for mitigating potential environmental impacts.

   The EAF is printed in its entirety and discussed in detail on pages FGEIS 30-34 of the Final GEIS. Information on the permit application review process is summarized in Chapter 7 of the Draft GEIS.

5. The majority of the industry's activity centers on drilling individual oil and gas wells for primary production. For purposes of this Findings Statement, standard oil and gas operations are defined as:

- any procedure relevant to rotary or cable tool drilling procedures, and
- production operations which do not utilize any type of artificial means to facilitate the recovery of hydrocarbons.

The basic features of standard oil and gas operations are described in detail in Chapters 9 through 11 of the Draft GEIS.

6. The diverse types of wells covered by the regulatory program have enough design and operational characteristics in common to group them according to their potential environmental impacts. Design and operational aspects of these wells are described in detail in Chapters 9 through 14 of the Draft GEIS.

7. The magnitude of potential environmental impacts associated with any proposed well covered by the regulatory program is strongly influenced by the types of natural and cultural resources in the well's vicinity. New York State's environmental resources are described in Chapter 6 of the Draft GEIS. Most of the information on the potential environmental impacts of the regulated activities on these environmental resources can be found in Chapter 8 of the Draft GEIS, which deals with siting issues. Additional information on potential impacts related to specific stages (drilling, completion, production, plugging and abandonment) of well operation can be found in Chapters 9 through 11 of the Draft GEIS. Additional information on potential environmental impacts related specifically to enhanced oil recovery, solution salt mining, underground gas storage and waste brine disposal can be found in Chapters 12 through 15 of the Draft GEIS.

8. The range of future alternatives concerning the activities covered by the Oil, Gas and Solution Mining Regulatory Program can be divided into three basic categories: 1) prohibition on regulated activities, 2) removal of regulation, and 3) maintenance of status quo versus revision of existing regulations. A prohibition on these regulated activities would deprive the State of substantial economic and natural resource benefits. Complete removal of regulation would lead to severe environmental problems. While the existing regulations and permit conditions provide significant environmental protection, there is still room to improve the efficiency and effectiveness of the program. Revision of the existing regulations is the best alternative. Chapter 21 of the Draft GEIS contains a more detailed assessment of the environmental, economic, and social aspects of each alternative.

**SEQR Determinations of Significance**

The SEQR determinations on the significance of the environmental impacts associated with the activities covered by this regulatory program are presented in the following table. The determinations are supported by the conclusions listed above, which in turn are supported by the referenced sections of the Draft and Final GEIS.

## SEQR DETERMINATIONS

| Agency Action | Environmental Impact | Explanation |
|---|---|---|
| a. Standard individual oil, gas, solution mining, stratigraphic, geothermal, or gas storage well drilling permits (no other permits involved). | not significant | Rules and regulations and conditions are adequate to protect the environment. The Draft and Final GEIS satisfy SEQR for these actions. A site-specific EAF is required with the permit application. |
| b. Oil and gas drilling permits in State Parklands. | may be significant | Site-specific conditions of State Parklands are not discussed in the Draft and Final GEIS. Further determination of significant environmental impacts is needed for State Parklands. A site-specific EAF is required with the permit application. |
| c. Oil and gas drilling permits in Agricultural Districts. | may be significant | Rules and regulations and conditions are adequate to protect the environment. For most oil and gas operations in Agricultural Districts which utilize less than 2½ acres the GEIS satisfies SEQR. If more than 2½ acres are disturbed, this is a Type I action under 6NYCRR Part 617 and an additional determination of significance is required. A site-specific EAF is required with the permit application. |
| d. Oil and gas drilling permits in the "Bass Island" fields. | not significant | Special conditions and regulations under Part 559 are adequate to protect the environment. The Draft and Final GEIS satisfy SEQR for these actions. A site-specific EAF is required with the permit application. |

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|---|---|---|
| e. Oil and gas drilling permits for locations above aquifers. | not significant | Rules and regulations and special aquifer conditions employed by DEC have been developed specifically to protect the groundwater resources of the State. The Draft and Final GEIS satisfy SEQR for these actions. A site-specific EAF is required with the permit application. |
| f. Oil and gas drilling permits in close proximity (less than 1,000 feet) to municipal water supply wells. | always significant | A supplemental EIS is required dealing with the groundwater hydrology, potential impacts and mitigation measures. A site-specific EAF is required with the permit application. |
| g. Oil and gas drilling permits in proximity (between 1,000 and 2,000 feet) to municipal water supply wells. | may be significant | A supplemental EIS may be required dealing with the groundwater hydrology, potential impacts and mitigation measures. A site-specific assessment and SEQR determination are required. A site-specific EAF is required with the permit application. |
| h. Oil and gas drilling permits when other DEC permits required. | may be significant | A site-specific SEQR assessment and determination are needed based on the environmental conditions requiring additional DEC permits. A site-specific EAF is required with the permit application. |
| i. Plugging permits for oil, gas, solution mining, stratigraphic, geothermal, gas storage and brine disposal wells. | Type II * | By law all wells drilled must be plugged before abandonment. Proper well plugging is a beneficial action with the sole purpose of environmental protection, and constitutes a routine agency action. |

* Under 6NYCRR 617.13, a Type II action is one which has been determined not to have a significant effect on the environment and does not require any other SEQR determination or procedure.

| | | |
|---|---|---|
| j. New waterflood or tertiary recovery projects. | may be significant | For major new waterfloods and new tertiary recovery projects, a site specific environmental assessment and SEQR determination are required. A supplemental EIS may be required for new waterfloods to ensure integrity of the flood. Also, a supplemental EIS may be required for new tertiary recovery projects depending on the scope of operations and methods used. A site-specific EAF is required with the permit application. |
| k. New underground gas storage projects or major modifications. | may be significant | A site-specific environmental assessment and SEQR determination are required. May require a supplemental EIS depending on the scope of the project. A site-specific EAF is required with the permit application. |
| l. New solution mining projects or major modifications. | may be significant | A site-specific environmental assessment and SEQR determination are required. May require a supplemental EIS depending on the scope of the project. A site-specific EAF is required with the permit application. |
| m. Spacing hearing. | not significant | Action to hold hearing is non-significant. A review and SEQR determination with respect to all other issues must be made before the hearing. Any permit issued subsequently will be reviewed on issues raised at hearing. A site-specific EAF is required with the permit application. |
| n. Variance hearing. | not significant | Action to hold hearing is non-significant. A review and SEQR determination with respect to all other issues must be made before the hearing. Any permit issued subsequently will be reviewed on issues raised at hearing. A site-specific EAF is required with the permit application. |

| | | |
|---|---|---|
| o. Compulsory unitization hearing. | not significant | Action to hold hearing is non-significant. A review and SEQR determination with respect to all other issues must be made before the hearing. Any permit issued subsequently will be reviewed on issues raised at hearing. A site-specific EAF is required with the permit application. |
| p. Natural Gas Policy Act pricing recommendations. | none | Action only results in recommendations to Federal Energy Regulatory Commission; therefore, action is not subject to SEQR. |
| q. Brine disposal well drilling or conversion permit. | may be significant | The brine disposal well permitting guidelines require an extensive surface and subsurface evaluation which is in effect a supplemental EIS addressing technical issues. An additional site specific environmental assessment and SEQR determination are required. A site-specific EAF is required with the permit application. |

**SEQR Review Procedures**

Upon filing of this Findings Statement, the following SEQR Review procedures will be adopted for the Oil, Gas and Solution Mining Regulatory Program:

1. A shortened program-specific Environmental Assessment Form (EAF) will continue to be required with every well drilling permit application, regardless of the SEQR determination listed in the previous table. Information required by the EAF is considered to be an essential part of the permit application. It contains vital site-specific information necessary to evaluate the need for individual permit conditions.

2. In the following cases where the GEIS satisfies SEQR, Department staff will no longer make Determinations of Significance and a Negative or Positive Declaration under SEQR will no longer be required so long as projects conform to the descriptions in the Draft and Final GEIS:

   - Standard individual oil, gas, solution mining, stratigraphic test, geothermal or gas storage well drilling permits,
   - Oil and gas drilling permits in the "Bass Islands" field, and
   - Oil and gas drilling permits for locations above aquifers.

3. In addition to the short program-specific EAF, permits for the following projects will also require detailed site-specific environmental assessments using the Long-Form EAF published in Appendix A of 6NYCRR Part 617. A site or project-specific EIS may also be required for the following projects depending upon the information revealed in the permit application and accompanying EAF's:

   - Oil and gas drilling permits in Agricultural Districts if more than two and one-half acres will be altered by construction of the well site and access road.
   - Oil and gas drilling permits in State Parklands.
   - Oil and gas drilling permits when other DEC permits are required.

- Oil and gas drilling permits less than 2,000 feet from a municipal water supply well.
- New major waterflood or tertiary recovery projects.
- New underground gas storage projects or major modifications.
- New solution mining projects or major modifications.
- Brine disposal well drilling or conversion permits.
- Any other project not conforming to the standards, criteria or thresholds required by the Draft and Final GEIS.

**Other SEQR Considerations**

In conducting SEQR reviews, the Department will handle the topics of individual project scope, project size, lead agency, and coastal resources as described below.

1. Project scope - Each application to drill a well will continue to be considered as an individual project. An applicant applying for five wells will continue to be treated the same as five applicants applying to the Department individually, since the wells may not be drilled at the same time or in the same area. Planned future wells might not be drilled at all depending on the results of the first well drilled.

   The exceptions to this are proposed new or major expansions of solution mining, enhanced recovery or underground gas storage operations which require that several wells be drilled and operated for an extended period of time within a limited area.

2. Size of Project - The size of the project will continue to be defined as the surface acreage affected by development.

3. Lead Agency - In 1981, the Legislature gave exclusive authority to the Department to regulate the oil, gas and solution mining industries under ECL Section 23-0303(2). Thus, only the Department has jurisdiction to grant drilling permits for wells subject to Article 23, except within State parklands. To the extent practicable, the Department will actively seek lead agency designation consistent

with the general intent of Chapter 846 of the Laws of 1981.

4. Coastal Resources - On the program specific EAF that must accompany every drilling permit application, the applicant must indicate whether the proposed well is in a legally designated New York State Coastal Zone Management (CZM) Area. Neither the policies in the New York State CZM Plan, nor the provisions of individual Local Waterfront Revitalization Plans (LWRP's) are covered in the GEIS. Once an LWRP is adopted by a community, it is a legally binding part of the New York State CZM Plan. The Department cannot issue any drilling permit unless it is consistent with the New York State CZM Plan to the "maximum extent practicable."

**CERTIFICATION OF FINDINGS TO ADOPT THE FINAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM**

Having considered the Draft and Final GEIS, and having considered the preceding written facts and conclusions relied upon to meet the requirements of 6NYCRR Part 617.9, this Statement of Findings certifies that:

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

2. Consistent with the social, economic and other essential considerations from among the reasonable alternatives thereto, the action approved is one which minimizes or avoids adverse environmental effects to the maximum extent practicable; including the effects disclosed in the environmental impact statement, and

3. Consistent with social, economic and other essential considerations, to the maximum extent practicable, adverse environmental effects revealed in the environmental impact statement process will be minimized or avoided by incorporating as conditions to the decision those mitigative measures which were identified as practicable.

4. Consistent with the applicable policies of Article 42 of the Executive Law, as implemented by 19 NYCRR 600.5, this action will achieve a balance between the protection of the environment and the need to accommodate social and economic considerations.

Director
Division of Mineral Resources

Sept. 29, 1992
Date

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New York State

DEC

# Appendix 3

## Supplemental SEQRA Findings Statement on Leasing of State Lands for Activities Regulated Under the Oil, Gas and Solution Mining Law

Revised Draft
Supplemental Generic Environmental Impact Statement

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SEQR File No.

P0-009900-00046

**Supplemental**
**Findings Statement**

Pursuant to the State Environmental Quality Review Act (SEQR) of the Environmental Conservation Law (ECL) and the SEQR Regulations 6NYCRR Part 617, the New York State Department of Environmental Conservation makes the following supplemental findings on the Final Generic Environmental Impact Statement (GEIS) on the Oil, Gas and Solution Mining Regulatory Program.

**Name of Action**

Adoption of supplemental findings on leasing of state lands for activities regulated under the Oil, Gas and Solution Mining Law (ECL Article 23).

**Description and Background**

In early 1988, the Department of Environmental Conservation released the Draft GEIS on the Oil, Gas and Solution Mining Regulatory Program. The Draft GEIS comprehensively reviewed the environmental impacts of the Department's program for regulating the siting, drilling, production and plugging and abandonment of oil, gas, underground gas storage, solution mining, brine disposal, geothermal and stratigraphic test wells. The findings statement issued on the Draft and Final GEIS in September, 1992 neglected to specifically mention DEC's program for leasing of State lands for these resource development activities.

Prior to adoption of the GEIS, proposed lease sales underwent a segmented review. Segmented reviews are permitted under certain circumstances if they are no less protective of the environment. This is true given the highly speculative nature of oil and gas leasing practices:

- It is impractical to review the potential environmental impacts of development activities at the leasing stage. Information on the placement of well sites is not generally known, even by the lessee. Not until a company successfully obtains a lease does it invest time and money in preparing the exploration and development plans that will be submitted to the Department for approval if the lessee wishes to commence operations.

- Most of the land leased will never be directly affected by development activities. Based on a 15 year record of the State's leasing program, less than one percent of all the State land leased has been subject to any direct impact.

- When the lessee does decide on a proposed well site on a State lease, the lessee must obtain a site-specific drilling permit from the Department. With eve well drilling permit application the Department requires: 1) a program-specific Environmental Assessment Form, 2) a plat (map) showing the proposed well location and support facilities, and 3) a pre-drilling site inspection that allows the Department to :
  - reliably determine potential environmental problems; and

- select appropriate permit conditions for mitigating potential environmental impacts.

- Possession of a lease does not a priori grant the right to drill on a lease. Nor is the lessee in any way guaranteed approval for their first-choice drilling location. Clauses included in the lease inform the lessee that any surface disturbing activities must receive Department review and approval prior. to their commencement. Leases also contain clauses recommended by other State agency staff that are necessary for protection of fish, wildlife, plant, land, air, wetlands, water and cultural resources on the leased parcels.

**SEOR Determination of Significance**

The Department has determined that the act of leasing State lands for activities regulated under ECL Article 23 does not have a significant environmental impact. This determination is supported by the facts listed above.

**SEOR Review Procedures**

Department staff will no longer make Determinations of Significance and Negative or Positive Declarations under SEQR for leases on State lands for activities regulated under ECL Article 23 at the time that the lease is granted; SEQR reviews will continue to be done as needed for site-specific development.

**CERTIFICATION OF SUPPLEMENTAL FINDINGS ON THE FINAL GENERIC ENVIRONMENTAL IMPACT STATEMENT ON THE OIL, GAS AND SOLUTION MINING REGULATORY PROGRAM**

Having considered the Draft and Final GEIS, and having considered the preceding written facts and conclusions relied upon to meet the requirements of 6NYCRR Part 617.9, this Supplemental Statement of Findings certifies that:

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

2. Consistent with the social, economic, and other essential considerations from among the reasonable alternatives thereto, the action approved is one which minimizes or avoids adverse environmental effects to the maximum extent practicable; including the effects disclosed in the environmental impact statement.

3. Consistent with the social, economic, and other essential considerations, to the maximum extent practicable, adverse environmental effects revealed in the environmental impact statement process will be minimized or avoided by incorporating as conditions to the decision those mitigative measures which were identified as practicable.

4. Consistent with the applicable policies of Article 42 of the Executive Law, as implemented by 19 NYCRR 600.5, this action will achieve a balance between the protection of the environment and the need to accommodate social and economic considerations.

/S/ April 19, 1993

Gregory H. Sovas, Director
Division of Mineral Resources

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New York State

DEC

# Appendix 4

## Application Form for Permit to Drill, Deepen, Plug Back or Convert A Well Subject to the Oil, Gas and Solution Mining Regulatory Program

Revised Draft
Supplemental Generic Environmental Impact Statement

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NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF MINERAL RESOURCES

**PRINT OR TYPE IN BLACK INK**

# APPLICATION FOR PERMIT TO DRILL, DEEPEN, PLUG BACK OR CONVERT A WELL SUBJECT TO THE OIL, GAS AND SOLUTION MINING LAW

THIS APPLICATION IS A LEGAL DOCUMENT. READ THE APPLICABLE AFFIRMATION AND ACKNOWLEDGMENT CAREFULLY BEFORE SIGNING.
For instructions on completing this form, visit the Division's website at www.dec.ny.gov/energy/205.html or contact your local Regional office.

PLANNED OPERATION: (Check one)
☐ Drill ☐ Deepen ☐ Plug Back ☐ Convert

TYPE OF WELL: (Check one)
☐ New ☐ Existing

**Existing API Well Identification Number**
31- | | | - | | | | | - | | - | | |

TYPE OF WELL BORE: (Check one)
☐ Vertical ☐ Directional ☐ Horizontal

| NAME OF OWNER (Full Name of Organization or Individual as registered with the Division) | TELEPHONE NUMBER (include area code) |
|---|---|
| ADDRESS (P.O. Box or Street Address, City, State, Zip Code) | |
| NAME AND TITLE OF LOCAL REPRESENTATIVE WHO CAN BE CONTACTED WHILE OPERATIONS ARE IN PROGRESS | |
| ADDRESS–Business (P.O. Box or Street Address, City, State, Zip Code) | TELEPHONE NUMBER (include area code) |
| ADDRESS–Night, Weekend and Holiday (P.O. Box or Street Address, City, State, Zip Code) | TELEPHONE NUMBER (include area code) |

**WELL LOCATION DATA (attach plat)**

| COUNTY | TOWN | FIELD/POOL NAME (or "Wildcat") |
|---|---|---|
| WELL NAME | WELL NUMBER | NUMBER OF ACRES IN UNIT |
| 7½ MINUTE QUAD NAME | QUAD SECTION | PROPOSED TARGET FORMATION |

LOCATION DESCRIPTION

| | | | Decimal Latitude (NAD83) | Decimal Longitude (NAD83) |
|---|---|---|---|---|
| Surface | 0' | 0 | ☐☐.☐☐☐☐☐☐ | ☐☐.☐☐☐☐☐☐ |
| Top of Target Interval | | | ☐☐.☐☐☐☐☐☐ | ☐☐.☐☐☐☐☐☐ |
| Bottom of Target Interval | | | ☐☐.☐☐☐☐☐☐ | ☐☐.☐☐☐☐☐☐ |
| Bottom Hole | TVD | TMD | ☐☐.☐☐☐☐☐☐ | ☐☐.☐☐☐☐☐☐ |

**PROPOSED WELL DATA**

WELL TYPE (check one)
☐ Oil Production ☐ Gas Production ☐ Brine ☐ Storage
☐ Injection ☐ Brine Disposal ☐ Geothermal ☐ Stratigraphic
☐ Other _____

PLANNED TOTAL DEPTH
TVD _____ ft.
TMD _____ ft.
Kickoff _____ TMD

PLANNED DATE OF COMMENCEMENT OF OPERATIONS

SURFACE ELEVATION (check how obtained)
_____ ft. ☐ Surveyed ☐ Topo Map ☐ Other _____

TYPE TOOLS
☐ Cable ☐ Rotary

PLANNED DRILLING FLUID
☐ Air ☐ Water ☐ Mud

| NAME OF PLANNED DRILLING CONTRACTOR (as registered with the Division) | TELEPHONE NUMBER (include area code) |
|---|---|

ON ATTACHED SHEET GIVE DETAILS FOR EACH PROPOSED CASING STRING AND CEMENT JOB INCLUDING BUT NOT LIMITED TO: Bit size, casing size, casing weight and grade, TVD and TMD of casing set, scratchers, centralizers, cement baskets, sacks of cement, class of cement, cement additives with percentages or pounds per sack, estimated TVD and TMD of the top of cement, estimated amount of excess cement and waiting-on-cement time.

FOR DIRECTIONAL OR SIDETRACK WELLS ALSO INCLUDE A WELL BORE DIAGRAM SHOWING THE LOCATION OF THE ITEMS INCLUDED IN THE ABOVE REFERENCED DETAILS.

**DEPARTMENT USE ONLY**

| | |
|---|---|
| BOND NUMBER | |
| API WELL IDENTIFICATION NUMBER<br>31- | |
| RECEIPT NUMBER | |
| DATE ISSUED | |

# APPLICATION FOR PERMIT TO DRILL, DEEPEN, PLUG BACK OR CONVERT



| WELL NAME | WELL NUMBER | NAME OF OWNER |
|---|---|---|
| | | |

COMMENTS:

## AFFIRMATION AND ACKNOWLEDGMENT

### A. For use by individual:

By the act of signing this application:

(1) I affirm under penalty that the information provided in this application is true to the best of my knowledge and belief; and that I possess the right to access property, and drill and/or extract oil, gas, or salt, by deed or lease, from the lands and site described in the well location data section of this application. I am aware that any false statement made in this application is punishable as a Class A Misdemeanor under Section 210.45 of the Penal Law.

(2) I acknowledge that if the permit requested to be issued in consideration of the information and affirmations contained in this application is issued, as a condition to the issuance of that permit, I accept full legal responsibility for all damage, direct or indirect, of whatever nature and by whomever suffered, arising out of the activity conducted under authority of that permit; and agree to indemnify and hold harmless the State, its representatives, employees, agents, and assigns for all claims, suits, actions, damages, and costs of every name and description, arising out of or resulting from the permittee's undertaking of activities or operation and maintenance of the facility or facilities authorized by the permit in compliance or non-compliance with the terms and conditions of the permit.

_____
Printed or Typed Name of Individual

_____ _____
Signature of Individual Date

### B. For use by organizations other than an individual:

By the act of signing this application:

(1) I affirm under penalty of perjury that I am _____ (title) of _____ (organization); that I am authorized by that organization to make this application; that this application was prepared by me or under my supervision and direction; and that the aforenamed organization possesses the right to access property, and drill and/or extract oil, gas, or salt by deed or lease, from the lands and site described in the well location data section of this application. I am aware that any false statement made in this application is punishable as a Class A Misdemeanor under Section 210.45 of the Penal Law.

(2) _____ (organization); acknowledges that if the permit requested to be issued in consideration of the information and affirmations contained in this application is issued, as a condition to the issuance of that permit, it accepts full legal responsibility for all damage, direct or indirect, of whatever nature and by whomever suffered, arising out of the activity conducted under authority of that permit; and agrees to indemnify and hold harmless the State, its representatives, employees, agents, and assigns for all claims, from suits, actions, damages, and costs of every name and description, arising out of or resulting from the permittee's undertaking of activities or operation and maintenance of the facility or facilities authorized by the permit in compliance or non-compliance with the terms and conditions of the permit.

_____
Printed or Typed Name of Authorized Representative

_____ _____
Signature of Authorized Representative Date

New York State

DEC

# Appendix 5

## Environmental Assessment Form (EAF) For Well Permitting

Revised Draft
Supplemental Generic Environmental Impact Statement

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85-16-5 (1/07)--10b

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
DIVISION OF MINERAL RESOURCES

# ENVIRONMENTAL ASSESSMENT FORM

Attachment to Drilling Permit Application

WELL NAME AND NUMBER

| NAME OF APPLICANT | BUSINESS TELEPHONE NUMBER ( ) |
|---|---|

ADDRESS OF APPLICANT

| CITY/P.O. | STATE | ZIP CODE |
|---|---|---|

DESCRIPTION OF PROJECT (Briefly describe type of project or action)

**PROJECT SITE IS THE WELL SITE AND SURROUNDING AREA WHICH WILL BE DISTURBED DURING CONSTRUCTION OF SITE, ACCESS ROAD, and PIT AND ACTIVITIES DURING DRILLING AND COMPLETION AT WELLHEAD.**

(PLEASE COMPLETE EACH QUESTION--Indicate N.A., if not applicable)

LAND USE AND PROJECT SITE

1. Project Dimensions. Total Area of Project Site _____ sq. ft.
   Approximate square footage for items below:

| | | During Construction (sq. ft.) | After Construction (sq. ft.) |
|---|---|---|---|
| a. Access Road | (length x width) | | |
| b. Well Site | (length x width) | | |

2. Characterize Project Site Vegetation and Estimate Percentage of Each Type Before Construction:

   _____ % Agricultural (cropland, hayland, pasture, vineyard, etc.) _____ % Forested _____ % Wetlands

   _____ % Meadow or Brushland (non agricultural) _____ % Non vegetated (rock, soil, fill)

3. Present Land Use(s) Within ¼ Mile of Project (Check all that apply)

   ☐ Rural ☐ Suburban ☐ Forest ☐ Urban ☐ Agricultural ☐ Commercial ☐ Park/Recreation
   ☐ Industrial ☐ Other _____

4. How close is the nearest residence, building, or outdoor facility of any type routinely occupied by people at least part of the day? _____ ft.

   Describe _____

ENVIRONMENTAL RESOURCES ON/NEAR PROJECT SITE

5. The presence of certain environmental resources on or near the project site may require additional permits, approvals or mitigation measures--Is any part of the well site or access road located:

| | | | |
|---|---|---|---|
| a. Over a primary or principal aquifer? | ☐ Yes | ☐ No | ☐ Not Known |
| b. Within 2,640 feet of a public water supply well? | ☐ Yes | ☐ No | ☐ Not Known |
| c. Within 150 feet of a surface municipal water supply? | ☐ Yes | ☐ No | ☐ Not Known |
| d. Within 150 feet of a lake, stream, or other public surface water body? | ☐ Yes | ☐ No | ☐ Not Known |
| e. Within an Agricultural District? | ☐ Yes | ☐ No | ☐ Not Known |
| f. Within a land parcel having a Soil and Water Conservation Plan? | ☐ Yes | ☐ No | ☐ Not Known |
| g. In a 100 year flood plain? | ☐ Yes | ☐ No | ☐ Not Known |
| h. In a regulated wetland or its 100 foot buffer zone? | ☐ Yes | ☐ No | ☐ Not Known |
| i. In a coastal zone management area? | ☐ Yes | ☐ No | ☐ Not Known |
| j. In a Critical Environmental Area? | ☐ Yes | ☐ No | ☐ Not Known |
| k. Does the project site contain any species of animal life that are listed as threatened or endangered? | ☐ Yes | ☐ No | ☐ Not Known |
| If yes, identify the species and source of information _____ | | | |
| l. Will proposed project significantly impact visual resources of statewide significance? | ☐ Yes | ☐ No | ☐ Not Known |
| If yes, identify the visual resource and source of information _____ | | | |

CULTURAL RESOURCES

6. Are there any known archeological and/or historical resources which will be affected by drilling operations? ☐ Yes ☐ No ☐ Not Known

7. Has the land within the project area been previously disturbed or altered (excavated, landscaped, filled, utilities installed)? ☐ Yes ☐ No ☐ Not Known

If answer to Number 6 or 7 is yes, briefly descrbe _____

EROSION AND RECLAMATION PLANS

8. Indicate percentage of project site within: 0-10% slope _____ % 10-15% slope _____ % greater than 15% slope _____ %

9. Are erosion control measures needed during construction of the access road and well site? ☐ Yes ☐ No ☐ Not Known

If yes, describe and/or sketch on attached photocopy of plat _____

10. Will the topsoil which is disturbed be stockpiled for reclamation use? ☐ Yes ☐ No

11. Does the reclamation plan include revegetation? ☐ Yes ☐ No

If yes, what plant materials will be used? _____

12. Does the reclamation plan include restoration or installation of surface or subsurface drainage features to prevent erosion or conform to a Soil and Water Conservation Plan? ☐ Yes ☐ No

If yes, describe _____

ACCESS ROAD SITING AND CONSTRUCTION

13. Are you going to use existing or common corridors when building the access road? ☐ Yes ☐ No
Locate access road on attached photocopy of plat.

DRILLING

14. Anticipated length of drilling operations? _____ days.

WASTE STORAGE AND DISPOSAL

15. How will drilling fluids and stimulation fluids:

a. Be contained? _____

b. Be disposed of? _____

16. Will production brine be stored on site? ☐ Yes ☐ No

If yes:
How will it be stored? _____

How will it be disposed of? _____

17. Will the drill cuttings and pit liner be disposed of on site? ☐ Yes ☐ No

If yes, expected burial depth? _____ feet

ADDITIONAL PERMITS

18. Are any additional State, Local or Federal permits or approvals required for this project? ☐ Yes ☐ No

| | Date Application Submitted | Date Application Received |
|---|---|---|
| Stream Disturbance Permit (DEC) | | |
| Wetlands Permit (DEC or Local) | | |
| Floodplain Permit (DEC or Local) | | |
| Other _____ | | |
| | | |
| | | |
| | | |

| PREPARER'S SIGNATURE | DATE |
|---|---|
| NAME/TITLE (Please print) | |
| REPRESENTING | |

## Suggested Sources of Information for Division of Mineral Resources Environmental Assessment Form

3. LAND USE
   Sources: Local Planning Office
   Town Supervisor's Office
   Town Clerk's Office

5a. PRIMARY OR PRINCIPAL AQUIFER
   Sources: Local unit of government
   NYS Department of Health
   NYSDEC, Division of Water--Regional Office
   *Availability of Water from Aquifers in New York State*--United States Geological Survey
   *Availability of Water from Unconsolidated Deposits in Upstate New York*--United States Geological Survey

5b. PUBLIC WATER SUPPLY
   Sources: Local unit of government
   NYS Department of Health
   *NYS Atlas of Community Water Systems Sources,* NYS Department of Health, 1982
   *Atlas of Eleven Selected Aquifers in New York State,* United States Geological Survey, 1982

5c. AGRICULTURAL DISTRICT INFORMATION
   Sources: Cooperative Extension
   DEC, Division of Lands and Forests
   NYS Department of Agriculture and Markets
   DEC, Division of Environmental Permits--Regional Office
   DEC, Division of Mineral Resources--Regional Office

5f. SOIL AND WATER CONSERVATION PLAN
   Sources: Landowner
   County Soil and Water Conservation District Office

5g. 100 YEAR FLOOD PLAIN
   Sources: DEC Division of Water
   DEC, Division of Environmental Permits--Regional Office
   DEC, Division of Mineral Resources--Regional Office

5h. WETLANDS
   Sources: DEC, Division of Fish and Wildlife--Regional Office
   DEC, Division of Mineral Resources--Regional Office

5i. COASTAL ZONE MANAGEMENT AREAS
   Sources: Local unit of government
   NYS Department of State, Coastal Management Program
   DEC, Division of Water (maps)
   DEC, Division of Environmental Permits--Regional Office

5k. THREATENED OR ENDANGERED SPECIES
   Sources: DEC, Natural Heritage Program--Albany
   DEC, Division of Environmental Permits--Regional Office

6. ARCHEOLOGICAL OR HISTORIC RESOURCES
   Sources: NYS Office of Parks, Recreation and Historic Preservation circles and squares map
   DEC, Division of Environmental Permits--Regional Office

18. ADDITIONAL PERMITS NEEDED
   Sources: DEC, Division of Environmental Permits--Regional Office
   DEC, Division of Mineral Resources--Regional Office
   NYS Office of Business Permits

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New York State

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# Appendix 6

# PROPOSED
# Environmental Assessment Form
# Addendum

Updated August 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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PROPOSED EAF ADDENDUM REQUIREMENTS
FOR HIGH-VOLUME HYDRAULIC FRACTURING

**REQUIRED INFORMATION**

- Minimum depth and elevation of top of objective formation or zone for entire length of wellbore
- Estimated maximum depth and elevation of bottom of potential fresh water, and basis for estimate (water well information, other well information, previous drilling at pad, published or private reports, etc.)
- Identification of proposed fracturing service company and additive products, by product name and purpose/type
    - Documentation of the applicant's evaluation of available alternatives for the proposed additive products that are efficacious but which exhibit reduced aquatic toxicity and pose less risk to water resources and the environment
- Proposed volume of water and each additive product to be used in hydraulic fracturing
- Proposed % by weight of water, proppants and each additive
- Water source for hydraulic fracturing
    - If a newly proposed surface water source (not previously approved by the Department as part of a well permit application):
        - Type of withdrawal (stream, lake, pond, groundwater, etc.)
        - Location of water withdrawal point, status of RBC approval if applicable
        - List and location of all private water wells within 500 feet of the proposed water withdrawal point
        - For proposed withdrawals from lakes and ponds:
            - Estimates of the maximum change in storage resulting from the proposed withdrawals, including estimates of inflow into the water body, precipitation onto water surface, existing and proposed water withdrawals, evaporation from water surface, and releases from water body
        - For proposed groundwater withdrawals:
            - Identification of and shortest distance to any wetland within 500 feet of the proposed withdrawal point
            - Results of pump testing as referenced in the SGEIS, including evaluation of any potential influence on wetland(s) within 500 feet
        - Indicate if an Article 15 permit is required and status
        - Size of drainage area above withdrawal point (in $mi^2$)
        - Indicate whether there is a USGS gage on the stream; if yes:
            - Distance to stream gage
            - Upstream or downstream of stream gage
            - Changes in stream flow (e.g., other withdrawals, diversions, tributary input) between gage and withdrawal point
            - Years of stream gage data available and period of record
    - If a previously proposed or Department-approved surface water source:
        - API # of well permit application associated with previous proposal or approval

- Scaled distance from surface location of well and closest edge of well pad to:
  - Any known water supply reservoir, river or stream intake, water well or domestic-supply spring within 2,640 feet, including public or private wells, community or non-community systems
  - Any primary or principal aquifer boundary, perennial or intermittent stream, wetland, storm drain, lake or pond within 660 feet
  - All residences, occupied structures or places of assembly within 1,320 feet
- Capacity of rig fueling tank(s) and distance to:
  - Any public or private water well, domestic-supply spring, reservoir, perennial or intermittent stream, storm drain, wetland, lake or pond within 500 feet of the planned location(s) of the fueling tank(s)
- Available information about water wells and domestic-supply springs within 2,640 feet
  - Well name and location
  - Distance from proposed surface location of well
  - Shortest distance from proposed well pad
  - Shortest distance from proposed centralized flowback water impoundment
  - Well depth
  - Well's completed interval
  - Public or private supply
  - Community or non-community system (see NYSDOH definitions)
  - Type of facility or establishment if not a residence
- Identification of any well listed in Department's Oil & Gas Database, or any other abandoned well identified by property owners or tenants, within the spacing unit of the proposed well and/or within 1 mile (5,280 feet) of the proposed well location. For each well identified, provide the following information:
  - Well name and API Number
  - Distance from proposed surface location of well to surface location of existing well
  - Well Type
  - Well Status
  - Well Orientation
  - Quantity and type of any freshwater, brine, oil or gas encountered during drilling, as recorded on the Department's Well Drilling and Completion Report
- Information about the planned construction and capacity of the reserve pit, if any, and an indication of the timing of the use of a closed-loop tank system (e.g., surface, intermediate and/or production hole)
- Information about the number and individual and total capacity of receiving tanks for flowback water
- If proposed flowback vent/flare stack height is less than 30 feet, then documentation that previous drilling at the pad did not encounter $H_2S$ is required
- Description of planned public access restrictions, including physical barriers and distance to edge of well pad
- Identify the EPA Tiers of the drilling and hydraulic fracturing engines used, if these use gasoline or diesel fuel. If particulate traps or Selective Catalytic Reduction (SCR) are not used, provide a description of other control measures planned to reduce particulate matter and $NO_x$ emissions during the drilling and hydraulic fracturing processes

- If condensate tanks are to be used, provide their capacity and the vapor recovery system to be used
- If a wellhead compressor is used, provide its size in horsepower. Describe the control equipment used for $NO_x$
- If a glycol dehydrator is to be used at the well pad, provide its stack height and the capacity of glycol to be used on an annual basis
- Information on the status of a sales line and interconnecting gathering line to the well or multi-well pad (i.e., is there currently a line in place or is one expected to be in place prior to conducting hydraulic fracturing operations to facilitate a Reduced Emissions Completion [REC])
    - If REC will not be used, the following must be provided
        - an estimate of how much total gas (MMcf) will be vented and flared during flowback
        - an estimate of how much total gas (MMcf) was previously vented and flared during flowback on the same well pad in the previous 12 months
- Well information with respect to local planning documents
    - Identify whether the location of the well pad, or any other activity under the jurisdiction of the Department, conflicts with local land use laws or regulations, plans or policies
    - Identify whether the well pad is located in an area where the affected community has adopted a comprehensive plan or other local land use plan and whether the proposed action is inconsistent with such plan(s)

**REQUIRED ATTACHMENTS**

- Scaled, stamped well plat showing the following:
    - Plan view of wellbore including surface and bottom-hole locations
    - Well pad close-up showing placement of fueling tank(s), reserve pit and receiving tanks for flowback water
    - Vertical section of wellbore showing the land surface elevation and wellbore elevation with an indication of the minimum depth of the wellbore within the objective formation or zone as required above
- A Material Safety Data Sheet (MSDS) for each additive product proposed for use in hydraulic fracturing, if not already on file with the Department
- Topographic map of area within at least 2,640 feet of surface location showing:
    - above features and scaled distances
    - location and orientation of well pad
    - location of access road
    - location of any flowback water pipelines or conveyances
- Evidence of diligent efforts by the well operator to determine the existence of public or private water wells and domestic-supply springs within one half-mile (2,640 feet) of any proposed drilling location or centralized flowback water impoundment if proposed
    - List of municipal officials contacted for water well information and printed copies of responses
    - List of property owners and tenants contacted for water well information
    - List of adjacent lessees contacted for water well information

  - Printed results of EPA SDWIS search (http://oaspub.epa.gov/enviro/sdw_form_v2.create_page?state_abbr=NY)
  - Printed results of Department Water Well search (http://www.dec.ny.gov/cfmx/extapps/WaterWell/index.cfm?view=searchByCounty)
- Evidence of diligent efforts by the well operator to determine the existence and condition of abandoned wells within the proposed spacing unit and/or within one mile of the proposed well location
  - Printed results of Department Oil & Gas database search
  - List of property owners and tenants contacted for abandoned well information
- For a newly proposed water withdrawal, topographic map showing:
  - The location of the proposed withdrawal
  - All private water wells within 500 feet of the proposed water withdrawal point
  - For proposed surface water withdrawals:
    - Drainage area above the withdrawal point
  - For proposed groundwater withdrawals:
    - Identification of and shortest distance to any Department-regulated wetland within 500 feet of the proposed withdrawal point
- Invasive Species Management Plan that includes:
  - Survey of the entire well site, documenting the presence, location, and identity of any invasive plant species;
  - Specific protocols or best management practices for preventing the spread or introduction of invasive species at the site;
  - Specific protocols for the restoration of native plant cover on the site; and
  - Identification of any Certified Pesticide Applicator, if applicable.
- A Partial Site Reclamation Plan that describes the methods for partially reclaiming the site after well completion. Partial reclamation shall be compatible with sound environmental management practices and minimize negative environmental impacts.
- A description of methods for final reclamation of the well site following plugging of all the wells on the well pad. Reclamation methods shall be compatible with sound environmental management practices and minimize negative environmental impacts from the well pad.
- Proposed fluid disposal plan, pursuant to 6 NYCRR 554.1(c)(1)
  - Planned transport of flowback water and production brine off of well pad – trucking or piping
    - If piping, describe construction including size, materials, leak prevention and spill control measures
  - Planned disposition of flowback water and production brine – treatment facility, disposal well, reuse on same well pad, reuse on another well pad, centralized flowback surface water impoundment, centralized tank facility, or other (describe)
    - If a treatment facility in NY:
      - Name, owner/operator, location
      - SPDES permit # and date if applicable
      - If a POTW, date of Department approval to receive flowback water (attach a copy of approval notification)
      - Brief description of facility and treatment if not a POTW

        - If a disposal well in NY:
            - SPDES permit # and date
            - EPA UIC permit # and date
        - If a centralized tank facility in New York:
            - Location, affirmation of ownership or permission
            - Certification of compliance with 360-6.3
- Proposed cuttings disposal plan for any drilling requiring cuttings to be disposed of off-site including at a landfill.
    - Planned disposition of cuttings – landfill or other (describe)
        - If a landfill in NY:
            - Name, owner/operator, location
            - Part 360 permit # and date if applicable
- Proposed blow-out preventer (BOP) use and test plan for all drilling and completion operations including:
    - Pressure rating of any:
        - Annular preventer
        - Rams including a description of type and number of rams
        - Choke manifold and connecting line (from BOP to choke manifold)
    - Timing and frequency of testing and/or visual inspection of BOP and related equipment including any scheduled retesting of equipment. Test pressure(s) and duration of test(s) including an explanation as to how the test pressure was determined
    - Test pressure(s) and timing for any internal pressure testing of surface, intermediate and production casing strings, and duration of test including an explanation as to how the test pressure was determined
    - Test pressure (psi/ft) and anticipated depth (TVD-ft) of any surface and/or intermediate casing seat integrity tests
        - If a casing seat integrity test will not be conducted on a casing string with a BOP installed on it, an explanation must be provided why such a test is not required and how any flow will be managed
    - System for recording, documenting and retaining the results of all pressure tests and inspections, and making such available to the Department
    - Copy of the operator's well control barrier policythat identifies acceptable barriers to be used during identified operations
    - Minimum distance from well for remote actuator (powered by a source other than rig hydraulics)
- Transportation plan developed by a NYS-licensed Professional Engineer, that specifies proposed routes and includes a road condition assessment.
- Noise mitigation plan, including any proposed mitigation measures for any occupied structure within 1,000 feet.
- If a new well pad is proposed in a Forest or Grassland Focus Area and involves disturbance in a contiguous forest patch of 150 acres or more in size or a contiguous grassland patch of 30 acres or more in size, then the Applicant should not submit this EAF or a well permit application prior to conducting a site-specific ecological assessment in accordance with a

detailed study plan that has been approved by the Department. The need and plan for an ecological assessment should be determined in consultation with the Department and will consider information such as existing site conditions, existing covertype and ongoing and historical land management activities. The completed ecological assessment must be attached to this EAF and must include, at a minimum:

- a compilation of historical information on use of the area by forest interior birds or grassland birds;
- results of pre-disturbance biological studies, including a minimum of one year of field surveys at the site to determine the current extent, if any, of use of the site by forest interior birds or grassland birds;
- an evaluation of potential impacts on forest interior or grassland birds from the project;
- additional mitigation measures proposed by the applicant; and
- protocols for monitoring of forest interior or grassland birds during the construction phase of the project and for a minimum of two years following well completion.

**REQUIRED AFFIRMATIONS**

- Any surface water withdrawal associated with this well pad will only occur when flow is above the appropriate threshold as described in the SGEIS
- Applicable FIRM and Flood Boundary and Floodway maps consulted, and proposed well pad and access road are not within a mapped100-year floodplain
- Baseline residential well sampling, analysis and ongoing monitoring will be conducted and results shared with property owner as described in SGEIS and permit conditions
- Unless otherwise required by private lease agreement, the access road will be located as far as practical from occupied structures, places of assembly and unleased property
- HVHF GP authorization for stormwater discharges will be obtained prior to site disturbance
- Operator will prepare and adhere to the following site plans, which will be available to the Department upon request and available on-site to Department inspector while activities addressed by the plan are occurring:
    - a visual impacts mitigation plan consistent with the SGEIS
    - a noise impacts mitigation plan consistent with the SGEIS
    - a greenhouse gas impacts mitigation plan consistent with the SGEIS
    - an invasive species mitigation plan which includes:
        - -the best management practices listed in the SGEIS and
        - seasonally appropriate site-specific and species-specific physical and chemical control methods (e.g., digging to remove all roots, cutting to the ground, applying herbicides to specific plant parts such as stems or foliage, etc.) based on the invasive species survey submitted with the EAF Addendum
    - an acid rock drainage (ARD) mitigation plan consistent with the SGEIS for on-site burial of Marcellus Shale cuttings from horizontal drilling in the Marcellus Shale if the operator elects to bury these cuttings
- Operator will utilize alternative hydraulic fracturing additive products that exhibit reduced aquatic toxicity and pose less risk to water resources and the environment, unless demonstrated to DMN's satisfaction that they are not equally effective or feasible

- Operator will prepare and adhere to an emergency response plan (ERP) consistent with the SGEIS that will be available on-site during any operation from well spud (i.e., first instance of driving pipe or drilling) through well completion. -A list of emergency contact numbers for the area in which the well site is located must be included in the ERP and the list must be prominently displayed at the well site during operations conducted under this permit
- Operator will adhere to all well permit conditions and approved plans, including requirement for Department approval prior to making any change
- Operator will adhere to best management practices for reducing direct impacts to terrestrial habitats and wildlife consistent with the SGEIS (see Section 7.4.1.1)

**ADDITIONAL SUBMISSION REQUIRED PRIOR TO SITE DISTURBANCE**

- Copy of any road use agreement between the operator and local municipality

**ADDITIONAL SUBMISSION REQUIRED AT LEAST 48 HOURS PRIOR TO WELL SPUD**

- Copy of the ERP in electronic form

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# Appendix 7

## Sample Drilling Rig Specifications

Provided by Chesapeake Energy

Revised Draft
Supplemental Generic Environmental Impact Statement

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# ATTACHMENT A
# RIG SPECIFICATIONS
# Example #1

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## National Cabot 900
## Working Depth: 12,000'

| | |
|---|---|
| **DRAWWORKS:** | National Model 2346 – Mechanical – Grooved for 1 1/8'' drilling line.<br>Air operated, water cooled Eaton Assist Brake |
| **ENGINES:** | 2 - Cat C-15 (475HP ea.) with Allison Transmissions |
| **MAST:** | NOV - 117' - 350,000 SHL on 8 lines |
| **SUBSTRUCTURE:** | NOV - 18' Floor Height /15' Working Height |
| **TRAVELING EQUIPMENT:** | IDECO UTB – 265 Ton Block and Hook |
| **ROTARY TABLE:** | 27 ½'' with 440,000# capacity |
| **TUBULARS:** | 12,000' - S-135 - 4 1/2''x 16.60# per foot w/ XH connections<br>18 - 6 ½'' collars with NC46 connections |
| **MUD PUMPS:** | 2 – National 9-P-100 with Cat 3508 Mechanicals (935HP ea.) |
| **MUD SYSTEM:** | 3 - Tank, 900 BBL total |
| **SOLIDS CONTROL EQUIPMENT:** | Shakers: 2 – NOV D285P-LP<br>Desander: Brandt - 2 - 10" Cones<br>Desilter: Brandt - 12 - 4" Cones<br>Agitators: 6 – Brandt with 36'' Impellers |
| **BOP EQUIPMENT:** | 1 - Shaffer LXT - 11" 5M - Double Ram<br>1 – Shaffer Spherical - 11" 5M - Annular |
| **CLOSING UNIT:** | Koomey - 6 Station - 160 Gallon; 3000 psi |
| **CHOKE MANIFOLD:** | 3'' x 4'' - 5M, 1 Hydraulic Choke and 1 Manual Choke |
| **GENERATORS:** | 2 - Caterpillar 545 kW, Powered by 2 Cat C-18's |
| **AUXILARY EQUIPMENT:** | Water Tank: 400 BBL<br>Fuel Tank: 10,000 Gallons |
| **SPECIAL TOOLS:** | 2 - Braden PD12C Hydraulic Hoist<br>Hydraulic Pipe Spinner<br>Oil Works OWI-1000 Wire line with 12,000' of wire |

# Rig Specifications
# Example #2

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## 610 Mechanical 750 HP
## Working Depth: 14,000'

**DRAWWORKS:** National 610 Mechanical
Wichita 325 Air Brake

**ENGINES:** 2 – Caterpillar C-18's, 600 HP Each

**MAST:** Dreco 142' 550,000 SHL on 10 Lines

**SUBSTRUCTURE:** Dreco 20' Box on Box

**TRAVELING EQUIPMENT:** Block-Hook: Ideco UTB-265-5-36

**ROTARY TABLE:** National C-275

**COMPOUND:** National 2 Engines

**TORQUE CONVERTERS:** 2 – National C195

**MUD PUMPS:** 2 – National 9-P-100, Independent Drive Cummins QSK38, 920 HP

**MUD SYSTEM:** 2 – Tank, 750 BBL total w/100 BBL Premix

**SOLIDS CONTROL EQUIPMENT:**
Shakers: 2 – National Model DLMS-285P
Desander: National with 2 - 10" Cones
Desilter: National with 16 - 4" Cones

**BOP EQUIPMENT:** 1 – Shaffer LWS Type 11" 5M
1 – Shaffer Spherical Type 11: 5M

**CLOSING UNIT:** Koomey 6 Station 180 Gallon; 1 Air and 1 Electrical Pump

**CHOKE MANIFOLD:** 4'' x 3'' 5M, 2 Adjustable Chokes

**GENERATORS:** 2 – Cat 545 kW, Powered by 2 Cat C-18's

**AUXILARY EQUIPMENT:**
Water Tank: 500 BBL
Fuel Tank: 12,000 Gallons

**SPECIAL TOOLS:**
ST-80 Iron Roughneck
Pipe Spinner: Hydraulic
Auto Driller: Satellite
Totco EDR (Rental)
Separator/Trip Tank Combo (Rental)
Hoists: 1 – Thern 2.5A Air Hoist
1 - Braden PD12C Hydraulic Hoist

# Rig Specifications
# Example #3

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## SpeedStar 185K -- 515 HP
## Working Depth: 8,000'

**ENGINE:** 1 – Caterpillar C-15 with Allison Transmission

**MAST:** SpeedStar – 61' – 185,000 LB SHL
Setback Capacity of 7,000' – 3.5" Drill Pipe

**SUBSTRUCTURE:** Box Type – 7'6" Working Height

**MUD PUMP:** 1 – MP5

**MUD SYSTEM:** 2 – Tank, 600 BBL

**BOP EQUIPMENT:** 11" x 3M Annular

**CLOSING UNIT:** Townsend 4 Station, 80 Gallon

**CHOKE MANIFOLD:** 3'' x 3'' 5K with 1 Hydraulic Choke

**GENERATORS:** 2 – Onan 320 kW with Cummins Engines

**DRILL PIPE:** 7,500' OF 3.5" 13.30 LB/FT with IF Connections

**DRILL COLLARS:** 12 – 6 ½"

**AIR SYSTEM:** 3 – Ingersoll Rand 1170/350 Air Compressors
2 – Single Stage Boosters

**AUXILARY EQUIPMENT:** Water Tank: 250 BBL
Fuel Tank: 3,500 Gallons

**SPECIAL TOOLS:** 2 – Braden PD12C Hydraulic Tub Winches
Myers 35GPM Soap Pump
Martin Decker Geolograph
Wireline Unit with 10,000' of Line

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# Appendix 8

## Casing & Cementing Practices Required for All Wells in NY

Revised Draft
Supplemental Generic Environmental Impact Statement

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New York State Department of Environmental Conservation
Casing and Cementing Practices

## SURFACE CASING

1. The diameter of the drilled surface casing hole shall be large enough to allow the running of centralizers in recommended hole sizes.

| RECOMMENDED CENTRALIZER-HOLE SIZE COMBINATIONS | | |
|---|---|---|
| **Centralizer Size Inches** | **Minimum Hole Sizes Inches** | **Minimum Clearance Inches** |
| 4-1/2 | 6-1/8 | 1-5/8 |
| 5-1/2 | 7-3/8 | 1-7/8 |
| 6-5/8 | 8-1/2 | 1-7/8 |
| 7 | 8-3/4 | 1-3/4 |
| 8-5/8 | 10-5/8 | 2 |
| 9-5/8 | 12-1/4 | 2-5/8 |
| 13-3/8 | 17-1/2 | 4-1/8 |

**NOTE:** (1) If a manufacturer's specifications call for a larger hole size than indicated in the above table, then the manufacturer's specs take precedence.

(2) Check with the appropriate regional office for sizes not listed above.

2. Surface casing shall extend at least 75 feet beyond the deepest fresh water zone encountered or 75 feet into competent rock (bedrock), whichever is deeper, unless otherwise approved by the Department. However, the surface pipe must be set deeply enough to allow the BOP stack to contain any formation pressures that may be encountered before the next casing is run.

3. Surface casing shall not extend into zones known to contain measurable quantities of shallow gas. In the event that such a zone is encountered before the fresh water is cased off, the operator shall notify the Department and, with the Department's approval, take whatever actions are necessary to protect the fresh water zone(s).

4. All surface casing shall be a string of new pipe with a mill test of at least 1,100 pounds per square inch (psi), unless otherwise approved. Used casing may be approved for use, but must be pressure tested before drilling out the casing shoe or, if there is no casing shoe, before drilling out the cement in the bottom joint of casing. If plain end pipe is welded together for use, it too must be pressure tested. The minimum pressure for testing used casing or casing joined together by welding, shall be determined by the Department at the time of permit application. The appropriate Regional Mineral Resources office staff will be notified six hours prior to making the test. The results will be entered on the drilling log.

5. Centralizers shall be spaced at least one per every 120 feet; a minimum of two centralizers shall be run on surface casing. Cement baskets shall be installed appropriately above major lost circulation zones.

6. Prior to cementing any casing strings, all gas flows shall be killed and the operator shall attempt to establish circulation by pumping the calculated volume necessary to circulate. If the hole is dry, the calculated volume would include the pipe volume and 125% of the annular volume. Circulation is deemed to have been established once fluid reaches the surface. A flush, spacer or extra cement shall be used to separate the cement from the bore hole spacer or extra cement shall be used to separate the cement from the bore hole fluids to prevent dilution. If cement returns are not present at the surface, the operator may be required to run a log to determine the top of the cement.

7. The pump and plug method shall be used to cement surface casing, unless approved otherwise by the Department. The amount of cement will be determined on a site-specific basis and a minimum of 25% excess cement shall be used, with appropriate lost circulation materials, unless other amounts of excesses are approved or specified by the Department.

8. The operator shall test or require the cementing contractor to test the mixing water for pH and temperature prior to mixing the cement and to record the results on the cementing ticket.

9. The cement slurry shall be prepared according to the manufacturer's or contractor's specifications to minimize free water content in the cement.

10. After the cement is placed and the cementing equipment is disconnected, the operator shall wait until the cement achieves a calculated compressive strength of 500 psi before the casing is disturbed in any way. The waiting-on-cement (WOC) time shall be recorded on the drilling log.

11. When drive pipe (conductor casing) is left in the ground, a pad of cement shall be placed around the well bore to block the downward migration of surface pollutants. The pad shall be three feet square or, if circular, three feet in diameter and shall be crowned up to the drive pipe (conductor casing), unless otherwise approved by the Department.

WHEN REQUESTED BY THE DEPARTMENT IN WRITING, EACH OPERATOR MUST SUBMIT CEMENT TICKETS AND/OR OTHER DOCUMENTS THAT INDICATE THE ABOVE SPECIFICATIONS HAVE BEEN FOLLOWED.

THE CASING AND CEMENTING PRACTICES ABOVE ARE DESIGNED FOR TYPICAL SURFACE CASING CEMENTING. THE DEPARTMENT WILL REQUIRE ADDITIONAL MEASURES FOR WELLS DRILLED IN ENVIRONMENTALLY OR TECHNICALLY SENSITIVE AREAS (i.e., PRIMARY OR PRINCIPAL AQUIFERS).

THE DEPARTMENT RECOGNIZES THAT VARIATIONS TO THE ABOVE PROCEDURES MAY BE INDICATED IN SITE SPECIFIC INSTANCES. SUCH VARIATIONS WILL REQUIRE THE PRIOR APPROVAL OF THE REGIONAL MINERAL RESOURCES OFFICE STAFF.

## INTERMEDIATE CASING

Intermediate casing string(s) and the cementing requirements for that casing string(s) will be reviewed and approved by Regional Mineral Resources office staff on an individual well basis.

## PRODUCTION CASING

12. The production casing cement shall extend at least 500 feet above the casing shoe or tie into the previous casing string, whichever is less. If any oil or gas shows are encountered or known to be present in the area, as determined by the Department at the time of permit application, or subsequently encountered during drilling, the production casing cement shall extend at least 100 feet above any such shows. The Department may allow the use of a weighted fluid in the annulus to prevent gas migration in specific instances when the weight of the cement column could be a problem.

13. Centralizers shall be placed at the base and at the top of the production interval if casing is run and extends through that interval, with one additional centralizer every 300 feet of the cemented interval. A minimum of 25% excess cement shall be used. When caliper logs are run, a 10% excess will suffice. Additional excesses may be required by the Department in certain areas.

14. The pump and plug method shall be used for all production casing cement jobs deeper than 1500 feet. If the pump and plug technique is not used (less than 1500 feet), the operator shall not displace the cement closer than 35 feet above the bottom of the casing. If plugs are used, the plug catcher shall be placed at the top of the

lowest (deepest) full joint of casing.

15. The casing shall be of sufficient strength to contain any expected formation or stimulation pressures.

16. Following cementing and removal of cementing equipment, the operator shall wait until a compressive strength of 500 psi is achieved before the casing is disturbed in any way. The operator shall test or require the cementing contractor to test the mixing water for pH and temperature prior to mixing the cement and to record the results on the cementing tickets and/or the drilling log. WOC time shall be adjusted based on the results of the test.

17. The annular space between the surface casing and the production string shall be vented at all times. If the annular gas is to be produced, a pressure relief valve shall be installed in an appropriate manner and set at a pressure approved by the Regional Mineral Resources office.

WHEN REQUESTED BY THE DEPARTMENT IN WRITING, EACH OPERATOR MUST SUBMIT CEMENT TICKETS AND/OR OTHER DOCUMENTS THAT INDICATE THE ABOVE SPECIFICATIONS HAVE BEEN FOLLOWED.

THE CASING AND CEMENTING PRACTICES ABOVE ARE DESIGNED FOR TYPICAL PRODUCTION CASING/ CEMENTING. THE DEPARTMENT WILL REQUIRE ADDITIONAL MEASURES FOR WELLS DRILLED IN ENVIRONMENTALLY OR TECHNICALLY SENSITIVE AREAS (i.e., PRIMARY OR PRINCIPAL AQUIFERS).

THE DEPARTMENT RECOGNIZES THAT VARIATIONS TO THE ABOVE PROCEDURES MAY BE INDICATED IN SITE SPECIFIC INSTANCES. SUCH VARIATIONS WILL REQUIRE THE PRIOR APPROVAL OF THE REGIONAL MINERAL RESOURCES OFFICE.

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# Appendix 9

# EXISTING
## Fresh Water Aquifer Supplementary Permit Conditions Required for Wells Drilled in Primary and Principal Aquifers

Revised Draft
Supplemental Generic Environmental Impact Statement

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# FRESH WATER AQUIFER SUPPLEMENTARY PERMIT CONDITIONS

Operator: Well Name:
API Number:

1. All pits must be lined and sized to fully contain all drilling, cementing and stimulation fluids plus any fluids as a result of natural precipitation. Use of these pits for any other purpose is prohibited.

2. All fluids must be contained on the site and properly disposed. If operations are suspended and the site is left unattended at any time, pit fluids must be removed from the site immediately. After the cessation of drilling and/or stimulation operations, pit fluids must be removed within 7 days. Disposal of fluids must be undertaken by a waste transporter with an approved 6 NYCRR Part 364 permit.

3. Any hole drilled for conductor or surface casing (i.e., "water string") must be drilled on air, fresh water, or fresh water mud. For any holes drilled with mud, techniques for removal of filter cake (e.g., spacers, additional cement, appropriate flow regimes) must be considered when designing any primary cement job on conductor and surface casing.

4. If conductor pipe is used, it must be run in a drilled hole and it must be cemented back to surface by circulation down the inside of the pipe and up the annulus, or installed by another procedure approved by this office. Lost circulation materials must be added to the cement to ensure satisfactory results. Additionally, at least two centralizers must be run with one each at the shoe and at the middle of the string. In the event that cement circulation is not achieved, cement must be grouted (or squeezed) down from the surface to ensure a complete cement bond. In lieu of or in combination with such grouting or squeezing from the surface, this office may require perforation of the conductor casing and squeeze cementing of perforations. This office must be notified _____ hours prior to cementing operations and cementing cannot commence until a state inspector is present.

5. A surface casing string must be set at least 100' below the deepest fresh water zone and at least 100' into bedrock. If shallow gas is known to exist or is anticipated in this bedrock interval, the casing setting depth may be adjusted based on site-specific conditions provided it is approved by this office. There must be at least a 2½" difference between the diameters of the hole and the casing (excluding couplings) or the clearance specified in the Department's Casing and Cementing Practices, whichever is greater. Cement must be circulated back to the surface with a minimum calculated 50% excess. Lost circulation materials must be added to the cement to ensure satisfactory results. Additionally, cement baskets and centralizers must be run at appropriate intervals with centralizers run at least every 120'. Pipe must be either new API graded pipe with a minimum internal yield pressure of 1,800 psi or reconditioned pipe that has been tested internally to a minimum of 2,700 psi. If reconditioned pipe is used, an affidavit that the pipe has been tested must be submitted to this office before the pipe is run. This office must be notified _____ hours prior to cementing operations and cementing cannot commence until a state inspector is present.

6. If multiple fresh water zones are known to exist or are found or if shallow gas is present, this office may require multiple strings of surface casing to prevent gas intrusion and/or preserve the hydraulic characteristics and water quality of each fresh water zone. The permittee must immediately inform this office of the occurrence of any fresh water or shallow gas zones not noted on the permittee's drilling application and prognosis. This office may require changes to the casing and cementing plan in response to unexpected occurrences of fresh water or shallow gas, and may also require the immediate, temporary cessation of operations while such alterations are developed by the permittee and evaluated by the Department for approval.

7. In the event that cement circulation is not achieved on any surface casing cement job, cement must be grouted (or squeezed) down from the surface to ensure a complete cement bond. This office must be notified _____ hours prior to cementing operations and cementing cannot commence until a state inspector is present. In lieu of or in combination with such grouting or squeezing from the surface, this office may require perforation of the surface casing and squeeze cementing of perforations. This office may also require that a cement bond log and/or other logs be run for evaluation purposes. In addition, drilling out of and below surface casing cannot commence if there is any evidence or indication of flow behind the surface casing until remedial action has occurred. Alternative remedial actions from those described above may be approved by this office on a case-by-case basis provided site-specific conditions form the basis for such proposals.

8. This office must be notified _____ hours prior to any stimulation operation. Stimulation may commence without the state inspector if the inspector is not on location at the time specified during the notification.

9. The operator must complete the "Record of Formations Penetrated" on the Well Drilling and Completion Report providing a log of formations, both unconsolidated and consolidated, and all water and gas producing zones.

10. If the well is a producer, holding tanks with water-tight diking capable of retaining 1½ times the capacity of the tank must be installed for the containment of oil, brine and other production fluids. Disposal of fluids must only be undertaken by a waste transporter with an approved 6 NYCRR Part 364 permit.

11. **Any deviation from the above conditions must be approved by the Department prior to making a change.**

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# Appendix 10

## PROPOSED
## Supplementary Permit Conditions
## For High-Volume Hydraulic Fracturing

Updated August 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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## PROPOSED Supplementary Permit Conditions for High-Volume Hydraulic Fracturing

**Note:** The operator must comply with all provisions of Attachment A and Attachment B as noted at the end of this document, along with Attachment C when applicable.

### Planning and Local Coordination

1) All operations authorized by this permit must be conducted in accordance with the following site-specific plans prepared by the operator, available to the Department upon request, and available on-site to a Department inspector while activities addressed by the plan are taking place:

   a) a visual impacts mitigation plan consistent with the SGEIS; and

   b) a greenhouse gas emissions impacts mitigation plan consistent with the SGEIS.

2) An emergency response plan (ERP) consistent with the SGEIS must be prepared by the well operator and be available on-site during any operation from well spud (i.e., first instance of driving pipe or drilling) through well completion. A list of emergency contact numbers for the area in which the well site is located must be included in the ERP and the list must be prominently displayed at the well site during operations conducted under this permit. Further, a copy of the ERP in electronic form must be provided to this office at least 3 days prior to well spud.

3) The county emergency management office (EMO) must be notified of the well's location including latitude and longitude (NAD 83) as follows:

   a) prior to spudding the well;

   b) first occurrence of flaring while drilling;

   c) prior to high-volume hydraulic fracturing, and;

   d) prior to flaring for well clean-up, treatment or testing. A flare permit from the Department is required prior to any flaring operation for well clean-up, treatment or testing.

   A record of the type, date and time of any notification provided to the EMO must be maintained by the operator and made available to the Department upon request. In counties without an EMO, the local fire department must be notified as described above.

4) The operator shall adhere to the Department-approved transportation plan which shall be incorporated by reference into this permit. In addition, issuance of this permit does not provide relief from any local requirements authorized by or enacted pursuant to the New York State Vehicle and Traffic Law. Prior to site disturbance, the operator shall submit to the Department a copy of any road use agreement between the operator and municipality.

5) Prior to site disturbance (for a new well pad) or spud (for an existing pad), the operator must sample and test residential water wells within 1,000 feet of the well pad as described by the SGEIS, and provide results to the property owner within 30 days of the operator's receipt of

laboratory results. If no residential water wells are available for sampling within 1,000 feet, either because there are none of record or because the property owner denies permission, then wells within 2,000 feet must be sampled and tested with the property owner's permission.

6) Ongoing water well monitoring and testing must continue as described by the SGEIS until one year after hydraulic fracturing at the last well on the pad. More frequent or additional monitoring and testing may be required by the Department in response to complaints or for other reasonable cause.

7) Water well analysis must be performed by an ELAP-certified laboratory. Analyses and documentation that all test results were provided to the property owner must be maintained by the operator. The results of the analyses (data) and delivery documentation must be made available to the Department and local health department upon Department request at any time during the period up to and including five years after the permitted hydrocarbon well is permanently plugged and abandoned under a Department permit. If the permitted hydrocarbon well is located on a multi-well pad, all residential water well data and delivery documentation must be maintained and made available during the period up to and including five years after the last permitted hydrocarbon well on the pad is permanently plugged and abandoned under a Department permit.

**Site Preparation**

8) Unless otherwise required by private lease agreement and in consideration of avoiding bisection of agricultural fields, to the extent practical the access road must be located as far away as possible from occupied structures, places of assembly and unleased property.

9) Unless otherwise approved or directed by the Department, all of the topsoil in the project area stripped to facilitate the construction of well pads and access roads must be stockpiled, stabilized and remain on site for use in final reclamation.

10) Authorization under the Department's General Permit for Stormwater Discharges Associated with High-Volume Hydraulic Fracturing (HVHF GP) must be obtained prior to any disturbance at the site.

11) Piping, conveyances, valves and tanks in contact with flowback water must be constructed of materials compatible with flowback water composition, and in accordance with the fluid disposal plan approved by the Department pursuant to 6 NYCRR 554.1(c)(1).

12) Any reserve pit, drilling pit or mud pit on the well pad which will be used for more than one well must be constructed as follows:

    a) Surface water and stormwater runoff must be diverted away from the pit;

    b) Pit volume may not exceed 250,000 gallons, or 500,000 gallons for multiple pits on one tract or related tracts of land;

    c) Pit sidewalls and bottoms must adequately cushioned and free of objects capable of puncturing and ripping the liner;

    d) Pits constructed in unconsolidated sediments must have beveled walls (45 degrees or less);

e) The pit liner must be sized and placed with sufficient slack to accommodate stretching;

f) Liner thickness must be at least 30 mils, and;

g) Seams must be factory installed or field seamed in accordance with the manufacturer's recommendations.

**Site Maintenance**

13) Secondary containment consistent with the Department's Spill Prevention Operations Technology Series 10, Secondary Containment Systems for Aboveground Storage Tanks, (SPOTS 10) is required for all fueling tanks;

14) To the extent practical, fueling tanks must not be placed within 500 feet of a public or private water-well, a domestic-supply spring, a reservoir, a perennial or intermittent stream, a storm drain, a wetland, a lake or a pond;

15) Fueling tank filling operations must be manned at the fueling truck and at the tank if the tank is not visible to the fueling operator from the truck, and;

16)Troughs, drip pads or drip pans are required beneath the fill port of a fueling tank during filling operations if the fill port is not within the secondary containment.

17) A copy of the SWPPP must be available on-site and available to Department inspectors while HVHF GP coverage is in effect. HVHF GP coverage may be terminated upon the plugging and abandonment of all wells on the well pad in accordance with Department-issued permits.

18) Two feet of freeboard must be maintained at all times for any on-site pit.

19) Except for freshwater storage pits, fluids must be removed from an on-site pit prior to any 45-day gap in use (i.e., from the completion date of the well) and the pit must be inspected by a Department inspector prior to resumed use.

**Drilling, Stimulation and Flowback**

**NOTE: Wildcat Supplementary Conditions may be separately imposed in addition to these. Unless superseded by more stringent conditions below, the Department's Casing and Cementing Practices also remain in effect.**

20) Lighting and noise mitigation measures as deemed necessary by the Department may be required at any time.

21) The operator must provide the drilling company with a well prognosis indicating anticipated formation top depths with appropriate warning comments prior to spud. The prognosis must be reviewed by all crew members and posted in a prominent location in the doghouse. The operator must revise the prognosis and inform the drilling company in a timely manner if

drilling reveals significant variation between the anticipated and actual geology and/or formation pressures.

22) Individual crew member's responsibilities for blowout control must be posted in the doghouse or other appropriate location and each crew member must be made aware of such responsibilities prior to spud of any well being drilled or when another rig is moved on a previously spudded well and/or prior to the commencement of any rig, snubbing unit or coiled tubing unit performing completion work. During all drilling and/or completion operations when a BOP is installed, tested or in use, the operator or operator's designated representative must be present at the wellsite and such person or personnel must have a current well control certification from an accredited training program that is acceptable to the Department (e.g., International Association of Drilling Contractors). Such certification must be available at the wellsite and provided to the Department upon request.

23) Appropriate pressure control procedures and equipment in proper working order must be properly installed and employed while conducting drilling and/or completion operations including tripping, logging, running casing into the well, and drilling out solid-core stage plugs. Unless otherwise approved by the Department, a snubbing unit and/or coiled tubing unit with a BOP must be used to enter any well with pressure and/or to drill out one or more solid-core stage plugs.

24) Pressure testing of the blow-out preventer (BOP) and related equipment for any drilling and/or completion operation must be performed in accordance with the approved BOP use and test plan, and any deviation from the approved plan must be approved by the Department. Testing must be conducted in accordance with American Petroleum Institute (API) Recommended Practice (RP) 53, RP for Blowout Prevention Systems for Drilling Wells, or other procedures approved by the Department. Unless otherwise approved by the Department, the BOP use and test plan must include the following provisions:

    a) A system for recording, documenting and retaining the results of all pressure tests and inspections conducted during drilling and/or completion operations. The results must be available to the Department at the wellsite during the corresponding operation, and to the Department upon request at any time during the period up to and including five years after the well is permanently plugged and abandoned under a Department permit. If the well is located on a multi-well pad, all pressure testing records must be maintained and made available during the period up to and including five years after the last well on the pad is permanently plugged and abandoned under a Department permit. The record for each pressure test, at a minimum, must identify the equipment or casing being tested, the date of the test, the minimum and maximum test pressures in psig, the test medium (e.g., water, brine, mud, air, nitrogen) including its density, test duration, and the results of the test including any pressure drop;

    b) A well control barrier policy developed by the operator that identifies acceptable barriers to be used during identified operations. Such policy must employ, at a minimum, two mechanical barriers capable of being tested when conducting any drilling and/or completion operation below the surface casing. In no event shall a stripper rubber or a stripper head be considered an acceptable barrier;

    c) BOP testing prior to being put into service. Such testing must include testing after the BOP is installed on the well but prior to use. Pressure control equipment,

including the BOP, that fails any pressure test must not be used until it is repaired and passes the pressure test, and;

d) A remote BOP actuator which is powered by a source other than rig hydraulics that is located at least 50 feet from the wellhead. All lines, valves and fittings between the BOP and the remote actuator and any other actuator must be flame resistant and have an appropriate rated working pressure.

25) The operator must detect, if practical, and document all naturally occurring methane in the conductor hole, if drilled, and the surface hole. Further, in accordance with 6 NYCRR 554.7(b), all freshwater, brine, oil and gas shows must be documented on the Department's *Well Drilling and Completion Report*. In the event $H_2S$ is encountered in any portion of the well, all regulated activities must be conducted by the operator in conformance with American Petroleum Institute Publication API RP49, "Recommended Practices For Safe Drilling of Wells Containing Hydrogen Sulfide."

26) Annular disposal of drill cuttings or fluid is prohibited.

27) All fluids must be contained on the site until properly removed in compliance with the fluid disposal plan approved in accordance with 6 NYCRR 554.1(c)(1) and applicable conditions of this permit.

28) A closed-loop tank system must be used instead of a reserve pit to manage and contain drilling fluids and cuttings for any of the following:

a) horizontal drilling in the Marcellus Shale without an acid rock drainage mitigation plan for on-site burial of such cuttings, and;

b) any drilling requiring cuttings to be disposed of off-site including at a landfill.

29) With respect to the closed-loop tank system, cuttings may be removed from the site in the primary capture container (e.g., tank or bin) or transferred onsite via a transfer area to a secondary container or truck for offsite disposal. If a cuttings transfer area is employed, it must be lined with a material acceptable to the department. Transfer of cuttings to an onsite stock pile is prohibited, regardless of any liner under the stock pile. Offsite transport of all cuttings must be undertaken by a waste transporter with an approved 6 NYCRR Part 364 permit. The *Drilling and Production Waste Tracking Form* must be completed and retained for three years by the generator, transporter and destination facility, and made available to the Department upon request during this period. If requested, the generator is responsible for producing its originating copy of the *Drilling and Production Waste Tracking Form* and the completed form with the original signatures of the generator, transporter and destination facility.

30) Only biocides with current registration for use in New York may be used for any operation at the wellsite. Products must be properly labeled, and the label must be kept on-site during application and storage.

31) With respect to all surface, intermediate and production casing run in the well, and in addition to the requirements of the Department's "Casing and Cementing Practices" and any approved centralizer plan for intermediate casing, the following shall apply:

a) Casing must be new and conform to American Petroleum Institute (API) Specification 5CT, Specifications for Casing and Tubing (April 2002), and welded connections are prohibited;

b) casing thread compound and its use must conform to API Recommended Practice (RP) 5A3, RP on Thread Compounds for Casing, Tubing, Line Pipe, and Drill Stem Elements (November 2009);

c) at least two centralizers (one in the middle and one at the top) must be installed on the first joint of casing (except production casing) and all bow-spring style centralizers must conform to API Specification 10D for Bow-Spring Casing Centralizers (March 2002);

d) cement must conform to API Specification 10A, Specifications for Cement and Material for Well Cementing (April 2002 and January 2005 Addendum). Further, the cement slurry must be prepared to minimize its free water content in accordance with the same API specification and it must contain a gas-block additive;

e) prior to cementing any casing string, the borehole must be circulated and conditioned to ensure an adequate cement bond;

f) a spacer of adequate volume, makeup and consistency must be pumped ahead of the cement;

g) the cement must be pumped at a rate and in a flow regime that inhibits channeling of the cement in the annulus;

h) after the cement is pumped, the operator must wait on cement (WOC):
   1. until the cement achieves a calculated (e.g., performance chart) compressive strength of at least 500 psig, and
   2. a minimum WOC time of 8 hours before the casing is disturbed in any way, including installation of a blow-out preventer (BOP). The operator may request a waiver from the Department from the required WOC time if the operator has bench tested the actual cement batch and blend using mix water from the actual source for the job, and determined that 8 hours is not required to reach a compressive strength of 500 psig, and;

i) A copy of the cement job log for any cemented casing in the well must be available to the Department at the wellsite during drilling operations, and thereafter available to the Department upon request. The operator must provide such to the Department upon request at any time during the period up to and including five years after the well is permanently plugged and abandoned under a Department permit. If the well is located on a multi-well pad, all cementing records must be maintained and made available during the period up to and including five years after the last well on the pad is permanently plugged and abandoned under a Department permit.

32) The surface casing must be run and cemented immediately after the hole has been adequately circulated and conditioned. This office must be notified _____ hours prior to surface

casing cementing operations. *(Blank to be filled in based on well's location and Regional Minerals Manager's direction.)*

33) Intermediate casing must be installed in the well. The setting depth and design of the casing must consider all applicable drilling, geologic and well control factors. Additionally, the setting depth must consider the cementing requirements for the intermediate casing and the production casing as noted below. Any request to waive the intermediate casing requirement must be made in writing with supporting documentation and is subject to the Department's approval. Information gathered from operations conducted on any single well or the first well drilled on a multi-well pad may serve to form the basis for the Department waiving the intermediate casing requirement on subsequent wells in the vicinity of the single well or subsequent wells on the same multi-well pad.

34) This office must be notified _____ hours prior to intermediate casing cementing operations. Intermediate casing must be fully cemented to surface with excess cement. Cementing must be by the pump and plug method with a minimum of 25% excess cement unless caliper logs are run, in which case 10% excess will suffice. *(Blank to be filled in based on well's location and Regional Minerals Manager's direction.)*

35) The operator must run a radial cement bond evaluation log or other evaluation approved by the Department to verify the cement bond on the intermediate casing. The quality and effectiveness of the cement job shall be evaluated by the operator using the above required evaluation in conjunction with appropriate supporting data per Section 6.4 "Other Testing and Information" under the heading of "Well Logging and Other Testing" of American Petroleum Institute (API) Guidance Document HF1 (First Edition, October 2009). Remedial cementing is required if the cement bond is not adequate for drilling ahead (i.e., diversion or shut-in for well control).

36) Production casing must be run to the surface. This office must be notified _____ hours prior to production casing cementing operations. If installation of the intermediate casing is waived by the Department, then production casing must be fully cemented to surface. If intermediate casing is installed, the production casing cement must be tied into the intermediate casing string with at least 500 feet of cement measured using True Vertical Depth (TVD). Any request to waive any of the preceding cementing requirements must be made in writing with supporting documentation and is subject to the Department's approval. The Department will only consider a request for a waiver if the open-hole wireline logs including a narrative analysis of such and all other information collected during drilling from the same well pad or offsetting wells verify that migration of oil, gas or other fluids from one pool or stratum to another will be prevented. *(Blank to be filled in based on well's location and Regional Minerals Manager's direction.)*

37) The operator must run a radial cement bond evaluation log or other evaluation approved by the Department to verify the cement bond on the production casing. The quality and effectiveness of the cement job shall be evaluated by the operator using the above required evaluation in conjunction with appropriate supporting data per Section 6.4 "Other Testing and Information" under the heading of "Well Logging and Other Testing" of American Petroleum Institute (API) Guidance Document HF1 (First Edition, October 2009). Remedial cementing is required if the cement bond is not adequate to effectively isolate hydraulic fracturing operations.

38) The installation of an additional cemented casing string or strings in the well as deemed necessary by the Department for environmental and/or public safety reasons may be required at any time.

39) Under no circumstances should the annulus between the surface casing and the next casing string be shut-in, except during a pressure test.

40) If hydraulic fracturing operations are performed down casing, prior to introducing hydraulic fracturing fluid into the well the casing extending from the surface of the well to the top of the treatment interval must be tested with fresh water, mud or brine to at least the maximum anticipated treatment pressure for at least 30 minutes with less than a 5% pressure loss. This pressure test may not commence for at least 7 days after the primary cementing operations are completed on this casing string. A record of the pressure test must be maintained by the operator and made available to the Department upon request. The actual hydraulic fracturing treatment pressure must not exceed the test pressure at any time during hydraulic fracturing operations.

41) Prior to commencing hydraulic fracturing and pumping of hydraulic fracturing fluid, the injection lines and manifold, associated valves, frac head or tree and any other wellhead component or connection not previously tested must be tested with fresh water, mud or brine to at least the maximum anticipated treatment pressure for at least 30 minutes with less than a 5% pressure loss. A record of the pressure test must be maintained by the operator and made available to the Department upon request. The actual hydraulic fracturing treatment pressure must not exceed the test pressure at any time during hydraulic fracturing operations.

42) The operator must record the depths and estimated flow rates where fresh water, brine, oil and/or gas were encountered or circulation was lost during drilling operations. This information and the Department's *Pre-Frac Checklist and Certification* form including a treatment plan, must be submitted to and received by the regional office at least 3 days prior to commencement of high-volume hydraulic fracturing operations. The treatment plan must include a profile showing anticipated pressures and volumes of fluid for pumping the first stage. It must also include a description of the planned treatment interval for the well [i.e., top and bottom of perforations expressed in both True Vertical Depth (TVD) and True Measured Depth (TMD)].

43) Fracturing products other than those identified in the well permit application materials may not be used without specific approval from this office.

44) This permit does not authorize the use of diesel as the primary carrier fluid (i.e., diesel-based hydraulic fracturing).

45) The operator may conduct hydraulic fracturing operations provided 1) all items on the checklist are affirmed by a response of "Yes," 2) the *Pre-Frac Checklist And Certification* and treatment plan are received by the Department at least 3 days prior to hydraulic fracturing, and 3) all other pre-frac notification requirements are met as specified elsewhere. The operator is prohibited from conducting hydraulic fracturing operations on the well without additional Department review and approval if a response of "No" is provided to any of the items in the *Pre-Frac Checklist and Certification*.

46) Hydraulic fracturing operations must be conducted as follows:

a) Secondary containment for fracturing additive containers and additive staging areas, and flowback tanks is required. Secondary containment measures may include, as deemed appropriate by the Department, one or a combination of the following; dikes, liners, pads, impoundments, curbs, sumps or other structures or equipment capable of containing the substance. Any such secondary containment must be sufficient to contain 110% of the total capacity of the single largest container or tank within a common containment area. No more than one hour before initiating any hydraulic fracturing stage, all secondary containment must be visually inspected to ensure all structures and equipment are in place and in proper working order. The results of this inspection must be recorded and documented by the operator, and available to the Department upon request;

b) At least two vacuum trucks must be on standby at the wellsite during the pumping of hydraulic fracturing fluid and during any subsequent flowback phases;

c) Hydraulic fracturing additives must be removed from the site if the site will be unattended;

d) Any hydraulic fracturing string, if used, must be either stung into a production liner or run with a packer set at least 100 feet below the deepest cement top. An adequately sized, function tested relief valve and an adequately sized diversion line must be installed and used to divert flow from the hydraulic fracturing string-casing annulus to a covered watertight steel tank or covered watertight tank made of another material approved by the Department in case of hydraulic fracturing string failure. The relief valve must be set to limit the annular pressure to no more than 95% of the working pressure rating of the casings forming the annulus. The annulus between the hydraulic fracturing string and casing must be pressurized to at least 250 psig and monitored;

e) The pressure exerted on treating equipment including valves, lines, manifolds, hydraulic fracturing head or tree, casing and hydraulic fracturing string, if used, must not exceed 95% of the working pressure rating of the weakest component;

f) The hydraulic fracturing treatment pressure must not exceed the test pressure of any given component at any time during hydraulic fracturing operations;

g) All annuli available at the surface must be continuously observed or monitored in order to detect pressure or flow, and the records of such maintained by the operator and made available to the Department upon request, and;

h) Hydraulic fracturing pumping operations must be immediately suspended if any anomalous pressure and/or flow condition is indicated or occurring including a significant deviation from the treatment plan (i.e., profile showing anticipated pressures and volume of fluid for pumping the first stage) provided to the Department with the *Pre-Frac Checklist and Certification* or any other anticipated pressure and/or flow condition. Suspension of operations due to an anomalous pressure and/or flow condition is considered a non-routine incident which must be reported in accordance with the General Provisions of these supplementary permit conditions. In the case of suspended hydraulic fracturing pumping operations and non-routine incident reporting of such, the operator must receive Department approval prior to recommencing hydraulic fracturing activities in the same well.

47) The operator must make and maintain a complete record of its hydraulic fracturing operation including the flowback phase, and provide such to the Department upon request at any time during the period up to and including five years after the well is permanently plugged and abandoned under a Department permit. If the well is located on a multi-well pad, all hydraulic fracturing records must be maintained and made available during the period up to and including five years after the last well on the pad is permanently plugged and abandoned under a Department permit. The record for each well must include all types and volumes of materials, including additives, pumped into the well, flowback rates, and the daily and total volumes of fluid recovered during the first 30 days of flow from well. The record must also include a complete description of pressures exhibited throughout the hydraulic fracturing operation and must include pressure recordings, charts and/or a pressure profile. A synopsis of the hydraulic fracturing operation must be provided in the appropriate section of the Department's *Well Drilling and Completion Report* which must be provided to the Department within 30 days after completing the well in accordance with 6 NYCRR 554.7.

48) Flowback water is prohibited from being directed to or stored in any on-site pit. Covered watertight steel tanks or covered watertight tanks constructed of another material approved by the Department are required for flowback handling and containment on the well pad. Flowback water tanks, piping and conveyances, including valves, must be constructed of suitable materials, be of sufficient pressure rating and be maintained in a leak-free condition. Fluid transfer operations from tanks to tanker trucks must be manned at the truck and at the tank if the tank is not visible to the truck operator from the truck. Additionally, during transfer operations, all interconnecting piping must be manned if not visible to transfer personnel at the truck and tank.

49) The venting of any gas originating from the target formation during the flowback phase must be through a flare stack at least 30 feet in height, unless the absence of $H_2S$ has been demonstrated at a previous well on the same pad. Gas vented through the flare stack must be ignited whenever possible. The stack must be equipped with a self-ignition device.

50) A reduced emissions completion, with minimal flaring (if any), must be performed whenever a sales line and interconnecting gathering line are available during completion at any individual well or a multi-well pad.

51) This permit authorizes a one-time single-stage or multi-stage high-volume hydraulic fracturing operation as described in the well permit application materials, subject to the *Pre-Frac Checklist and Certification* and any modifications required by the Department. Any subsequent high-volume re-fracturing operations are subject to the Department's approval after:
    a) review of the planned fracturing procedures and products, water source, proposed site disturbance and layout, and fluid disposal plans;

    b) a site inspection by Department staff, and;

    c) a determination of whether any other Department permits are required.

**Reclamation**

52) Fluids must be removed from any on-site pit and the pit reclaimed no later than 45 days after completion of drilling and stimulation operations at the last well on the pad, unless the

Department grants an extension pursuant to 6 NYCRR 554.1(c)(3). Flowback water must be removed from on-site tanks within the same time frame.

53) Removed pit fluids must be disposed, recycled or reused as described in the approved fluid disposal plan submitted pursuant to 6 NYCRR 554.1(c)(1). Transport of all waste fluids by vehicle must be undertaken by a waste transporter with an approved 6 NYCRR Part 364 permit. The *Drilling and Production Waste Tracking Form* must be completed and retained for three years by the generator, transporter and destination facility, and made available to the Department upon request during this period. If requested, the generator is responsible for producing its originating copy of the *Drilling and Production Waste Tracking Form* and the completed form with the original signatures of the generator, transporter and destination facility.

54) If any fluid or other waste material is moved off site by pipeline or other piping, the operator must maintain a record of the date and time the fluid or other material left the site, the quantity of fluid or other material, and its intended disposition and use at that destination or receiving facility.

55) Cuttings contaminated with oil-based mud and polymer-based muds must be contained and managed in a closed-loop tank system and not be buried on site, and must be removed from the site for disposal in a 6 NYCRR Part 360 solid waste facility. Consultation with the Department's Division of Materials Management (DMM) is required prior to disposal of any cuttings associated with water-based mud-drilling and pit liner associated with water-based mud-drilling where the water-based mud contains chemical additives. Any sampling and analysis directed by DMM must be by an ELAP-certified laboratory. Disposal must conform to all applicable Department regulations. The pit liner must be ripped and perforated prior to any permitted burial on-site and to the extent practical, excess pit liner material must be removed and disposed of properly. Permission of the surface owner is required for any on-site burial of cuttings and pit liner, regardless of type of drilling and fluids used. Burial of any other trash on-site is specifically prohibited and all such trash must be removed from the site and properly disposed. Transport of all cuttings and pit liner off-site, if required by the Department or otherwise performed, must be undertaken by a waste transporter with an approved 6 NYCRR Part 364 permit. The *Drilling and Production Waste Tracking Form* must be completed and retained for three years by the generator, transporter and destination facility, and made available to the Department upon request during this period. If requested, the generator is responsible for producing its originating copy of the *Drilling and Production Waste Tracking Form* and the completed form with the original signatures of the generator, transporter and destination facility.

56) A site-specific acid rock drainage (ARD) mitigation plan consistent with the SGEIS must be prepared by the operator and followed for on-site burial of Marcellus Shale cuttings from horizontal drilling in the Marcellus Shale if the operator elects to bury these cuttings. The plan must be available to the Department upon request, and available on-site to a Department inspector while activities addressed by the plan are taking place.

57) The operator must fully implement the Partial Site Reclamation Plan described in the approved application materials.

58) Final reclamation of the wellsite must be approved by the Department. Unless otherwise approved by this office, well pads and access roads constructed for drilling and production operations must be scarified or ripped to alleviate compaction prior to replacement of topsoil.

Reclaimed areas must be seeded and mulched after topsoil replacement. Any proposal by the operator to waive these reclamation requirements must be accompanied by documentation of the landowner's written request to keep the access road and/or well pad.

**General**

59) The operator must follow applicable best management practices (BMPs) for reducing direct impacts at individual well pads described in Section 7.4.1.1 of the SGEIS.

60) The operator must fully implement the Invasive Species Management Plan described in the approved application materials.

61) The operator must follow applicable best management practices (BMPs) for reducing the potential for transfer and introduction of invasive species described in Section 7.4.2.2 of the SGEIS.

62) The operator must complete the "Record of Formations Penetrated" on the *Well Drilling and Completion Report* providing a log of formations, both unconsolidated and consolidated, and depths and estimated flow rates of any fresh water, brine, oil and/or gas. In accordance with 6 NYCRR 554.7, the well operator must provide the Department with the *Well Drilling and Completion Report* within 30 days after completing the well.

63) Any non-routine incident of potential environmental and/or public safety significance must be verbally reported to the Department within two hours of the incident's known occurrence or discovery, with a written report detailing the non-routine incident to follow within twenty-four hours of the incident's known occurrence or discovery. Non-routine incidents may include, but are not limited to: -casing, drill pipe or hydraulic fracturing equipment failures, cement failures, fishing jobs, fires, seepages, blowouts, surface chemical spills, observed leaks in surface equipment, observed pit liner failure, surface effects at previously plugged or other wells, observed effects at water wells or at the surface, complaints of water well contamination, anomalous pressure and/or flow conditions indicated or occurring during hydraulic fracturing operations, or other potentially polluting non-routine incident or incident that may affect the health, safety, welfare, or property of any person. Provided the environment and public safety would not be further endangered, any action and/or condition known or suspected of causing and/or contributing to a non-routine incident must cease immediately upon known occurrence or discovery of the incident, and appropriate initial remedial actions commenced. The required written non-routine incident report noted above must provide details of the incident and include, as necessary, a proposed remedial plan for Department review and approval. In the case of suspended hydraulic fracturing pumping operations and non-routine incident reporting of such, the operator must receive Department approval prior to recommencing hydraulic fracturing activities in the same well.

64) Flowback water recovered after high-volume hydraulic fracturing operations must be tested for NORM prior to removal from the site. Fluids recovered during the production phase (i.e., production brine) must be tested for NORM prior to removal.

65) Periodic radiation surveys must be conducted at specified time intervals during the production phase for Marcellus wells developed by high-volume hydraulic fracturing completion methods. Such surveys must be performed on all accessible well piping, tanks, or equipment that could contain NORM scale buildup. The surveys must be conducted for as long as the facility remains in active use. If piping, tanks, or equipment is to be removed,

radiation surveys must be performed to ensure their appropriate disposal. All surveys must be conducted in accordance with NYSDOH protocols.

66) Production brine is prohibited from being directed to or stored in any on-site pit. Covered watertight steel, fiberglass or plastic tanks, or covered watertight tanks constructed of another material approved by the Department, are required for production brine handling and containment on the well pad. Production brine tanks, piping and conveyances, including valves, must be constructed of suitable materials, be of sufficient pressure rating and be maintained in a leak-free condition.

67) Production brine which is removed from the site must be disposed, recycled or reused as described by the well permit application materials. Transport of all waste fluids must be undertaken by a waste transporter with an approved 6 NYCRR Part 364 permit. The *Drilling and Production Waste Tracking Form* must be completed and retained for three years by the generator, transporter and destination facility, and made available to the Department upon request during this period. If requested, the generator is responsible for producing its originating copy of the *Drilling and Production Waste Tracking Form* and the completed form with the original signatures of the generator, transporter and destination facility.

**Any deviation from the above conditions must be approved by the Department prior to making a change.**

## ATTACHMENT A

To avoid or mitigate adverse air quality impacts from the well drilling, completion and production operations, the following restrictions are imposed:

1. The diesel fuel used in drilling and completion equipment engines will be limited to Ultra Low Sulfur Fuel (ULSF) with a maximum sulfur content of 15 ppm.

2. There will not be any simultaneous operations of the drilling and completion equipment engines at the single well pad.

3. The maximum number of wells to be drilled and completed annually or during any consecutive 12--month period at a single pad will be limited to four.

4. The emissions of benzene at any glycol dehydrator to be used at the well pad will be limited to one ton/year as determined by calculations with the GRI-GlyCalc program. If wet gas is encountered, then the dehydrator will have a minimum stack height of 30 feet (9.1m) and will be equipped with a control devise to limit the benzene emissions to 1 Tpy.

5. Condensate tanks used at the well pad shall be equipped with vapor recovery systems to minimize fugitive VOC emissions.

6. During the flowback phase, the venting of gas from each well pad will be limited to a maximum of 5 MMscf during any consecutive 12--month period. If "sour" gas is encountered with detected $H_2S$ emissions, the height at which the gas will be vented will be a minimum of 30 feet (9.1m).

7. During the flowback phase, flaring of gas at each well pad will be limited to a maximum of 120 MMscf during any consecutive 12--month period.

8. Wellhead compressor will be equipped with NSCR controls.

9. No uncertified (i.e., EPA Tier 0) drilling or completion equipment engines will be used for any activity at the well sites.

10. The drilling engines and drilling air compressors will be limited to EPA Tier 2 or newer equipment. If Tier 1 drilling equipment is to be used, these will be equipped with both

particulate traps (CRDPF) and SCR controls. During operations, this equipment will be positioned as close to the center of the well pad as practicable. If industry deviates from the control requirements or proposes alternate mitigation and/or control measures to demonstrate ambient standard compliance, site specific information will be provided to the Department for review and concurrence.

11. The completion equipment engines will be limited to EPA Tier 2 or newer equipment. Particulate traps will be required for all Tier 2 engines. SCR control will be required on all completion equipment engines regardless of the emission Tier. During operations, this equipment will be positioned as close to the center of the well pad as practicable. If industry deviates from this requirement or proposes mitigation and/or alternate control measures to demonstrate ambient standard compliance, site specific information will be provided to the Department for review and concurrence.

## ATTACHMENT B

PASSBY FLOW IMPLEMENTATION AND ENFORCEMENT

1. Monitoring and Reporting**.** Passby flows must be maintained instantaneously. Determinations of allowable removal rates will be made based on comparisons with instantaneous flow data.

2. Description of Gage Types

***Tier I***- Gage data in this category is collected by the permitee immediately downstream of the water withdrawal location using streamflow gage equipment capable of accurately measuring instantaneous flow rates as approved at the discretion of the Department.

***Tier II***- Gage data in this category is obtained from acceptable USGS gages that must be located at a point in the same watershed where the drainage area at the gage is from 0.5x to 2.0x the size of the drainage area as measured at the withdrawal point. The catchment area must not have altered flows unless the instantaneous flow measurements can take into account the alterations.

***Tier III***- Gage data in this category is obtained from USGS gages that are either outside the acceptable distance within the same watershed or are in adjacent watersheds that possess similar basin characteristics. The use of these "surrogate" watersheds are the most inaccurate account of stream flow and should be used only as approved at the discretion of the Department.

3. All streamflow records used in determining the instantaneous passby flow rates should be measured to the nearest 0.1 cfs at 15-minute increments. Water withdrawal rates must be reported as instantaneous measurements to the nearest 0.1 cfs at 5-minute increments. Reporting is required annually to Department in Microsoft Excel or similar electronic spreadsheet/database formats.

4. Violations and Suspension of Operations. Water withdrawal operations will be suspended immediately upon determination that the required passby flow has not been maintained. The Department has the right to modify passby flow requirements if water quality standards are not being met within a watercourse as the result of a water withdrawal. Failure to submit annual reports, filing of inaccurate reports on water withdrawals, and continuing to withdraw water after a determination that the required passby flow has not been maintained, are all considered separate violations of this permit and the Environmental Conservation Law Article 71-1305(2).

## ATTACHMENT C

## FOREST AND GRASSLAND FOCUS AREAS

Operators developing well sites in Forest and Grassland Focus Areas that involve disturbance in a contiguous forest patch of 150 acres or more in size or in a contiguous grassland patch of 30 acres or more in size must:

1) Implement mitigation measures identified as part of the Department-approved ecological assessment;

2) Monitor the effects of disturbance as active development proceeds and for a minimum of two years following well completion; and

3) Practice adaptive management as previously unknown effects are documented.

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New York State

DEC

# Appendix 11

## Analysis of Subsurface Mobility of Fracturing Fluids

Excerpted from ICF International, Task 1, 2009

Revised Draft
Supplemental Generic Environmental Impact Statement

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### *1.2.4 Principles governing fracturing fluid flow*

The mobility of hydraulic fracturing fluid depends on the same physical and chemical principles that dictate all fluid transport phenomena. Frac fluid will flow through the well, the fractures, and the porous media based on pressure differentials and hydraulic conductivities. In addition to the overall flow of the frac fluids, additives may experience greater or lesser movement due to diffusion and adsorption. The concentrations of the fluids and additives may change due to dilution in formation waters and possibly by biological or chemical degradation.

#### 1.2.4.1 Limiting conditions

The analyses below present flow calculations for a range of parameters, with the intent to define reasonable bounds for the conditions likely to be encountered in New York State. Although one or more conditions at some future well sites may lie outside of the ranges analyzed, it is considered unlikely that the combination of conditions at any site would produce environmental impacts that are significantly more adverse than the worst case scenarios analyzed. The equations used in the analyses are presented below to facilitate the assessment of additional scenarios.

The analyses consider potentially useful aquifers with lower limits at depths up to 1,000 feet, somewhat deeper than the maximum aquifer depth reported in Table 3 for the Marcellus Shale. Similarly, the minimum depth to the top of the shale is taken as 2,000 ft, well above the minimum depth reported in Table 3 for the Marcellus Shale. The 2,000 ft. depth has been postulated as the probable upper limit for economic development of the New York shales.

The analyses include an additional conservative assumption. Even for deep aquifers, the analyses consider the pore pressure at the bottom of the aquifer to be zero as if a deep well or well field was operating at maximum drawdown. This assumption maximizes the potential for upward flow of fracturing fluid or its components from the fracture zone to the aquifer.

[134] U.S. EPA, 2004. *Evaluation of Impacts to Underground Sources of Drinking Water by Hydraulic Fracturing of Coalbed Methane Reservoirs*, Report number: EPA 816-R-04-003.

### 1.2.4.2 Gradient

For a fracturing fluid or its additives to have a negative impact on a groundwater aquifer, some deleterious component of the fracturing fluid would need to travel from the target fracture zone to the aquifer. In order for fluid to flow from the fracture zone to an aquifer, the *total head*[135] must be greater in the fracture zone than at the well. We can estimate the *gradient*[136] that might exist between a fracture zone in the shale and a potable water aquifer as follows:

$$i = \frac{h_{t1} - h_{t2}}{L} \tag{1}$$

where $i$ = gradient
$h_{tn}$ = total head at Point n
$L$ = length of flow path from Point 1 to Point 2

Since the total head is the sum of the elevation head and the pressure head,

$$h_t = h_e + h_p \tag{2}$$

The gradient can be restated as

$$i = \frac{(h_{e1} + h_{p1}) - (h_{e2} + h_{p2})}{L} \tag{3}$$

where $h_{en}$ = elevation head at Point n
$h_{pn}$ = pressure head at Point n

If the ground surface is taken as the elevation datum, we can express the elevation head in terms of depth.

$$d_n = -h_{en} \tag{4}$$

Restating the gradient yields

$$i = \frac{(h_{e1} + h_{p1}) - (h_{e2} + h_{p2})}{L} = \frac{(-d_1 + h_{p1}) - (-d_2 + h_{p2})}{L} = \frac{(d_2 - d_1) + (h_{p1} - h_{p2})}{L} \tag{5}$$

where $d_n$ = depth at Point n

We can estimate the maximum likely gradient by considering the combination of parameters which would be most favorable to flow from the hydraulically fractured zone to a potential groundwater aquifer. These include assuming the minimum possible pressure head in the aquifer and the shortest possible flow path, i.e. setting $h_{p2}$ to zero to simulate a well pumped to the maximum aquifer drawdown and setting $L$ to the vertical distance between the fracture zone and the aquifer, $d_1 - d_2$.

[135] Total head at a point is the sum of the elevation at the point plus the pore pressure expressed as the height of a vertical column of water.
[136] The groundwater gradient is the difference in total head between two points divided by the distance between the points.

The gradient now becomes

$$i = \frac{(d_2 - d_1) + h_{p1}}{|d_1 - d_2|} \tag{6}$$

The total vertical stress in the fracture zone equals

$$\sigma_v = d_1 \times \gamma_R \tag{7}$$

where $\sigma_v$ = total vertical stress
$d_1$ = depth at Point 1, in the fracture zone
$\gamma_R$ = average total unit weight of the overlying rock

The effective vertical stress, or the stress transmitted through the mineral matrix, equals the total unit weight minus the pore pressure. For the purposes of this analysis, the pore pressure is taken to be equivalent to that of a vertical water column from the fracture zone to the surface. The effective vertical stress is given by

$$\sigma'_v = \sigma_v - (d_1 \times \gamma_W) \tag{8}$$

where $\sigma'_v$ = effective vertical stress
$\gamma_W$ = unit weight of water

The effective horizontal stress and the total horizontal stress therefore equal

$$\sigma'_h = K \times \sigma'_v \tag{9}$$

$$\sigma_h = \sigma'_h + (d_1 \times \gamma_W) \tag{10}$$

where $\sigma'_h$ = effective horizontal stress
$K$ = ratio of horizontal to vertical stress
$\sigma_h$ = total horizontal stress

The hydraulic fracturing pressure needs to exceed the minimum total horizontal stress. Allowing for some loss of pressure from the wellbore to the fracture tip, the pressure head in the fracture zone equals

$$h_{p1} = c \times \sigma_h = \frac{c \times d_1 \times [K(\gamma_R - \gamma_W) + \gamma_W]}{\gamma_W} \tag{11}$$

where $h_{p1}$ = pressure head at Point 1, in the fracture zone
$c$ = coefficient to allow for some loss of pressure from the wellbore to the fracture tip

Since the horizontal stress is typically in the range of 0.5 to 1.0 times the vertical stress, the fracturing pressure will equal the depth to the fracture zone times, say, 0.75 times the density of

the geologic materials (estimated at 150 pcf average), times the depth.[137] To allow for some loss of pressure from the wellbore to the fracture tip, the calculations assume a fracturing pressure 10% higher than the horizontal stress, yielding

$$h_{p1} = \frac{110\% \times d_1 \times \left[0.75\left(150\,pcf - 62.4\,pcf\right) + 62.4\,pcf\right]}{62.4\,pcf} = 2.26 d_1 \tag{12}$$

Equation (6) thus becomes

$$i = \frac{\left(d_2 - d_1\right) + 2.26 d_1}{\left|d_1 - d_2\right|} = \frac{d_2 + 1.26 d_1}{\left|d_1 - d_2\right|} \tag{13}$$

Figure 1 shows the variation in the average hydraulic gradient between the fracture zone and an overlying aquifer during hydraulic fracturing for a variety of aquifer and shale depths. The gradient has a maximum of about 3.5, and is less than 2.0 for most depth combinations.

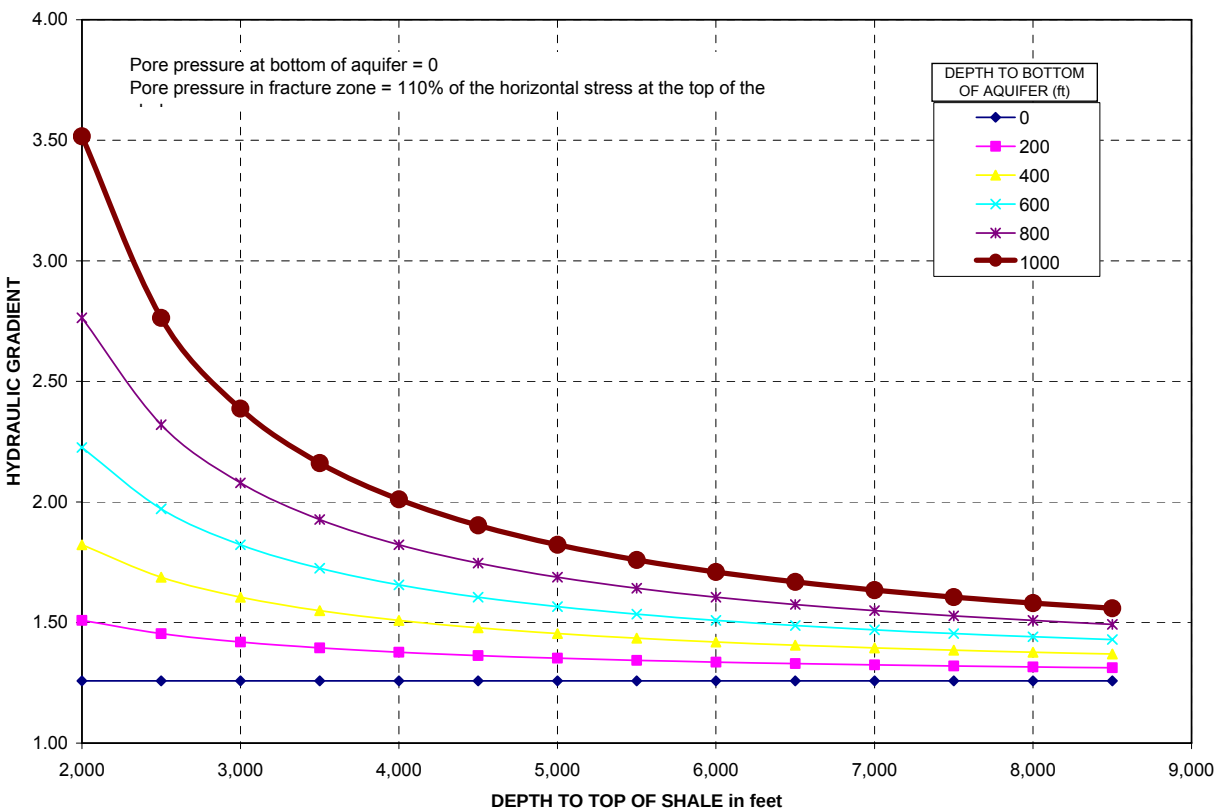


**Figure 1: Average hydraulic gradient during fracturing**

In an actual fracturing situation, non-steady state conditions will prevail during the limited time of application of the fracturing pressures, and the gradients will be higher than the average closer

[137] Zhang, Lianyang, 2005. *Engineering Properties of Rocks*, Elsevier Geo-Engineering Book Series, Volume 4, Amsterdam.

to the fracture zone and lower than the average closer to the aquifer. It is important to note that these gradients only apply while fracturing pressures are being applied.

Once fracturing pressures are removed, the total head in the reservoir will fall to near its original value, which may be higher or lower than the total head in the aquifer. Evidence suggests that the permeabilities of the Devonian shales are too low for any meaningful hydrological connection with the post-Devonian formations. The high dissolved solid content near 300,000 ppm in pre-Late Devonian formations supports the concept that these formations are hydrologically discontinuous, i.e. not well-connected to other formations.[138] During production, the pressure in the shale would decrease as gas is extracted, further reducing any potential for upward flow.

#### 1.2.4.3 Seepage velocity

The second aspect to consider with regards to flow is the time required for a particle of fluid to flow from the fracture zone to the well. Using Darcy's law, the seepage velocity would equal

$$v = \frac{ki}{n} \tag{10}$$

where $v$ = seepage velocity
$k$ = hydraulic conductivity
$n$ = porosity

The average hydraulic conductivity between a fracture zone and an aquifer would depend on the hydraulic conductivity of each intervening stratum, which in turn would depend on the type of material and whether it was intact or fractured. The rock types overlying the Marcellus Shale are primarily sandstones and other shales.[139] Table 4 lists the range of hydraulic conductivities for sandstone and shale rock masses. The hydraulic conductivity of rock masses tends to decrease with depth as higher stress levels close or prevent fractures. Vertical flow across a horizontally layered system of geologic strata is controlled primarily by the less permeable strata, so the average vertical hydraulic conductivity of all the strata lying above the target shale would be expected to be no greater than 1E-5 cm/sec and could be substantially lower.

**Table 4: Hydraulic conductivity of rock masses[140]**

| Material | Minimum k | Maximum k |
|---|---|---|
| Intact Sandstone | 1E-8 cm/sec | 1E-5 cm/sec |
| Sandstone rock mass | 1E-9 cm/sec | 1E-1 cm/sec |
| Intact Shale | 1E-11 cm/sec | 1E-9 cm/sec |
| Shale rock mass | 1E-9 cm/sec | 1E-4 cm/sec |

Figure 2 shows the seepage velocity from the fracture zone to an overlying aquifer based on the average gradients shown in Figure 1 over a range of hydraulic conductivity values and for the maximum aquifer depth of 1000 feet. For all lesser aquifer depths, the seepage velocity would

[138] Russell, William L., 1972, "Pressure-Depth Relations in Appalachian Region", *AAPG Bulletin*, March 1972, v. 56, No. 3, p. 528-536.
[139] Arthur, J.D., et al, 2008. "Hydraulic Fracturing Considerations for Natural Gas Wells of the Marcellus Shale," Presented at Ground Water Protection Council 2008 Annual Forum, September 21-24, 2008, Cincinnati, Ohio.
[140] Zhang, Lianyang, 2005. *Engineering Properties of Rocks*, Elsevier Geo-Engineering Book Series, Volume 4, Amsterdam.

be lower. For all of the analyses presented in this report, the porosity is taken as 10%, the reported total porosity for the Marcellus Shale.[141] Total porosity equals the contribution from both micro-pores within the intact rock and void space due to fractures. For the overlying strata, the analyses also use the same value for total porosity of 10% which is in the lower range of the typical values for sandstones and shales. This may result in a slight overestimation of the calculated seepage velocity, and an underestimation of the required travel time and available pore storage volume.

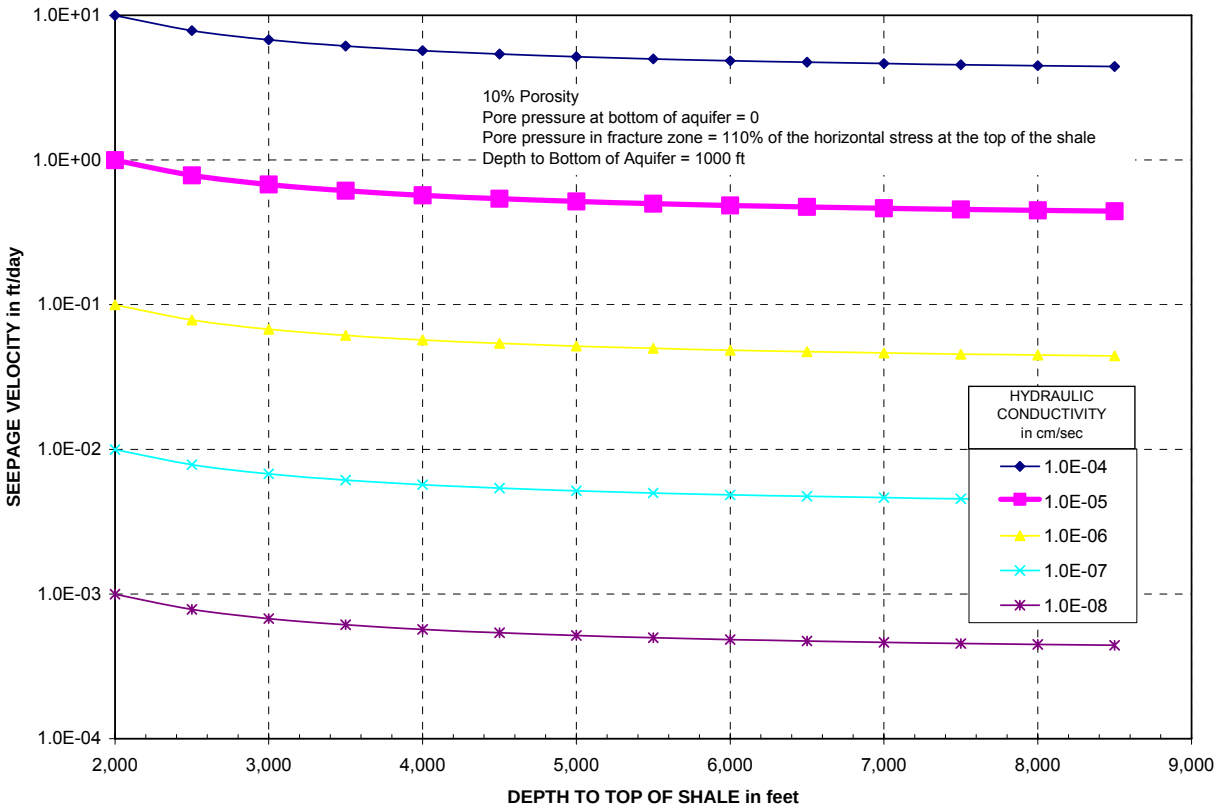


**Figure 2: Seepage velocity as a function of hydraulic conductivity**

Figure 2 shows that the seepage of hydraulic fracturing fluid would be limited to no more than 10 feet per day, and would be substantially less under most conditions. Since the cumulative amount of time that the fracturing pressure would be applied for all steps of a typical fracture stage is less than one day, the corresponding seepage distance would be similarly limited.

It is important to note that the seepage velocities shown in Figure 2 are based on average gradients between the fracture zone and the overlying aquifer. The actual gradients and seepage velocities will be influenced by non-steady state conditions and by variations in the hydraulic conductivities of the various strata.

[141] DOE, Office of Fossil Energy, 2009. *State Oil and National Gas Regulations Designed to Protect Water Resources*, May 2009.

#### 1.2.4.4 Required travel time

The time that the fracturing pressure would need to be maintained for the fracturing fluid to flow from the fracture zone to an overlying aquifer is given by

$$t = \frac{|d_2 - d_1|}{v} \tag{11}$$

where $t$ = required travel time

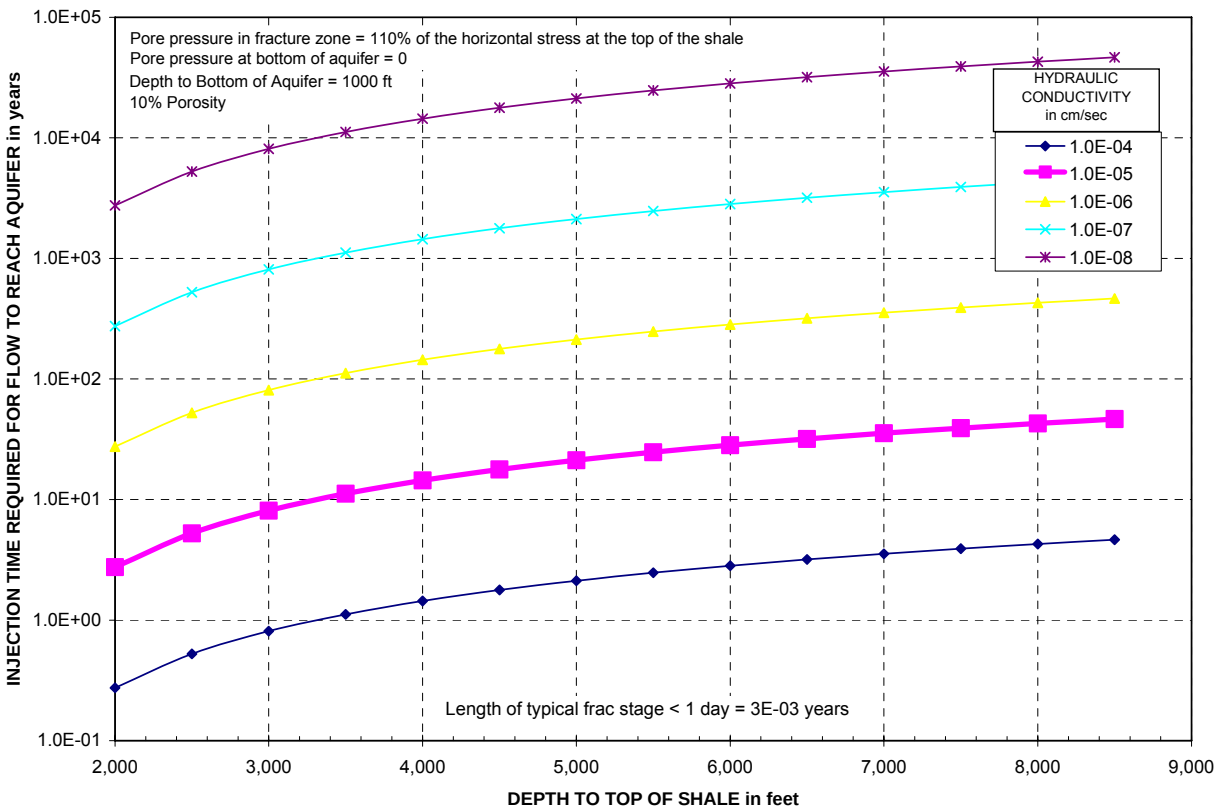


**Figure 3: Injection time required for fracture fluid to reach aquifer as a function of hydraulic conductivity**

Figure 3 shows the required travel time based on the average gradients shown in Figure 1 over a range of hydraulic conductivity values and for the maximum aquifer depth of 1000 feet. For all lesser aquifer depths, the required flow time would be longer. The required flow times under the fracturing pressure is several orders of magnitude greater than the duration over which the fracturing pressure would be applied.

Figure 4 presents the results of a similar analysis, but with the hydraulic conductivity held at 1E-5 cm/sec and considering various depths to the bottom of the aquifer. Compared to a 1000 ft. deep aquifer, 10 to 20 more years of sustained fracturing pressure would be required for the fracturing fluid to reach an aquifer that was only 200 ft. deep.

The required travel times shown relate to the movement of the groundwater. Dissolved chemicals would move at a slower rate due to retardation. The retardation factor, which is the

ratio of the chemical movement rate compared to the water movement rate, is always between 0.0 and 1.0, so the required travel times for any dissolved chemical would be greater than those shown in Figures 3 and 4.

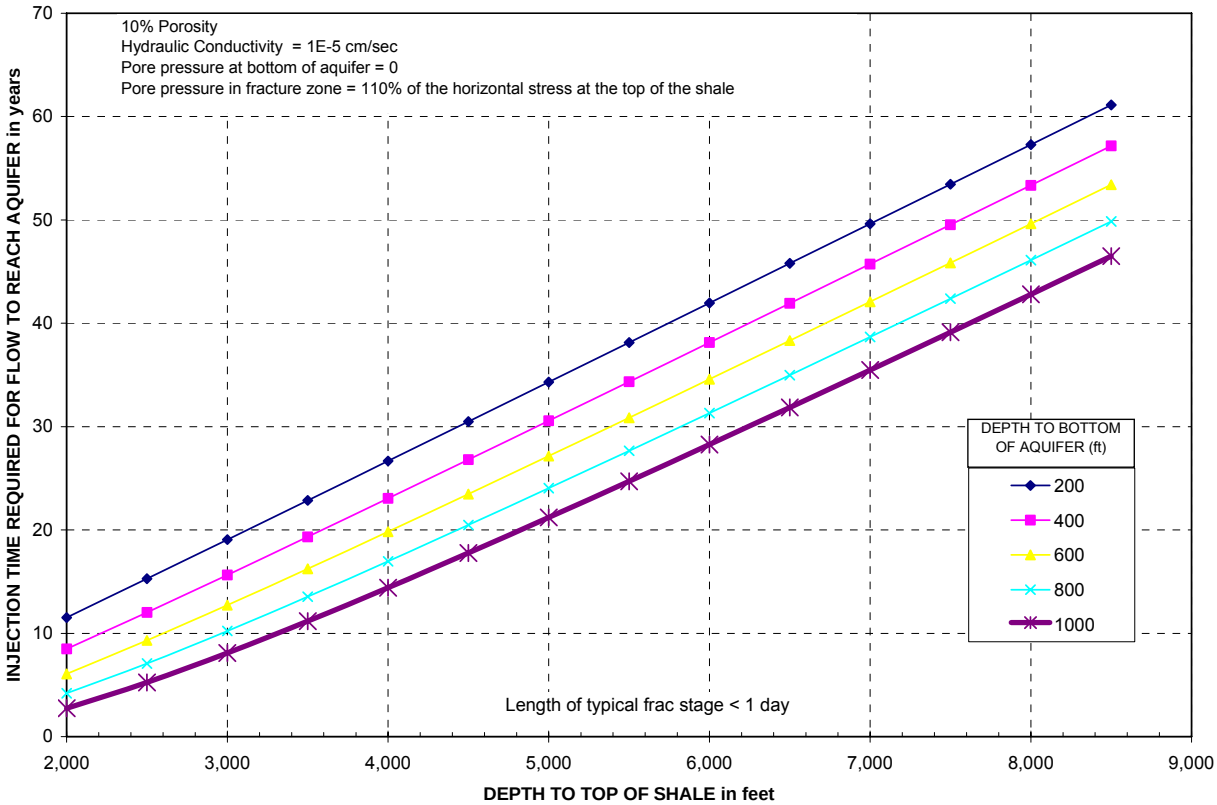


**Figure 4: Injection time required for flow to reach aquifer as a function of aquifer depth**

### 1.2.4.5 Pore storage volume

The fourth aspect to consider in evaluating the potential for adverse impacts to overlying aquifers is the volume of fluid injected compared to the volume of the void spaces and fractures that the fluid would need to fill in order to flow from the fracture zone to the aquifer. Figure 5 shows the void volume based on 10% total porosity for the geologic materials for various combinations of depths for the bottom of an aquifer and for the top of the shale, calculated as follows:

$$V = |d_1 - d_2| \times n \times \frac{43{,}560\, ft^2}{acre} \times \frac{7.48 gal}{ft^3} \qquad (12)$$

where $V$ = volume of void spaces and fractures

A typical slickwater fracturing treatment in a horizontal well would use less than 4 million gallons of fracturing fluid, and some portion of this fluid would be recovered as flowback. The void volume, based on 10% total porosity, for the geologic materials between the bottom of an aquifer at 1,000 ft. depth and the top of the shale at a 2,000 ft. depth is greater than 32 million gallons per acre. Since the expected area of a well spacing unit is no less than the equivalent of

40 acres per well,[142,143,144,145] the fracturing fluid could only fill about 0.3% of the overall void space. Alternatively, if the fracturing fluid were to uniformly fill the overall void space, it would be diluted by a factor of over 300. As shown in Figure 5, for shallower aquifers and deeper shales, the void volume per acre is significantly greater.

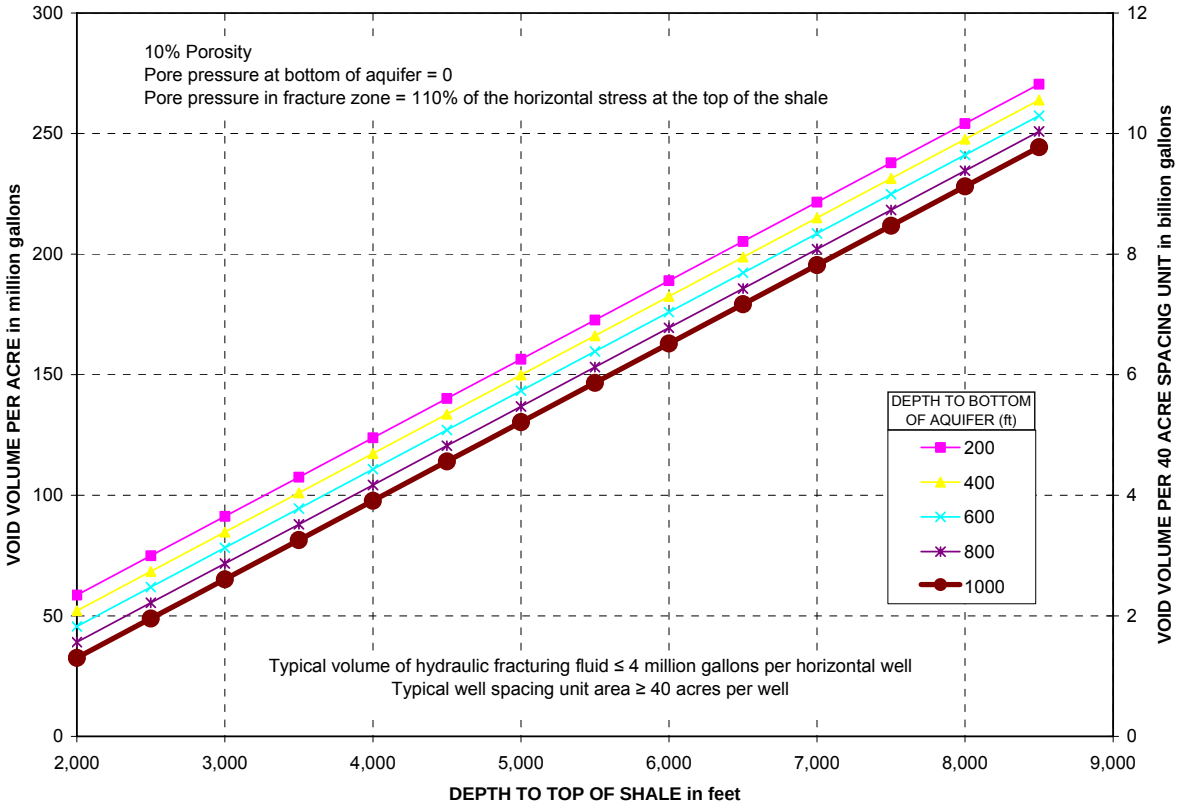


**Figure 5: Comparison of void volume to frac fluid volume**

### *1.2.5 Flow through fractures, faults, or unplugged borings*

It is theoretically possible but extremely unlikely that a flow path such as a network of open fractures, an open fault, or an undetected and unplugged wellbore could exist that directly connects the hydraulically fractured zone to an aquifer. The open flow path would have a much smaller area of flow leading to the aquifer and the resistance to flow would be lower. In such an improbable case, the flow velocity would be greater, the time required for the fracturing fluid to reach the aquifer would be shorter, and the storage volume between the fracture zone and the aquifer would be less than in the scenarios described above. The probability of such a combination of unlikely conditions occurring simultaneously (deep aquifer, shallow fracture

[142] Infill wells could result in local increases in well density.
[143] New York regulations (Part 553.1 Statewide spacing) require a minimum spacing of 1320 ft. from other oil and gas wells in the same pool. This spacing equals 40 acres per well for wells in a rectangular grid.
[144] New York Codes, Rules, and Regulations, Title 6 Department of Environmental Conservation, Chapter V Resource Management Services, Subchapter B Mineral Resources, 6 NYCRR Part 553.1 Statewide spacing, (as of 5 April 2009).
[145] NYSDEC, 2009, "Final Scope for Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas And Solution Mining Regulatory Program, Well Permit Issuance For Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low-permeability Gas Reservoirs", February 2009.

zone, and open flow path) is very small. The fracturing contractor would notice an anomaly if these conditions led to the inability to develop or maintain the predicted fracturing pressure.

During flowback, the same conditions would result in a high rate of recapture of the frac fluid from the open flow path, decreasing the potential for any significant adverse environmental impacts. Moreover, during production the gradients along the open flow path would be toward the production zone, flushing any stranded fracturing fluid in the fracture or unplugged wellbore back toward the production well.

### *1.2.6 Geochemistry*

The ability of the chemical constituents of the additives in fracturing fluids to migrate from the fracture zone are influenced not just by the forces governing the flow of groundwater, but also by the properties of the chemicals and their interaction with the subterranean environment. In addition to direct flow to an aquifer, the constituents of fracturing fluid would be affected by limitations on solubility, adsorption and diffusion.

#### 1.2.6.1 Solubility

The solubility of a substance indicates the propensity of the substance to dissolve in a solvent, in this case, groundwater. The substance can continue to dissolve up to its saturation concentration, i.e. its solubility. Substances with high solubilities in water have a higher likelihood of moving with the groundwater flow at high concentrations, whereas substances with low solubilities may act as longer term sources at low level concentrations. The solubilities of many chemicals proposed for use in hydraulic fracturing in New York State are not well established or are not available in standard databases such as the IUPAC-NIST Solubility Database.[146]

The solubility of a chemical determines the maximum concentration of the chemical that is likely to exist in groundwater. Solubility is temperature dependent, generally increasing with temperature. Since the temperature at the depths of the gas shales is higher than the temperature closer to the surface where a usable aquifer may lie, the solubility in the aquifer will be lower than in the shale formation.

Given the depth of the New York gas shales and the distance between the shales and any overlying aquifer, chemicals with high solubilities would be more likely to reach an aquifer at higher concentrations than chemicals of low solubility. Based on the previously presented fluid flow calculations, the concentrations would be significantly lower than the initial solubilities due to dilution.

#### 1.2.6.2 Adsorption

Adsorption occurs when molecules of a substance bind to the surface of another material. As chemicals pass through porous media or narrow fractures, some of the chemical molecules may adsorb onto the mineral surface. The adsorption will retard the flow of the chemical constituents relative to the rate of fluid flow. The retardation factor, expressed as the ratio of the fluid flow velocity to the chemical movement velocity, generally is higher in fine grained materials and in materials with high organic content. The Marcellus shale is both fine grained and of high organic content, so the expected retardation factors are high. The gray shales overlying the Marcellus

[146] IUPAC-NIST Solubility Database, Version 1.0, NIST Standard Reference Database 106, URL: http://srdata.nist.gov/solubility/index.aspx.

shale would also be expected to substantially retard any upward movement of fracturing chemicals.

The octanol-water partition coefficient, commonly expressed as $K_{ow}$, is often used in environmental engineering to estimate the adsorption of chemicals to geologic materials, especially those containing organic materials. Chemicals with high partition coefficients are more likely to adsorb onto organic solids and become locked in the shale, and less likely to remain in the dissolve phase than are chemicals with low partition coefficients.

The partition coefficients of many chemicals proposed for use in hydraulic fracturing in New York State are not well established or are not available in standard databases. The partition coefficient is inversely proportional to solubility, and can be estimated from the following equation[147]

$$\log K_{ow} = -0.862 \log S_w + 0.710 \tag{13}$$

where $K_{ow}$ = octanol-water partition coefficient
$S_w$ = solubility in water at 20ºC in mol/liter

Adsorption in the target black shales or the overlying gray shales would effectively remove some percentage of the chemical mass from the groundwater for long periods of time, although as the concentration in the water decreased some of the adsorbed chemicals could repartition back into the water. The effect of adsorption could be to lower the concentration of dissolved chemicals in any groundwater migrating from the shale formation.

#### 1.2.6.3 Diffusion

Through diffusion, chemicals in fracturing fluids would move from locations with higher concentrations to locations with lower concentrations. Diffusion may cause the transport of chemicals even in the absence of or in a direction opposed to the gradient driving fluid flow. Diffusion is a slow process, but may continue for a very long time. As diffusion occurs, the concentration necessarily decreases. If all diffusion were to occur in an upward direction (an unlikely, worst-case scenario) from the fracture zone to an overlying freshwater aquifer, the diffused chemical would be dispersed within the intervening void volume and be diluted by at least an average factor of 160 based on the calculated pore volumes in Section 1.2.4.5. Since a concentration gradient would exist from the fracture zone to the aquifer, the concentration at the aquifer would be significantly lower than the calculated average. Increased vertical distance between the aquifer and the fracture zone due to shallower aquifers and deeper shales would further increase the dilution and reduce the concentration reaching the aquifer.

#### 1.2.6.4 Chemical interactions

Mixtures of chemicals in a geologic formation will behave differently than pure chemicals analyzed in a laboratory environment, so any estimates based on the solubility, adsorption, or diffusion properties of individual chemicals or chemical compounds should only be used as a guide to how they might behave when injected with other additives into the shale. Co-solubilities can change the migration properties of the chemicals and chemical reactions can create new compounds.

[147] Chiou, Cary T., *Partition and adsorption of organic contaminants in environmental systems*, John Wiley & Sons, New York, 2002, p.57.

### *1.2.7 Conclusions*

Analyses of flow conditions during hydraulic fracturing of New York shales help explain why hydraulic fracturing does not present a reasonably foreseeable risk of significant adverse environmental impacts to potential freshwater aquifers. Specific conditions or analytical results supporting this conclusion include:

- The developable shale formations are separated from potential freshwater aquifers by at least 1,000 feet of sandstones and shales of moderate to low permeability.
- The fracturing pressures which could potentially drive fluid from the target shale formation toward the aquifer are applied for short periods of time, typically less than one day per stage, while the required travel time for fluid to flow from the shale to the aquifer under those pressures is measured in years.
- The volume of fluid used to fracture a well could only fill a small percentage of the void space between the shale and the aquifer.
- Some of the chemicals in the additives used in hydraulic fracturing fluids would be adsorbed by and bound to the organic-rich shales.
- Diffusion of the chemicals throughout the pore volume between the shale and an aquifer would dilute the concentrations of the chemicals by several orders of magnitude.
- Any flow of frac fluid toward an aquifer through open fractures or an unplugged wellbore would be reversed during flowback, with any residual fluid further flushed by flow toward the production zone as pressures decline in the reservoir during production.

The historical experience of hydraulic fracturing in tens of thousands of wells is consistent with the analytical conclusion. There are no known incidents of groundwater contamination due to hydraulic fracturing.

New York State

DEC

# Appendix 12

## Beneficial Use Determination (BUD) Notification Regarding Road Spreading

Revised Draft
Supplemental Generic Environmental Impact Statement

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**New York State Department of Environmental Conservation**
**Division of Solid and Hazardous Materials**
**Bureau of Solid Waste, Reduction and Recycling, 9th Floor**
625 Broadway, Albany, New York 12233-7253
**Phone:** (518) 402-8704 • **FAX:** (518) 402-9024
**Website:** www.dec.ny.gov

Alexander B. Grannis
Commissioner

January 2009

# NOTICE TO GAS AND OIL WELL & LPG STORAGE FLUID HAULERS

All gas or oil well drilling and production fluids including but not limited to brine and fracturing fluids, and brine from liquefied petroleum gas (LPG) well storage operations, transported for disposal, road spreading, reuse in another gas or oil well, or recycling must be specifically identified in Part C and D of the New York State Waste Transporter Permit Application Form. Transporters must identify the type of fluid proposed to be transported in Section C in the Non-Hazardous Industrial/Commercial box and the Disposal or Destination Facility (or Use) in Part D.

Fracture fluids obtained during flowback operations may not be spread on roads and must be disposed at facilities authorized by the Department. Such disposal facilities must be identified in Part D of the permit application. If fluids are to be transported for use or reuse at another gas or oil well, that location must be identified in Part D of the permit application.

With respect to fluids transported under a Waste Transporter Permit, only production brines or brine from LPG storage operations may be used for road spreading. Drilling, fracing, and plugging fluids are not acceptable for road spreading.

Any person, including any government entity, applying for a Part 364 permit or permit modification to use production brine from oil or gas wells or brine from LPG well storage operations for road spreading purposes (i.e. road de-icing, dust suppression, or road stabilization) must submit a petition for a beneficial use determination (BUD). If a contract hauler is applying for a Part 364 permit or permit modification to deliver brine to a government agency for road spreading purposes, that government agency must submit the BUD petition. The BUD must be granted and the Part 364 permit/modification must be issued before brine can be removed from the well or LPG storage site for road spreading purposes or storage at an offsite facility.

The BUD petition must include:

1. An original letter signed and dated by the government agency representative or other property owner authorizing the use of brine on the locations identified in below item 3.

2. The name, address and telephone number of the person, company or government official seeking the approval.

3. An identification (or map) of the specific roads or other areas that are to receive the brine and any brine storage locations, excluding the well site storage locations.

4. The physical address of the brine storage locations from which the brine is hauled.

5. For each well field or LPG storage facility, a chemical analysis of a representative sample of the brine performed by a NYSDOH approved laboratory for the following parameters: calcium, sodium, chloride, magnesium, total dissolved solids, pH, iron, barium, lead, sulfate, oil & grease, benzene, ethylbenzene, toluene, and xylene. Depending upon the analytical results, the Department may require additional analyses. (This analysis is not required for brine from a LPG well operation with a valid New York State SPDES permit.)

6. A road spreading plan that includes a description of the procedures to prevent the brine from flowing or running off into streams, creeks, lakes and other bodies of water. The plan should include:

- a description of how the brine will be applied, including the equipment to be used and the method for controlling the rate of application. In general this should indicate that the brine is applied by use of a spreader bar or similar spray device with shut-off controls in the cab of the truck; and with vehicular equipment that is dedicated to this use or cleaned of previously transported waste materials prior to this use;
- the proposed rate and frequency of application;
- a description of application restrictions. For dust control and road stabilization use this description should indicate that the brine is not applied: after daylight hours; within 50 feet of a stream, creek, lake or other body of water; on sections of road having a grade exceeding 10 percent; or on wet roads, during rain, or when rain is imminent. For road deicing use, this description should indicate that the brine is applied in accordance NYSDOT Guidelines for Anit-Icing with Liquids and include any other restrictions.

7. Where applicable, a brine storage plan that includes:

- a description of the type, material, size, and number of storage tanks and the maximum anticipated storage;
- procedures for run off and run-on control;
- provisions for secondary containment; and
- a contingency plan.

If you have any questions concerning your permit, please feel free to call this office at (518) 402-8707. You may also visit our public website at the address above for information and forms to download or print.

Waste Transporter Permit Program

New York State

DEC

# Appendix 13

## Radiological Data - Production Brine from NYS Marcellus Wells

Revised Draft
Supplemental Generic Environmental Impact Statement

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## NYS Marcellus Radiological Data from Production Brine

| Well | API # | Date Collected | Town (County) | Parameter | Result +/- Uncertainty |
|---|---|---|---|---|---|
| Maxwell 1C | 31-101-22963-03-01 | 10/7/2008 | Caton (Steuben) | Gross Alpha | 17,940 +/- 8,634 pCi/L |
| | | | | Gross Beta | 4,765 +/- 3,829 pCi/L |
| | | | | Cesium-137 | -2.26 +/- 5.09 pCi/L |
| | | | | Cobalt-60 | -0.748 +/- 4.46 pCi/L |
| | | | | Ruthenium-106 | 9.27 +/- 46.8 pCi/L |
| | | | | Zirconium-95 | 37.8 +/- 21.4 pCi/L |
| | | | | Radium-226 | 2,472 +/- 484 pCi/L |
| | | | | Radium-228 | 874 +/- 174 pCi/L |
| | | | | Thorium-228 | 53.778 +/- 8.084 pCi/L |
| | | | | Thorium-230 | 0.359 +/- 0.221 pCi/L |
| | | | | Thorium-232 | 0.065 +/- 0.103 pCi/L |
| | | | | Uranium-234 | 0.383 +/- 0.349 pCi/L |
| | | | | Uranium-235 | 0.077 +/- 0.168 pCi/L |
| | | | | Uranium-238 | 0.077 +/- 0.151 pCi/L |
| Frost 2 | 31-097-23856-00-00 | 10/8/2008 | Orange (Schuyler) | Gross Alpha | 14,530 +/-3,792 pCi/L |
| | | | | Gross Beta | 4,561 +/- 1,634 pCi/L |
| | | | | Cesium-137 | 2.54 +/- 4.64 pCi/L |
| | | | | Cobalt-60 | -1.36 +/- 3.59 pCi/L |
| | | | | Ruthenium-106 | -9.03 +/- 36.3 pCi/L |
| | | | | Zirconium-95 | 31.6 +/- 14.6 pCi/L |
| | | | | Radium-226 | 2,647 +/- 494 pCi/L |
| | | | | Radium-228 | 782 +/- 157 pCi/L |
| | | | | Thorium-228 | 47.855 +/- 9.140 pCi/L |
| | | | | Thorium-230 | 0.859 +/- 0.587 pCi/L |
| | | | | Thorium-232 | 0.286 +/- 0.328 pCi/L |
| | | | | Uranium-234 | 0.770 +/- 0.600 pCi/L |
| | | | | Uranium-235 | 0.113 +/- 0.222 pCi/L |
| | | | | Uranium-238 | 0.431 +/- 0.449 pCi/L |
| Webster T1 | 31-097-23831-00-00 | 10/8/2008 | Orange (Schuyler) | Gross Alpha | 123,000 +/- 23,480 pCi/L |
| | | | | Gross Beta | 12,000 +/- 2,903 pCi/L |
| | | | | Cesium-137 | 1.32 +/- 5.76 pCi/L |
| | | | | Cobalt-60 | -2.42 +/- 4.76 pCi/L |
| | | | | Ruthenium-106 | -18.3 +/- 44.6 pCi/L |
| | | | | Zirconium-95 | 34.5 +/- 15.6 pCi/L |
| | | | | Radium-226 | 16,030 +/- 2,995 pCi/L |
| | | | | Radium-228 | 912 +/- 177 pCi/L |
| | | | | Thorium-228 | 63.603 +/- 9.415 pCi/L |
| | | | | Thorium-230 | 0.783 +/- 0.286 pCi/L |
| | | | | Thorium-232 | 0.444 +/- 0.213 pCi/L |
| | | | | Uranium-234 | 0.232 +/- 0.301 pCi/L |
| | | | | Uranium-235 | 0.160 +/- 0.245 pCi/L |
| | | | | Uranium-238 | -0.016 +/- 0.015 pCi/L |

| Well | API # | Date Collected | Town (County) | Parameter | Result +/- Uncertainty |
|---|---|---|---|---|---|
| Calabro T1 | 31-097-23836-00-00 | 3/26/2009 | Orange (Schuyler) | Gross Alpha | 18,330 +/- 3,694 pCi/L |
| | | | | Gross Beta | -324.533 +/- 654 pCi/L |
| | | | | Cesium-137 | 3.14 +/- 7.19 pCi/L |
| | | | | Cobalt-60 | 0.016 +/- 5.87 pCi/L |
| | | | | Ruthenium-106 | 17.0 +/- 51.9 pCi/L |
| | | | | Zirconium-95 | 24.2 +/- 13.6 pCi/L |
| | | | | Radium-226 | 13,510 +/- 2,655 pCi/L |
| | | | | Radium-228 | 929 +/- 179 pCi/L |
| | | | | Thorium-228 | 45.0 +/- 8.41 pCi/L |
| | | | | Thorium-230 | 2.80 +/- 1.44 pCi/L |
| | | | | Thorium-232 | -0.147 +/- 0.645 pCi/L |
| | | | | Uranium-234 | 1.91 +/- 1.82 pCi/L |
| | | | | Uranium-235 | 0.337 +/- 0.962 pCi/L |
| | | | | Uranium-238 | 0.765 +/- 1.07 pCi/L |
| Maxwell 1C | 31-101-22963-03-01 | 4/1/2009 | Caton (Steuben) | Gross Alpha | 3,968 +/- 1,102 pCi/L |
| | | | | Gross Beta | 618 +/- 599 pCi/L |
| | | | | Cesium-137 | -0.443 +/- 3.61 pCi/L |
| | | | | Cobalt-60 | -1.840 +/- 2.81 pCi/L |
| | | | | Ruthenium-106 | 17.1 +/- 29.4 pCi/L |
| | | | | Zirconium-95 | 26.4 +/- 8.38 pCi/L |
| | | | | Radium-226 | 7,885 +/- 1,568 pCi/L |
| | | | | Radium-228 | 234 +/- 50.5 pCi/L |
| | | | | Thorium-228 | 147 +/- 23.2 pCi/L |
| | | | | Thorium-230 | 1.37 +/- 0.918 pCi/L |
| | | | | Thorium-232 | 0.305 +/- 0.425 pCi/L |
| | | | | Uranium-234 | 1.40 +/- 1.25 pCi/L |
| | | | | Uranium-235 | 0.254 +/- 0.499 pCi/L |
| | | | | Uranium-238 | 0.508 +/- 0.708 pCi/L |
| Haines 1 | 31-101-14872-00-00 | 4/1/2009 | Avoca (Steuben) | Gross Alpha | 54.6 +/- 37.4 pCi/L |
| | | | | Gross Beta | 59.3 +/- 58.4 pCi/L |
| | | | | Cesium-137 | 0.476 +/- 2.19 pCi/L |
| | | | | Cobalt-60 | -0.166 +/- 2.28 pCi/L |
| | | | | Ruthenium-106 | 7.15 +/- 19.8 pCi/L |
| | | | | Zirconium-95 | 0.982 +/- 4.32 pCi/L |
| | | | | Radium-226 | 0.195 +/- 0.162 pCi/L |
| | | | | Radium-228 | 0.428 +/- 0.335 pCi/L |
| | | | | Thorium-228 | 0.051 +/- 0.036 pCi/L |
| | | | | Thorium-230 | 0.028 +/- 0.019 pCi/L |
| | | | | Thorium-232 | 0.000 +/- 0.007 pCi/L |
| | | | | Uranium-234 | 0.000 +/- 0.014 pCi/L |
| | | | | Uranium-235 | 0.000 +/- 0.005 pCi/L |
| | | | | Uranium-238 | -0.007 +/- 0.006 pCi/L |

| Well | API # | Date Collected | Town (County) | Parameter | Result +/- Uncertainty |
|---|---|---|---|---|---|
| Haines 2 | 31-101-16167-00-00 | 4/1/2009 | Avoca (Steuben) | Gross Alpha | 70.0 +/- 47.8 pCi/L |
| | | | | Gross Beta | 6.79 +/- 54.4 pCi/L |
| | | | | Cesium-137 | 2.21 +/- 1.64 pCi/L |
| | | | | Cobalt-60 | 1.42 +/- 2.83 pCi/L |
| | | | | Ruthenium-106 | 5.77 +/- 15.2 pCi/L |
| | | | | Zirconium-95 | 2.43 +/- 3.25 pCi/L |
| | | | | Radium-226 | 0.163 +/- 0.198 pCi/L |
| | | | | Radium-228 | 0.0286 +/- 0.220 pCi/L |
| | | | | Thorium-228 | 0.048 +/- 0.038 pCi/L |
| | | | | Thorium-230 | 0.040 +/- 0.022 pCi/L |
| | | | | Thorium-232 | -0.006 +/- 0.011 pCi/L |
| | | | | Uranium-234 | 0.006 +/- 0.019 pCi/L |
| | | | | Uranium-235 | 0.006 +/- 0.013 pCi/L |
| | | | | Uranium-238 | -0.013 +/- 0.009 pCi/L |
| Carpenter 1 | 31-101-26014-00-00 | 4/1/2009 | Troupsburg (Steuben) | Gross Alpha | 7,974 +/- 1,800 pCi/L |
| | | | | Gross Beta | 1,627 +/- 736 pCi/L |
| | | | | Cesium-137 | 2.26 +/- 4.97 pCi/L |
| | | | | Cobalt-60 | -0.500 +/- 3.84 pCi/L |
| | | | | Ruthenium-106 | 49.3 +/- 38.1 pCi/L |
| | | | | Zirconium-95 | 30.4 +/- 11.0 pCi/L |
| | | | | Radium-226 | 5,352 +/- 1,051 pCi/L |
| | | | | Radium-228 | 138 +/- 37.3 pCi/L |
| | | | | Thorium-228 | 94.1 +/- 14.9 pCi/L |
| | | | | Thorium-230 | 1.80 +/- 0.946 pCi/L |
| | | | | Thorium-232 | 0.240 +/- 0.472 pCi/L |
| | | | | Uranium-234 | 0.000 +/- 0.005 pCi/L |
| | | | | Uranium-235 | 0.000 +/- 0.005 pCi/L |
| | | | | Uranium-238 | -0.184 +/- 0.257 pCi/L |
| Zinck 1 | 31-101-26015-00-00 | 4/1/2009 | Woodhull (Steuben) | Gross Alpha | 9,426 +/- 2,065 pCi/L |
| | | | | Gross Beta | 2,780 +/- 879 pCi/L |
| | | | | Cesium-137 | 5.47 +/- 5.66 pCi/L |
| | | | | Cobalt-60 | 0.547 +/- 4.40 pCi/L |
| | | | | Ruthenium-106 | -16.600 +/- 42.8 pCi/L |
| | | | | Zirconium-95 | 48.0 +/- 15.1 pCi/L |
| | | | | Radium-226 | 4,049 +/- 807 pCi/L |
| | | | | Radium-228 | 826 +/- 160 pCi/L |
| | | | | Thorium-228 | 89.1 +/- 14.7 pCi/L |
| | | | | Thorium-230 | 0.880 +/- 1.23 pCi/L |
| | | | | Thorium-232 | 0.000 +/- 0.705 pCi/L |
| | | | | Uranium-234 | -0.813 +/- 0.881 pCi/L |
| | | | | Uranium-235 | -0.325 +/- 0.323 pCi/L |
| | | | | Uranium-238 | -0.488 +/- 0.816 pCi/L |

| Well | API # | Date Collected | Town (County) | Parameter | Result +/- Uncertainty |
|---|---|---|---|---|---|
| Schiavone 2 | 31-097-23226-00-01 | 4/6/2009 | Reading (Schuyler) | Gross Alpha | 16,550 +/- 3,355 pCi/L |
| | | | | Gross Beta | 1,323 +/- 711 pCi/L |
| | | | | Cesium-137 | 1.46 +/- 5.67 pCi/L |
| | | | | Cobalt-60 | -2.550 +/- 5.11 pCi/L |
| | | | | Ruthenium-106 | 20.6 +/- 42.7 pCi/L |
| | | | | Zirconium-95 | 30.6 +/- 12.1 pCi/L |
| | | | | Radium-226 | 15,140 +/- 2,989 pCi/L |
| | | | | Radium-228 | 957 +/- 181 pCi/L |
| | | | | Thorium-228 | 38.7 +/- 7.45 pCi/L |
| | | | | Thorium-230 | 1.68 +/- 1.19 pCi/L |
| | | | | Thorium-232 | 0.153 +/- 0.301 pCi/L |
| | | | | Uranium-234 | 3.82 +/- 2.48 pCi/L |
| | | | | Uranium-235 | 0.354 +/- 0.779 pCi/L |
| | | | | Uranium-238 | 0.354 +/- 0.923 pCi/L |
| Parker 1 | 31-017-26117-00-00 | 4/2/2009 | Oxford (Chenango) | Gross Alpha | 3,914 +/- 813 pCi/L |
| | | | | Gross Beta | 715 +/- 202 pCi/L |
| | | | | Cesium-137 | 4.12 +/- 3.29 pCi/L |
| | | | | Cobalt-60 | -1.320 +/- 2.80 pCi/L |
| | | | | Ruthenium-106 | -9.520 +/- 24.5 pCi/L |
| | | | | Zirconium-95 | 1.39 +/- 6.35 pCi/L |
| | | | | Radium-226 | 1,779 +/- 343 pCi/L |
| | | | | Radium-228 | 201 +/- 38.9 pCi/L |
| | | | | Thorium-228 | 15.4 +/- 3.75 pCi/L |
| | | | | Thorium-230 | 1.25 +/- 0.835 pCi/L |
| | | | | Thorium-232 | 0.000 +/- 0.385 pCi/L |
| | | | | Uranium-234 | 1.82 +/- 1.58 pCi/L |
| | | | | Uranium-235 | 0.304 +/- 0.732 pCi/L |
| | | | | Uranium-238 | 0.304 +/- 0.732 pCi/L |
| WGI 10 | 31-097-23930-00-00 | 4/6/2009 | Dix (Schuyler) | Gross Alpha | 10,970 +/- 2,363 pCi/L |
| | | | | Gross Beta | 1,170 +/- 701 pCi/L |
| | | | | Cesium-137 | 1.27 +/- 5.17 pCi/L |
| | | | | Cobalt-60 | 0.960 +/- 4.49 pCi/L |
| | | | | Ruthenium-106 | 14.5 +/- 37.5 pCi/L |
| | | | | Zirconium-95 | 15.2 +/- 8.66 pCi/L |
| | | | | Radium-226 | 6,125 +/- 1,225 pCi/L |
| | | | | Radium-228 | 516 +/- 99.1 pCi/L |
| | | | | Thorium-228 | 130 +/- 20.4 pCi/L |
| | | | | Thorium-230 | 2.63 +/- 1.39 pCi/L |
| | | | | Thorium-232 | 0.444 +/- 0.213 pCi/L |
| | | | | Uranium-234 | 0.000 +/- 0.702 pCi/L |
| | | | | Uranium-235 | 1.17 +/- 1.39 pCi/L |
| | | | | Uranium-238 | 0.389 +/- 1.01 pCi/L |

| Well | API # | Date Collected | Town (County) | Parameter | Result +/- Uncertainty |
|---|---|---|---|---|---|
| WGI 11 | 31-097-23949-00-00 | 4/6/2009 | Dix (Schuyler) | Gross Alpha | 20,750 +/- 4,117 pCi/L |
| | | | | Gross Beta | 2,389 +/- 861 pCi/L |
| | | | | Cesium-137 | 4.78 +/- 6.95 pCi/L |
| | | | | Cobalt-60 | -0.919 +/- 5.79 pCi/L |
| | | | | Ruthenium-106 | -19.700 +/- 49.8 pCi/L |
| | | | | Zirconium-95 | 9.53 +/- 11.8 pCi/L |
| | | | | Radium-226 | 10,160 +/- 2,026 pCi/L |
| | | | | Radium-228 | 1,252 +/- 237 pCi/L |
| | | | | Thorium-228 | 47.5 +/- 8.64 pCi/L |
| | | | | Thorium-230 | 1.55 +/- 1.16 pCi/L |
| | | | | Thorium-232 | -0.141 +/- 0.278 pCi/L |
| | | | | Uranium-234 | 0.493 +/- 0.874 pCi/L |
| | | | | Uranium-235 | 0.000 +/- 0.540 pCi/L |
| | | | | Uranium-238 | -0.123 +/- 0.172 pCi/L |

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New York State

DEC

# Appendix 14

## Department of Public Service Environmental Management & Construction Standards and Practices – Pipelines

Revised Draft
Supplemental Generic Environmental Impact Statement

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**ENVIRONMENTAL MANAGEMENT AND CONSTRUCTION**

**STANDARDS AND PRACTICES**

**CHECK-OFF LIST: PART III**

**PIPELINE**


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New York State

DEC

# Appendix 15

## Hydraulic Fracturing – 15 Statements from Regulatory Officials

Revised Draft
Supplemental Generic Environmental Impact Statement

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# Part A

# GWPC's Congressional Testimony

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STATEMENT OF
SCOTT KELL
ON BEHALF OF THE
GROUND WATER PROTECTION COUNCIL

HOUSE COMMITTEE ON NATURAL RESOURCES
SUBCOMMITTEE ON ENERGY AND MINERAL RESOURCES
WASHINGTON, D.C.
JUNE 4, 2009

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Mr. Chairman, thank you for the opportunity to testify today. My name is Scott Kell. I am President of the Ground Water Protection Council (GWPC) and appear here today on its behalf. I am also Deputy Chief of the Ohio Department of Natural Resources Division of Mineral Resources Management. With me today are Mike Paque, Executive Director of the GWPC, Dave Bolin, Assistant Director of the Alabama Oil and Gas Board, and Lori Wrotenbery, Director of the Oklahoma Corporation Commission's Oil and Gas Conservation Division. Within our respective States, we are responsible for implementing the state regulations governing the exploration and development of oil and natural gas resources. First and foremost, we are resource protection professionals committed to stewardship of water resources in the exercise of our authority.

The GWPC is a non-profit association of state agencies responsible for environmental safeguards related to ground water. The members of the association consist of state ground water and underground injection control regulators. The GWPC provides a forum through which its state members work with federal scientists and regulators, environmental groups, industry, and other stakeholders to advance protection of ground water resources through development of policy and regulation that is based on sound science. I have included a list of the GWPC Board of Directors in our written submission.

The GWPC understands that our nation's water and energy needs are intertwined, and that demand for both resources is increasing. Smart energy policy will consider and minimize impacts to water resources.

With respect to the protection of water resources, the GWPC recently published two reports of note. The first of these reports is called *Modern Shale Gas Development in the United States: A Primer (http://www.gwpc.org/e-library/documents/general/Shale%20Gas%20Primer%202009.pdf)*. The primer discusses the regulatory framework, policy issues, and technical aspects of developing unconventional shale gas resources. As you know, there are numerous deep shale gas basins in the United States, which contain trillions of cubic feet of natural gas. The environmentally responsible development of these resources is of critical importance to the energy security of the U.S. Recently, however, there has been concern raised about the methods used to tap these valuable resources. Technologies such as

hydraulic fracturing have been characterized as being environmentally risky and inadequately regulated. The primer is designed to provide accurate technical information to assist policy makers in their understanding of these issues.

In recent months, the states have become aware of press reports and websites alleging that six states have documented over one thousand incidents of ground water contamination resulting from the practice of hydraulic fracturing. Such reports are not accurate. Attached to my testimony are signed statements from state officials representing Ohio, Pennsylvania, New Mexico, Alabama, and Texas, responding to these allegations.

From the standpoint of the GWPC, the most critical issue is protection of water resources. As such, our goal is to ensure that oil and gas development is managed in a way that does not create unnecessary and unwarranted risks to water. As a state regulatory official, I can assure you that our regulations are focused on this task. This leads me to the second report the GWPC has recently published.

This report, entitled *State Oil and Gas Regulations Designed to Protect Water Resources,* (http://www.gwpc.org/e-library/documents/general/Oil%20and%20Gas%20Regulation%20Report%20Final%20with%20Cover%205-27-2009.pdf) evaluates regulations implemented by state oil and gas regulatory agencies as they relate to the protection of water. To prepare this report, the GWPC reviewed the regulations of the twenty-seven states that, when combined, account for more than 99.8% of all the oil and natural gas extracted in the U.S. annually. To prepare this report, each state's regulatory requirements were studied with respect to their water protection capacity. The study evaluated regulated processes such as well drilling, construction, and plugging, above-ground storage tanks, pits and a number of other topics. The report also contains a statistical analysis of state regulations. As a result of our regulatory review and analysis, the GWPC concluded that state oil and gas regulations are adequately designed to directly protect water resources through the application of specific programmatic elements such as permitting, well construction, hydraulic fracturing, waste handling, and well plugging requirements. While State regulations are generally adequate, the GWPC report makes the following recommendations.

First, a study of effective hydraulic fracturing practices should be considered for the purpose of developing Best Management Practices (BMPs) that can be adjusted to fit the specific conditions of individual states. A one-size-fits-all federal program is not the most effective way to regulate in this area. BMPs related to hydraulic fracturing would assist states and operators in ensuring the safety of the practice. Of special concern are zones in close proximity to underground sources of drinking water, as determined by the state regulatory authority.

Second, the state review process conducted by the national non-profit organization State Review of Oil and Natural Gas Environmental Regulations (STRONGER) is an effective tool in assessing the capability of state programs to manage exploration and production waste and in measuring program improvement over time. This process should be expanded, where appropriate, to include state oil and gas programmatic

elements not covered by the current state review guidelines. STRONGER is currently convening a stakeholder workgroup to consider drafting guidelines for state regulation of hydraulic fracturing.

Finally, the GWPC concludes that implementation and advancement of electronic data management systems has enhanced state regulatory capacity and focus. However, further work is needed in the areas of paper-to-digital data conversion and inclusion of more environmental, or water related data. States should continue to develop comprehensive electronic data management systems and incorporate widely scattered environmental data as expeditiously as possible. Federal agencies should provide financial assistance to states in these efforts.

In conclusion, Mr. Chairman and Committee Members, we believe that state regulations are designed to provide the level of water protection needed to assure water resources remain both viable and available. The states are continuously striving to improve both the regulatory language and the programmatic tools used to implement that language. In this regard, the GWPC will continue to assist states with their regulatory needs for the purpose of protecting water, our most vital natural resource.

Thank you.

**DISCLOSURE REQUIREMENT**
**Required by House Rule XI, clause 2(g)**
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9. Any federal grants or contracts (including subgrants or subcontracts) from the Department of the Interior (and /or other agencies invited) which **you** have received in the last three years, including the source and the amount of each grant or contract: **Office of Surface Mining, 2008 National Technology Transfer Grant, RBDMS-W, $200,000**

10. Any federal grants or contracts (including subgrants or subcontracts) the Department of the Interior (and /or other agencies invited) which were received in the last three years by the **organization(s) which you represent** at this hearing, including the source and amount of each grant or contract: **Office of Surface Mining, 2008 National Technology Transfer Grant, RBDMS-W, $200,000**

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*Attachment 1 – GWPC Testimony to the House Committee on Natural Resources, Subcommittee on energy and Mineral Resources, June 4, 2009*

# State Oil and Natural Gas Regulations Designed to Protect Water Resources

## EXECUTIVE SUMMARY

Over the past several years the GWPC has been asked, "Do state oil and gas regulations protect water?" How do their rules apply? Are they adequate? The first step in answering these questions is to evaluate the regulatory frameworks within which programs operate. That is the purpose of this report.

State regulation of oil and natural gas exploration and production activities are approved under state laws that typically include a prohibition against causing harm to the environment. This premise is at the heart of the regulatory process. The regulation of oil and gas field activities is managed best at the state level where regional and local conditions are understood and where regulations can be tailored to fit the needs of the local environment. Hence, the experience, knowledge and information necessary to regulate effectively most commonly rests with state regulatory agencies. Many state agencies use programmatic tools and documents to apply state laws including regulations, formal and informal guidance, field rules, and Best Management Practices (BMPs). They are also equipped to conduct field inspections, enforcement/oversight, and witnessing of specific operations like well construction, testing and plugging.

Regulations alone cannot convey the full measure of a regulatory program. To gain a more complete understanding of how regulatory programs actually function, one has to evaluate the use of state guides, manuals, environmental policy processes, environmental impact statements, requirements established by permit and many other practices. However, that is not the purpose of this study. This study evaluates the language of state oil and gas regulations as they relate to the direct protection of water resources. It is not an evaluation of state programs.

To conduct the study, state oil and gas regulations were reviewed in the following areas: 1) permitting, 2) well construction, 3) hydraulic fracturing, 4) temporary abandonment, 5) well plugging, 6) tanks, 7) pits, and 8) waste handling and spills. Within each area specific sub-areas were included to broaden the scope of this review. For example, in the area of pits, a review was conducted of sub-areas such as pit liners, siting, construction, use, duration and closure. The selection of the twenty-seven states for this study was based upon the last full-year list (2007) of producing states compiled by the U.S. Energy Information Administration.

In the area of well construction, state regulations were evaluated to determine whether the setting of surface casing below ground water zones was required, whether cement circulation on surface casing was also required, and whether the state utilized recognized cement standards. Attachment 3 is a listing of the programmatic areas and sub-areas reviewed.

After evaluation, each state was given the opportunity to review and comment on the findings and to provide updated information concerning their regulations. Thirteen states responded. These responses were incorporated into the study.

One of the most important accomplishments of the study was the development of a regulations reference document (Addendum). This document contains excerpted language from each state's oil and gas regulations related to the programmatic areas included in the study. Hyperlinks to web versions of each

state's oil and gas regulations are included as well as some of the forms used by state agencies to implement those regulations. A web enabled version of the study (to be completed by September, 2009) will also contain numerous hyperlinked text segments designed to provide the reader with an easy and effective way to review references and regulations.

**Key Messages and Suggested Actions:**

Key Message 1: State oil and gas regulations are adequately designed to directly protect water resources through the application of specific programmatic elements such as permitting, well construction, well plugging, and temporary abandonment requirements.

Suggested Action 1: States should review current regulations in several programmatic areas to determine whether or not they meet an appropriate level of specificity (e.g. use of standard cements, plugging materials, pit liners, siting criteria, and tank construction standards etc…)

Key Message 2: Experience suggests that state oil and gas regulations related to well construction are designed to be protective of ground water resources relative to the potential effects of hydraulic fracturing. However, development of Best Management Practices (BMPs) related to hydraulic fracturing would assist states and operators in insuring continued safety of the practice; especially as it relates to hydraulic fracturing of zones in close proximity to ground water, as determined by the regulatory authority.

Suggested Action 2: A study of effective hydraulic fracturing practices should be considered for the purpose of developing (BMPs); which can be adjusted to fit the specific conditions of individual states.

Key Message 3: Many states divide jurisdiction over certain elements of oil and gas regulation between the oil and gas agency and other state water protection agencies. This is particularly evident in the areas of waste handling and spill management.

Suggested Action 3: States with split jurisdiction of programs should insure that formal memorandums of agreement (MOAs) between agencies exist and that these MOAs are maintained to provide more effective and efficient implementation of regulations.

Key Message 4: The state review process conducted by the national non-profit organization State Review of Oil and Natural Gas Environmental Regulations (STRONGER) is an effective tool in assessing the capability of state programs to manage exploration and production waste and in measuring program improvement over time.

Suggested Action 4: The state review process should be continued and, where appropriate, expanded to include state oil and gas programmatic elements not covered by the current state review guidelines.

Key Message 5: The implementation and advancement of electronic data management systems has enhanced regulatory capacity and focus. However, further work is needed in the areas of paper-to-digital data conversion and inclusion of more environmental data.

Suggested Action 5: States should continue to develop and install comprehensive electronic data management systems, convert paper records to electronic formats and incorporate widely scattered environmental data as expeditiously as possible. Federal agencies should provide financial assistance to states in these efforts.

*Attachment 2 – GWPC Testimony to the House Committee on Natural Resources, Subcommittee on energy and Mineral Resources, June 4, 2009*

# Modern Shale Gas Development in the United States: A Primer

## EXECUTIVE SUMMARY

Natural gas production from hydrocarbon rich shale formations, known as "shale gas," is one of the most rapidly expanding trends in onshore domestic oil and gas exploration and production today. In some areas, this has included bringing drilling and production to regions of the country that have seen little or no activity in the past. New oil and gas developments bring change to the environmental and socio-economic landscape, particularly in those areas where gas development is a new activity. With these changes have come questions about the nature of shale gas development, the potential environmental impacts, and the ability of the current regulatory structure to deal with this development. Regulators, policy makers, and the public need an objective source of information on which to base answers to these questions and decisions about how to manage the challenges that may accompany shale gas development.

Natural gas plays a key role in meeting U.S. energy demands. Natural gas, coal and oil supply about 85% of the nation's energy, with natural gas supplying about 22% of the total. The percent contribution of natural gas to the U.S. energy supply is expected to remain fairly constant for the next 20 years.

The United States has abundant natural gas resources. The Energy Information Administration estimates that the U.S. has more than 1,744 trillion cubic feet (tcf) of technically recoverable natural gas, including 211 tcf of proved reserves (the discovered, economically recoverable fraction of the original gas-in-place). Technically recoverable unconventional gas (shale gas, tight sands, and coalbed methane) accounts for 60% of the onshore recoverable resource. At the U.S. production rates for 2007, about 19.3 tcf, the current recoverable resource estimate provides enough natural gas to supply the U.S. for the next 90 years. Separate estimates of the shale gas resource extend this supply to 116 years.

Natural gas use is distributed across several sectors of the economy. It is an important energy source for the industrial, commercial and electrical generation sectors, and also serves a vital role in residential heating. Although forecasts vary in their outlook for future demand for natural gas, they all have one thing in common: natural gas will continue to play a significant role in the U.S. energy picture for some time to come.

The lower 48 states have a wide distribution of highly organic shales containing vast resources of natural gas. Already, the fledgling Barnett Shale play in Texas produces 6% of all natural gas produced in the lower 48 States. Three factors have come together in recent years to make shale gas production economically viable: 1) advances in horizontal drilling, 2) advances in hydraulic fracturing, and, perhaps most importantly, 3) rapid increases in natural gas prices in the last several years as a result of significant supply and demand pressures. Analysts have estimated that by 2011 most new reserves growth (50% to 60%, or approximately 3 bcf/day) will come from unconventional shale gas reservoirs. The total recoverable gas resources in four new shale gas plays (the Haynesville, Fayetteville, Marcellus, and Woodford) may be over 550 tcf. Total annual production volumes of 3 to 4 tcf may be sustainable for decades. This potential for production in the

known onshore shale basins, coupled with other unconventional gas plays, is predicted to contribute significantly to the U.S.'s domestic energy outlook.

Shale gas is present across much of the lower 48 States. The most active shales to date are the Barnett Shale, the Haynesville/Bossier Shale, the Antrim Shale, the Fayetteville Shale, the Marcellus Shale, and the New Albany Shale. Each of these gas shale basins is different and each has a unique set of exploration criteria and operational challenges. Because of these differences, the development of shale gas resources in each of these areas faces potentially unique opportunities and challenges.

The development and production of oil and gas in the U.S., including shale gas, are regulated under a complex set of federal, state, and local laws that address every aspect of exploration and operation. All of the laws, regulations, and permits that apply to conventional oil and gas exploration and production activities also apply to shale gas development. The U.S. Environmental Protection Agency administers most of the federal laws, although development on federally-owned land is managed primarily by the Bureau of Land Management (part of the Department of the Interior) and the U.S. Forest Service (part of the Department of Agriculture). In addition, each state in which oil and gas is produced has one or more regulatory agencies that permit wells, including their design, location, spacing, operation, and abandonment, as well as environmental activities and discharges, including water management and disposal, waste management and disposal, air emissions, underground injection, wildlife impacts, surface disturbance, and worker health and safety. Many of the federal laws are implemented by the states under agreements and plans approved by the appropriate federal agencies.

A series of federal laws governs most environmental aspects of shale gas development. For example, the Clean Water Act regulates surface discharges of water associated with shale gas drilling and production, as well as storm water runoff from production sites. The Safe Drinking Water Act regulates the underground injection of fluids from shale gas activities. The Clean Air Act limits air emissions from engines, gas processing equipment, and other sources associated with drilling and production. The National Environmental Policy Act (NEPA) requires that exploration and production on federal lands be thoroughly analyzed for environmental impacts. Most of these federal laws have provisions for granting "primacy" to the states (i.e., state agencies implement the programs with federal oversight).

State agencies not only implement and enforce federal laws; they also have their own sets of state laws to administer. The states have broad powers to regulate, permit, and enforce all shale gas development activities—the drilling and fracture of the well, production operations, management and disposal of wastes, and abandonment and plugging of the well. State regulation of the environmental practices related to shale gas development, usually with federal oversight, can more effectively address the regional and state-specific character of the activities, compared to one-sizefits-all regulation at the federal level. Some of these specific factors include: geology, hydrology, climate, topography, industry characteristics, development history, state legal structures, population density, and local economics. State laws often add additional levels of environmental protection and requirements. Also, several states have their own versions of the federal NEPA law, requiring environmental assessments and reviews at the state level and extending those reviews beyond federal lands to state and private lands.

A key element in the emergence of shale gas production has been the refinement of cost-effective horizontal drilling and hydraulic fracturing technologies. These two processes, along with the implementation of protective environmental management practices, have allowed shale gas

development to move into areas that previously would have been inaccessible. Accordingly, it is important to understand the technologies and practices employed by the industry and their ability to prevent or minimize the potential effects of shale gas development on human health and the environment and on the quality of life in the communities in which shale gas production is located.

Modern shale gas development is a technologically driven process for the production of natural gas resources. Currently, the drilling and completion of shale gas wells includes both vertical and horizontal wells. In both kinds of wells, casing and cement are installed to protect fresh and treatable water aquifers. The emerging shale gas basins are expected to follow a trend similar to the Barnett Shale play with increasing numbers of horizontal wells as the plays mature. Shale gas operators are increasingly relying on horizontal well completions to optimize recovery and well economics. Horizontal drilling provides more exposure to a formation than does a vertical well. This increase in reservoir exposure creates a number of advantages over vertical wells drilling. Six to eight horizontal wells drilled from only one well pad can access the same reservoir volume as sixteen vertical wells. Using multi-well pads can also significantly reduce the overall number of well pads, access roads, pipeline routes, and production facilities required, thus minimizing habitat disturbance, impacts to the public, and the overall environmental footprint.

The other technological key to the economic recovery of shale gas is hydraulic fracturing, which involves the pumping of a fracturing fluid under high pressure into a shale formation to generate fractures or cracks in the target rock formation. This allows the natural gas to flow out of the shale to the well in economic quantities. Ground water is protected during the shale gas fracturing process by a combination of the casing and cement that is installed when the well is drilled and the thousands of feet of rock between the fracture zone and any fresh or treatable aquifers. For shale gas development, fracture fluids are primarily water based fluids mixed with additives that help the water to carry sand proppant into the fractures. Water and sand make up over 98% of the fracture fluid, with the rest consisting of various chemical additives that improve the effectiveness of the fracture job. Each hydraulic fracture treatment is a highly controlled process designed to the specific conditions of the target formation.

The amount of water needed to drill and fracture a horizontal shale gas well generally ranges from about 2 million to 4 million gallons, depending on the basin and formation characteristics. While these volumes may seem very large, they are small by comparison to some other uses of water, such as agriculture, electric power generation, and municipalities, and generally represent a small percentage of the total water resource use in each shale gas area. Calculations indicate that water use for shale gas development will range from less than 0.1% to 0.8% of total water use by basin. Because the development of shale gas is new in some areas, these water needs may still challenge supplies and infrastructure. As operators look to develop new shale gas plays, communication with local water planning agencies, state agencies, and regional water basin commissions can help operators and communities to coexist and effectively manage local water resources. One key to the successful development of shale gas is the identification of water supplies capable of meeting the needs of a development company for drilling and fracturing water without interfering with community needs. While a variety of options exist, the conditions of obtaining water are complex and vary by region.

After the drilling and fracturing of the well are completed, water is produced along with the natural gas. Some of this water is returned fracture fluid and some is natural formation water. Regardless of the source, these produced waters that move back through the wellhead with the gas represent a stream that must be managed. States, local governments, and shale gas operators seek to manage produced water in a way that protects surface and ground water resources and, if possible, reduces

future demands for fresh water. By pursuing the pollution prevention hierarchy of "Reduce, Re-use, and Recycle" these groups are examining both traditional and innovative approaches to managing shale gas produced water. This water is currently managed through a variety of mechanisms, including underground injection, treatment and discharge, and recycling. New water treatment technologies and new applications of existing technologies are being developed and used to treat shale gas produced water for reuse in a variety of applications. This allows shale gas-associated produced water to be viewed as a potential resource in its own right.

Some soils and geologic formations contain low levels of naturally occurring radioactive material (NORM). When NORM is brought to the surface during shale gas drilling and production operations, it remains in the rock pieces of the drill cuttings, remains in solution with produced water, or, under certain conditions, precipitates out in scales or sludges. The radiation from this NORM is weak and cannot penetrate dense materials such as the steel used in pipes and tanks.

Because the general public does not come into contact with gas field equipment for extended periods, there is very little exposure risk from gas field NORM. To protect gas field workers, OSHA requires employers to evaluate radiation hazards, post caution signs and provide personal protection equipment when radiation doses could exceed regulatory standards. Although regulations vary by state, in general, if NORM concentrations are less than regulatory standards, operators are allowed to dispose of the material by methods approved for standard gas field waste. Conversely, if NORM concentrations are above regulatory limits, the material must be disposed of at a licensed facility. These regulations, standards, and practices ensure that shale gas operations present negligible risk to the general public and to workers with respect to potential NORM exposure.

Although natural gas offers a number of environmental benefits over other sources of energy, particularly other fossil fuels, some air emissions commonly occur during exploration and production activities. Emissions may include $NO_x$, volatile organic compounds, particulate matter, $SO_2$, and methane. EPA sets standards, monitors the ambient air across the U.S., and has an active enforcement program to control air emissions from all sources, including the shale gas industry. Gas field emissions are controlled and minimized through a combination of government regulation and voluntary avoidance, minimization, and mitigation strategies.

The primary differences between modern shale gas development and conventional natural gas development are the extensive uses of horizontal drilling and high-volume hydraulic fracturing. The use of horizontal drilling has not introduced any new environmental concerns. In fact, the reduced number of horizontal wells needed coupled with the ability to drill multiple wells from a single pad has significantly reduced surface disturbances and associated impacts to wildlife, dust , noise, and traffic. Where shale gas development has intersected with urban and industrial settings, regulators and industry have developed special practices to alleviate nuisance impacts, impacts to sensitive environmental resources, and interference with existing businesses. Hydraulic fracturing has been a key technology in making shale gas an affordable addition to the Nation's energy supply, and the technology has proved to be an effective stimulation technique. While some challenges exist with water availability and water management, innovative regional solutions are emerging that allow shale gas development to continue while ensuring that the water needs of other users are not affected and that surface and ground water quality is protected. Taken together, state and federal requirements along with the technologies and practices developed by industry serve to reduce environmental impacts from shale gas operations.

# Ohio Department of Natural Resources

TED STRICKLAND, GOVERNOR | SEAN D. LOGAN, DIRECTOR

***John F. Husted, Chief***
*Division of Mineral Resources Management*
*2045 Morse Road, Building H-3*
*Columbus, OH 43229-6693*
*Phone: (614) 265-6633 Fax: (614) 265-7999*

May 27, 2009

Mike Paque
Executive Director
Ground Water Protection Council
13309 North MacArthur Boulevard
Oklahoma City, Oklahoma 73142

Dear Mike:

In recent months, the Ohio Department of Natural Resources, Division of Mineral Resources Management (DMRM) has become aware of website and media releases reporting that the State of Ohio has documented cases of ground water contamination caused by the standard industry practice of hydraulic fracturing. Such reports are not accurate. For example, some articles inaccurately portrayed hydraulic fracturing as the cause of a natural gas incident in Bainbridge Township of Geauga County that resulted in an in-home explosion in December 2007. This portrayal is not consistent with the findings or conclusions of the DMRM.

DMRM completed a thorough investigation into the cause of a natural gas invasion into fresh water aquifers in Bainbridge Township. The DMRM investigation found that this incident was caused by a defective primary cement job on the production casing, which was further complicated by operator error. As a consequence of this finding, the operator corrected the construction problem by completing remedial cementing operations. The findings and conclusions of this investigation are available on the web at http://www.dnr.state.oh.us/bainbridge/tabid/20484/default.aspx.

While an explosion significantly damaged one house, the investigation did not find any evidence to support the claim "that pressure caused by hydraulic fracturing pushed the gas...through a system of cracks into the ground water aquifer" as reported by some media accounts. In actuality, the team of geologists who completed the evaluation of the gas invasion incident in Bainbridge Township concluded that the problem would have occurred even if the well had never been stimulated by hydraulic fracturing.

After 25 years of investigating citizen complaints of contamination, DMRM geologists have not documented a single incident involving contamination of ground water attributed to hydraulic fracturing. Over this time, the Ohio DMRM has consistently taken decisive action to address oil and gas exploration and production practices that have caused documented incidents of ground water contamination. The DMRM has initiated amendments to statutes and rules, designed permit conditions, refined standards

operating procedures, and developed best management practices to improve protection of ground water resources. These actions resulted in substantive changes including:

1. elimination of tens of thousands of earthen pits for produced water storage;
2. development of a model Class II brine injection well program;
3. development of technical standards for synthetic liners used in pits during drilling operations;
4. tighter standards for construction and mechanical integrity testing for annular disposal wells;
5. detailed plugging regulations; and,
6. establishment of an orphaned well plugging program funded by a severance tax on oil and gas production.

The Ohio DMRM will continue to assign the highest priority to improving protection of water resources and public health and safety.

In conclusion, the Ohio DMRM has not identified hydraulic fracturing as a significant threat to ground water resources.

Sincerely,

Scott R. Kell, Deputy Chief

SRK/csc

Enclosure

cc: Cathryn Loucas, Deputy Director, ODNR
Mike Shelton, Chief, Legislative Services, ODNR
John Husted, Chief, DMRM

Pennsylvania Department of Environmental Protection

**Rachel Carson State Office Building**
**P.O. Box 8555**
**Harrisburg, PA 17105-8555**
June 1, 2009

**Bureau of Watershed Management** 717-772-4048

Michael Paque, Executive Director
Ground Water Protection Council
13308 North MacArthur Boulevard
Oklahoma City, OK 73142

Dear Mr. Paque:

I am the program manager for Pennsylvania's Ground Water Protection Program in the Pennsylvania Department of Environmental Protection (DEP). I have been concerned about press reports stating extensive groundwater pollution and contamination of underground sources of drinking water in Pennsylvania, as a result of hydraulic fracturing to stimulate gas production from deep, gas bearing rock formations. DEP has not concluded that the activity of hydraulic fracturing of these formations has caused wide-spread groundwater contamination.

After review of DEP's complaint database and interviews with regional staff that investigate groundwater contamination related to oil and gas activities, no groundwater pollution or disruption of underground sources of drinking water has been attributed to hydraulic fracturing of deep gas formations. All investigated cases that have found pollution, which are less then 80 in over 15 years of records, have been primarily related to physical drilling through the aquifers, improper design or setting of upper and middle well casings, or operator negligence.

If you have any questions or concerns, you may contact me by e-mail at josless@state.pa.us or by telephone at 717-772-4048.

Sincerely,

Joseph J. Lee, Jr., P.G., chief
Source Protection Section
Division of Water Use Planning

New Mexico Energy, Minerals and Natural Resources Department

Mark Fesmire
Division Director
Oil Conservation Division

May 29, 2009

Mr. Michael Paque, Executive Director
Ground Water Protection Council
13308 N. MacArthur Blvd.
Oklahoma City, OK 73142

Dear Mike:

As per your request, I have reviewed the New Mexico Oil Conservation Division Data concerning water contamination caused by Hydraulic Fracturing in New Mexico.

While we do currently list approximately 421 ground water contamination cases caused by pits and approximately an equal number caused by other contamination mechanisms, we have found no example of contamination of usable water where the cause was claimed to be hydraulic fracturing.

Sincerely,

Mark E. Fesmire, PE
Director, New Mexico Oil Conservation Division

Oil Conservation Division
1220 South St. Francis Drive • Santa Fe, New Mexico 87505
Phone (505) 476-3440 • Fax (505) 476-3462 • www.emnrd.state.nm.us/OCD

# *STATE OIL AND GAS BOARD OF ALABAMA*

***OIL AND GAS BOARD***
*James H. Griggs, Chairman*
*Charles E. (Ward) Pearson, Vice Chairman*
*Rebecca Wright Pritchett, Member*
*Berry H. (Nick) Tew, Jr., Secretary*
*S. Marvin Rogers, Counsel*

*420 Hackberry Lane*
*P.O. Box 869999*
*Tuscaloosa, Alabama 35486-6999*
*Phone (205)349-2852*
*Fax (205)349-2861*
*www.ogb.state.al.us*

***Berry H. (Nick) Tew, Jr.***
*Oil and Gas Supervisor*

May 27, 2009

Mr. Michel Paque, Executive Director
Ground Water Protection Council
13308 N. MacArthur Blvd.
Oklahoma City, OK 73142

Dear Mr. Paque:

This letter is in response to your recent inquiry regarding any cases of drinking water contamination that have resulted from hydraulic fracturing operations to stimulate oil and gas wells in Alabama. I can state with authority that there have been no documented cases of drinking water contamination caused by such hydraulic fracturing operations in our State.

The U.S. Environmental Protection Agency (EPA) approved the State Oil and Gas Board's (Board) Class II Underground Injection Control (UIC) Program in August 1982, pursuant to Section 1425 of the Safe Drinking Water Act (SDWA). This approval was made after EPA determined that the Board's program accomplished the objectives of the SDWA, that being to protect underground sources of drinking water. Obtaining primacy for the Class II UIC Program, however, was not the beginning of the Board's ground-water protection programs. These programs, to include the regulation and approval of hydraulic fracturing operations, have been actively implemented continually since the Board was established in 1945, pursuant to its legislative mandates.

The point to be made here is that the State of Alabama has a vested interest in protecting its drinking water sources and has adequate rules and regulations, as well as statutory mandates, to protect those sources from all oil and gas operations. The fact that there has been no documented case of contamination from these operations, to include hydraulic fracturing, is a testament to the proactive regulation of the industry by the Board. Additional federal regulations will not provide any greater level of protection for our drinking water sources than is currently being provided.

If we can be of further assistance in this matter, please let me know.

Sincerely,

David E. Bolin

David E. Bolin
Deputy Director

# RAILROAD COMMISSION OF TEXAS

**CHAIRMAN VICTOR G. CARRILLO**

May 29, 2009

Mike Paque, Executive Director
Ground Water Protection Agency
13308 N. MacArthur Blvd.
Oklahoma City, OK 73142

Re: Hydraulic Fracturing of Gas Wells in Texas

Dear Mr. Paque:

I am pleased that representatives of the Ground Water Protection Council will be appearing before the U.S. House Committee on Natural Resources next week on the issue of hydraulic fracturing. I was asked to participate but had a longstanding commitment to tour energy projects in Canada that prevented me from personally participating.

I sincerely hope that you will clear up the misconception that there are "thousands" of contamination cases in Texas and other states resulting from hydraulic fracturing. The Railroad Commission of Texas is the chief regulatory agency over oil and gas activities in this state. Though hydraulic fracturing has been used for over 50 years in Texas, our records do not indicate a single documented contamination case associated with hydraulic fracturing.

The Texas Groundwater Protection Committee (TGPC) tracks groundwater pollution in Texas. All Texas water protection agencies, including the Railroad Commission, are members. Each year, the TGPC publishes a Joint Groundwater Monitoring and Contamination Report, which can be found at http://www.tceq.state.tx.us/comm_exec/forms_pubs/pubs/sfr/056_07_index.html. The 2007 report cites a total of 354 active groundwater cases attributed to oil and gas activity – this in a state with over 255,000 active oil and gas wells. The majority of these cases are associated with previous practices that are no longer allowed, or result from activity now prohibited by our existing regulations. A few cases were due to blowouts that primarily occur during drilling activity. *Not one of these cases was caused by hydraulic fracturing activity.*

Hydraulic fracturing plays a key role in the development of virtually all unconventional gas resources in Texas. As of this year, over 11,000 gas wells have been completed (and hydraulically fractured) in the Barnett Shale reservoir, one of the nation's most active and largest natural gas fields. Since 2000, over five trillion cubic feet of gas has been produced from this one reservoir and the Barnett Shale production currently contributes over 20% of Texas' total natural gas production. While the volume of gas-in-place in the Barnett Shale is estimated to be over 27 trillion cubic feet, recovery of the gas is difficult because of the shale's low permeability. The remarkable success of the Barnett Shale results in large part from the use of horizontal drilling coupled with hydraulic fracturing. Even with this intense activity, there are no known instances of ongoing groundwater contamination in the Barnett Shale play.

P.O. Box 12967 ★ Austin, Texas 78711-2967 ★ Phone (512) 463-7131 ★ Fax (512) 463-7161

Regulation of oil and gas exploration and production activities, including hydraulic fracturing, has traditionally been the province of the states. Most oil and gas producing state have had effective programs in place for decades. Regulating hydraulic fracturing as underground injection under the federal Safe Drinking Water Act would impose significant additional costs and regulatory burdens and could ultimately reverse the significant U.S. domestic unconventional gas reserve additions of recent years – harming domestic energy security. I urge the U.S. Congress to leave the regulatory authority over hydraulic fraturing and other oil and gas activities where it belongs – at the state level.

Sincerely,

Victor G. Carrillo, Chairman
Railroad Commission of Texas

cc: Commissioner Michael Williams
Commissioner Elizabeth Ames Jones
John J. Tintera, Executive Director

# Part B

# IOGCC's Statements from Oil & Gas Regulators from 12 Member States

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# REGULATORY STATEMENTS ON HYDRAULIC FRACTURING
# SUBMITTED BY THE STATES
# JUNE 2009

The following statements were issued by state regulators for the record related to hydraulic fracturing in their states. Statements have been compiled for this document.

## ALABAMA:

**Nick Tew, Ph.D., P.G.**
**Alabama State Geologist & Oil and Gas Supervisor**
**President, Association of American State Geologists**

There have been no documented cases of drinking water contamination that have resulted from hydraulic fracturing operations to stimulate oil and gas wells in the State of Alabama.

The U.S. Environmental Protection Agency (EPA) approved the State Oil and Gas Board of Alabama's (Board) Class II Underground Injection Control (UIC) Program in August 1982, pursuant to Section 1425 of the Safe Drinking Water Act (SDWA). This approval was made after EPA determined that the Board's program accomplished the objectives of the SDWA, that is, the protection of underground sources of drinking water. Obtaining primacy for the Class II UIC Program, however, was not the beginning of the Board's ground-water protection programs. These programs, which include the regulation and approval of hydraulic fracturing operations, have been continuously and actively implemented since the Board was established in 1945, pursuant to its mission and legislative mandates.

The State of Alabama, acting through the Board, has a vested interest in protecting its drinking water sources and has adequate rules and regulations, as well as statutory mandates, to protect these sources from all oil and gas operations, including hydraulic fracturing. The fact that there has been no documented case of contamination from these operations, including hydraulic fracturing, is strong evidence of effective regulation of the industry by the Board. In our view, additional federal regulations will not provide any greater level of protection for our drinking water sources than is currently being provided.

## ALASKA:

**Cathy Foerster**
**Commissioner**
**Alaska Oil and Gas Conservation Commission**

There have been no verified cases of harm to ground water in the State of Alaska as a result of hydraulic fracturing.

State regulations already exist in Alaska to protect fresh water sources. Current well construction standards used in Alaska (as required by Alaska Oil and Gas Conservation Commission statutes

and regulations) properly protect fresh drinking waters. Surface casing is always set well below fresh waters and cemented to surface. This includes both injectors and producers as the casing/cementing programs are essentially the same in both types of wells. There are additional casings installed in wells as well as tubing which ultimately connects the reservoir to the surface. The AOGCC requires rigorous testing to demonstrate the effectiveness of these barriers protecting fresh water sources.

By passing this legislation [FRAC Act] it is probable that every oil and gas well within the State of Alaska will come under EPA jurisdiction. EPA will then likely set redundant construction guidelines and testing standards that will merely create duplicate reporting and testing requirements with no benefit to the environment. Additional government employees will be required to monitor the programs, causing further waste of taxpayer dollars.

Material safety data sheets for all materials used in oil and gas operations are required to be maintained on location by Hazard Communication Standards of OSHA. Therefore, requiring such data in the FRAC bill is, again, merely duplicate effort with and accomplishes nothing new.

## COLORADO:

**David Neslin**
**Director**
**Colorado Oil and Gas Conservation Commission**

To the knowledge of the Colorado Oil and Gas Conservation Commission staff, there has been no verified instance of harm to groundwater caused by hydraulic fracturing in Colorado.

## INDIANA:

**Herschel McDivitt**
**Director**
**Indiana Department of Natural Resources**

There have been no instances where the Division of Oil and Gas has verified that harm to groundwater has ever been found to be the result of hydraulic fracturing in Indiana. In fact, we are unaware of any allegations that hydraulic fracturing may be the cause of or may have been a contributing factor to an adverse impact to groundwater in Indiana.

The Division of Oil and Gas is the sole agency responsible for overseeing all aspects of oil and gas production operations as directed under Indiana's Oil and Gas Act. Additionally, the Division of Oil and Gas has been granted primacy by the U.S. Environmental Protection Agency, to implement the Underground Injection Control (UIC) Program for Class II wells in Indiana under the Safe Drinking Water Act.

## KENTUCKY:

**Kim Collings, EEC**
**Director**
**Kentucky Division of Oil and Gas**

In Kentucky, there have been alleged contaminations from citizen complaints but nothing that can be substantiated, in every case the well had surface casing cemented to surface and production casing cemented.

## LOUISIANA:

**James Welsh**
**Commissioner of Conservation**
**Louisiana Department of Natural Resources**

The Louisiana Office of Conservation is unaware of any instance of harm to groundwater in the State of Louisiana caused by the practice of hydraulic fracturing. My office is statutorily responsible for regulation of the oil and gas industry in Louisiana, including completion technology such as hydraulic fracturing, underground injection and disposal of oilfield waste operations, and management of the major aquifers in the State of Louisiana.

## MICHIGAN:

**Harold Fitch**
**Director, Office of Geological Survey**
**Department of Environmental Quality**

My agency, the Office of Geological Survey (OGS) of the Department of Environmental Quality, regulates oil and gas exploration and production in Michigan. The OGS issues permits for oil and gas wells and monitors all aspects of well drilling, completion, production, and plugging operations, including hydraulic fracturing.

Hydraulic fracturing has been utilized extensively for many years in Michigan, in both deep formations and in the relatively shallow Antrim Shale formation. There are about 9,900 Antrim wells in Michigan producing natural gas at depths of 500 to 2000 feet. Hydraulic fracturing has been used in virtually every Antrim well.

There is no indication that hydraulic fracturing has ever caused damage to ground water or other resources in Michigan. In fact, the OGS has never received a complaint or allegation that hydraulic fracturing has impacted groundwater in any way.

## OKLAHOMA:

**Lori Wrotenbery**
**Director, Oil and Gas Conservation Division**
**Oklahoma Corporation Commission**

You asked whether there has been a verified instance of harm to groundwater in our state from the practice of hydraulic fracturing. The answer in no. We have no documentation of such an instance. Furthermore, I have consulted the senior staffs of our Pollution Abatement Department, Field Operations Department, and Technical Services Department, and they have no recollection of having ever received a report, complaint, or allegation of such an instance. We also contacted the senior staffs of the Oklahoma Department of Environmental Quality, who likewise, have no such knowledge or information.

While there have been incidents of groundwater contamination associated with oil and gas drilling and production operations in the State of Oklahoma, none of the documented incidents have been associated with hydraulic fracturing. Our agency has been regulating oil and gas drilling and production operations in the state for over 90 years. Tens of thousands of hydraulic fracturing operations have been conducted in the state in the last 60 years. Had hydraulic fracturing caused harm to groundwater in our state in anything other than a rare and isolated instance, we are confident that we would have identified that harm in the course of our surveillance of drilling and production practices and our investigation of groundwater contamination incidents.

## TENNESSEE:

**Paul Schmierbach**
**Manager**
**Tennessee Department of Environmental Conservation**

We have had no reports of well damage due to fracking.

## TEXAS:

**Victor G. Carrillo**
**Chairman**
**Railroad Commission of Texas**

The practice of reservoir stimulation by hydraulic fracturing has been used safely in Texas for over six decades in tens of thousands of wells across the state.

Recently in his introductory Statement for the Record (June 9, 2009) of the Fracturing Responsibility and Awareness of Chemicals (FRAC) Act, Senator Robert Casey stated:

> "Now, the oil and gas industry would have you believe that there is no threat to drinking water from hydraulic fracturing. But the fact is we are already seeing cases in Pennsylvania, Colorado, Virginia, West Virginia, Alabama, Wyoming, Ohio, Arkansas, Utah, Texas, and New Mexico where residents have become ill or groundwater has become contaminated after hydraulic fracturing operations began in the area."

This statement perpetuates the misconception that there are many surface or groundwater contamination cases in Texas and other states due to hydraulic fracturing. This is not true and here are the facts: Though hydraulic fracturing has been used for over 60 years in Texas, our Railroad Commission records ***do not reflect a single documented surface or groundwater contamination case associated with hydraulic fracturing***.

Hydraulic fracturing plays a key role in the development of unconventional gas resources in Texas. As of this year, over 11,000 gas wells have been completed - and hydraulically fractured - in the Newark East (Barnett Shale) Field, one of the nation's largest and most active natural gas fields. Since 2000, over 5 Tcf (trillion cubic feet) of gas has been produced from this one reservoir and Barnett Shale production currently contributes over 20% of total Texas natural gas production (over 7 Tcf in 2008 – more than a third of total U.S. marketed production). While the volume of gas-in-place in the Barnett Shale is estimated to be over 27 Tcf, conventional recovery of the gas is difficult because of the shale's low permeability. The remarkable success of the Barnett Shale results in large part from the use of horizontal drilling coupled with hydraulic fracturing. Even with this intense activity, there are no known instances of ongoing surface or groundwater contamination in the Barnett Shale play.

Regulating oil and gas exploration and production activities, including hydraulic fracturing, has traditionally been the province of the states, which have had effective programs in place for decades. Regulating hydraulic fracturing as underground injection under the federal Safe Drinking Water Act would impose significant additional costs and regulatory burdens and could ultimately reverse the significant U.S. domestic unconventional gas reserve additions of recent years – substantially harming domestic energy security. Congress should maintain the status quo and let the states continue to responsibly regulate oil and gas activities, including hydraulic fracturing.

In summary, I am aware of no verified instance of harm to groundwater in Texas from the decades long practice of hydraulic fracturing.

## SOUTH DAKOTA:

**Fred Steece**
**Oil and Gas Supervisor**
**Department of Environment and Natural Resource**

Oil and gas wells have been hydraulically fractured, "fracked," in South Dakota since oil was discovered in 1954 and since gas was discovered in 1970. South Dakota has had rules in place, dating back to the 1940's, that require sufficient surface casing and cement to be installed in

wells to protect ground water supplies in the state's oil fields. Producing wells are required to have production casing and cement, and tubing with packers installed. The casing, tubing, and cement are all designed to protect drinking waters of the state as well as to prevent commingling of water and oil and gas in the subsurface. In the 41 years that I have supervised oil and gas exploration, production and development in South Dakota, no documented case of water well or aquifer damage by the fracking of oil or gas wells, has been brought to my attention. Nor am I aware of any such cases before my time.

**WYOMING:**

**Rick Marvel**
**Engineering Manager**
**Wyoming Oil and Gas Conservation Commission**

**Tom Doll**
**Oil and Gas Commission Supervisor**
**Wyoming Oil and Gas Conservation Commission**

- No documented cases of groundwater contamination from fracture stimulations in Wyoming.

- No documented cases of groundwater contamination from UIC regulated wells in Wyoming.

- Wyoming took primacy over UIC Class II wells in 1982, currently 4,920 Class II wells permitted.

Wyoming's 2008 activity:

- Powder River Basin Coalbed Wells – 1,699 new wells, no fracture stimulation.
- Rawlins Area (deeper) Coalbed Wells – 109 new wells, 100% fracture stimulated.
- Statewide Conventional Gas Wells – 1,316 new wells, 100% fracture stimulated – many wells with multi-zone fracture stimulations in each well bore, some staged and some individual fracture stimulations.
- Statewide Oil Wells – 237 new wells, 75% fracture stimulated.

The Wyoming Oil and Gas Commission Rules and Regulations are specific in requiring the operator receive approval prior to performing hydraulic fracturing treatments. The Rules require the operator to provide detailed information regarding the hydraulic fracturing process, to include the source of water and/or trade name fluids, type of proponents, as well as estimated pump pressures. After the treatment is complete the operator is required to provide actual fracturing data in detail and resulting production results.

Under Chapter 3, Section 8 (c) The Application for Permit to Drill or Deepen (Form 1) states…"information shall also be given relative to the drilling plan, together with any other information which may be required by the Supervisor. Where multiple Applications for Permit

to Drill will be sought for several wells proposed to be drilled to the same zone within an area of geologic similarity, approval may be sought from the Supervisor to file a comprehensive drilling plan containing the information required above which will then be referenced on each Application for Permit to Drill." Operators have been informed by Commission staff to include detailed information regarding the hydraulic fraction stimulation process on the Form 1 Application for Permit to Drill.

The Rules also state, in Chapter 3, Section 1 (a) "A written notice of intention to do work or to change plans previously approved on the original APD and/or drilling and completion plan (Chapter 3, Section 8 (c)) must be filed with the Supervisor on the Sundry Notice (Form 4), unless otherwise directed, and must reach the Supervisor and receive his approval before the work is begun. Approval must be sought to acidize, cleanout, flush, fracture, or stimulate a well. The Sundry Notice must include depth to perforations or the openhole interval, the source of water and/or trade name fluids, type proponents, as well as estimated pump pressures. Routine activities that do not affect the integrity of the wellbore or the reservoir, such as pump replacements, do not require a Sundry Notice. The Supervisor may require additional information." Most operators will submit the Sundry Notice Form 4 to provide the specific detail for the hydraulic fracturing treatment even though the general information might have been provided under the Form 1 Application for Permit to Drill.

After the hydraulic fracture treatment is complete, results must be reported to the Supervisor. Chapter 3, Section 12 Well Completion or Recompletion Report and Log (Form 3) state "upon completion or recompletion of a well, stratigraphic test or core hole, or the completion of any remedial work such as plugging back or drilling deeper, acidizing, shooting, formation fracturing, squeezing operations, setting a liner, gun perforating, or other similar operations not specifically covered herein, a report on the operation shall be filed with the Supervisor. Such report shall present a detailed account of the work done and the manner in which such work was performed; the daily production of the oil, gas, and water both prior to and after the operation; the size and depth of perforations; the quantity of sand, crude, chemical, or other materials employed in the operation and any other pertinent information of operations which affect the original status of the well and are not specifically covered herein."

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New York State

DEC

# Appendix 16

## Applicability of $NO_x$ RACT Requirements for Natural Gas Production Facilities

Revised Draft
Supplemental Generic Environmental Impact Statement

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**Applicability of $NO_x$ RACT Requirements for Natural Gas Production Facilities**

New York State's air regulation 6 NYCRR Part 227-2, Reasonably Available Control Technology (RACT) for Oxides of Nitrogen ($NO_x$), applies to boilers (furnaces) and internal combustion engines at major sources.

The requirements of Part 227-2 include emission limits, stack testing, and annual tune-ups, among others. Many facilities whose potential to emit (PTE) air pollutants would make them susceptible to $NO_x$ RACT requirements can limit, or "cap", their emissions using the limits within the New York State Department of Environmental Conservation's (DEC) Air Emissions Permits applicability thresholds to avoid this regulation.

New York State has two different major source thresholds for $NO_x$ RACT and permitting. Downstate (in New York City and Nassau, Suffolk, Westchester, Rockland, and Lower Orange Counties) the major source permitting and $NO_x$ RACT requirements apply to facilities with a PTE of 25 tons/yr or more of $NO_x$. For the rest of the state (where the majority of natural gas production facilities are anticipated to be located), the threshold is a PTE of 100 tons/yr or more of $NO_x$.

If the stationary engines at a natural gas production facility exceed the applicability levels or if the PTE at the facility would classify it as a Major $NO_x$ source, the following compliance options are available:

1. Develop a $NO_x$ RACT compliance plan and apply for a Title V permit.

2. Limit the facility's emissions to remain under the $NO_x$ RACT applicability levels by applying for one of two New York State Air Emissions permits, depending on how low emissions can be limited.

The permitting options for facilities that wish to limit, or "cap", their emissions by establishing appropriate permit conditions are described below.

New York State's air regulation 6 NYCRR Part 201, Permits and Registrations, includes a provision that allows a facility to register if its actual emissions are less than 50% of the applicability thresholds
(less than 12.5 tons/yr downstate and less than 50 tons/yr upstate). This permit option is known as "cap by rule" registration.

Part 201 also includes a provision that allows a facility to limit its emissions by obtaining a State Facility Permit, if its actual emissions are above the 50% level but below the applicability level (between 12.5 and 25 tons/yr downstate and between 50 and 100 tons/yr upstate).

If the facility $NO_x$ emissions cannot be capped below the applicability levels, then the facility should immediately develop a $NO_x$ RACT compliance plan. This plan should contain the necessary steps (purchase of equipment and controls, installation of equipment, source testing, submittal of permit application, etc.) and projected completion dates required to bring the facility into compliance. This plan is to be submitted to the appropriate DEC Regional Office as soon as possible. In this case the facility would also be subject to Title V, and a Title V air permit application must be prepared and submitted.

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New York State

DEC

# Appendix 17

## Applicability of 40 CFR Part 63 Subpart ZZZZ (Engine MACT) for Natural Gas Production Facilities – Final Rule

Updated July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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**Applicability of 40 CFR Part 63 Subpart ZZZZ (Engine MACT)**
**for Natural Gas Production Facilities – Final Rule**

EPA published a final rule on August 20, 2010 revising 40 CFR Part 63, Subpart ZZZZ, in order to address hazardous air pollutant (HAP) emissions from existing stationary reciprocating internal combustion engines (RICE) located at area sources. A major source of HAP emissions is a stationary source that emits or has the potential to emit any single HAP at a rate of 10 tons or more per year or any combination of HAP at a rate of 25 tons or more per year. An area source of HAP emissions is a source that is not a major source.

Available emissions data show that several HAP, which are formed during the combustion process or which are contained within the fuel burned, are emitted from stationary engines. The HAP which have been measured in emission tests conducted on natural gas fired and diesel fired RICE include: 1,1,2,2-tetrachloroethane, 1,3-butadiene, 2,2,4-trimethylpentane, acetaldehyde, acrolein, benzene, chlorobenzene, chloroethane, ethylbenzene, formaldehyde, methanol, methylene chloride, n-hexane, naphthalene, polycyclic aromatic hydrocarbons, polycyclic organic matter, styrene, tetrachloroethane, toluene, and xylene. Metallic HAP from diesel fired stationary RICE that have been measured are: cadmium, chromium, lead, manganese, mercury, nickel, and selenium. Although numerous HAP may be emitted from RICE, only a few account for essentially all of the mass of HAP emissions from stationary RICE. These HAP are: formaldehyde, acrolein, methanol, and acetaldehyde. EPA is proposing to limit emissions of HAP through emissions standards for formaldehyde for non-emergency four stroke-cycle rich burn (4SRB) engines and through emission standards for carbon monoxide (CO) for all other engines.

The applicable emission standards (at 15% oxygen) or management practices for existing RICE located at area sources are provided in the table below.

In addition to emission standards and management practices, certain stationary CI RICE located at existing area sources are subject to fuel requirements. Stationary non-emergency diesel-fueled CI engines greater than 300 HP with a displacement of less than 30 liters per cylinder located at existing area sources must only use diesel fuel meeting the requirements of 40 CFR 80.510(b),

which requires that diesel fuel have a maximum sulfur content of 15 ppm and either a minimum cetane index of 40 or a maximum aromatic content of 35 volume percent.

| Subcategory | Emission standards at 15 percent O2, as applicable, or management practice | |
|---|---|---|
| | **Except during periods of startup** | **During periods of startup** |
| **Non-Emergency 4SLB* >500HP** | 47 ppmvd CO or 93% CO reduction | Minimize the engine's time spent at idle and minimize the engine's startup time at startup to a period needed for appropriate and safe loading of the engine, not to exceed 30 minutes, after which time the non-startup emission limitations apply. |
| **Non-Emergency 4SLB ≤500HP** | Change oil and filter every 1440 hours; inspect spark plugs every 1440 hours; and inspect all hoses and belts every 1440 hours and re-place as necessary. | Same as above |
| **Non-Emergency 4SRB** >500HP** | 2.7 ppmvd formaldehyde or 76% formaldehyde reduction. | Same as above |
| **Non-Emergency CI >500HP** | 23 ppmvd CO or 70% CO reduction | Same as above |
| **Non-Emergency CI*** 300-500HP** | 49 ppmvd CO or 70% CO reduction | Same as above |
| **Non-Emergency CI ≤300HP** | Change oil and filter every 1000 hours; inspect air cleaner every 1000 hours; and inspect all hoses and belts every 500 hours and re-place as necessary. | Same as above |

*4SLB - four stroke-cycle lean burn
**4SRB – four stroke-cycle rich burn
***CI – compression ignition

New York State

DEC

# Appendix 18

# Definition of Stationary Source or Facility for the Determination of Air Permit Requirements

Revised July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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**Definition of Stationary Source or Facility**
**for the Determination of Air Permit Requirements**

Summary

NYSDEC must determine the applicability of air permitting regulations and requirements to natural gas drilling activities in the Marcellus Shale formation. Specifically, NYSDEC must determine applicable regulations and permit requirements for:

• sources subject to stationary source permitting under 6 NYCRR Part 201.
major stationary source - one that emits or has the potential to emit any of the following:
100 tons per year (TPY) or more of any regulated air pollutant ($NO_X$, $SO_2$, CO,, PM2.5, $PM_{10}$); 50 TPY of VOC.
10 TPY or more of any individual Hazardous Air Pollutant (HAP); or
25 TPY or more of any combination of HAPs.

• sources subject to New Source Performance Standards (**NSPS**)

• sources subject to National Emission Standards for Hazardous Air Pollutants (**NESHAP**), and

• 6 NYCRR Part 231 for major new or major modifications to existing sources subject to preconstruction review requirements under Prevention of Significant Deterioration (**PSD**) and/or Non-Attainment New Source Review (**NSR**)

In addition to threshold criteria detailed in regulation and guidance, NYSDEC must evaluate a variety of technical and factual information to assess applicability of these rules to specific sources through the permit application process. These evaluations, as they pertain to natural gas drilling activities in the Marcellus Shale formation, are discussed herein, including 1) whether emissions from two or more pollutant-emitting activities should be aggregated into a single major stationary source for purposes of NSR and Title V programs; and 2) how to assess NESHAP applicability given the unique regulatory definition of "facility" for the oil and gas industry.

Major Stationary Source Determinations for Criteria Pollutants

PSD, NSR and Title V operating permit program (Title V) regulations apply to certain sources with the potential to emit pollutants in excess of the major source thresholds. To assess applicability, DEC must evaluate whether emissions from two or more pollutant-emitting activities should be aggregated into a single major stationary source. The evaluation begins with the federal definition of "stationary source" at 40 CFR 52.21(b)(5) and a similar definition for major source under 6 NYCRR 201-2.1(b)(21). The federal definition reads "any building, structure, facility, or installation which emits or may emit a regulated NSR pollutant." "Building, structure, facility, or installation" is further defined in 40 CFR 52.21(b)(6):

> *Building, structure, facility, or installation* means all of the pollutant-emitting activities which belong to the same industrial grouping, are located on one or more contiguous or adjacent properties, and are under the control of the same person (or persons under common control) except the activities of any vessel. Pollutant-emitting activities shall be considered as part of the same industrial grouping if they belong to the same "Major Group" (i.e., which have the same first two digit code) as described in the *Standard Industrial Classification Manual, 1972*, as amended by the 1977 Supplement (U. S. Government Printing Office stock numbers 4101–0066 and 003–005–00176–0, respectively).

To identify pollutant-emitting activity that belongs to the same building, structure, facility, or installation, permitting authorities rely on the following three criteria: 1) whether the activities belong to the same industrial grouping; 2) whether the activities are located on one or more contiguous or adjacent properties; and 3) whether the activities are under the control of the same person (or person under common control).[1] These criteria are applied case-by-case to make the major stationary source determination.

Since the original SGEIS, DEC reviewed numerous source determinations from EPA permitting actions, guidance provided by EPA to inform permitting actions by other permitting authorities, and source determination protocol developed by other states. These documents have been informative. However, EPA has clearly stated that "no single determination can serve as an adequate justification for how to treat any other source determination for pollutant-emitting activities with different fact-specific circumstances." [2] "Therefore, while the prior agency statements and determinations related to oil and gas activities and other similar sources may be instructive, they are not determinative in resolving the source determination issue…, particularly where a state with independent permitting authority is making the determination and the prior agency statements had… substantially different fact-specific circumstances."[3]As such, DEC will formulate case-specific source determinations based on the foregoing, federal and state regulation, industry data and the specific facts of each air permit application. These determinations will be made during the review of permit applications for compressor stations which are associated with Marcellus Shale activities.

The three source determination criteria are discussed in more detail below.

1) **Do the pollutant-emitting activities belong to the same industrial grouping or "Major Group"?** In formulating the definition of "source," EPA uses a Standard Industrial Classification(SIC) code for distinguishing between sets of activities on the basis of their functional interrelationships.[4] Each source is to be classified according to its primary activity,

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[1] Memorandum from Gina McCarthy, EPA Assistant Administrator, to Regional Administrators, Sept. 22, 2009, available at http://www.epa.gov/region7/air/nsr/nsrmemos/oilgaswithdrawal.pdf
[2] Id.
[3] In The Matter Of Anadarko Petroleum Corporation, Frederick Compressor Station, Order Responding To Petitioners' Request That The Administrator Object To Issuance Of A State Operating Permit, February 2, 2011, Petition Number: VIII-2010-4.
[4] 45 FR 52695, at 31.

which is determined by its principal product or group of products produced or distributed, or services rendered.[5]

The Standard Industrial Classification Manual lists activities associated with oil and gas extraction in Major Group 13 and activities associated with natural gas transmission in Major Group 49. Establishments primarily engaged in operating oil and gas field properties, including wells, are grouped into Major Group 13. The Standard Industrial Classification Manual does not expressly list all equipment, such as midstream compressor stations, in Major Group 13, nor Major Group 49. Therefore, DEC may look to other information, such as federal and state regulations, industry data, and gas gathering agreements, to help make the source determination. For instance, under NESHAP, EPA regulates compressor stations that transport natural gas to a natural gas processing plant[6] in accordance with natural gas production facilities, Major Group 13.[7] In the absence of a natural gas processing plant, EPA regulates a compressor station in accordance with natural gas production facilities where the compressor station is prior to the point of custody transfer.[8] If the compressor station is after the point of custody transfer, EPA regulates the compressor station in accordance with natural gas transmission and storage facilities, Major Group 49. In relevant part, custody transfer means the transfer of natural gas to pipelines *after processing or treatment*.[9]

Where the pollutant-emitting activities do not belong to the same industrial grouping or "Major Group," DEC will ascertain whether one activity serves exclusively as a support facility for the other. In the Preamble to its 1980 PSD regulations, EPA "clarifies that "support facilities" that "convey, store, or otherwise assist in the production of the principal product*"* should be considered under one source classification, even when the support facility has a different two-digit SIC code.[10]

2**) Are the pollutant-emitting activities contiguous or adjacent?** EPA has routinely relied on the plain meaning of the word "contiguous," that is - being in actual contact; touching along a boundary or at a point. However, "the more difficult assessment is determining whether … a non-contiguous [pollutant-emitting activity] might be considered "adjacent."[11] First, EPA has not established a specific distance between activities in assessing whether such activities are adjacent.[12] Second, "the concept of "interdependency," which many individual EPA determinations consider, is not discussed in the 1980 Preamble or mentioned in the federal PSD or Title V regulations defining "source.*"*[13] "[I]nterdependency is a factor that has evolved over time in various case-by-case determinations. While interdependency is a consideration, it is not an express element of the actual three-part test set forth in regulation, and in the context of oil

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[5] 45 FR 52695, at 32.
[6] 40 CFR §63.761, *Natural gas processing plant.*
[7] 40 CFR §63.761, *Facility.*
[8] 40 CFR §63.760(a)(3)
[9] 40 CFR §63.761, *Custody transfer.*
[10] 45 Fed. Reg. 52676 (August 9, 1980)
[11] Response of Colorado Department of Public Health and Environment, Air Pollution Control Division, to Order Granting Petition for Objection to Permit, July 14, 2010, at 15, http://www.cdphe.state.co.us/ap/down/K-MOrderResponseDocumentJuly142010.pdf
[12] Id.
[13] Id. at 14

and gas infrastructure, it may have reduced relevance to an agency determination"[14] Nevertheless, to be thorough, DEC staff will evaluate the nature of the relationship between the facilities and the degree of interdependence between them to determine whether the non-contiguous emissions points should be aggregated.[15]

A "high level of connectedness and interdependence between two activities" is needed to deem them adjacent, and "interdependence requires that the two activities rely on each other – not just that one activity relies on the other activity.[16] Furthermore, "a determination of interdependence requires that the two activities rely upon each other *exclusively*; i.e., one activity cannot operate or occur without the other. The case-by-case determinations indicate that if activities operate independently and one activity does not act solely as a support operation for the other, the activities should not be deemed contiguous or adjacent."[17] In guidance provided by EPA to the Utah Division of Air Quality[18], EPA recommended using the following indicators as determinative of adjacency for two Utility Trailer Manufacturing Company facilities: 1) whether the location of the new facility was chosen because of its proximity to the existing facility; 2) whether materials would routinely be transferred back and forth between the two facilities; 3) whether managers and other workers would be shared between the two facilities; and 4) whether the production process itself would be split between the two facilities.[19] While DEC will use these and other questions to inform its source determination, some questions may have reduced relevance in the oil and gas industry. For instance, the location of oil and gas activity, proximate or otherwise, may "be controlled by land agreements, access issues, geologic formations, terrain, and, in other situations, by federal or state land management agencies, such as the Bureau of Land Management for oil and gas production on federal lands,"[20] and thus not necessarily indicative of a particular source category.

3) **Are the activities under common control?** To assess common control, EPA has historically relied on the Securities and Exchange Commission's definition of control as follows: The term control (including the terms controlling, controlled by and under common control with) means the possession, direct or indirect, of the power to direct or cause the direction of the management and policies of a person (or organization or association), whether through the ownership of voting shares, by contract or otherwise. The following questions have been used previously and in more recent actions by EPA to determine "common control" [21]: 1) Whether control has been

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[14] Id. at 36

[15] Letter from Cheryl Newton, U.S. EPA, to Scott Huber, Summit Petroleum Corporation, October 18, 2010, at 4, http://www.epa.gov/region07/air/title5/t5memos/singler5.pdf

[16] Response of Colorado Department of Public Health and Environment, Air Pollution Control Division, to Order Granting Petition for Objection to Permit, July 14, 2010, at 21, http://www.cdphe.state.co.us/ap/down/K-MOrderResponseDocumentJuly142010.pdf

[17] Id. at 36 – 37.

[18] Letter from Richard Long of EPA Region VIII to Lynn Menlove of Utah Division of Air Quslity, dated May 21, 1998. http://www.epa.gov/region07/air/title5/t5memos/util-trl.pdf

[19] Response of Colorado Department of Public Health and Environment, Air Pollution Control Division, to Order Granting Petition for Objection to Permit, July 14, 2010, at 20, http://www.cdphe.state.co.us/ap/down/K-MOrderResponseDocumentJuly142010.pdf

[20] Id. at 40

[21] Letter from Kathleen Henry of EPA Region III to John Slade of Pennsylvania DEP, dated 1/15/99. Also, Letter from Richard Long of EPA Region VIII to Margie Perkins, Air Pollution Control Division, Colorado Department of Public Health Environment, dated October 1, 1999, http://www.epa.gov/region07/air/nsr/nsrmemos/frontran.pdf

established through ownership of two entities by the same parent corporation or a subsidiary of the parent corporation; 2) Whether control has been established by a contractual arrangement giving one entity decision making authority over the operations of the second entity; 3) Whether there is a contract for service relationship between the two entities in which one sells all of its product to the other under a single purchase or contract; 4) Whether there is a support or dependency relationship between the two entities such that one would not exist "but for" the other?

Thus, DEC will use answers to the following questions to help guide the case-specific source determinations for natural gas drilling activities in the Marcellus Shale formation that may be subject to NSR and Title V for criteria pollutants.

1. Do the pollutant-emitting activities belong to the same industrial grouping or “Major Group” as described in the Standard Industrial Classification Manual?
    a. What is the primary activity engaged in by the facility?
    b. If the pollutant-emitting activities do not belong to the same industrial grouping or Major Group, does one activity serve exclusively as a support facility for the other?
2. Are the pollutant-emitting activities contiguous or adjacent?
    a. Are the pollutant-emitting activities contiguous? Do they share a boundary or touch each other physically?
    b. If the pollutant-emitting facilities are non-contiguous, are they proximate or interdependent?
    c. Was the location of the new facility chosen because of its proximity to the existing facility?
    d. Will materials routinely be transferred back and forth between the two facilities?
    e. Will managers and other workers be shared between the two facilities?
    f. Will the production process be split between the two facilities?
3. Are the activities under common control?
    a. Has control been established through ownership of two entities by the same parent corporation or a subsidiary of the parent corporation?
    b. Has control been established by a contractual arrangement giving one entity decision making authority over the operations of the second entity?
    c. Is there a contract for service relationship between the two entities in which one sells all of its product to the other under a single purchase or contract?
    d. Is there an exclusive support or dependency relationship between the two entities such that one would not exist "but for" the other?

NESHAPS Applicability for Hazardous Air Pollutants

"[I]n the hazardous air pollutant ("HAP") arena, EPA has expressly determined, consistent with Congress' statutory mandate in the [Clean Air Act] CAA, 42 U.S.C. § 7412(n)(4)(A), oil and gas production field facilities are typically not industrial facilities that should be aggregated."[22] The CAA, 42 U.S.C. § 7412, defines "major source" as any stationary source or group of stationary sources located within a contiguous area and under common control that emits or has the potential to emit considering controls, in the aggregate, 10 tons per year or more of any hazardous air pollutant or 25 tons per year or more of any combination of hazardous air pollutants; and "area source" as any stationary source of hazardous air pollutants that is not a major source. Notwithstanding this definition, Section 7412(n)(4)(A) exempts oil and gas wells and pipeline facilities from the requirement to aggregate with contiguous sources under common control when deciding if the source is a major source for NESHAPS applicability.

In the context of hazardous air pollutants, EPA declared that "[s]uch facilities generally are not in close proximity to or co-located with one another (contiguous) and located within an area boundary, the entirety of which (other than roads, railroads, etc.), is under the physical control of the same owner."[23,24] In light of this, EPA developed a unique definition of facility for the oil and gas industry NESHAP regulations (40 CFR 63 Subparts HH and HHH). For HAP major source determinations, the EPA-promulgated definition of "facility" states that "pieces of production equipment or groupings of equipment located on different oil and gas leases, mineral fee tracts, lease tracts . . . or separate surface sites, whether or not connected by a road, waterway, power line or pipeline, shall not be considered part of the same facility."[25,26] EPA defines a "surface site" at 40 CFR 63.761 of Subpart HH as " Surface site means any combination of one or more graded pad sites, gravel pad sites, foundations, platforms, or the immediate physical location upon which equipment is physically affixed".

Accordingly, to determine applicability of the NESHAPs rules governing Oil and Gas Production and Natural Gas Transmission industry sectors, the regulatory definition of facility authorized by CAA, 42 U.S.C. § 7412(n)(4)(A) and found at 40 CFR 63 Subparts HH and HHH, must be used. DEC will follow this definition in determining the regulatory applicability of NESHAPS requirements for HAPS. This opens up the possibility that a "facility" definition for a certain permit application may result in a determination of "major source" for purposes of NSR or Title V permitting, but which will consist of several area source surface sites for the purposes

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[22] Id. at 23
[23] 63 Fed. Reg. 6288, 6303 (Feb. 6, 1998)
[24] Response of Colorado Department of Public Health and Environment, Air Pollution Control Division, to Order Granting Petition for Objection to Permit, July 14, 2010, at 23, http://www.cdphe.state.co.us/ap/down/K-MOrderResponseDocumentJuly142010.pdf
[25] 64 Fed. Reg. 32610, 32630 (June 17, 1999)
[26] Response of Colorado Department of Public Health and Environment, Air Pollution Control Division, to Order Granting Petition for Objection to Permit, July 14, 2010, at 23, http://www.cdphe.state.co.us/ap/down/K-MOrderResponseDocumentJuly142010.pdf

of NESHAP applicability. Guided by EPA's three source determination criteria and the underlying recommendation to use case specific facts, DEC will consider all pertinent information on a case-by-case basis in arriving at its conclusions during source permitting review.

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New York State

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# Appendix 18A

## Evaluation of Particulate Matter and Nitrogen Oxides Emissions Factors and Potential Aftertreatment Controls for Nonroad Engines for Marcellus Shale Drilling and Hydraulic Fracturing

New July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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# Evaluation of Particulate Matter and Nitrogen Oxides Emissions Factors and Potential Aftertreatment Controls for Nonroad Engines for Marcellus Shale Drilling and Hydraulic Fracturing Operations

## Nonroad Emissions Standards

Tables 1 and 2 describe the EPA emissions standards for nonroad diesel engines relevant to natural gas well drilling and hydraulic fracturing. These standards are contained in 40 CFR Parts 89 and 1039. These standards may be considered worst case emission levels. Table 1 covers engines rated from 600-750 horsepower. Table 2 covers engines rated at more than 750 horsepower that are not installed in a generator set. Engines are held to these standards for a useful life of the lesser of 8000 hours or 10 years. Actual operating lifetimes are likely much longer.

Table 1 Nonroad Engine Standards for Engines Rated Between 600 and 750 Horsepower

| Standard | Initial Year | PM (g/bhp*hr) | NOx (g/bhp/hr) | HC (g/bhp*hr) | Notes |
|---|---|---|---|---|---|
| Tier 1 | 1996 | 0.4 | 6.9 | 1.0 | |
| Tier 2 | 2002 | 0.15 | 4.32 | 0.48 | 4.8 g/bhp*hr NOx + HC standard |
| Tier 3 | 2006 | 0.15 | 2.7 | 0.3 | 3.0 g/bhp*hr NOx + HC standard |
| Tier 4 interim | 2011 | 0.01 | 1.35 | 0.14 | NOx standard half-way between Tier 3 and Tier 4 |
| Tier 4 | 2014 | 0.01 | 0.3 | 0.14 | |

Tier 2 and Tier 3 $NO_x$ and hydrocarbon standards are an additive $NO_x$ plus hydrocarbon (HC) standard. For Tier 2 the limit is 4.8 g/bhp*hr. For Tier 3 the limit is reduced to 3.0 g/bhp*hr. In order to use the standards as conservative emissions limits, it is necessary to apportion the emission limit between the two pollutants. The Tables apportions 90% of the emissions to $NO_x$ and the remaining 10% to hydrocarbons. EPA and European Union (EU) emissions tiers that have separate $NO_x$ and hydrocarbon standards, not requiring exhaust aftertreatment, generally have the $NO_x$ standard equaling 86-88% of the sum of the two standards. It should be noted that data supplied on behalf of industry (1) assumed that 100% of these emissions are $NO_x$, which is deemed conservative.

There is no official "Tier 4 interim" standard for engines in the Table 1 horsepower class. Beginning in 2011, 50% of the engines in the class are supposed to meet the Tier 4 $NO_x$ standards. This would increase to 100% in 2014. When faced with the exact same phase-in schedule from 2007-2010 for highway diesel engines, manufacturers universally chose to initially certify all engines to a Family Emissions Level half way between the old standard and the new standard, and postpone the $NO_x$ aftertreatment requirements for three years. Thus, the $NO_x$ emissions level of 1.35 g/bhp*hr in the Table is the average of the Tier 3 and Tier 4 standards.

Table 2 Nonroad Engine Standards for Engines Rated Above 750 Horsepower

| Standard | Initial Year | PM (g/bhp*hr) | NOx (g/bhp/hr) | HC (g/bhp*hr) | Notes |
|---|---|---|---|---|---|
| Tier 1 | 2000 | 0.4 | 6.9 | 1.0 | |
| Tier 2 | 2006 | 0.15 | 4.32 | 0.48 | 4.8 g/bhp*hr NOx + HC standard |
| Tier 4 interim | 2011 | 0.075 | 2.6 | 0.3 | |
| Tier 4 final | 2015 | 0.03 | 2.6 | 0.14 | |

Tier 1 and Tier 2 standards for engines rated above 750 horsepower are the same as the corresponding standards for engines rated between 600 and 750 horsepower. Again, the Tier 2 $NO_x$ plus hydrocarbon standard is apportioned 90% $NO_x$ and 10% hydrocarbon. There are no Tier 3 standards for these engines. The Tier 4 interim standards are promulgated standards. Also, the Tier 4 standards for engines rated above 750 horsepower not installed in generator sets do not force the use of $NO_x$ aftertreatment.

## Retrofit of Exhaust Aftertreatment

Prior to Tier 4, none of the new engine standards were stringent enough to require exhaust aftertreatment. Current highway engine standards require aftertreatment to meet both the PM and $NO_x$ standards. Furthermore, there is now substantial experience with retrofitting exhaust aftertreatment to highway engines and stationary engines. Technologies include: Diesel Oxidation Catalysts which oxidize hydrocarbons and carbon based particulate matter, Continuously Regenerating Diesel Particulate Filters or "Traps" (CRDPF) where particulate matter is collected and oxidized, and Selective Catalytic Reduction (SCR) which uses ammonia (usually supplied as urea) or "$NO_x$ absorbers" to reduce $NO_x$ emissions. Although in the past EPA had identified the $NO_x$ absorbers as a promising technology, more recently it has not been proven to be so. Its use has been limited to certain light duty trucks and cars, but it has not been applied to the size class of the fracking engines. In addition, the "lean $NO_x$ Catalyst" system noted by EPA to have a certain $NO_x$ reduction would be insufficient to meet the ultimate engine standards. Thus, for $NO_x$ control, the SCR system is recommended.

Table 3 lists the aftertreatment effectiveness claimed by one manufacturer, Johnson Matthey[1], as an example for retrofit installations on stationary engines (2).

[1] Listing of this manufacturer does not imply any form of endorsement. Other manufacturers could provide similar aftertreatment information.

Table 3 Exhaust Aftertreatment Retrofit Effectiveness

| Technology | Abbreviation | PM Emissions Reduction (%) | NOx Emissions Reduction (%) | HC Emissions Reduction (%) |
|---|---|---|---|---|
| Diesel Oxidation Catalyst | DOC | 30% | 0 | 90% |
| Particulate Trap | CRDPF | 85% | 0 | 90% |
| Particulate Trap and SCR | SCR-DPF (SCRT) | 85% | 90% | 90% |

Johnson Matthey has EPA certification of its SCR-DPF system (referred to as SCRT) as a verified retrofit for some classes of highway diesel engines. That verification is for a 70% $NO_x$ emissions reduction (3). The development of Johnson Matthey's retrofit system is described by Conway and coworkers (4). This certification does not negate the 90% reduction expected for these nonroad engines due to factors discussed below.

The SCR and CRDPF technologies are the dominant technologies used to meet the current highway emissions standards, and are expected to dominate the market for large nonroad diesel engine exhaust aftertreatment. There are other $NO_x$ control technologies; however their applicability appears to be limited to smaller engines, such as those in light duty vehicles. Although the engines used in drilling and hydraulic fracturing are defined in regulation as nonroad mobile engines, they are physically static during drilling or hydraulic fracturing. They also have a relatively steady duty cycle, without the frequent transient operation seen in motor vehicles. Thus, the engineering and operational challenges associated with exhaust aftertreatment retrofits should be reduced in comparison to highway vehicles. It should also be easier to achieve higher $NO_x$ reduction levels with SCR.

The exhaust temperatures reported on behalf of industry (800-900 °F) (1) are high enough to support aftertreatment retrofits which require minimum temperatures of roughly 250 °C (<500 °F) (3) (4).

## Emissions of Nitrogen Dioxide

Nitrogen Dioxide ($NO_2$) is not explicitly regulated via EPA engine emissions standards. It is a component of the regulated pollutant $NO_x$. However, primary $NO_2$ emissions are a concern in our Marcellus Shale evaluation due to the new 1 hour $NO_2$ standard and specific emission factor estimates are necessary to assure that modeling results account for the $NO_2$ portion of the emissions.

Conventional information has been that roughly 5% of $NO_x$ emissions from internal combustion engines are $NO_2$; the balance are NO. However, European researchers have noted that ambient $NO_2$ concentrations have not been declining despite declining $NO_x$ emissions from engines and vehicles. This has led to some investigation of the $NO_2$ fraction of primary NOx emissions from highway vehicles. The most comprehensive summary is by Grice, et al (5), who needed the data

for model inputs. These researchers found that the conventional use of 5% $NO_2$ holds for gasoline engines. The $NO_2$ fraction for diesel engines varies for different emissions control technologies, but is always greater than 5%. The data are summarized based on European emissions standards which must be translated into aftertreatment technology level.

$NO_2$ fractions for diesels range between 10% and 55% (5). EURO II engines, which have no exhaust aftertreatment, have a $NO_2$ fraction of 11%. This $NO_2$ fraction is used for Tier 1, Tier 2, and Tier3 engines with no retrofitted aftertreatment. For particulate trap equipped EURO III engines the $NO_2$ fraction is 35%. This $NO_2$ fraction is used for cases with either a DOC or a CRDPF either standard or retrofitted. The oxidation reactions in DOCs oxidize some NO to $NO_2$ along with the desired oxidation of hydrocarbons and particulate carbon. Indeed, oxidation catalysts are placed ahead of CRDPFs to produce $NO_2$ for use in oxidizing particulate matter to regenerate the PM trap. $NO_2$ oxidizes carbon at a lower temperature than $O_2$.

Finally, Grice and coworkers chose to use a $NO_2$ fraction of 10% for engines equipped with SCR (EURO IV and later). However, the data for the SCR equipped engines was particularly sparse. This uncertainty is discussed further below.

For light duty vehicles equipped with $NO_x$ aftertreatment a $NO_2$ fraction of 55% was reported. Light duty vehicle $NO_x$ control generally avoids SCR, with its requirement that the operator maintain the urea supply. These alternative $NO_x$ aftertreatment technologies have not proven viable for heavy duty truck engines, never mind the even larger engines to be used in Marcellus Shale drilling and hydraulic fracturing. Thus the 55% $NO_2$ fraction does not have any applicability here.

Table 4 below summarizes the recommended $NO_2$ fractions.

Table 4 $NO_2$ Emissions as Fraction of $NO_x$ Emissions

| Technology | Fraction $NO_2$ (in %) |
|---|---|
| No Exhaust Aftertreatment | 11 |
| Diesel Oxidation Catalyst or Particulate Trap | 35 |
| SCR (with or without DOC or CRDPF) | 10 (see text) |

Specifying a single $NO_2$ fraction for an engine technology is clearly a simplification. Researchers have documented variation in the $NO_2$ fraction depending on engine load (6) and exhaust temperature (7). The $NO_2$ fractions in Table 4 for engines without SCR could be low for engines operated at low loads and low exhaust temperatures. They appear to better reflect the emissions at higher loads more in line with the operations expected during drilling and hydraulic fracturing.

Given the particularly high level of uncertainty regarding the $NO_2$ fraction when SCR is used, a review of the chemistry involved might help. SCR generally converts $NO_x$ to $N_2$. There are several different reactions involved (8), (9), (10). One of these reactions, the “fast” SCR reaction is much faster (and has lower minimum temperature requirements) than the others.

$$2NH_3 + NO + NO_2 \rightarrow 2N_2 + 3H_2O$$

The fast SCR reaction generally goes to completion before any of the other reactions become significant. This leads to a desire to have a $NO_2$ fraction near 50% at the SCR reactor inlet. However, given variations on the $NO_2$ consumption by a CRT and variations in engine load and engine out exhaust gas composition, consistently providing the SCR reactor with a 50:50 $NO_2$ to NO ratio would be quite difficult.

As long as the exhaust gases remain in the SCR reactor after the fast SCR reaction has exhausted one of the $NO_x$ species, other chemical reactions will continue to reduce $NO_x$. The reaction for NO produces nitrogen and water. Several competing reactions are possible for $NO_2$. Some of these produce ammonium nitrate or nitrous oxide in addition to nitrogen.

Another concern with SCR is "ammonia slip," the emission of ammonia injected into the exhaust stream but not consumed. Oxidation catalysts are employed after SCR reactors to oxidize ammonia to nitrogen. This catalyst could also oxidize NO to $NO_2$. Thus, it cannot be completely ruled out that $NO_x$ emissions from SCR equipped engines may consist of more than 10% $NO_2$ , possibly with an upper bound of 0.35%. However, further review of the literature regarding the chemistry of ammonia slip catalysts leads to the conclusion that oxidation of NO to $NO_2$ is not a major concern. The desired reaction in the ammonia slip catalyst is the oxidation of ammonia to nitrogen and water. Competing reactions form NO and $N_2O$, but not $NO_2$ (2). The fate of NO in an ammonia slip catalyst is to react with ammonia and form $N_2O$. $NO_2$ production would likely only begin if the ammonia was exhausted. The chemical reaction mechanism of ammonia oxidation is well known, it is an intermediate step in the industrial production of nitric acid (3). Given that there is no apparent path to $NO_2$ formation as long as $NH_3$ is present, greater confidence can be placed in a $NO_2$ emission estimate of 10% of $NO_x$ for SCR equipped engines.

Thus, actual data summarized by Grice and coworkers, although sparse, currently suggests that we consider the DOC/CRDPF $NO_2$ fraction of 10% as the appropriate factor. Regardless of the actual $NO_2$ fraction of the NOx emissions from a SCR equipped engine (retrofitted or standard), SCR will provide the lowest $NO_2$ and $NO_x$ emissions achievable with diesel engines.

**Emission Rates for Various Emissions Standards Tiers & Exhaust Aftertreatment Retrofit Options**

Considering the different Tiers of engine standards, the variety of possible exhaust aftertreatment retrofits, and the uncertainty in the $NO_2$ fraction of $NO_x$ emissions from SCR equipped engines, there are in excess of 20 different emissions cases possible. Calculations were performed by Barnes, (11) (12), but only the pertinent part of these results are presented in Tables 5 and 6.

These emissions rates are estimated from the relevant U.S. EPA standards presented in Tables One and Two. In cases where a NOx + HC standard was promulgated, the standard is apportioned 90% $NO_x$, 10% HC. Effectiveness of exhaust aftertreatment retrofits are based on Table Three. Where the claimed retrofit effectiveness reduces an emission rate below a subsequent standard expected to require the same exhaust aftertreatment technology the subsequent standard (the higher number) is used as the emissions rate. $NO_2$ emission rates are

calculated from $NO_x$ emission rates using factors presented in Table Four. For SCR equipped engines the $NO_2$ fraction of 10 of the NOx emissions is presented.

Table 5 Emissions Factors for Engines between 600 and 750 Horsepower

Air Drilling Engines

| Standard | Effective Year | Retrofit | PM (g/bhp*hr) | NOx (g/bhp*hr) | HC (g/bhp*hr) | $NO_2$ (g/bhp*hr) |
|---|---|---|---|---|---|---|
| Tier 1 | 1996 | None | 0.4 | 6.9 | 1.0 | 0.759 |
| | | DOC | 0.28 | 6.9 | 0.14 | 2.415 |
| | | CRDPF | 0.06 | 6.9 | 0.14 | 2.415 |
| | | SCR-DPF | 0.06 | 0.69 | 0.14 | 0.069 |
| Tier 2 | 2002 | None | 0.15 | 4.32 | 0.48 | 0.475 |
| | | DOC | 0.105 | 4.32 | 0.14 | 1.512 |
| | | CRDPF | 0.03 | 4.32 | 0.14 | 1.512 |
| | | SCR-DPF | 0.03 | 0.432 | 0.14 | 0.043 |
| Tier 3 | 2006 | None | 0.15 | 2.7 | 0.3 | 0.297 |
| | | DOC | 0.105 | 2.7 | 0.14 | 0.945 |
| | | CRDPF | 0.03 | 2.7 | 0.14 | 0.945 |
| | | SCR-DPF | 0.03 | 0.3 | 0.14 | 0.03 |
| Tier 4 | 2011 | None | 0.01 | 1.35 | 0.14 | 0.473 |
| | | SCR | 0.01 | 0.3 | 0.14 | 0.03 |
| Tier 4 | 2014 | None | 0.01 | 0.3 | 0.14 | 0.03 |

Table 6 Emissions Factors for Engines Greater than 750 Horsepower

Drilling Rig and Hydraulic Fracturing Engines

| Standard | Effective Year | Retrofit | PM (g/bhp*hr) | NOx (g/bhp*hr) | HC (g/bhp*hr) | $NO_2$ (g/bhp*hr) |
|---|---|---|---|---|---|---|
| Tier 1 | 2000 | None | 0.4 | 6.9 | 1.0 | 0.759 |
| | | DOC | 0.28 | 6.9 | 0.14 | 2.415 |
| | | CRDPF | 0.06 | 6.9 | 0.14 | 2.415 |
| | | SCR-DPF | 0.06 | 0.69 | 0.14 | 0.069 |
| Tier 2 | 2006 | None | 0.15 | 4.32 | 0.48 | 0.475 |
| | | DOC | 0.105 | 4.32 | 0.14 | 1.512 |
| | | CRDPF | 0.03 | 4.32 | 0.14 | 1.512 |
| | | SCR-DPF | 0.03 | 0.432 | 0.14 | 0.043 |
| Tier 4 interim | 2011 | None | 0.075 | 2.6 | 0.3 | 0.91 |
| | | CRDPF | 0.03 | 2.6 | 0.14 | 0.91 |
| | | SCR-DPF | 0.03 | 0.3 | 0.14 | 0.03 |
| Tier 4 | 2015 | None | 0.03 | 2.6 | 0.14 | 0.91 |
| | | SCR-DPF | 0.03 | 0.3 | 0.14 | 0.03 |

**Summary**

Between 2000 and 2015 nonroad engines will have gone through four or five (depending on engine power) different sets of emissions standards. PM mass reduction over this timeframe will be 93% for the largest engines and 98% for engines rated between 600 and 750 horsepower. NOx emissions will be reduced 96% for the 600 to 750 horsepower engines, but only 62% for the larger engines. Much of these emissions reductions can be achieved without premature replacement of older engines by retrofitting exhaust aftertreatment to these engines. A key consideration with these retrofits is that PM aftertreatment in the absence of SCR will increase $NO_2$ emissions. This concern also applies to current and future Tier 4 engines which may have PM aftertreatment but not NOx aftertreatment.

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New York State

DEC

# Appendix 18B

## Cost Analysis of Mitigation of $NO_2$ Emissions and Air Impacts by Selected Catalytic Reduction (SRC) Treatment

New July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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**Cost Analysis of Mitigation of $NO_2$ Emissions and Air Impacts by Selected Catalytic Reduction (SRC) Treatment**

## 1. Introduction

In order to mitigate modeled exceedences of the National Ambient Air Quality Standards (NAAQS) for nitrogen dioxide ($NO_2$) the SGEIS has recommended that the hydraulic fracturing engines (and tier 1 drilling engines) used in the development of gas production wells in the Marcellus formation in New York State must be equipped with post-combustion controls. Selective catalytic reduction (SCR) is the recommended technology for addressing $NO_2$ concerns (see Appendix 18A). SCR is a proven technology for reducing oxides of nitrogen ($NO_x$) emissions from combustion sources. This technology involves the use of a urea solution (32.5 percent urea) which converts $NO_x$ to nitrogen gas on a catalyst.

To determine the viability of the SCR control use for the hydraulic fracturing engines in terms of the associated costs, an approximate estimate of mitigation cost is presented in this appendix. It should be noted that these estimates are not necessarily representative of the actual costs which industry will experience. The purpose of these estimates is to determine the cost per ton of NOx removal for a relative comparison to cost thresholds used by the Department for NOx RACT purposes at stationary sources.[1] In addition, it should be noted that any reference to specific manufacturers (in footnotes) does not constitute an endorsement, but merely presents the specific information source.

First, an estimate is developed regarding how many jobs and how many hours a hydraulic fracturing engine could be used each year. In the third section, the costs of installing and operating an SCR system on a typical 2250 hp hydraulic fracturing engine are presented. In the fourth section the cost per ton of $NO_x$ removed from the exhaust stream is compared with the $NO_x$ RACT cost threshold used for stationary sources. A summary of the findings of this investigation are presented in the final section.

## 2. Operation of Hydraulic Fracturing Engines

According to ALL Consulting, hydraulic fracturing engines will be used at any given well pad for no more than 14 days. Mobilization and de-mobilization activities are expected to take a total of four days. Hydraulic fracturing activities are expected to take ten days per well pad (five days per well).[2] At most, a hydraulic fracturing engine could be used for 26 jobs per year. Allowing for additional travel time, maintenance and vacations, the Department is assuming an engine will be used for approximately 20 jobs per year in the Marcellus play. Further, it was assumed that these engines will be used for a maximum of five hydraulic fracturing events per day and will operate two hours per event at their maximum loading and emissions.[3] Therefore, a hydraulic fracturing engine could be used up to 2,000 hours per year at their maximum load:

$$(20\ \text{jobs/year})(10\ \text{days/job})(5\ \text{fracs/day})(2\ \text{hours/frac}) = 2{,}000\ \text{hours/year}$$

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[1] Hydraulic fracturing engines are considered nonroad sources.
[2] "NY DEC SGEIS Information Requests", ALL Consulting, September 16, 2010, page 39.
[3] "Horizontally Drilled/High-Volume Hydraulically Fractured Wells, Air Emissions Data", August 26, 2009, page 9.

3. Reduction of Oxides of Nitrogen and Costs

Selective catalytic reduction (SCR) is a proven technology for reducing $NO_x$ emissions and the Department is assuming that this technology will be preferentially used to reduce $NO_x$ emissions from hydraulic fracturing engines. The Department considered capital, periodic and annual costs in the cost estimates discussed in this section.

*Capital Costs*

The capital cost for a SCR system was assumed to be $16 per hp.[4] It was assumed that the scale-up factor was one. Installation costs were assumed to be 60 percent of the system cost.[5] Taxes were assumed to be eight (8) percent of the system cost. The estimated capital cost for a typical 2250 hp hydraulic fracturing engine is $60,480 as detailed below:

| | |
|---|---|
| System Cost: | $36,000 |
| Installation: | $21,600 |
| Taxes: | $ 2,880 |
| Total: | $60,480 |

As noted previously, these costs are used in order to estimate the "cost effectiveness" value for the purpose of comparisons to "thresholds" used by the Department.

*Periodic Costs*

The periodic costs considered by the Department were for replacing SCR catalysts every five years.[6] It was assumed that the replacement costs were seven (7) percent of the system costs[7] and installation 60 percent of the replacement cost. The periodic costs (at year 5) were estimated to be $4,032 as detailed below:

| | |
|---|---|
| Catalyst Replacement: | $2,520 |
| Installation: | $1,512 |
| Total: | $4,032 |

*Annual Costs*

Reagent (urea) costs are the primary costs in this category. The quantity of reagent used depends upon the amount of $NO_x$ coming from the engine. The control efficiency for SCRs was assumed

[4] The cost for a Volvo SCR is reported to be $9600 ("2010-Compliant Diesel Truck Price Increases Out – The Changing Paradigm", Jay Thompson, www.glgroup.com/NewsWatchPrefs/Print.aspx?pid=42461, August 14, 2009). Further, it was assumed the power rating for a typical truck is 600 hp.

[5] Plant Design and Economics for Chemical Engineers, Third Edition, M.S. Peters and K. D. Timmerhaus, 1980, pages 168-169.

[6] E-mail from Wilson Chu (Johnson Matthey) to John Barnes (NYSDEC) dated January 24, 2008.

[7] E-mail from Chad Whiteman (Institute of Clean Air Companies) to John Barnes dated November 27, 2007 and e-mail from Wilson Chu (Johnson-Matthey) to John Barnes dated January 24, 2008..

to be 90 percent for engines. The emission rates factored into this analysis are presented in Table 1 (see Appendix 18B). Further, it was assumed that hydraulic fracturing engines will be operated at 50 percent of capacity.[8] The urea requirement for each pound of $NO_x$ treated in an SCR is 0.2088 gallons.[9]

Table 1: $NO_x$ Emission Rates for Tier 2, Interim 4 (I4) and 4 Hydraulic Fracturing Engines

| Tier # | $NO_x$ (without control)[10] (g/bhp-h) | $NO_x$ (with control) g/bhp-h |
|---|---|---|
| 2 | 4.32 | 0.43 |
| Interim 4 (I4) | 2.60 | 0.26 |
| 4 | 2.60 | 0.26 |

The urea requirements range from 1.21 gallons per hour (gal/h) for a Tier 4 engine to 2.01 gal/h for a Tier 2 engine. The estimated cost of urea is $3.67 per gallon.[11]

In addition to the reagent requirements, annual insurance costs were estimated to be one (1) percent of the system cost[12] and maintenance costs were assumed to be six (6) percent of the system cost.[13] A summary of the annual costs is presented below:

| | Tier 2 | Tier I4 | Tier 4 |
|---|---|---|---|
| Reagent: | $14,800 | $9,200 | $8,900 |
| Insurance: | $ 600 | $ 600 | $ 600 |
| Maintenance: | $ 3,600 | $3,600 | $3,600 |
| Total: | $19,000 | $13,400 | $13,100 |

*Annualized Cost*

A discount rate of seven (7) percent was used to convert the above costs into an equivalent annual cost for a 10-year horizon. The estimated annualized costs are presented in the next section.

4. Cost Effectiveness Analysis

The cost effectiveness of applying SCR controls on Tier 2, I4 and 4 hydraulic fracturing engines is presented in Table 2. By comparison, the current cost threshold for the $NO_x$ standards used by the Department to judge the cost effectiveness of control limits as set forth in Subpart 227-2 Reasonably Available Control Technology (RACT) for Oxides of Nitrogen ($NO_x$) is $5,500 per

[8] "Horizontally Drilled/High-Volume Hydraulically Fractured Wells, Air Emissions Data", August 26, 2009, p. 10.
[9] E-mail from Michael Baran (Johnson Matthey) to John Barnes, April 17, 2008.
[10] See Appendix 18A
[11] E-mail from Wilson Chu (Johnson Matthey) to John Barnes (NYSDEC) dated January 24, 2008. Also factored was Consumer Price Index data: www.bls.gov/cpi/cpid0801.pdf and www.bls.gov/cpi/cpid0211.pdf.
[12] Plant Design and Economics for Chemical Engineers, Third Edition, M.S. Peters and K. D. Timmerhaus, 1980, page 202.
[13] IBID, page 200.

ton of $NO_x$ removed from the exhaust gas. This value is used in determining whether a "waiver" should be granted to a major stationary source which demonstrates that the cost of such controls is unreasonable. As an analogy, the Subpart 227-2 $NO_x$ standard that would apply to hydraulic fracturing engines if they were considered stationary sources is 2.3 g/bhp-h. Hydraulic fracturing engines equipped with SCRs will have emission rates ranging from 0.26 g/bhp-h (Tier I4) to 0.43 g/bhp-h (Tier 2).

Table 2: Cost Effectiveness of SCR Control on Hydraulic Fracturing Engines

| Engine Tier | Annualized Cost | $NO_x$ Removed (tons) | Cost Effectiveness ($ton^{-1}$) |
|---|---|---|---|
| 2 | $28,000 | 9.64 | $2,907 |
| I4 | $22,500 | 6.03 | $3,732 |
| 4 | $22,000 | 5.80 | $3,816 |

## Summary and Recommendations

The costs for mitigating the modeled $NO_2$ NAAQS exceedences are considered reasonable. The costs of control presented in Table 2 are less than the cost threshold for the Department's Reasonably Available Control Technology (RACT) for $NO_x$ which is $5,500 per ton. The $NO_x$ emission limits for these engines will range from 0.26 g/bhp-h (Tier 4) to 0.43 g/bhp-h (Tier 2). Therefore, it is concluded that the large (2250 hp) hydraulic fracturing engines can be, cost-effectively, equipped with SCR control systems as recommended in the SGEIS.

New York State

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# Appendix 18C

## Regional On-Road Mobile Source Emission Estimates from EPA's MOVES Model and Single Pad PM2.5 Estimates from MOBILE 6 Model

New July 2011

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2007 Annual Mobile Source Emissions

MOVES 2010a Based Inventory Runs

Includes all MOVES Emission Processes Except Evap. Permeation, Evap. Vapor Venting & Evap. Fuel Leaks

| | | Base Emissions | | | | | | Emissions resulting from additonal VMT from proposed drilling activity | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FIPS | County | NOX | VOC | $SO_2$ | $PM_{10}$ Total | $PM_{25}$ Total | CO | NOX | VOC | $SO_2$ | $PM_{10}$ Total | $PM_{25}$ Total | CO |
| | | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) |
| 36001 | ALBANY | 8423.0 | 3323.7 | 64.2 | 356.3 | 339.0 | 51044.0 | 8447.2 | 3326.2 | 64.3 | 357.6 | 340.2 | 51067.1 |
| 36003 | ALLEGANY | 1436.5 | 495.0 | 8.5 | 63.8 | 60.9 | 7205.9 | 1458.5 | 497.1 | 8.6 | 64.8 | 61.9 | 7227.5 |
| 36007 | BROOME | 4807.1 | 1998.9 | 36.2 | 209.0 | 198.5 | 30424.5 | 4830.2 | 2001.2 | 36.3 | 210.2 | 199.6 | 30447.8 |
| 36009 | CATTARUAGUS | 2446.6 | 839.0 | 15.0 | 107.9 | 103.0 | 12115.4 | 2468.7 | 841.2 | 15.0 | 108.9 | 104.0 | 12137.9 |
| 36011 | CAYUGA | 2020.5 | 774.2 | 13.6 | 84.0 | 80.2 | 11210.1 | 2043.2 | 776.5 | 13.7 | 85.2 | 81.3 | 11231.9 |
| 36013 | CHAUTAQUA | 4178.1 | 1410.3 | 26.5 | 184.6 | 176.3 | 20379.8 | 4200.5 | 1412.5 | 26.6 | 185.7 | 177.3 | 20402.2 |
| 36015 | CHEMING | 2113.2 | 861.3 | 15.1 | 89.3 | 85.2 | 12366.7 | 2137.1 | 863.8 | 15.1 | 90.5 | 86.4 | 12390.9 |
| 36017 | CHENANGO | 1066.9 | 510.5 | 7.9 | 43.8 | 41.5 | 7513.7 | 1089.4 | 512.8 | 7.9 | 44.9 | 42.6 | 7535.9 |
| 36023 | CORTLAND | 1653.3 | 543.1 | 11.1 | 71.8 | 68.5 | 8158.8 | 1675.5 | 545.3 | 11.1 | 72.9 | 69.6 | 8180.9 |
| 36025 | DELAWARE | 1224.2 | 539.2 | 9.0 | 50.1 | 47.5 | 8013.5 | 1246.3 | 541.3 | 9.1 | 51.1 | 48.6 | 8034.7 |
| 36029 | ERIE | 19260.0 | 7997.4 | 138.2 | 798.8 | 760.4 | 117094.0 | 19282.6 | 7999.7 | 138.3 | 799.9 | 761.5 | 117116.0 |
| 36037 | GENESEE | 3035.1 | 855.2 | 20.5 | 127.1 | 121.5 | 13116.7 | 3057.1 | 857.4 | 20.6 | 128.2 | 122.6 | 13138.1 |
| 36039 | GREENE | 1997.6 | 672.1 | 14.1 | 83.1 | 79.3 | 10151.8 | 2020.1 | 674.4 | 14.2 | 84.2 | 80.4 | 10174.1 |
| 36051 | LIVINGSTON | 1911.9 | 683.9 | 12.3 | 83.5 | 79.6 | 10006.3 | 1934.2 | 686.1 | 12.4 | 84.6 | 80.7 | 10028.8 |
| 36053 | MADISON | 1797.8 | 729.6 | 13.1 | 73.4 | 69.9 | 10881.9 | 1820.3 | 731.8 | 13.2 | 74.6 | 71.0 | 10903.7 |
| 36065 | ONEIDA | 4997.0 | 2222.6 | 38.1 | 211.2 | 200.7 | 32376.2 | 5020.6 | 2225.1 | 38.1 | 212.4 | 201.8 | 32399.3 |
| 36067 | ONONDAGA | 11468.5 | 4535.9 | 82.3 | 501.2 | 477.7 | 66575.9 | 11492.9 | 4538.4 | 82.4 | 502.4 | 479.0 | 66600.0 |
| 36069 | ONTARIO | 3628.0 | 1241.3 | 25.5 | 150.8 | 144.0 | 18507.6 | 3650.8 | 1243.7 | 25.6 | 152.0 | 145.1 | 18529.9 |
| 36071 | ORANGE | 7527.5 | 3123.6 | 49.7 | 302.3 | 286.3 | 53982.4 | 7551.6 | 3126.0 | 49.8 | 303.6 | 287.5 | 54005.2 |
| 36077 | OTSEGO | 1620.0 | 640.5 | 11.4 | 70.1 | 66.6 | 9659.1 | 1641.8 | 642.6 | 11.5 | 71.1 | 67.6 | 9681.4 |
| 36095 | SCHOHARIE | 1505.6 | 496.2 | 11.6 | 62.0 | 59.0 | 7964.9 | 1527.7 | 498.4 | 11.7 | 63.1 | 60.1 | 7987.0 |
| 36097 | SCHUYLER | 558.3 | 215.0 | 3.8 | 22.8 | 21.7 | 3102.1 | 580.9 | 217.4 | 3.9 | 23.9 | 22.9 | 3122.9 |
| 36099 | SENECA | 1234.1 | 401.9 | 8.3 | 52.1 | 49.8 | 5979.4 | 1256.6 | 404.2 | 8.4 | 53.2 | 50.8 | 6002.1 |
| 36101 | STEUBEN | 3969.5 | 1197.4 | 24.2 | 173.8 | 166.3 | 17845.0 | 3991.3 | 1199.5 | 24.3 | 174.9 | 167.3 | 17867.0 |
| 36105 | SULLIVAN | 1481.6 | 752.4 | 11.8 | 58.4 | 55.3 | 11050.7 | 1504.9 | 754.7 | 11.9 | 59.6 | 56.5 | 11070.8 |
| 36107 | TIOGA | 1398.8 | 599.9 | 10.5 | 57.6 | 54.9 | 8538.5 | 1423.3 | 602.6 | 10.6 | 58.9 | 56.2 | 8561.8 |
| 36109 | TOMPKINS | 1727.3 | 790.5 | 12.8 | 72.3 | 68.8 | 11227.7 | 1751.6 | 793.1 | 12.9 | 73.5 | 70.1 | 11250.9 |
| 36111 | ULSTER | 4114.3 | 1895.8 | 36.0 | 156.2 | 148.2 | 29231.2 | 4138.3 | 1898.4 | 36.1 | 157.5 | 149.4 | 29254.8 |
| 36121 | WYOMING | 999.9 | 414.6 | 6.5 | 42.3 | 40.4 | 5827.2 | 1022.8 | 416.9 | 6.6 | 43.5 | 41.5 | 5847.9 |
| 36123 | YATES | 477.8 | 222.1 | 3.2 | 19.3 | 18.4 | 3152.6 | 500.8 | 224.5 | 3.3 | 20.5 | 19.6 | 3173.5 |

| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Total For Counties in Marcellus Shale Area | | 104,080 | 40,983 | 741 | 4,379 | 4,170 | 614,703 | | 104,767 | 41,053 | 743 | 4,413 | 4,203 | 615,372 |
| | | Estimated additional mobile source emissions resulting from additional VMT associated with proposed gas drilling * | | | | | | | | Percentage increase in emissions assuming all wells operating | | | | | |
| | | | | | | | | | | NOX | VOC | $SO_2$ | $PM_{10}$ Total | $PM_{25}$ Total | CO |
| | | NOX | VOC | $SO_2$ | $PM_{10}$ Total | $PM_{25}$ Total | CO | | | 0.66% | 0.17% | 0.33% | 0.79% | 0.80% | 0.11% |
| | | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | (Tons/Yr) | | | | | | | | |
| | | 686.7 | 70.0 | 2.5 | 34.4 | 33.3 | 668.6 | | | | | | | | |
| | | Well pad emissions assuming total emissions split equally across all | | | | | | | | | | | | | |
| | | 0.28 | 0.03 | 0.00 | 0.01 | 0.01 | 0.27 | | | | | | | | |

* Does NOT include Evaporative emissions processes

**Marcellus Single Pad MOBILE Model Emissions of PM2.5 for CP-33 Comparison**

## Vehicle Trip Emissions

| Vehicle Type | Range of Trucks | Max Number of Trucks | Feet travelled per site* | Distance travelled per truck (miles) | PM 2.5 EF (lbs/mile) | Emissions (tons) |
|---|---|---|---|---|---|---|
| Drill Pad and Road Construction Equipment | 10-45 | 45 | 1700 | 14.49 | 0.0003 | 2.18799E-06 |
| Drilling Rig | 30 | 30 | 1700 | 9.66 | 0.0003 | 1.45866E-06 |
| Drilling Fluid and Materials | 25-50 | 50 | 1700 | 16.10 | 0.0003 | 2.4311E-06 |
| Drilling Equipment (casing, drill pipe, etc.) | 25-50 | 50 | 1700 | 16.10 | 0.0003 | 2.4311E-06 |
| Completion Rig | 15 | 15 | 1700 | 4.83 | 0.0003 | 7.2933E-07 |
| Completion Fluid and Materials | 10-20 | 20 | 1700 | 6.44 | 0.0003 | 9.72439E-07 |
| Completion Equipment – (pipe, wellhead) | 5 | 5 | 1700 | 1.61 | 0.0003 | 2.4311E-07 |
| Hydraulic Fracture Equipment (pump trucks, tanks) | 150-200 | 200 | 1700 | 64.39 | 0.0003 | 9.72439E-06 |
| Hydraulic Fracture Water | 400-600 | 600 | 1700 | 193.18 | 0.0003 | 2.91732E-05 |
| Hydraulic Fracture Sand | 20-25 | 25 | 1700 | 8.05 | 0.0003 | 1.21555E-06 |
| Flow Back Water Removal | 200-300 | 300 | 1700 | 96.59 | 0.0003 | 1.45866E-05 |
| **Total** | | **1340** | | **431.44** | | **6.51534E-05** |

*(1 - 750 foot trip onto site, 1 - 100 foot trip to station, 1- 100 foot trip back from the station and 1-750 foot trip off the site)

## Vehicle Idle Emissions

| Vehicle Type | Range of Trucks | Max Number of Trucks | Idle Time per truck (hrs)** | Hours idling per truck type (hrs) | PM 2.5 EF (lbs/hr) | Emissions (tons) |
|---|---|---|---|---|---|---|
| Drill Pad and Road Construction Equipment | 10-45 | 45 | 2 | 90.00 | 0.0013 | 5.74901E-05 |
| Drilling Rig | 30 | 30 | 2 | 60.00 | 0.0013 | 3.83267E-05 |
| Drilling Fluid and Materials | 25-50 | 50 | 2 | 100.00 | 0.0013 | 6.38779E-05 |
| Drilling Equipment (casing, drill pipe, etc.) | 25-50 | 50 | 2 | 100.00 | 0.0013 | 6.38779E-05 |
| Completion Rig | 15 | 15 | 2 | 30.00 | 0.0013 | 1.91634E-05 |
| Completion Fluid and Materials | 10-20 | 20 | 2 | 40.00 | 0.0013 | 2.55511E-05 |
| Completion Equipment – (pipe, wellhead) | 5 | 5 | 2 | 10.00 | 0.0013 | 6.38779E-06 |
| Hydraulic Fracture Equipment (pump trucks, tanks) | 150-200 | 200 | 2 | 400.00 | 0.0013 | 0.000255511 |
| Hydraulic Fracture Water | 400-600 | 600 | 2 | 1200.00 | 0.0013 | 0.000766534 |
| Hydraulic Fracture Sand | 20-25 | 25 | 2 | 50.00 | 0.0013 | 3.19389E-05 |
| Flow Back Water Removal | 200-300 | 300 | 2 | 600.00 | 0.0013 | 0.000383267 |
| **Total** | | **1340** | | **2680.00** | | **0.001711927** |

** Assume each truck idles at least 2 hours over the duration of the project

## Road Dust Emissions

| Vehicle Type | Range of Trucks | Max Number of Trucks | Feet travelled per site* | Distance travelled per truck (miles) | PM 2.5 EF (lbs/mile) | Emissions (tons) |
|---|---|---|---|---|---|---|
| Drill Pad and Road Construction Equipment | 10-45 | 45 | 1700 | 14.49 | 0.0863 | 0.000625511 |
| Drilling Rig | 30 | 30 | 1700 | 9.66 | 0.0863 | 0.000417007 |
| Drilling Fluid and Materials | 25-50 | 50 | 1700 | 16.10 | 0.0863 | 0.000695012 |
| Drilling Equipment (casing, drill pipe, etc.) | 25-50 | 50 | 1700 | 16.10 | 0.0863 | 0.000695012 |
| Completion Rig | 15 | 15 | 1700 | 4.83 | 0.0863 | 0.000208504 |
| Completion Fluid and Materials | 10-20 | 20 | 1700 | 6.44 | 0.0863 | 0.000278005 |
| Completion Equipment – (pipe, wellhead) | 5 | 5 | 1700 | 1.61 | 0.0863 | 6.95012E-05 |
| Hydraulic Fracture Equipment (pump trucks, tanks) | 150-200 | 200 | 1700 | 64.39 | 0.0863 | 0.002780047 |
| Hydraulic Fracture Water | 400-600 | 600 | 1700 | 193.18 | 0.0863 | 0.008340142 |
| Hydraulic Fracture Sand | 20-25 | 25 | 1700 | 8.05 | 0.0863 | 0.000347506 |
| Flow Back Water Removal | 200-300 | 300 | 1700 | 96.59 | 0.0863 | 0.004170071 |
| **Total** | | **1340** | | **431.44** | | **0.018626317** |

| Total PM 2.5 Emissions | Emissions (tons) | Emissions (lbs) |
|---|---|---|
| Vehicle Trip Emissions | 6.51534E-05 | 0.13 |
| Vehicle Idle Emissions | 0.001711927 | 3.42 |
| Road Dust Emissions | 1.86E-02 | 37.25 |
| **Total** | **0.02** | **40.81** |

New York State

DEC

# Appendix 19

## Greenhouse Gas (GHG) Emissions

Updated July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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# Part A

# GHG Tables

Updated July 2011

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GHG Tables (Revised July 2011, following replaces tables released in September 2009)

Table GHG-1 – Emission Rates for Well Pad[1]

| Emission Source/ Equipment Type | $CH_4$ EF | $CO_2$ EF | Units | EF Reference[2] |
|---|---|---|---|---|
| Fugitive Emissions | | | | |
| ***Gas Wells*** | | | | |
| Gas Wells | 0.014 | 0.00015 | lbs/hr per well | Vol 8, page no. 34, table 4-5 |
| ***Field Separation Equipment*** | | | | |
| Heaters | 0.027 | 0.001 | lbs/hr per heater | Vol 8, page no. 34, table 4-5 |
| Separators | 0.002 | 0.00006 | lbs/hr per separator | Vol 8, page no. 34, table 4-5 |
| Dehydrators | 0.042 | 0.001 | lbs/hr per dehydrator | Vol 8, page no. 34, table 4-5 |
| Meters/Piping | 0.017 | 0.001 | lbs/hr per meter | Vol 8, page no. 34, table 4-5 |
| ***Gathering Compressors*** | | | | |
| Large Reciprocating Compressor | 29.252 | 1.037 | lbs/hr per compressor | GRI - 96 - Methane Emissions from the Natural Gas Industry, Final Report |
| ***Vented and Combusted Emissions*** | | | | |
| ***Normal Operations*** | | | | |
| 1,775 hp Reciprocating Compressor | not determined | 1,404.716 | lbs/hr per compressor | 6,760 Btu/hp-hr, 2004 API, page no. 4-8 |
| Pneumatic Device Vents | 0.664 | 0.024 | lbs/hr per device | Vol 12, page no. 48, table 4-6 |
| Dehydrator Vents | 12.725 | 0.451 | lbs/MMscf throughput | Vol 14, page no. 27 |
| Dehydrator Pumps | 45.804 | 1.623 | lbs/MMscf throughput | GRI June Final Report |
| ***Blowdowns*** | | | | |
| Vessel BD | 0.00041 | 0.00001 | lbs/hr per vessel | Vol 6, page no. 18, table 4-2 |
| Compressor BD | 0.020 | 0.00071 | lbs/hr per compressor | Vol 6, page no. 18, table 4-2 |
| Compressor Starts | 0.045 | 0.00158 | lbs/hr per compressor | Vol 6, page no. 18, table 4-2 |
| ***Upsets*** | | | | |
| Pressure Relief Valves | 0.00018 | 0.00001 | lbs/hr per valve | Vol 6, page no. 18, table 4-2 |

[1] Adapted from Exhibit 2.6.1, ICF Incorporated, LLC. *Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs*, Agreement No. 9679, August 2009., pp 34-35.

[2] Unless otherwise noted, all emission factors are from the Gas Research Institute, *Methane Emissions from the Natural Gas Industry*, 1996. Available at: epa.gov/gasstar/tools/related.html.

Table GHG-2 – Drilling Rig Mobilization, Site Preparation and Demobilization – GHG Emissions

| | **Single Vertical, Single Horizontal or Four-Well Pad**[3] | | | | |
|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions Light Truck & Heavy Truck Combined Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Transportation [4] | 432 | NA | NA | 4 | NA |
| Drill Pad and Road Construction [5] | NA | 48 hours | NA | 11 | NA |
| **Total Emissions** | 432 | NA | NA | 15 | NA |

Table GHG-3 – Completion Rig Mobilization and Demobilization – GHG Emissions

| | **Single Vertical, Single Horizontal or Four-Well Pad** | | | | |
|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions Light Truck & Heavy Truck Combined Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Completion Rig[6] | 432 | NA | NA | 4 | NA |
| **Total Emissions** | 432 | NA | NA | 4 | NA |

[3] Site preparation for a single vertical well would be less due to a smaller pad size but for simplification site preparation is assumed the same for all well scenarios considered.
[4] ALL Consulting, 2011, Exhibit19B.
[5] Assumed 20 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[6] ALL Consulting, 2011, Exhibit19B. Completion rig mobilization likely less than that for drilling rig but for simplification assumed the same.

Table GHG-4 – Well Drilling – Single Vertical Well GHG Emissions

| | Single Vertical Well | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Transportation[7] | 788 | NA | NA | NA | 9 | NA |
| Power Engines[8] | NA | 132 hours | 1 | NA | 74 | NA |
| Circulating System[9] | NA | 132 hours | 1 | negligible | NA | negligible |
| Well Control System[10] | NA | As needed | 1 | negligible | negligible | negligible |
| **Total Emissions** | NA | NA | NA | negligible | 83 | negligible |

[7] ALL Consulting, 2011, Exhibit 20B.
[8] Power Engines include rig engines, air compressor engines, mud pump engines and electrical generator engines. Assumed 50 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[9] Circulating system includes mud system piping and valves, mud-gas separator, mud pits or tanks and blooie line for air drilling.
[10] Well Control System includes well control piping and valves, BOP, choke manifold and flare line.

Table GHG-5 – Well Drilling – Single Horizontal Well GHG Emissions

| | Single Horizontal Well | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Transportation[11] | 2,298 | NA | NA | NA | 26 | NA |
| Power Engines[12] | NA | 300 hours | 1 | NA | 168 | NA |
| Circulating System[13] | NA | 300 hours | 1 | negligible | NA | negligible |
| Well Control System[14] | NA | As needed | 1 | negligible | negligible | negligible |
| **Total Emissions** | NA | NA | NA | negligible | 194 | negligible |

[11] ALL Consulting, 2011, Exhibit19B.
[12] Power Engines include rig engines, air compressor engines, mud pump engines and electrical generator engines. Assumed 50 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[13] Circulating system includes mud system piping and valves, mud-gas separator, mud pits or tanks and blooie line for air drilling.
[14] Well Control System includes well control piping and valves, BOP, choke manifold and flare line.

Table GHG-6 – Well Drilling – Four-Well Pad GHG Emissions

| | Four-Well Pad | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Transportation[15] | 9,192 | NA | NA | NA | 104 | NA |
| Power Engines[16] | NA | 1,200 hours | 1 | NA | 672 | NA |
| Circulating System[17] | NA | 1,200 hours | 1 | negligible | NA | negligible |
| Well Control System[18] | NA | As needed | 1 | negligible | negligible | negligible |
| **Total Emissions** | NA | NA | NA | negligible | 776 | negligible |

[15] ALL Consulting, 2011, Exhibit19B.
[16] Power Engines include rig engines, air compressor engines, mud pump engines and electrical generator engines. Assumed 50 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[17] Circulating system includes mud system piping and valves, mud-gas separator, mud pits or tanks and blooie line for air drilling.
[18] Well Control System includes well control piping and valves, BOP, choke manifold and flare line.

Table GHG-7 – Well Completion – Single Vertical Well GHG Emissions

| | Single Vertical Well | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours or Fuel Use** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Transportation[19] | 818 | NA | 1 | NA | 9 | NA |
| Hydraulic Fracturing Pump Engines | NA | 4,833 gallons[20] | 1 | NA | 54 | NA |
| Line Heater | NA | 72 hours | 1 | NA | negligible | NA |
| Flowback Pits/Tanks | NA | 72 hours | 1 | NA | NA | negligible |
| Flare Stack[21] | NA | 72 hours | 1 | 12[22] | 1,728[23] | NA |
| Rig Engines[24] | NA | 12 hours | 1 | NA | 4 | NA |
| Site Reclamation[25] | NA | 24 hours | NA | NA | 6 | NA |
| Transportation for Site Reclamation[26] | 280 | NA | NA | NA | 3 | NA |
| **Total Emissions** | NA | NA | NA | 12 | 1,804 | negligible |

[19] ALL Consulting, 2011, Exhibit 20B.
[20] ALL Consulting, 2009. *Horizontally Drilled/High-Volume Hydraulically Fractured Wells Air Emissions Data,* Table 11, p. 10. Assumed vertical job is one-sixth of high-volume job.
[21] Assumed no use of reduced emission completion ("REC").
[22] ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, August 2009, NYSERDA Agreement No. 9679. p. 28. . Vertical well not likely to produce at assumed rate due to reduced completion interval.
[23] ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, August 2009, NYSERDA Agreement No. 9679. p. 28. Vertical well not likely to produce at assumed rate due to reduced completion interval.
[24] Assumed 25 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[25] Assumed 20 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[26] ALL Consulting, 2011, Exhibit 20B.

Table GHG-8 – Well Completion – Single Horizontal Well GHG Emissions

| | Single Horizontal Well | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours or Fuel Use** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Transportation[27] | 2,462 | NA | 1 | NA | 28 | NA |
| Hydraulic Fracturing Pump Engines | NA | 29,000 gallons[28] | 1 | NA | 325 | NA |
| Line Heater | NA | 72 hours | 1 | NA | negligible | NA |
| Flowback Pits/Tanks | NA | 72 hours | 1 | NA | NA | negligible |
| Flare Stack[29] | NA | 72 hours | 1 | 12[30] | 1,728[31] | NA |
| Rig Engines[32] | NA | 24 hours | 1 | NA | 7 | NA |
| Site Reclamation[33] | NA | 24 hours | NA | NA | 6 | NA |
| Transportation for Site Reclamation[34] | 280 | NA | NA | NA | 3 | NA |
| **Total Emissions** | NA | NA | NA | 12 | 2,097 | negligible |

[27] ALL Consulting, 2011, Exhibit 19B.
[28] ALL Consulting, 2009. *Horizontally Drilled/High-Volume Hydraulically Fractured Wells Air Emissions Data,* Table 11, p. 10.
[29] Assumed no use of reduced emission completion ("REC").
[30] ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, August 2009, NYSERDA Agreement No. 9679. p. 28.
[31] ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, August 2009, NYSERDA Agreement No. 9679. p. 28.
[32] Assumed 25 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[33] Assumed 20 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[34] ALL Consulting, 2011, Exhibit 19B.

Table GHG-9 – Well Completion – Four-Well Pad GHG Emissions

| | Four-Well Pad | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Light Truck & Heavy Truck Combined Fuel Use (gallons diesel)** | **Total Operating Hours or Fuel Use** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Transportation[35] | 9,848 | NA | NA | NA | 112 | NA |
| Hydraulic Fracturing Pump Engines | NA | 116,000 gallons | NA | NA | 1,300 | NA |
| Line Heater | NA | 288 hours | 1 | NA | negligible | NA |
| Flowback Pits/Tanks | NA | 288 hours | 1 | NA | NA | negligible |
| Flare Stack[36] | NA | 288 hours | 1 | 48 | 6,912 | NA |
| Rig Engines[37] | NA | 96 hours | 1 | NA | 28 | NA |
| Site Reclamation[38] | NA | 24 hours | NA | NA | 6 | NA |
| Transportation for Site Reclamation | 280 | NA | NA | NA | 3 | NA |
| **Total Emissions** | NA | NA | NA | 48 | 8,361 | negligible |

[35] ALL Consulting, 2011, Exhibit 19B.
[36] Assumed no use of reduced emission completion ("REC").
[37] Assumed 25 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.
[38] Assumed 20 gallons of diesel fuel used per hour with 100% oxidation of fuel carbon to $CO_2$.

Table GHG-10 – First-Year Well Production – Single Vertical Well GHG Emissions[39]

| | Single Vertical Well | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Vehicle Miles Traveled (VMT)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Production Equipment 10 Truckloads[40] | 400 | NA | NA | NA | 1 | NA |
| Wellhead | NA | 8,376 hours[41] | 1 | NA | NA | negligible |
| Compressor | NA | 8,376 hours | 1 | not determined | 5,883[42] (&4[43]) | 123[44] |
| Line Heater | NA | 8,376 hours | 1 | negligible | negligible | negligible |
| Separator | NA | 8,376 hours | | NA | negligible | negligible |
| Glycol Dehydrator | NA | 8,376 hours | 1 | negligible | negligible | negligible |
| Dehydrator Vents | NA | 8,376 hours | 1 | 22[45] | 3[46] | negligible |
| Dehydrator Pumps | NA | 8,376 hours | 1 | 80[47] | NA | negligible |
| Pneumatic Device Vents | NA | 8,376 hours | 3 | 9[48] | NA | negligible |
| Meters/Piping | NA | 8,376 hours | 1 | NA | NA | negligible |
| Vessel BD | NA | 4 hours | 4 | negligible | NA | negligible |
| Compressor BD | NA | 4 hours | 4 | negligible | NA | negligible |
| Compressor Starts | NA | 4 hours | 4 | negligible | NA | negligible |
| Pressure Relief Valves | NA | 4 hours | 5 | negligible | NA | negligible |
| Production Brine Tanks | NA | 8,376 hours | 1 | negligible | NA | negligible |
| Production Brine Removal 44Truckloads[49] | 1,760 | NA | NA | NA | 3 | NA |
| **Total Emissions** | NA | NA | NA | 111 | 5,894 | 123 |

[39] First-Year production is the production period in the first year after drilling and completion activities have been concluded. Assumed production 10 mmcfd per well. However, vertical well not likely to produce at assumed rate due to reduced completion interval.
[40] Assumed roundtrip of 40 miles.
[41] Calculated by subtracting total time required to drill and complete one vertical well (16 days) from 365 days.
[42] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[43] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[44] One compressor at Emissions Factor (EF) of 29.252 lbs per hour.
[45] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[46] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
[47] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[48] Emissions Factor (EF) of 0.664 lbs per hour.
[49] Assumed roundtrip of 40 miles.

Table GHG-11 – First-Year Well Production – Single Horizontal Well GHG Emissions[50]

| | Single Horizontal Well | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Vehicle Miles Traveled (VMT)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Production Equipment 10 Truckloads[51] | 400 | NA | NA | NA | 1 | NA |
| Wellhead | NA | 7,944 hours[52] | 1 | NA | NA | negligible |
| Compressor | NA | 7,944 hours | 1 | not determined | 5,580[53] (&4[54]) | 122[55] |
| Line Heater | NA | 7,944 hours | 1 | negligible | negligible | negligible |
| Separator | NA | 7,944 hours | | NA | negligible | negligible |
| Glycol Dehydrator | NA | 7,944 hours | 1 | negligible | negligible | negligible |
| Dehydrator Vents | NA | 7,944 hours | 1 | 21[56] | 3[57] | negligible |
| Dehydrator Pumps | NA | 7,944 hours | 1 | 76[58] | NA | negligible |
| Pneumatic Device Vents | NA | 7,944 hours | 3 | 9[59] | NA | negligible |
| Meters/Piping | NA | 7,944 hours | 1 | NA | NA | negligible |
| Vessel BD | NA | 4 hours | 4 | negligible | NA | negligible |
| Compressor BD | NA | 4 hours | 4 | negligible | NA | negligible |
| Compressor Starts | NA | 4 hours | 4 | negligible | NA | negligible |
| Pressure Relief Valves | NA | 4 hours | 5 | negligible | NA | negligible |
| Production Brine Tanks | NA | 7,944 hours | 1 | negligible | NA | negligible |
| Production Brine Removal 44Truckloads[60] | 1,760 | NA | NA | NA | 3 | NA |
| **Total Emissions** | NA | NA | NA | 106 | 5,591 | 122 |

[50] First-Year production is the production period in the first year after drilling and completion activities have been concluded. Assumed production 10 mmcfd per well.
[51] Assumed roundtrip of 40 miles.
[52] Calculated by subtracting total time required to drill and complete one horizontal well (34 days) from 365 days.
[53] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[54] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[55] One compressor at Emissions Factor (EF) of 29.252 lbs per hour.
[56] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[57] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
[58] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[59] Emissions Factor (EF) of 0.664 lbs per hour.
[60] Assumed roundtrip of 40 miles.

Table GHG-12 – First-Year Well Production – Four-Well Pad GHG Emissions[61]

| | Four-Well Pad | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Vehicle Miles Traveled (VMT)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Production Equipment 10 Truckloads[62] | 1,600 | NA | NA | NA | 3 | NA |
| Wellhead | NA | 5,496 hours[63] | 1 | NA | NA | negligible |
| Compressor | NA | 5,496 hours | 1 | not determined | 3,860[64] (&3[65]) | 80[66] |
| Line Heater | NA | 5,496 hours | 1 | negligible | negligible | negligible |
| Separator | NA | 5,496 hours | | NA | negligible | negligible |
| Glycol Dehydrator | NA | 5,496 hours | 1 | negligible | negligible | negligible |
| Dehydrator Vents | NA | 5,496 hours | 1 | 58[67] | 8[68] | negligible |
| Dehydrator Pumps | NA | 5,496 hours | 1 | 210[69] | NA | negligible |
| Pneumatic Device Vents | NA | 5,496 hours | 3 | 6[70] | NA | negligible |
| Meters/Piping | NA | 5,496 hours | 4 | NA | NA | negligible |
| Vessel BD | NA | 16 hours | 8 | negligible | NA | negligible |
| Compressor BD | NA | 16 hours | 8 | negligible | NA | negligible |
| Compressor Starts | NA | 16 hours | 8 | negligible | NA | negligible |
| Pressure Relief Valves | NA | 16 hours | 10 | negligible | NA | negligible |
| Production Brine Tanks | NA | 5,496 hours | 2 | negligible | NA | negligible |
| Production Brine Removal 176 Truckloads[71] | 7,040 | NA | NA | NA | 11 | NA |
| **Total Emissions** | NA | NA | NA | 274 | 3,885 | 80 |

[61] First-Year production is the production period in the first year after drilling and completion activities have been concluded. Assumed production 10 mmcfd per well.
[62] Assumed roundtrip of 40 miles.
[63] Calculated by subtracting total time required to drill and complete four horizontal wells (136 days) from 365 days.
[64] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[65] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[66] One compressor at Emissions Factor (EF) of 29.252 lbs per hour.
[67] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[68] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
[69] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[70] Emissions Factor (EF) of 0.664 lbs per hour.
[71] Assumed roundtrip of 40 miles.

Table GHG-13 – Post-First Year Annual Well Production – Single Vertical or Single Horizontal Well GHG Emissions[72]

| | Single Vertical Well or Single Horizontal Well | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Vehicle Miles Traveled (VMT)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Wellhead | NA | 8,760 hours[73] | 1 | NA | NA | negligible |
| Compressor | NA | 8,760 hours | 1 | not determined | 6,153[74] (&5[75]) | 128[76] |
| Line Heater | NA | 8,760 hours | 1 | negligible | negligible | negligible |
| Separator | NA | 8,760 hours | | NA | negligible | negligible |
| Glycol Dehydrator | NA | 8,760 hours | 1 | negligible | negligible | negligible |
| Dehydrator Vents | NA | 8,760 hours | 1 | 23[77] | 3[78] | negligible |
| Dehydrator Pumps | NA | 8,760 hours | 1 | 84[79] | NA | negligible |
| Pneumatic Device Vents | NA | 8,760 hours | 3 | 9[80] | NA | negligible |
| Meters/Piping | NA | 8,760 hours | 1 | NA | NA | negligible |
| Vessel BD | NA | 4 hours | 4 | negligible | NA | negligible |
| Compressor BD | NA | 4 hours | 4 | negligible | NA | negligible |
| Compressor Starts | NA | 4 hours | 4 | negligible | NA | negligible |
| Pressure Relief Valves | NA | 4 hours | 5 | negligible | NA | negligible |
| Production Brine Tanks | NA | 8,760 hours | 1 | negligible | NA | negligible |
| Production Brine Removal 50Truckloads[81] | 2,000 | NA | NA | NA | 3 | NA |
| **Total Emissions** | NA | NA | NA | 116 | 6,164 | 128 |

[72] Assumed production 10 mmcfd per well.
[73] Hours in 365 days.
[74] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[75] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[76] One compressor at Emissions Factor (EF) of 29.252 lbs per hour.
[77] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[78] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
[79] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[80] Emissions Factor (EF) of 0.664 lbs per hour.
[81] Assumed roundtrip of 40 miles.

Table GHG-14 – Post-First Year Annual Well Production – Four-Well Pad GHG Emissions[82]

| | Four-Well Pad | | | | | |
|---|---|---|---|---|---|---|
| **Emissions Source** | **Vehicle Miles Traveled (VMT)** | **Total Operating Hours** | **Activity Factor** | **Vented Emissions (tons $CH_4$)** | **Combustion Emissions (tons $CO_2$)** | **Fugitive Emissions (tons $CH_4$)** |
| Wellhead | NA | 8,760 hours[83] | 1 | NA | NA | negligible |
| Compressor | NA | 8,760 hours | 1 | not determined | 6,153[84] (&5[85]) | 128[86] |
| Line Heater | NA | 8,760 hours | 1 | negligible | negligible | negligible |
| Separator | NA | 8,760 hours | | NA | negligible | negligible |
| Glycol Dehydrator | NA | 8,760 hours | 1 | negligible | negligible | negligible |
| Dehydrator Vents | NA | 8,760 hours | 1 | 93[87] | 12[88] | negligible |
| Dehydrator Pumps | NA | 8,760 hours | 1 | 335[89] | NA | negligible |
| Pneumatic Device Vents | NA | 8,760 hours | 3 | 9[90] | NA | negligible |
| Meters/Piping | NA | 8,760 hours | 4 | NA | NA | negligible |
| Vessel BD | NA | 16 hours | 8 | negligible | NA | negligible |
| Compressor BD | NA | 16 hours | 8 | negligible | NA | negligible |
| Compressor Starts | NA | 16 hours | 8 | negligible | NA | negligible |
| Pressure Relief Valves | NA | 16 hours | 10 | negligible | NA | negligible |
| Production Brine Tanks | NA | 8,760 hours | 2 | negligible | NA | negligible |
| Production Brine Removal 200Truckloads[91] | 8,000 | NA | NA | NA | 13 | NA |
| **Total Emissions** | NA | NA | NA | 437 | 6,183 | 128 |

[82] Assumed production 10 mmcfd per well.
[83] Hours in 365 days.
[84] Combustion emission, Emissions Factor (EF) of 1,404.716 lbs per hour.
[85] Fugitive emission, Emissions Factor (EF) of 1.037 lbs per hour.
[86] One compressor at Emissions Factor (EF) of 29.252 lbs per hour.
[87] Emissions Factor (EF) of 12.725 lbs. per mmcf throughput.
[88] Vented emission, Emissions Factor (EF) of 1.623 lbs per mmcf throughput.
[89] Emissions Factor (EF) of 45.804 lbs. per mmcf throughput.
[90] Emissions Factor (EF) of 0.664 lbs per hour.
[91] Assumed roundtrip of 40 miles.

Table GHG-15 – Estimated First-Year Green House Gas Emissions from Single Vertical Well

| | **Single Vertical Well** | | | |
|---|---|---|---|---|
| | **$CO_2$ (tons)** | **$CH_4$ (tons)** | **$CH_4$ Expressed as $CO_2e$ (tons)**[92] | **Total Emissions from Proposed Activity $CO_2e$ (tons)** |
| Drilling Rig Mobilization, Site Preparation and Demobilization | 447 | NA | NA | 447 |
| Completion Rig Mobilization and Demobilization | 432 | NA | NA | 432 |
| Well Drilling | 83 | negligible | negligible | 83 |
| Well Completion including Hydraulic Fracturing and Flowback | 1,804 | 12 | 300 | 2,104 |
| Well Production | 5,894 | 234 | 5,850 | 11,744 |
| **Total** | 8,660 | 246 | 6,150 | 14,810 |

Table GHG-16 – Estimated First-Year Green House Gas Emissions from Single Horizontal Well

| | **Single Horizontal Well** | | | |
|---|---|---|---|---|
| | **$CO_2$ (tons)** | **$CH_4$ (tons)** | **$CH_4$ Expressed as $CO_2e$ (tons)**[93] | **Total Emissions from Proposed Activity $CO_2e$ (tons)** |
| Drilling Rig Mobilization, Site Preparation and Demobilization | 447 | NA | NA | 447 |
| Completion Rig Mobilization and Demobilization | 432 | NA | NA | 432 |
| Well Drilling | 194 | negligible | negligible | 194 |
| Well Completion including Hydraulic Fracturing and Flowback | 2,097 | 12 | 300 | 2,397 |
| Well Production | 5,591 | 228 | 5,700 | 11,291 |
| **Total** | 8,761 | 240 | 6,000 | 14,761 |

Table GHG-17 – Estimated Post First-Year Annual Green House Gas Emissions from Single Vertical Well or Single Horizontal Well

| | **Single Vertical Well or Single Horizontal Well**[94] | | | |
|---|---|---|---|---|
| | **$CO_2$ (tons)** | **$CH_4$ (tons)** | **$CH_4$ Expressed as $CO_2e$ (tons)**[95] | **Total Emissions from Proposed Activity $CO_2e$ (tons)** |
| Well Production | 6,164 | 244 | 6,100 | 12,264 |

[92] Equals $CH_4$ (tons) multiplied by 25 (100-Year GWP).
[93] Equals $CH_4$ (tons) multiplied by 25 (100-Year GWP).
[94] Assumed production 10 mmcfd per well. However, vertical well not likely to produce at assumed rate due to reduced completion interval, and therefore emission estimates are conservative for vertical well production.
[95] Equals $CH_4$ (tons) multiplied by 25 (100-Year GWP).

Table GHG-18 – Estimated First-Year Green House Gas Emissions from Four-Well Pad

| | **Four-Well Pad** | | | |
|---|---|---|---|---|
| | **$CO_2$ (tons)** | **$CH_4$ (tons)** | **$CH_4$ Expressed as $CO_2e$ (tons)[96]** | **Total Emissions from Proposed Activity $CO_2e$ (tons)** |
| Drilling Rig Mobilization, Site Preparation and Demobilization | 447 | NA | NA | 447 |
| Completion Rig Mobilization and Demobilization | 432 | NA | NA | 432 |
| Well Drilling | 776 | negligible | negligible | 776 |
| Well Completion including Hydraulic Fracturing and Flowback | 8,361 | 48 | 1,200 | 9,561 |
| Well Production | 3,885 | 354 | 8,850 | 12,735 |
| **Total** | 13,901 | 402 | 10,050 | 23,951 |

Table GHG-19 – Estimated Post First-Year Annual Green House Gas Emissions from Four-Well Pad

| | **Four-Well Pad** | | | |
|---|---|---|---|---|
| | **$CO_2$ (tons)** | **$CH_4$ (tons)** | **$CH_4$ Expressed as $CO_2e$ (tons)[97]** | **Total Emissions from Proposed Activity $CO_2e$ (tons)** |
| Well Production | 6,183 | 565 | 14,125 | 20,300 |

[96] Equals $CH_4$ (tons) multiplied by 25 (100-Year GWP).
[97] Equals $CH_4$ (tons) multiplied by 25 (100-Year GWP).

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# Part B

## Sample Calculations for Combustion Emissions from Mobile Sources

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## Sample Calculation for Combustion Emissions ($CO_2$) from Mobile Sources[1]

INPUT DATA: A fleet of heavy-duty (HD) diesel trucks travels 70,000 miles during the year. The trucks are equipped with advance control systems.

CALCULATION METHODOLOGY:

The fuel usage of the fleet is unknown, so the first step in the calculation is to convert from miles traveled to a volume of diesel fuel consumed basis. This calculation is performed using the default fuel economy factor of 7 miles/gallon for diesel heavy trucks provided API's Table 4-10.

$$70{,}000\,\frac{miles}{project} \times \frac{gallon\ diesel}{7\ miles} = 10{,}000\ \frac{gallons\ diesel\ consumed}{project\ move}$$

Carbon dioxide emissions are estimated using a fuel-based factor provided in API's Table 4-1. This factor is provided on a heat basis, so the fuel consumption must be converted to an energy input basis. This conversion is carried out using a recommended diesel heating value of $5.75 \times 10^6$ Btu/bbl (HHV), given in Table 3-5 of this document. Thus, the fuel heat rate is:

$$10{,}000\,\frac{gallons}{project\ move} \times \frac{bbl}{42\ gallons} \times \frac{5.75\ x\ 10^6\ Btu}{bbl} = 1{,}369{,}047{,}619\,\frac{Btu}{project\ move}(HHV)$$

According to API's Table 4-1, the fuel basis $CO_2$ emission factor for diesel fuel (diesel oil) is 0.0742 tonne $CO_2/10^6$ Btu (HHV basis).

Therefore, $CO_2$ emissions are calculated as follows, assuming 100% oxidation of fuel carbon to $CO_2$:

$$1{,}369{,}047{,}619\,\frac{Btu}{project\ move} \times 0.0742\ \frac{tonne\ CO2}{10^6}Btu = 101.78\ \frac{tonnes\ CO2}{project\ move}$$

To convert tonnes to US short tons:

$$101.78\ tonnes \times 2204.62\,\frac{lbs}{tonne} \div 2000\,\frac{lbs}{short\ ton} = 112.19\ tons\,\frac{CO2}{project\ move}$$

[1] American Petroleum Institute (API). *Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Gas Industry*, Washington DC, 2004; amended 2005. pp. 4-39, 4-40.

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# Appendix 20

# PROPOSED
# Pre-Frac Checklist and Certification

Updated July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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# PRE-FRAC CHECKLIST AND CERTIFICATION

**Well Name and Number:**
*(as shown on the Department-issued well permit)*

**API Number:**

**Well Owner:**

**Planned Frac Commencement Date:**

| Yes | No | |
|---|---|---|
| ☐ | ☐ | Well drilled, cased and cemented in accordance with well permit, or in accordance with revisions approved by the Regional Mineral Resources Manager on the dates listed below and revised wellbore schematic filed in regional Mineral Resources office.<br><br>Approval Date & Brief Description of Approved Revision(s)<br>*(attach additional sheets if necessary)* |
| ☐ | ☐ | All depths where fresh water, brine, oil and/or gas were encountered or circulation was lost during drilling operations are recorded on the attached sheet. Additional sheets are attached which describe how any lost circulation zones were addressed. |
| ☐ | ☐ | Enclosed radial cement bond evaluation log and narrative analysis of such, or other Department-approved evaluation, and consideration of appropriate supporting data per Section 6.4 "Other Testing and Information" of American Petroleum Institute (API) Guidance Document HF1 (First Edition, October 2009) verifies top of cement and effective cement bond at least 500 feet above the top of the formation to be fractured or at least 300 feet into the previous casing string. If intermediate casing was not installed, or if was not production casing was not cemented to surface, then provide the date of approval by the Department and a brief description of justification.<br><br>Approval Date & Brief Description of Justification<br>*(attach additional sheets if necessary)* |
| ☐ | ☐ | Per Section 7.1 "General" under the heading "Well Construction Guidelines" of American Petroleum Institute (API) Guidance Document HF1 (First Edition, October 2009), a representative blend of the cement used for the production casing was bench tested in accordance with API 10A Specification for Cements and Materials for Well Cementing (Twenty-Fourth Edition, December 2010) and was found to be of sufficient strength to withstand the maximum anticipated treatment pressure during hydraulic fracturing operations. |
| ☐ | ☐ | If fracturing operations will be performed down casing, then the pre-fracturing pressure tests required by permit conditions will be conducted and fracturing operations will only commence if the tests are successful. Any unsuccessful test will be reported to the Department and remedial measures will be proposed by the operator and must be approved by the Department prior to further operations. |

☐ ☐ All other information collected while drilling, listed below, verifies that all observed gas zones are isolated by casing and cement and that the well is properly constructed and suitable for high-volume hydraulic fracturing.

Date and Brief Description of Information Collected
*(attach additional sheets if necessary)*

☐ ☐ Fracturing products used will be the same products identified in the well permit application materials or otherwise identified and approved by the Department.

I hereby affirm under penalty of perjury that information provided on this form is true to the best of my knowledge and belief. False statements made herein are punishable as a Class A misdemeanor pursuant to Section 210.45 of the Penal Law.

**Printed or Typed Name and Title of Authorized Representative**
**Signature, Date**

## INSTRUCTIONS FOR PRE-FRAC CHECKLIST AND CERTIFICATION

The completed and signed form, and treatment plan must be received by the appropriate Regional office at least 3 days prior to the commencement of hydraulic fracturing operations. The treatment plan must include a profile showing anticipated pressures and volume of fluid for pumping the first stage. It must also include a description of the planned treatment interval for the well (i.e., top and bottom of perforations expressed in both True Vertical Depth (TVD) and True Measured Depth (TMD)). The operator may conduct hydraulic fracturing operations provided 1) all items on the checklist are affirmed by a response of "Yes," 2) the *Pre-Frac Checklist And Certification*, and treatment plan are received by the Department at least 3 days prior to hydraulic fracturing and 3) all other pre-frac notification requirements are met as specified elsewhere. **The well owner is prohibited from conducting hydraulic fracturing operations on the well without additional Department review and approval if a response of "No" is provided to any of the items in the pre-frac checklist.**

## SIGNATURE SECTION

**Signature Section -** The person signing the *Pre-Frac Checklist And Certification* must be authorized to do so on the Organizational Report on file with the Division of Mineral Resources.

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# Appendix 21

## Publically Owned Treatment Works (POTWs) With Approved Pretreatment Programs

Revised Draft
Supplemental Generic Environmental Impact Statement

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# Pretreatment Facilities and Associated WWTPs

| Region | Pretreatment Program | Facility | SPDES Number |
|---|---|---|---|
| 1 | Nassau County DPW - this facility is tracked under Cedar Creek in PCS. | Inwood STP<br>Bay Park STP<br>***Cedar Creek WPCP | NY0026441<br>NY0026450<br>NY0026859 |
| | Glen Cove (C) | Glen Cove STP | NY0026620 |
| | Suffolk DPW | Suffolk Co. SD #3 - Southwest | NY0104809 |
| 2 | New York City DEP | Wards Island WPCP<br>Owls Head WPCP<br>Newtown Creek WPCP<br>Jamaica WPCP<br>North River WPCP<br>26th Ward WPCP<br>Coney Island WPCP<br>Red Hook WPCP<br>Tallman Island WPCP<br>Bowery Bay WPCP<br>Rockaway WPCP<br>Oakwood Beach WPCP<br>Port Richmond WPCP<br>Hunts Point WPCP | NY0026131<br>NY0026166<br>NY0026204<br>NY0026115<br>NY0026247<br>NY0026212<br>NY0026182<br>NY0027073<br>NY0026239<br>NY0026158<br>NY0026221<br>NY0026174<br>NY0026107<br>NY0026191 |
| 3 | Suffern (V) | Suffern | NY0022748 |
| | Orangetown SD #2 | | NY0026051 |
| | Orange County SD #1 | Harriman STP | NY0027901 |
| | Newburgh (C) | Newburgh WPCF | NY0026310 |
| | Westchester County | Blind Brook<br>Mamaroneck<br>New Rochelle<br>Ossining<br>Port Chester<br>Peekskill<br>Yonkers Joint | NY0026719<br>NY0026701<br>NY0026697<br>NY0108324<br>NY0026786<br>NY0100803<br>NY0026689 |
| | Rockland County SD #1 | | NY0031895 |
| | Poughkeepsie (C) | Poughkeepsie STP | NY0026255 |
| | New Windsor (T) | New Windsor STP | NY0022446 |
| | Beacon (C) | Beacon STP | NY0025976 |
| | Haverstraw Joint Regional Sewer Board | Haverstraw Joint Regional Stp | NY0028533 |
| | Kingston (C) | Kingston (C) WWTF | NY0029351 |
| 4 | Amsterdam (C) | Amsterdam STP | NY0020290 |
| | Albany County | North WWTF<br>South WWTF | NY0026875<br>NY0026867 |
| | Schenectady (C) | Schenectady WPCP | NY0020516 |
| | Rennselaer County SD #1 | Rennselaer County SD #1 | NY0087971 |
| 5 | Plattsburgh (C) | City of Plattsburgh WPCP | NY0026018 |
| | Glens Falls (C) | Glens Fall (C) | NY0029050 |
| | Gloversville-Johnstown Joint Board | | NY0026042 |
| | Saratoga County SD #1 | | NY0028240 |

| Region | Pretreatment Program | Facility | SPDES Number |
|---|---|---|---|
| 6 | Little Falls (C) | Little Falls WWTP | NY0022403 |
| | Herkimer County | Herkimer County SD | NY0036528 |
| | Rome (C) | Rome WPCF | NY0030864 |
| | Ogdensburg (C) | City of Ogdensburg WWTP | NY0029831 |
| | Oneida County | | NY0025780 |
| | Watertown | | NY0025984 |
| 7 | Auburn (C) | Auburn STP | NY0021903 |
| | Fulton (C) | | NY0026301 |
| | Oswego (C) | Westside Wastewater Facility<br>Eastside Wastewater Facility | NY0029106<br>NY0029114 |
| | Cortland (C) | LeRoy R. Summerson WTF | NY0027561 |
| | Endicott (V) | Endicott WWTF | NY0027669 |
| | Ithaca (C) | | NY0026638 |
| | Binghamton-Johnson City | | NY0024414 |
| | Onondaga County | Metropolitan Syracuse<br>Baldwinsville/Seneca Knolls<br>Meadowbrook/Limestone<br>Oak Orchard<br>Wetzel Road | NY0027081<br>NY0030571<br>NY0027723<br>NY0030317<br>NY0027618 |
| 8 | Canandaigua (C) | Canandaigua STP | NY0025968 |
| | Webster (T) | Walter W. Bradley WPCP | NY0021610 |
| | Monroe County | Frank E VanLare STP<br>Northwest Quadrant STP | NY0028339<br>NY0028231 |
| | Batavia (C) | | NY0026514 |
| | Geneva (C) | Marsh Creek STP | NY0027049 |
| | Newark (V) | | NY0029475 |
| | Chemung County | Chemung County SD #1<br>Chemung County - Elmira<br>Chemung County - Baker Road | NY0036986<br>NY0035742<br>NY0246948 |
| 9 | Middleport (V) | Middleport (V) STP | NY0022331 |
| | North Tonawanda (C) | | NY0026280 |
| | Newfane STP (T) | | NY0027774 |
| | Erie County Southtowns | Erie County Southtowns<br>Erie County SD #2 - Big Sister | NY0095401<br>NY0022543 |
| | Niagara County | Niagara County SD #1 | NY0027979 |
| | Blasdell (V) | Blasdell | NY0020681 |
| | Buffalo Sewer Authority | Buffalo (C) | NY0028410 |
| | Amherst SD (T) | | NY0025950 |
| | Niagara Falls (C) | | NY0026336 |
| | Tonawanda (T) | Tonawanda (T) SD #2 WWTP | NY0026395 |
| | Lockport (C) | | NY0027057 |
| | Olean STP (C) | | NY0027162 |
| | Jamestown STP (C) | | NY0027570 |
| | Dunkirk STP (C) | | NY0027961 |

# Mini-Pretreatment Facilities

| Region | Facility | SPDES Number |
|---|---|---|
| 3 | Arlington WWTP | NY0026271 |
| 3 | Port Jervis STP | NY0026522 |
| 3 | Wallkill (T) STP | NY0024422 |
| 4 | Canajoharie (V) WWTP | NY0023485 |
| 4 | Colonie (T) Mohawk View WPCP | NY0027758 |
| 4 | East Greenbush (T) WWTP | NY0026034 |
| 4 | Hoosick Falls (V) WWTP | NY0024821 |
| 4 | Hudson (C) STP | NY0022039 |
| 4 | Montgomery co SD#1 STP | NY0107565 |
| 4 | Park Guilderland N.E. IND STP | NY0022217 |
| 4 | Rotterdam (T) SD2 STP | NY0020141 |
| 4 | Delhi (V) WWTP | NY0020265 |
| 4 | Hobart (V) WWTP | NY0029254 |
| 4 | Walton (V) WWTP | NY0027154 |
| 7 | Canastota (V) WPCP | NY0029807 |
| 7 | Cayuga Heights (V) WWTP | NY0020958 |
| 7 | Moravia (V) WWTP | NY0022756 |
| 7 | Norwich (C) WWTP | NY0021423 |
| 7 | Oak Orchard STP | NY0030317 |
| 7 | Oneida (C) STP | NY0026956 |
| 7 | Owego (T) SD#1 | NY0022730 |
| 7 | Owego WPCP #2 | NY0025798 |
| 7 | Sherburne (V) WWTP | NY0021466 |
| 7 | Waverly (V) WWTP | NY0031089 |
| 7 | Wetzel Road WWTP | NY0027618 |
| 8 | Avon (V) STP | NY0024449 |
| 8 | Bath (V) WWTP | NY0021431 |
| 8 | Bloomfield (V) WWTP | NY0024007 |
| 8 | Clifton Springs (V) WWTP | NY0020311 |
| 8 | Clyde (V) WWTP | NY0023965 |
| 8 | Corning (C) WWTP | NY0025721 |
| 8 | Dundee STP | NY0025445 |
| 8 | Erwin (T) WWTP | NY0023906 |
| 8 | Holley (V) WPCP | NY0023256 |
| 8 | Honeoye Falls (V) WWTP | NY0025259 |
| 8 | Hornell (C) WPCP | NY0023647 |
| 8 | Marion STP | NY0031569 |
| 8 | Ontario (T) STP | NY0027171 |
| 8 | Seneca Falls (V) WWTP | NY0033308 |
| 8 | Walworth SD #1 | NY0025704 |
| 9 | Akron (V) WWTP | NY0031003 |
| 9 | Arcade (V) WWTP | NY0026948 |
| 9 | Attica (V) WWTP | NY0021849 |
| 9 | East Aurora (V) STP | NY0028436 |
| 9 | Gowanda (V) | NY0032093 |

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# Appendix 22

## Publically Owned Treatment Works (POTWs) Procedures for Accepting Wastewater from High-Volume Hydraulic Fracturing

Revised July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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**POTW Procedures for Accepting High-Volume Hydraulic Fracturing Wastewater**

The following procedure shall be followed when a Publically Owned Treatment Works (POTW) proposes to accept high-volume hydraulic fracturing wastewater from a well driller or other development company. Page 5 of this appendix shows a simplified flowchart of this process. Please note that this disposal option is limited to the extent that municipal POTWs which utilize biological wastewater treatment are generally optimized for the removal of domestic wastewater and as such are not designed to treat several of the contaminants present in high-volume hydraulic fracturing wastewater. In addition to the above concerns, the additional monitoring and laboratory costs which will result from additional monitoring conditions in the permit must also be considered prior to deciding to accept this source of wastewater.

1. The POTW operator receives a request to accept flowback water from a well driller. Prior to submitting this request to the Department for approval, the POTW should review the request to assure that it includes, at a minimum:
    a. The volume of water to be sent to wastewater treatment plant in gallons per unit time (e.g. 25,000 gallons per day);
    b. Whether the discharge is a one-time disposal, or will be an ongoing source of wastewater to the POTW;
    c. A characterization of high-volume hydraulic fracturing wastewater quality including all high-volume hydraulic facturing parameters of concern and NORM analysis;
    d. A characterization of existing POTW wastewater quality including:
        i. Sample results for all high-volume hydraulic fracturing parameters of concern, and
        ii. the results of short term high intensity monitoring for both TDS (in mg/l) and Radium 226 (in piC/l), consisting of the results of ten (10) samples each of existing influent, sludge, and effluent from the POTW.
    e. The source of the wastewater (well name, well developer, Mineral Resources permit number, and location(s) of the wells); and

f. A list of all additives used in the hydraulic fracturing process at the source well(s).

2. The POTW shall forward the above request to the Bureau of Water Permits, 625 Broadway, Albany NY 12233-3505 along with the following supporting information:
   a. Documentation of existing EPA and Departmental approval of the facility's headworks analysis for the acceptance of high-volume hydraulic fracturing wastewater; or a completed headworks analysis for the high-volume hydraulic fracturing specific parameters of concern for Department and USEPA approval;
   b. Demonstration of available POTW capacity to accept the proposed volume of high-volume hydraulic fracturing wastewater; and
   c. Confirmation that the facility has an approved USEPA pretreatment or Department mini-pretreatment program as part of its SPDES permit.

3. The Division of Water will review the submitted information to determine whether the high-volume hydraulic fracturing wastewater source has been adequately characterized. If additional information is necessary, the Division of Water will request additional sampling and source information from the POTW.

4. The Division of Water will review the facility's SPDES permit to determine whether the permit needs to be modified to include high-volume hydraulic fracturing specific monitoring, limits, and reporting conditions.

5. Concurrently with 3. and 4. above, if a headworks analysis for the high-volume hydraulic fracturing specific parameters of concern was submitted for approval, the Division of Water will forward a copy of the headworks analysis to the USEPA Region 2 office for its review and approval. The Division of Water and USEPA Region 2 will review the facility's headworks analysis to assure that the POTW is capable of accepting the proposed volume and quantity of high-volume hydraulic fracturing wastewater

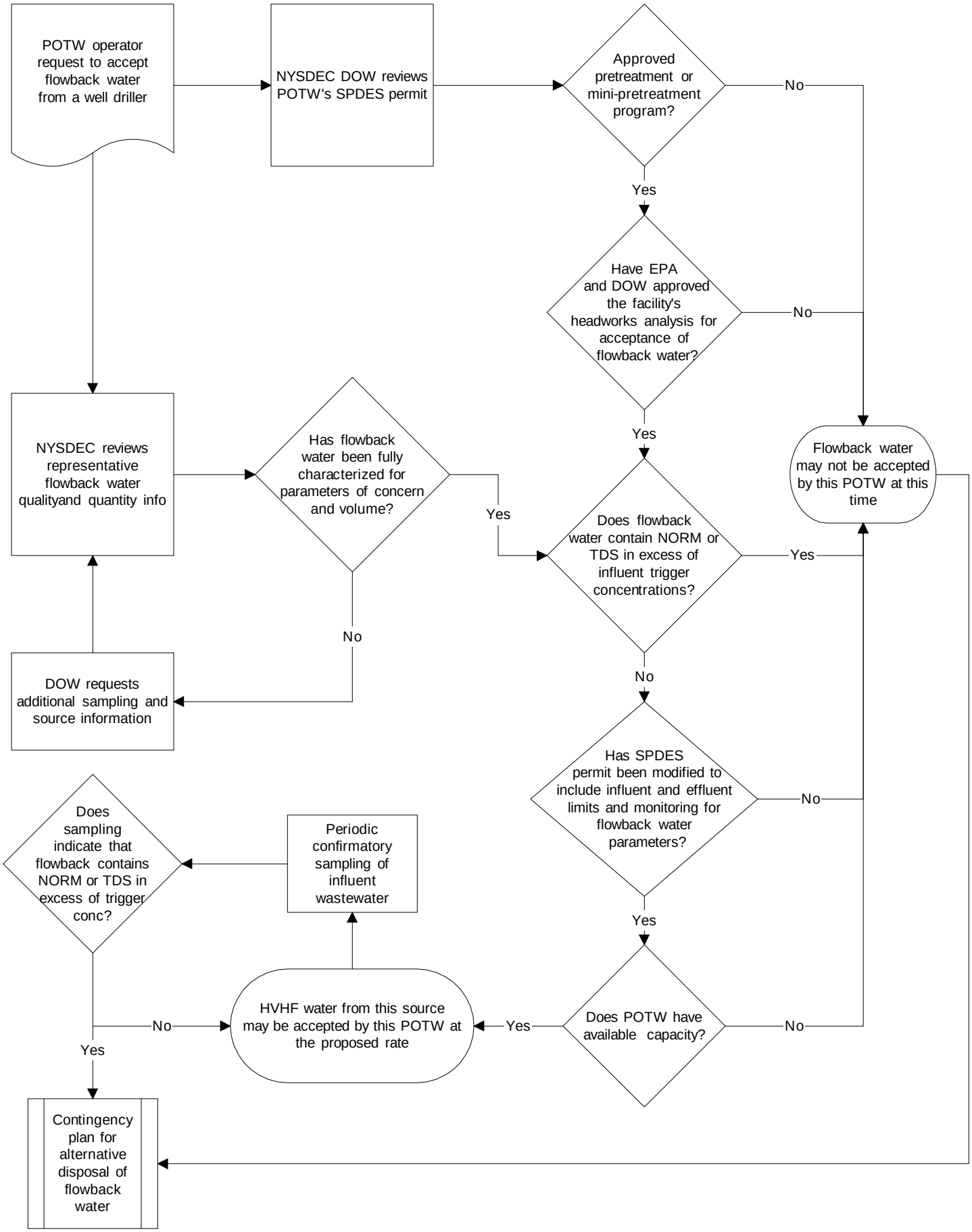
6. The Department will send a determination regarding the request to the permittee following the Division of Water and USEPA's analysis of the request. If the request is approved, the POTW may accept high-volume hydraulic fracturing wastewater from the requested source at the specified maximum concentrations and requested discharge rate following receipt of Departmental approval, which will include the following components:
    a. Approval of submitted headworks analysis by the Department and USEPA; and
    b. SPDES permit modification with high-volume hydraulic fracturing specific monitoring, limits, and reporting conditions, including;
        i. Specification of the source and maximum discharge rate of the high-volume hydraulic fracturing wastewater to be accepted;
        ii. Influent radium-226 and TDS limits;
        iii. Effluent limits and/or monitoring for NORM, TDS, and other high-volume hydraulic fracturing parameters of concern;
        iv. Periodic confirmatory sampling of influent wastewater for high-volume hydraulic fracturing parameters of concern to assure that the characteristics of the influent wastewater have not changed substantially from the characterization provided in the approval request;
        v. periodic sludge sampling to assure that the concentration of radionuclides in the sludge do not exceed 5 piC/g; and
        vi. Any other monitoring conditions necessary to assure that the discharge from the POTW does not cause or contribute to a violation of NYS water quality standards.

7. If the Department does not approve the acceptance of flowback water, a written denial will be sent to the permittee with the reason(s) for denial. These reasons could include, but not be limited to: inadequate receiving water assimilative capacity, NORM concentrations in excess of the applicable influent Radium-226 limit of 15- piC/l, influent concentrations of any other parameters in excess of the levels acceptable in the approved headworks analysis, or inadequate POTW capacity.

8. Following approval and permit modification, the POTW must notify the Department whenever:
    a. The facility wishes to increase the quantity of high-volume hydraulic fracturing wastewater accepted from this source;
    b. The facility wishes to accept any volume of high-volume hydraulic fracturing wastewater from a new or additional source;
    c. The high-volume hydraulic fracturing wastewater contains NORM or TDS in excess of the influent limits for these parameters; or
    d. The facility has decided to stop accepting high-volume hydraulic fracturing wastewater from one or more sources.

The notifications in a. – c. would be treated as a request for a new source of high-volume hydraulic fracturing wastewater, and would be processed in accordance with Items 1-7 above.

# Flowchart for acceptance of High Volume Hydraulic Fracturing (HVHF) wastewater by publicly owned treatment works (POTWs)



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# Appendix 23

## USEPA Natural Gas STAR Program

Revised Draft
Supplemental Generic Environmental Impact Statement

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TO: Peter Briggs, New York State Department of Environmental Conservation, Mineral Resources

FROM: Jerome Blackman, Natural Gas STAR International

DATE: September 1, 2009

RE: Natural Gas Star

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This memo lists methane emission mitigation options applicable in exploration and production; in reference to your inquiry. Natural Gas STAR Partners have reported a number of voluntary activities to reduce exploration and production methane emissions, and major project types are listed and summarized below and may help focus your research as you review the resources available on the Natural Gas STAR website.

In addition to these practices and technologies is an article that lists the same and several more cost effective options for producers to reduce methane emissions. Please refer to the link below.

*Cost-Effective Methane Emissions Reductions for Small and Midsize Natural Gas Producers*
www.epa.gov/gasstar/documents/CaseStudy.pdf

**Reduced Emission Completions**
Traditionally, "cleaning up" drilled wells, before connecting them to a production sales line, involves producing the well to open pits or tankage where sand, cuttings, and reservoir fluids are collected for disposal and the produced natural gas is vented to the atmosphere. Partners reported using a "green completion" method in which tanks, separators, dehydrators are brought on site to clean up the gas sufficiently for delivery to sales. The result is reducing completion emissions, creating an immediate revenue stream, and less solid waste.

Partner Recommended Opportunity from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/greencompletions.pdf

BP Experience Presentation with Reduced Emission Completions
www.epa.gov/gasstar/documents/workshops/2008-annual-conf/smith.pdf

Green Completion Presentation from a Tech-Transfer Workshop in 2005 at Houston, TX
www.epa.gov/gasstar/documents/workshops/houston-2005/green_c.pdf

**Optimize Glycol Circulation and Install of Flash Tank Separators in Dehydrator**
In dehydrators, as triethylene glycol (TEG) absorbs water, it also absorbs methane, other volatile organic compounds (VOCs), and hazardous air pollutants (HAPs). When the TEG is regenerated through heating, absorbed methane, VOCs, and HAPs are vented to the atmosphere with the water, wasting gas and money. Many wells produce gas below the initial design capacity yet

TEG circulation rates remain two or three times higher than necessary, resulting in little improvement in gas moisture quality but much higher methane emissions and fuel use. Optimizing circulation rates reduces methane emissions at negligible cost. Installing flash tank separators on glycol dehydrators further reduces methane, VOC, and HAP emissions and saves even more money. Flash tanks can recycle typically vented gas to the compressor suction and/or used as a fuel for the TEG reboiler and compressor engine.

Lessons Learned Document from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/ll_flashtanks3.pdf

Dehydrator Presentation from a 2008 Tech-Transfer Workshop in Charleston, WV:
www.epa.gov/gasstar/documents/workshops/2008-tech-transfer/charleston_dehydration.pdf

**Replacing Glycol Dehydrators with Desiccant Dehydrators**
Natural Gas STAR Partners have found that replacing glycol dehydrators with desiccant dehydrators reduces methane, VOC, and HAP emissions by 99 percent and also reduces operating and maintenance costs. In a desiccant dehydrator, wet gas passes through a drying bed of desiccant tablets. The tablets pull moisture from the gas and gradually dissolve in the process. Replacing a glycol dehydrator processing 1 million cubic feet per day (MMcfd) of gas with a desiccant dehydrator can save up to $9,232 per year in fuel gas, vented gas, operation and maintenance (O&M) costs, and reduce methane emissions by 444 thousand cubic feet (Mcf) per year.

Lessons Learned Document from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/ll_desde.pdf

**Directed Inspection and Maintenance**
A directed inspection and maintenance (DI&M) program is a proven, cost-effective way to detect, measure, prioritize, and repair equipment leaks to reduce methane emissions. A DI&M program begins with a baseline survey to identify and quantify leaks. Repairs that are cost-effective to fix are then made to the leaking components. Subsequent surveys are based on data from previous surveys, allowing operators to concentrate on the components that are most likely to leak and are profitable to repair.

Lessons Learned Documents from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/ll_dimgasproc.pdf
www.epa.gov/gasstar/documents/ll_dimcompstat.pdf

Partner Recommended Opportunity from the Natural Gas STAR website:
www.epa.gov/gasstar/documents/conductdimatremotefacilities.pdf

DI&M Presentation from a Tech-Transfer Workshop in 2008 at Midland, TX
www.epa.gov/gasstar/documents/workshops/2008-tech-transfer/midland4.ppt

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# Appendix 24

## Key Features of the USEPA Natural Gas STAR Program

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## Key Features of USEPA Natural Gas STAR Program[1]

Complete information on the Natural Gas STAR Program is given in USEPA's web site (http://epa.gov/gasstar/index.html)

- Participation in the program is voluntary.
- Program outreach is provided through the web site, annual national two-day implementation workshop, and sector– or activity – specific technology transfer workshops or webcasts, often with a regional focus (approximately six to nine per year).
- Companies agreeing to join ("Partners") commit to evaluating Best Management Practices (BMP) and implementing them when they are cost-effective for the company. In addition, " …partners are encouraged to identify, implement, and report on other technologies and practices to reduce methane emissions (referred to as Partner Reported Opportunities or PROs )."
- Best Management Practices are a limited set of reduction measures identified at the initiation of the program as widely applicable. PROs subsequently reported by partners have increased the number of reduction measures.
- The program provides calculation tools for estimating emissions reductions for BMPs and PROs, based on the relevant features of the equipment and application.
- Projected emissions reductions for some measures can be estimated accurately and simply; for example, reductions from replacing high-bleed pneumatic devices with low-bleed devices are a simple function of the known bleed rates of the respective devices, and the methane content of the gas. For others, such as those involving inspection and maintenance to detect and repair leaks, emissions reductions are difficult to anticipate because the number and magnitude of leaks is initially unknown or poorly estimated.
- Tools are also provided for estimating the economics of emission reduction measures, as a function of factors such as gas value, capital costs, and operation and maintenance costs.
- Technical feasibility is variable between measures and is often site- or application- specific. For example, in the Gas STAR Lessons Learned for replacing high-bleed with low-bleed pneumatic devices, it is estimated that "nearly all" high-bleed devices can feasibly be replaced with low-bleed devices. Some specific exceptions are listed, including very large valves requiring fast and/or precise response, commonly on large compressor discharge and bypass controllers.
- Partners report emissions reductions annually, but the individual partner reports are confidential. Publicly reported data are aggregated nationally, but include total reductions by sector and by emissions reduction measure.

[1] New Mexico Environment Department, *Oil and Gas Greenhouse Gas Emissions Reductions*. December 2007, pp. 19-20.

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# Appendix 25

## Reduced Emissions Completion (REC) Executive Summary

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## Reduced Emissions Completions – Executive Summary[1]

High prices and high demand for natural gas, have seen the natural gas production industry move into development of the more technologically challenging unconventional gas reserves such as tight sands, shale and coalbed methane. Completion of new wells and re-working (workover) of existing wells in these tight formations typically involves hydraulic fracturing of the reservoir to increase well productivity. Removing the water and excess proppant (generally sand) during completion and well clean-up may result in significant releases of natural gas and methane emissions to the atmosphere.

Conventional completion of wells (a process that cleans the well bore of stimulation fluids and solids so that the gas has a free path from the reservoir) results in gas being either vented or flared. Vented gas results in large amounts of methane, volatile organic compounds (VOCs), and hazardous air pollutants (HAPs) emissions to the atmosphere while flared gas results in carbon dioxide emissions.

Reduced emissions completion (REC) – also known as reduced flaring completion – is a term used to describe an alternate practice that captures gas produced during well completions and well workovers following hydraulic fracturing. Portable equipment is brought on site to separate the gas from the solids and liquids so that the gas is suitable for injection into the sales pipeline. Reduced emissions completions help to mitigate methane, VOC, and HAP emissions during the well flowback phase and can eliminate or significantly reduce the need for flaring.

RECs have become a popular practice among Natural Gas STAR production partners. A total of eight different partners have reported performing reduced emissions completions in their operations. RECs have become a major source of methane emission reductions since 2000. Between 2000 and 2005 emissions reductions from RECs have increased from 200 MMcf to over 7,000 MMcf. This represents additional revenue from natural gas sales of over $65 million in 2005 (assuming $7/Mcf gas prices).

| **Method for Reducing Gas Loss** | **Volume of Natural Gas Savings (Mcf/yr)[1]** | **Value of Natural Gas Savings ($/yr)[2]** | **Additional Savings ($/yr)[3]** | **Set-up Costs ($/yr)** | **Equipment Rental and Labor Costs ($)** | **Other Costs ($/yr)[4]** | **Payback (Months)[5]** |
|---|---|---|---|---|---|---|---|
| Reduced Emissions Completion | 270,000 | 1,890,000 | 197,500 | 15,000 | 212,500 | 129,500 | 3 |

1. Based on an annual REC program of 25 completions per year
2. Assuming $7/Mcf gas
3. Savings from recovering condensate and gas compressed to lift fluids
4. Cost of gas used to fuel compressor and lift fluids
5. Time required to recover the entire annual cost of the program

[1]Adapted from ICF Incorporated, LLC. Technical Assistance for the Draft Supplemental Generic EIS: Oil, Gas and Solution Mining Regulatory Program. Well Permit Issuance for Horizontal Drilling and High-Volume Hydraulic Fracturing to Develop the Marcellus Shale and Other Low Permeability Gas Reservoirs, *Task 2 – Technical Analysis of Potential Impacts to Air*, Agreement No. 9679, August 2009. Appendix 2.1.

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# Appendix 26

## Instructions for Using The On-Line Searchable Database to Locate Drilling Applications

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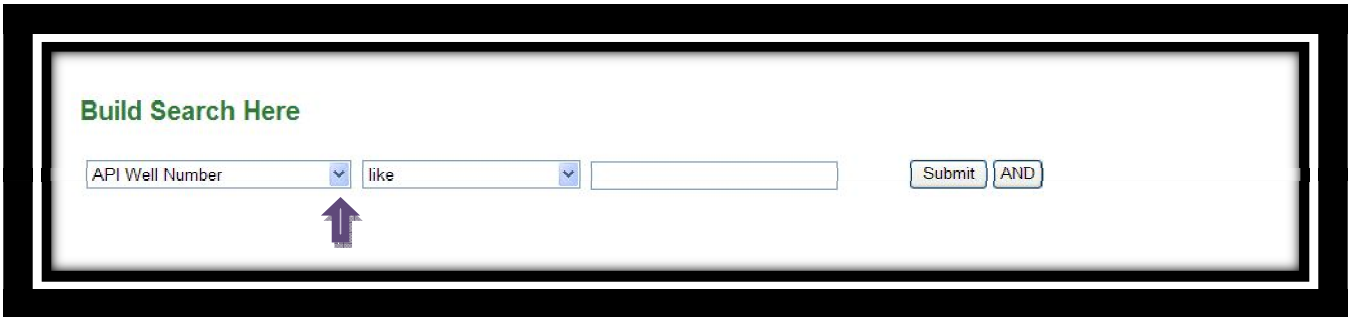
# How to Use the Online Searchable Database to Find Information about Recently Filed Permit Applications

The online searchable database can be found at http://www.dec.ny.gov/cfmx/extapps/GasOil/. It is a very user friendly program and can be used to conduct both simple and complex searches.

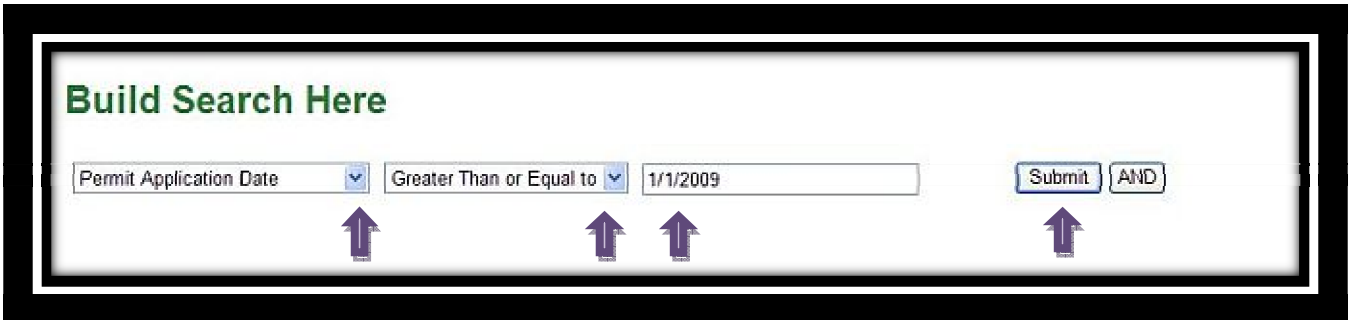
**How to Conduct a Simple Search**

1. Select Wells Data to begin your search.

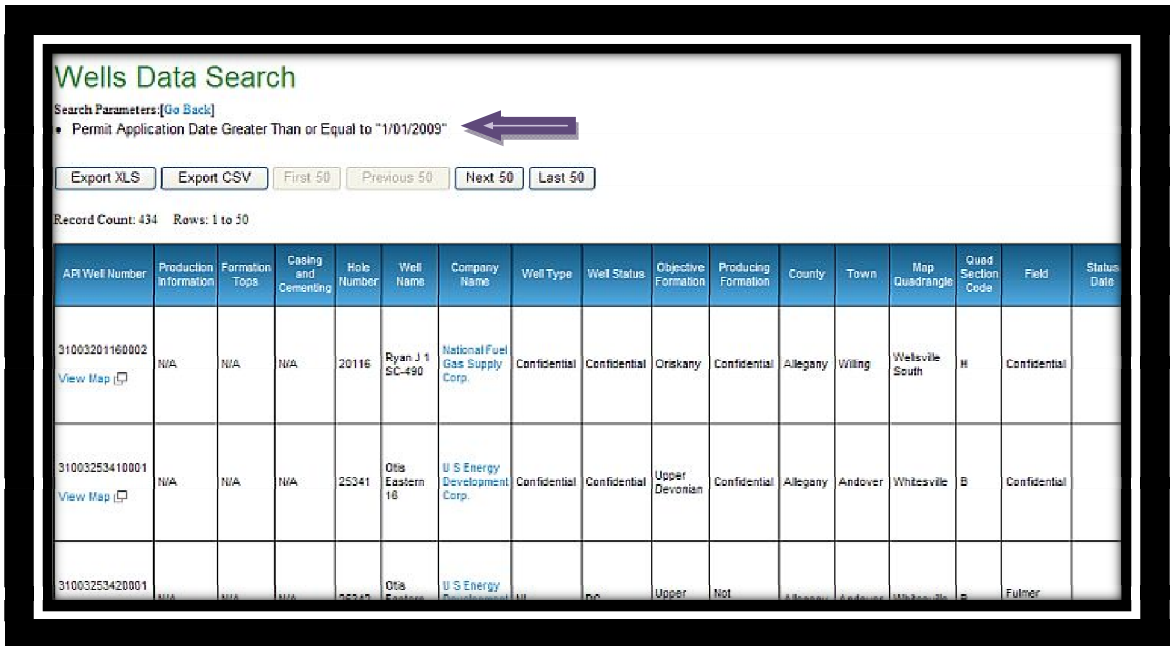
2. Select your search criteria. Use the drop down arrow next to API Number to select your search criteria.




3. To find a new permit application, enter Permit Application Date is Greater Than or Equal to, and the date that you would like to search from. Enter Permit Application Data is Greater Than or Equal to 1/1/year to find all permit applications filed during a specific year. Click the Submit button.



4. View results. By selecting the View Map hyperlink, a new window will open to Google Maps showing the well location along with latitude and longitude information. The results from your query can be saved to your computer as either an Excel spreadsheet (xls) or as a comma separated value file (csv) by clicking the appropriate Export button at the bottom the results screen. Clicking a hyperlink in the Company Name column will provide contact information for the company.



Wells Data Search

Search Parameters:[Go Back]

- Permit Application Date Greater Than or Equal to "1/01/2009"

Export XLS | Export CSV | First 50 | Previous 50 | Next 50 | Last 50

Record Count: 434 Rows: 1 to 50

| API Well Number | Production Information | Formation Tops | Casing and Cementing | Hole Number | Well Name | Company Name | Well Type | Well Status | Objective Formation | Producing Formation | County | Town | Map Quadrangle | Quad Section Code | Field | Status Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31003201160002 View Map | N/A | N/A | N/A | 20116 | Ryan J 1 SC-490 | National Fuel Gas Supply Corp. | Confidential | Confidential | Oriskany | Confidential | Allegany | Willing | Wellsville South | H | Confidential | |
| 31003253410001 View Map | N/A | N/A | N/A | 25341 | Otis Eastern 16 | U S Energy Development Corp. | Confidential | Confidential | Upper Devonian | Confidential | Allegany | Andover | Whitesville | B | Confidential | |
| 31003253420001 | N/A | N/A | N/A | 25342 | Otis Eastern | U S Energy Development | [illegible] | [illegible] | Upper | Not | [illegible] | [illegible] | [illegible] | [illegible] | Fulmer | |

**How to Narrow or Expand Your Search Utilizing the AND Button**

1. Select Wells Data to begin your search.

Search Database

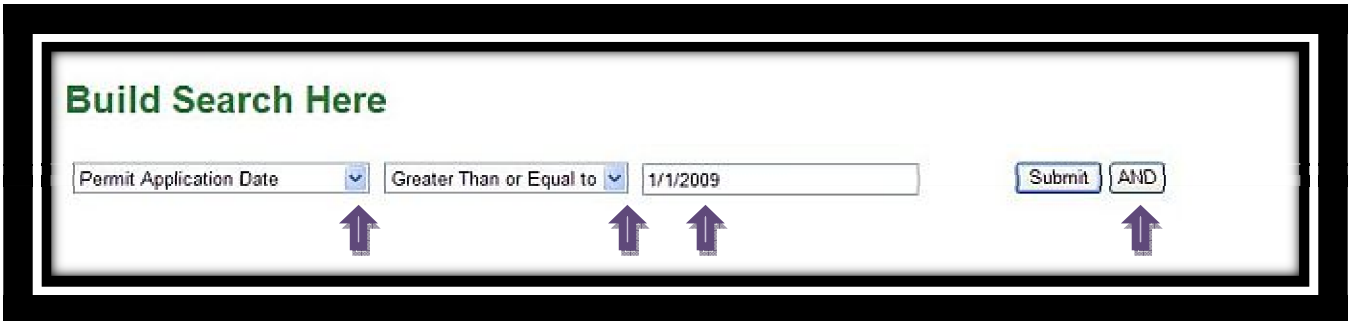
- General Search Tips/Help
- Set User Preferences
- Company Data
- Wells Data
- Annual Well Production
- Well Transfers
- Geologic Formation
- Geologic Fields

For more information:

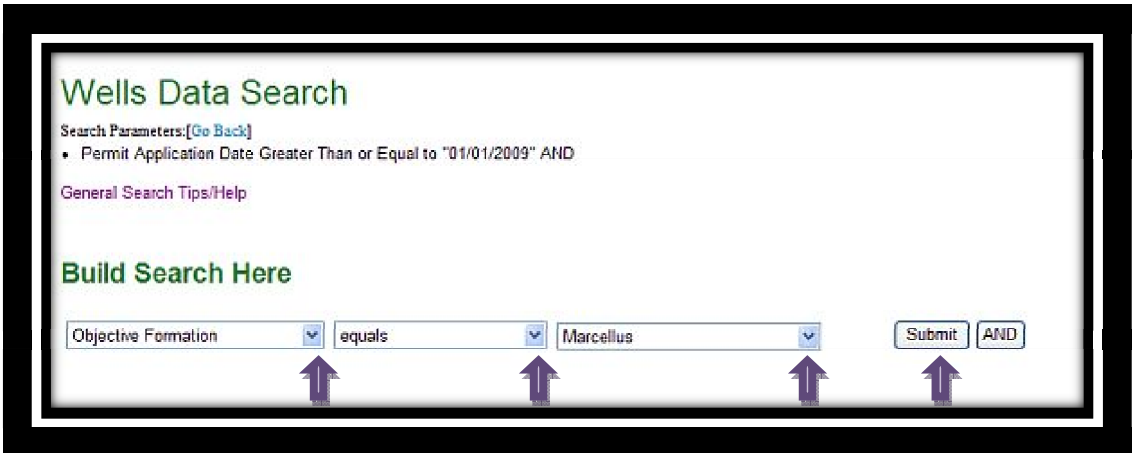
Division of Mineral Resources

Environmental Notice Bulletin for Minerals

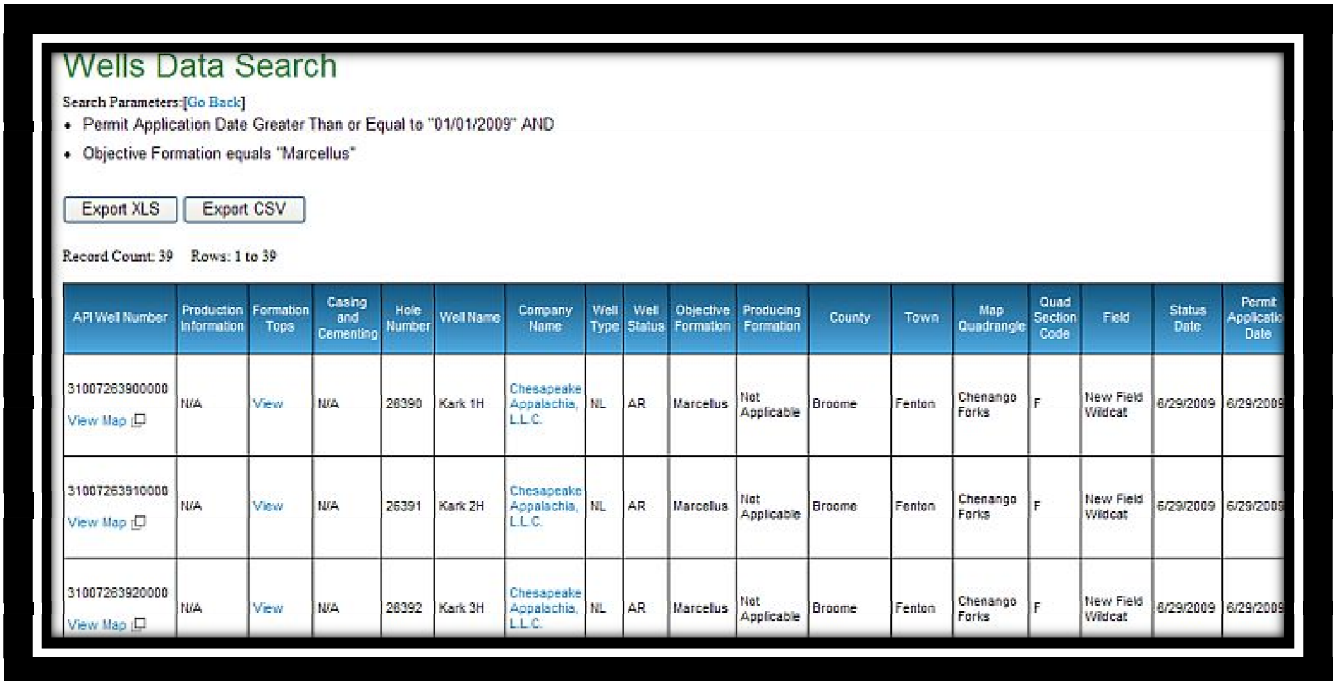
2. Select your search criteria. To find all permit applications filed in 2009 that target a specific geologic formation, select Permit Application Date is Greater Than or Equal to 1/1/2009. Click the AND button.




3. Select your next set of search criteria. To find all permit applications filed in 2009 for the Marcellus formation, select Objective Formation equals Marcellus. Click the Submit button.




4. View Results.

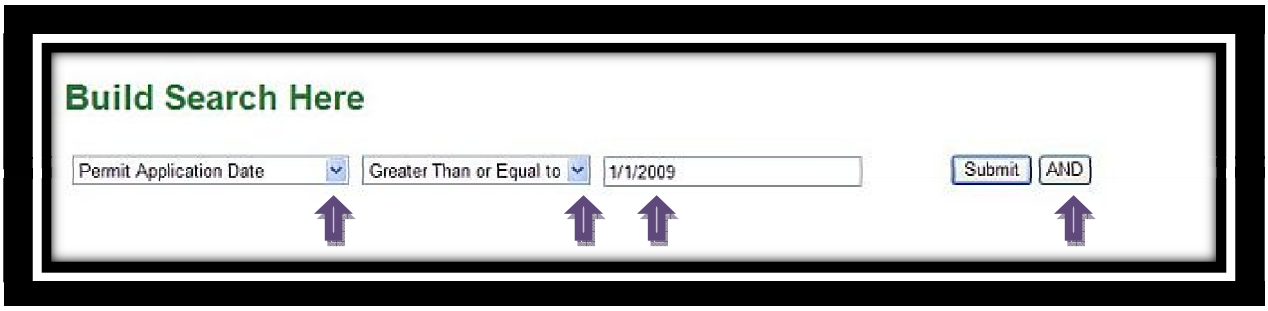



| API Well Number | Production Information | Formation Tops | Casing and Cementing | Hole Number | Well Name | Company Name | Well Type | Well Status | Objective Formation | Producing Formation | County | Town | Map Quadrangle | Quad Section Code | Field | Status Date | Permit Applicatio Date |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 31007263900000 View Map | N/A | View | N/A | 26390 | Kark 1H | Chesapeake Appalachia, L.L.C. | NL | AR | Marcellus | Not Applicable | Broome | Fenton | Chenango Forks | F | New Field Wildcat | 6/29/2009 | 6/29/2009 |
| 31007263910000 View Map | N/A | View | N/A | 26391 | Kark 2H | Chesapeake Appalachia, L.L.C. | NL | AR | Marcellus | Not Applicable | Broome | Fenton | Chenango Forks | F | New Field Wildcat | 6/29/2009 | 6/29/2009 |
| 31007263920000 View Map | N/A | View | N/A | 26392 | Kark 3H | Chesapeake Appalachia, L.L.C. | NL | AR | Marcellus | Not Applicable | Broome | Fenton | Chenango Forks | F | New Field Wildcat | 6/29/2009 | 6/29/2009 |

**How to Narrow Your Search to Applications Submitted For a Specific County**

1. Select Wells Data to begin your search.

2. Select your search criteria. To find all permit applications filed in 2009 in a specific county, select Permit Application Date is Greater Than or Equal to 1/1/2009. Click the AND button.




3. Select your next set of search criteria. To find all permits applied for in 2009 in Allegany County, select County equals Allegany. Click the Submit button.

New York State

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# Appendix 27

## NYSDOH Radiation Survey Guidelines and Sample Radioactive Materials Handling License

New July 2011

Revised Draft
Supplemental Generic Environmental Impact Statement

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# Radiological Survey Requirements

## I. Instrumentation

Instrumentation utilized to determine exposure rates must be capable of measuring 1 microrem to at least 3 millirem per hour.

A pressurized ionization detector/instrument is an optimal choice for gamma exposure rate measurements because the displayed reading provides a true (accurate) exposure rate, therefore no correction factor is necessary.

An instrument with a sodium iodide detector calibrated to cesium-137 (typical/standard calibration) has a high sensitivity but may require the use of a correction factor to determine the true exposure rates associated with the energy emissions from NORM isotopes. Provide a description of the instrumentation including the make(s) and model number(s) of the instrument(s) and detector(s). (Detector information is not needed for instruments that use a detector that is physically mounted within the instrument body.) The instrument must be designed for exposure rate measurement of gamma emissions with energies similar to NORM. Caution: radiological survey instruments may not be safe for use in environments with combustible vapors - Consult the manufacturer.

## II. General

Performance of daily (on days of use) operational check is recommended. This can be accomplished by measuring a radiation source of known activity to confirm that instrument is properly functioning, i.e., the reading is consistent from measurement to measurement.

Instruments must be used within the manufacturer's recommended operational conditions, i.e. temperature, etc.

It is recommended that the user remove batteries from instruments during periods of non-use to avoid potential damage from “leaking” batteries.

## III. Survey Procedure

Confirm that the instrument is calibrated and functioning properly.

The background exposure rate should be measured in an area unaffected by elevated NORM prior to measuring equipment (pipes, tanks, etc.). (Typical background readings are in the range of 3-15 uR/hr but can vary.)

The orientation of the instrument is important. In general the face/front of the instrument should be directed toward the surface being measured.

For instruments that have an audio function the switch should be in the on position. The audio feature will assist the user in identifying elevated exposure rates.

The survey instruments or detector should be held close (within approximately 1 inch) to the surface of the item being surveyed.

The instrument reading should be taken after sufficient time is allowed for the reading to stabilize, generally 10-20 seconds.

Surveys should be conducted systematically. In general, follow the gas production train. Equipment that exceeds 50 uR/hour should be marked/tagged.

Maintain survey records for a period of 5 years. The records include the date, name of person who conducted the survey, the background exposure rate (in an unaffected area), the survey instrument description/make, model, serial number, calibration date, and a diagram or sketch of the areas surveyed and the survey data.

## IV. Survey Frequency

Radiological survey data must be conducted within 6 months following the start of gas production and at intervals not to exceed 12 months thereafter.

The permit tee must conduct surveys of all equipment used on the production train prior to disposal, recycling or transfer to any entity.

Equipment that exceeds 50microrem/hr is subject licensure by the New York State Department of Health.

## V. Survey data reports

Survey data must be submitted within 30 days following the survey, and must contain the information required by Section III.

NEW YORK STATE
DEPARTMENT OF HEALTH
BUREAU OF ENVIRONMENTAL RADIATION PROTECTION

# Radiation Guide 1.15

## GUIDE FOR APPLICATION TO POSSESS NATURALLY OCCURRING RADIOACTIVE MATERIAL (NORM) INCIDENT TO NATURAL GAS INDUSTRY

# I. INTRODUCTION

## PURPOSE OF GUIDE

The purpose of this regulatory guide is to provide assistance to applicants in preparing applications for new licenses for the possession of naturally occurring radioactive materials (NORM) incident to natural gas exploration and production. This regulatory guide is intended to provide you, the applicant, with information that will enable you to understand specific regulatory requirements and licensing policies as they apply to the license activities proposed.

After you are issued a license, you must conduct your program in accordance with (1) the statements, representations and procedures contained in your application; (2) the terms and conditions of the license; and (3) the Department of Health's regulations in 10 NYCRR 16 and 12 NYCRR 38. The information you provide in your application should be clear, specific and accurate.

# II. FILING AN APPLICATION

You, as the applicant for a materials license, must complete Items 1 through 4 and 18 on the attached application form. For other applicable Items, submit the information on supplementary pages. Each separate sheet or document submitted with the application should be identified and keyed to the item number on the application to which it refers. All typed pages, sketches, and, if possible, drawings should be on 8 ½ x 11 inch paper to facilitate handling and review. If larger drawings are necessary, they should be folded to 8 ½ x 11inches. You should complete all items in the application in sufficient detail for the Department to determine that your equipment, facilities, training and experience, and radiation safety program are adequate to protect health and to minimize danger to life and property.

You must submit two copies of your application with attachments. Retain one copy of the application for yourself, because the license will require that you possess and use licensed material in accordance with the statements and representations in your application and in any supplements to it.

Mail your completed application and the required non-refundable triennial fee ($3000) to:

New York State Department of Health
Bureau of Environmental Radiation Protection
Flanigan Square, 547 River Street
Troy, New York 12180

Please Note: Applications received without fees will not be processed .

## III. CONTENTS OF AN APPLICATION

Item 1. Name and address.

Enter the name and corporate address of the applicant and the telephone number of company management. The name of the firm must appear exactly as it appears on legal papers authorizing the conduct of business. Indicate if the name and address are different from those listed on the NYS Department of Environmental Conservation, Division of Mineral Resources Permits to Drill.

Item 2A. Addresses at which radioactive material will be used.

List all addresses and locations where radioactive material will be used or stored, i.e., the NYS Department of Environmental Conservation, Division of Mineral Resources Permits to Drill Nos., well name, and town name.

2.B. Not applicable

Item 3. Nature of business

Enter the nature of the business the applicant is engaged in and the name and telephone number (including area code) of the individual to be contacted in connection with this application.

Item 4. Previous radioactive materials license

Enter any previous or current radioactive materials license numbers and identify the issuing agency. Also indicate whether you possess any radioactive material under a general license.

Describe the circumstances of any denial, revocation or suspension of a radioactive materials license previously held.

Item 5. Department to Use Radioactive Material

Not Applicable

Item 6. Individual Users of Radioactive Materials

Not Applicable,

Item 7. Radiation Safety Officer

State the name, title and contact information (phone, fax, and e-mail) of the person designated by, and responsible to, management for the coordination of the radiation safety program. This person will be named on the license as the Radiation Safety Officer. He/she will be responsible to oversee and ensure that licensed radioactive material is possessed in accordance with regulations and the radioactive materials license.

Item 8. Radioactive Material

No response is required. The license will list Naturally Occurring Radioactive Material (NORM).

Item 9. Purpose for which Radioactive Material Will be Used

No response is required. (The type of use will be specified on the license as possession and maintenance of radiologically contaminated equipment, with specific limitations.)

Item 10. Training of individual users

Persons who perform radiological surveys that are required by regulation and radioactive materials license must receive initial and annual radiation protection training. The scope of training needs to be commensurate with their duties. Appendix A contains a model training program. Confirm that you will follow the model or submit your proposed training program for review.

Item 11. Experience with radioactive materials for individual users

No response is required. Implementation of a training program as required in Item 10 of the application addresses Item 11 for the scope of license tasks.

Item 12. Instrumentation

Instrumentation utilized to determine exposure rates must be capable of measuring 1 microrem to at least 3 millirem per hour.

A pressurized ionization detector/instrument is an optimal choice for gamma exposure rate measurements because the displayed reading provides a true (accurate) exposure rate, therefore no correction factor is necessary.

An instrument with a sodium iodide detector calibrated to cesium-137 (typical/standard calibration) has a high sensitivity but may require the use of a correction factor to determine the true exposure rates associated with the energy emissions from NORM isotopes. Provide a description of the instrumentation including the make(s) and model number(s) of the instrument(s) and detector(s). (Detector information is not needed for instruments that use a detector that is physically mounted within the instrument body.) The instrument must be designed for exposure rate measurement of gamma emissions with energies similar to NORM. Caution: radiological survey instruments may not be safe for use in environments with combustible vapors - Consult the manufacturer.

A model procedure for conducting a radiological survey is provided in Appendix C.

Item 13. Calibration and operational checks of instrumentation

Instrument calibrations must be performed before first use of the instrument and at intervals not to exceed 12 months by an entity that is licensed by the US Nuclear Regulatory Commission or an Agreement State to perform radiological survey instrument calibrations. The instrument must be checked for proper operation (minimally a battery condition check must be performed, and a response to a radiation source is recommended) on each day of use. Records of instrument calibrations must be maintained for a period of 5 years for review by the Department. Confirm that calibrations and daily battery checks will be performed as indicated above and that instrument calibration records will be maintained.

Item 14. Personnel monitoring and bioassays

Not applicable.

Item 15. Facilities and Equipment

Submit simple sketches of any storage area(s), pipe yards, etc., for contaminated equipment.

Item 16. Radiation Protection Program

The applicant does not need to establish a comprehensive radiation safety program. However, the applicant needs to implement a radiation protection program that is commensurate with the type of radioactive material authorized by the license. Appendix B contains a model radiation protection program. Please confirm that you will implement the model program or submit your proposed program for review.

Item 17. Waste Disposal

The applicant must plan for proper disposal of radiologically contaminated equipment when their use has been discontinued. Confirm that you will dispose of radiologically contaminated items in accordance with all applicable state and federal requirements.

Item 18. Certification

Provide the signature of the chief executive officer of the corporation or legal entity applying for the license or of an individual authorized by management to sign official documents and to certify that all information in this application is accurate to the best of the signator's knowledge and belief.

## IV. AMENDMENTS TO LICENSES

Licensees are required to conduct their programs in accordance with statements, representations and procedures contained in the license application and supporting documents. The license must therefore be amended if the licensee plans to make any changes in the facilities, equipment, procedures, and authorized users or radiation safety officer, or the radioactive material to be used.

Applications for license amendments may be filed either on the application form or in letter form. The application should identify the license by number and should clearly describe the exact nature of the changes, additions, or deletions. References to previously submitted information and documents should be clear and specific and should identify the pertinent information by date, page and paragraph.

APPENDIX A  Training Program for Individuals Performing Radiological Survey Measurements.

The applicant/licensee may use the services of a health physicist, licensed medical physicist or an individual who is authorized by a radioactive materials license to conduct radiological surveys. In these situations, the applicant/licensee needs to obtain documentation that the individual is qualified. Examples of documentation include a radioactive materials license that names the person as an authorized user, or copy of a resume for the health physicist or licensed medical physicist. Records of training must be maintained for a period of 5 years.

However, if the applicant/licensee plans to use his/her staff to conduct surveys, such individuals must receive training.

Individuals must demonstrate competence in the following subjects that prior to being approved to perform required surveys. Training must be conducted by an individual who is knowledgeable in health physics principles and procedures.

I. Fundamentals of Radiation Safety

- A. Characteristics of radiation
- B. Units of radiation dose and quantity of radioactivity
- C. Levels of radiation from sources of radiation
- D. Methods of minimizing radiation dose:
  1. working time
  2. working distance
  3. shielding

II. Radiation Detection Instruments

- A. Use of radiation survey instruments
  1. operational
  2. calibration

- B. Survey techniques

III. Requirements of the regulations and License Conditions

IV. Records of training will be maintained for a period of 5 years. Records will include the date of training, name of persons trained, name of the trainer and his/her employer, a copy of the training agenda or topics covered, and the results of any test or determination of proficiency. Records will be maintained for review by the Department.

APPENDIX B Radiation Protection Program

I. Responsibility

A. The owner/licensee will delegate authority to the Radiation Safety Officer to implement the program and the responsibility to oversee the day to day oversight of the program

B. Ensure that individuals receive initial and annual radiation protection training.

C. Ensure that radiological surveys are performed in an effective manner and at the time intervals required by the License.

D. Ensure that notifications required by regulations and License Conditions are made.

E. Ensure that an inventory of radiologically contaminated equipment is maintained.

F. Ensure that contaminated equipment in storage is labeled as containing radioactive material and is not released for unrestricted use.

G. Ensure that radioactive waste is disposed in accordance with all applicable state and federal requirements.

H. Ensure that only entities that have a specific license to perform decontamination perform service of equipment that exceeds 50 microrem at any accessible surface.

II. Maintain Records of:

A. Radiation Protection Training Program

B. Results of radiological surveys including instrumentation calibrations and operational checks.

C. Inventories of contaminated equipment

D. Waste disposal records

E. Service of contaminated equipment that exceeds 50 microrem at any accessible surface, including documentation of the service provider's radioactive materials license.

F. Radiological survey data

G. Maintain a complete radioactive materials license

APPENDIX C

Radiological Survey Guidance

I. General

Performance of daily (on days of use) operational check is recommended. This can be accomplished by measuring a radiation source of known activity to confirm that instrument is properly functioning, i.e., the reading is consistent from measurement to measurement.

Instruments must be used within the manufacturer's recommended operational conditions, i.e. temperature, etc.

It is recommended that the user remove batteries from instruments during periods of non-use to avoid potential damage from “leaking” batteries.

II Survey Procedure

Confirm that the instrument is calibrated and functioning properly.

The background exposure rate should be measured in an area unaffected by elevated NORM prior to measuring equipment (pipes, tanks, etc.). (Typical background readings are in the range of 3-15 uR/hr but can vary.)

The orientation of the instrument is important. In general the face/front of the instrument should be directed toward the surface being measured.

For instruments that have an audio function the switch should be in the on position. The audio feature will assist the user in identifying elevated exposure rates.

The survey instruments or detector should be held close (within approximately 1 inch) to the surface of the item being surveyed.

The instrument reading should be taken after sufficient time is allowed for the reading to stabilize, generally 10-20 seconds.

Surveys should be conducted systematically. In general, follow the gas production train. Equipment that exceeds 50 uR/hour should be marked/tagged.

Maintain survey records for a period of 5 years. The records include the date, name of person who conducted the survey, the background exposure rate (in an unaffected area), the survey instrument description/make, model, serial number, calibration date, and a diagram or sketch of the areas surveyed and the survey data.

**NEW YORK STATE DEPARTMENT OF HEALTH**
**RADIOACTIVE MATERIALS LICENSE**

Pursuant to the Public Health Law and Part 16 of the New York State Sanitary Code, and in reliance on statements and representations heretofore made by the licensee designated below, a license is hereby issued authorizing radioactive material(s) for the purpose(s), and at the place(s) designated below. The license is subject to all applicable rules, regulations, and orders now or hereafter in effect of all appropriate regulatory agencies and to any conditions specified below.

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1. Name

_____

2. Address

_____

_____

Attention:
Radiation Safety Officer

3. License Number

4. a. Effective Date

_____

b. Expiration Date

_____

5. Reference Number
DH No. _____

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| 6. Radioactive Materials (element & mass no.) | 7. Chemical and/or Physical Form | 8. Maximum quantity licensee may possess at one time |
|---|---|---|
| A. Radium 226 | A. Any | A. As necessary |
| B. Naturally Occurring Radioactive Material (NORM) | B. Any | B. As necessary |

9. Authorized use. The authorized locations of use are those specified in New York State Department of Environmental Conservation Permit to Drill Nos. _____.

A. The licensee is authorized for possession only of NORM listed in License Condition No. 6 as contamination in equipment incidental to oil and gas exploration and production.

B. The licensee may perform maintenance, not inculding decontamination or removal of scale containing radioactive material on equipment that does not exceed 50 microrem per hour at any accessible point.Only a licensee authorized by the US Nuclear Regulatory Commission or an

Agreement State to perform decontamination and decommissioning services shall service equipment that exceeds 50 microrem per hour at any accessible point.

10. A. Radioactive material listed in Item 6 shall be used by, or under the supervision of the Radiation Safety Officer.

_____ B.

C. The licensee shall notify the Department by letter within 30 days if the Radiation Safety Officer permanently discontinues performance of duties under the license.

11. Except as specifically provided otherwise by this license, the licensee shall possess and use licensed material described in Items 6, 7 and 8 of this license, in accordance with statements, representations, and procedures contained in the documents (including any enclosures) listed below:

A. Application for New York State Department of Health Radioactive Materials License dated _____, signed by _____.

B. Letter dated _____, signed by _____.

The New York State Department of Health's regulations shall govern the licensee's statements in applications or letters unless the statements are more restrictive than the regulations.

12. A. Transportation of licensed radioactive material shall be subject to all regulations of the U.S. Department of Transportation and other agencies of the United States having jurisdiction insofar as such regulations relate to the packaging of radioactive material, marking and labeling of the packages, loading and storage of packages, monitoring requirements, accident reporting, and shipping papers.

B. Transportation of low level radioactive waste shall be in accordance with the regulations of the New York State Department of Environmental Conservation as contained in 6 NYCRR Part 381.

13. The licensee shall have available appropriate survey instruments which shall be maintained operational and shall be calibrated before initial use and at subsequent intervals not exceeding twelve months by a person specifically authorized by the U.S. Nuclear Regulatory Commission or an Agreement State to perform such services. Records of all calibrations shall be kept a minimum of five years.

14, The licensee shall conduct gamma exposure rate measurements of accessable areas of gas production equipment within 6 months of the effective date of the license and at subsequent

intervals not to exceed 12 months. The licensee shall maintain measurement records for review by the Department. The licensee shall notify the Department within 7 calendar days following identification of any exposure rate measurement that meet or exceed 2 millirem per hour. Notification may be made by phone or in writing.

15. Equipment in storage that exceeds 50 microrem per hour at any accessible point shall be labeled by means of paint or durable label or tag.

16. The licensee shall maintain an inventory of equipment, including but not limited to tubular goods, piping, vessels, wellheads, separators, etc., that exceeds 50 microrem per hour at any accessible point. The records of the inventories shall be maintained for inspection by the Department, and shall include the location and description of the items, and the date that items were entered on the inventory record.

17. A. Before treatment or disposal of any gas production water in a manner that could result in discharge or release to the environment, the licensee shall obtain from the New York State Department of Environmental Conservation either:

    i) A valid permit, or

    ii) A letter stating that no permit is required.

    B. The licensee shall maintain the letter or valid permit required in paragraph A of this condition on file for the duration of the license and make such letter or permit available for inspection by the Department upon request.

18. The licensee shall submit complete decontamination procedures to the Department for approval ninety (90) days prior to the termination of operations involving radioactive materials.

19. Plans of facilities which the licensee intends to dedicate to operations involving the use of radioactive material shall be submitted to the Department for review and approval prior to any such use.

20. The licensee shall maintain records of information important to safe and effective decommissioning at the location listed in License Condition No. 2 and at other locations as the licensee chooses. The records shall be maintained until this license is terminated by the Department and shall include:

    A. Records of spills or other unusual occurrences involving the spread of contamination in and around the facility, equipment, or site;

    B. As-built drawings and modifications of structures and equipment in restricted areas where radioactive materials are used and/or stored, and locations of possible inaccessible contamination, such as buried pipes, which may be subject to contamination;

C. Records of the cost estimate performed for the decommissioning funding plan or the amount certified for decommissioning, and records of the funding method used for assuring funds if either a funding plan or certification is used.

21. The licensee may transfer contaminated equipment that exceeds 50 microrem at any accessible point to a Department licensee if the equipment is to be used in the oil and gas industry. The licensee shall maintain records of each transfer of equipment authorized by this License Condition.

FOR THE NEW YORK STATE DEPARTMENT OF HEALTH

Date: By _____
CJB/ :

Charles J. Burns, Chief
Radioactive Materials Section
Bureau of Environmental Radiation Protection

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