REPORT REVIEW NARRATIVE

Review of dSGEIS Concerning Natural Gas Development of the Marcellus Shale within the New York City Watershed

ARCADIS U.S., Inc.
December 30, 2009

Prepared for:

NYSERDA
17 Columbia Circle
Albany, New York 12203

January 19, 2011

ALPHA GEOSCIENCE

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Geology

Hydrology

Remediation

Water Supply

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Report Review Narrative

"Review of the Draft Supplemental Generic Impact Statement Concerning Natural Gas Development of the Marcellus Shale within the New York City Watershed"; ARCADIS U.S., Inc., Highlands Ranch, Colorado; December 30, 2009.

1.0 OVERVIEW

ARCADIS U.S., Inc. (ARCADIS) prepared a report on behalf of the Watershed Inspector General, Office of the Attorney General for the State of New York (NYSOAG), that identifies potential concerns and impacts to the NYC water supply resulting from the development of natural gas resources in the Marcellus and Utica shales in the West-of-Hudson (WOH) watershed.

ARCADIS' report argues that the description of the proposed action (dSGEIS Chapter 2) should be expanded because there is insufficient information to address cumulative impacts. The report presents a discussion of potential changes to the dSGEIS that incorporate a "reasonably foreseeable development" (RFD) approach in evaluating potential benefits and risks of natural gas development in the WOH watershed. Examples of specific issues that may be evaluated using an RFD approach are provided. It is Alpha's understanding that the NYSDEC will address whether the RFD approach can or will be addressed in the context of the SGEIS; therefore, this review of ARCADIS' report will address the accuracy and completeness of the comments, proposed mitigation measures, and revisions to the dSGEIS. It is also understood that an evaluation of cumulative impacts is being conducted by others under contract to NYSERDA at the request of NYSDEC.

The New York City and Skaneateles Lake watersheds are exempted from federal water filtration requirements and must comply with the requirements of a Filtration Avoidance Determination (FAD), which focus on closely and comprehensively coordinating and managing existing activities within the watersheds. The NYSDEC has decided to exclude the NYC West of Hudson and the Skaneateles Watersheds from the SGEIS on the basis that there are distinct and unique issues presented in these areas which are unrelated to the environmental safety of high volume hydraulic fracturing (HVHF). This review and response addresses those comments concerning environmental safety that may be relevant to all watersheds in New York and can be applied state-wide.

2.0 COMMENTS REGARDING BASELINE DATA

ARCADIS comments that "Baseline information presented in the dSGEIS is inadequate to evaluate potential impacts on water-related resources." Recommendations are made for additional data collection/analysis and revisions to the dSGEIS.

2.1 Accuracy and Completeness

ARCADIS describes, in very general terms, direct and indirect environmental impacts to ground water and surface water resources within the WOH watershed from natural gas development.

2.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the issues of potential ground water and surface impacts as the result of natural gas development can be applied statewide. The proposed evaluation of turbidity, phosphorous, and pathogen potential discharges and effects on the filtration avoidance determination is relevant only within the context of a FAD watershed. The potential impacts to an FAD is not addressed here, in light of the NYSDEC's decision to exclude the WOH and Skaneateles watersheds from the SGEIS.

2.3 Supporting Information

No specific references were provided to published or unpublished studies, technical journals, text books, or news articles.

2.4 Mitigation Measures

No specific mitigation measures were proposed relative to this general comment concerning the FAD. ARCADIS offers several general recommendations in Section 4.3, and those recommendations are distributed among the specific comments responded herein.

2.5 Proposed SGEIS Revisions

ARCADIS proposes two revisions to the dSGEIS pursuant to this general comment:

- A plan should be created to collect and compile surface water and ground water resource-related data.
- Effects on surface water and ground water resources within the WOH watershed should be described in more detail.

Response:

The potential effects on surface and ground water resources are considered and comprehensively addressed in various sections of the dSGEIS. Sections 7.1.1 through 7.1.4 of the dSGEIS identify existing regulations and programs and describe additional mitigation measures to address surface and ground water withdrawals, potential degradation of use, protection of stream flows, potential impacts to aquatic ecosystems and wetlands, potential aquifer depletion, and cumulative impacts. Other jurisdictions are identified that provide additional regulatory

oversight, including those for the Great Lakes and the Susquehanna and Delaware river basins. Section 7.1.1.4 describes three specific methods for mitigating surface water withdrawals. Section 7.1.4 describes and provides requirements for identifying, testing, and monitoring ground water supplies, including schedules, water quality parameters, investigating complaints. Supplementary Permit Conditions (Appendices 8, 9, 10) provide additional protection for surface and ground water resources through enhanced well construction and cementing practices.

ARCADIS' proposed plan to collect and compile surface water and ground water resource-related data includes existing data on water quantity and quality by aquifer and/or watershed, information on existing drilling activity, soil types, erosion rates, forest cover, topography, and areas not available for development. It is Alpha's opinion that this change is not needed and that the GEIS and dSGEIS adequately address these concerns. Much of the data already is available through various state, federal, and other publically accessible sources. The following table lists example sources for some of the water resource-related data specified by ARCADIS.

Data	Example Data Source
Existing drilling information	NYSDEC Division of Mineral Resources oil & gas well database (http://www.dec.ny.gov/energy/1524.html)
Existing surface disturbance	USGS Land Use and Land Cover Map (http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/LULC)
Soil types	USDA Soil Survey Geographic (SSURGO) database (http://soildatamart.nrcs.usda.gov/Default.aspx)
Forested cover	USGS Land Use and Land Cover Map (http://eros.usgs.gov/#/Find_Data/Products_and_Data_Available/LULC)
Roads and other development in close proximity to watercourses and reservoirs	NYS GIS Clearinghouse (www.nysgis.state.ny.us) and US Census Bureau TIGER/Line shapefiles (http://www.census.gov/geo/www/tiger/tgrshp2009/tgrshp2009.html)
Topography	USGS National Elevation Dataset (NED) (http://datagateway.nrcs.usda.gov/GDGOrder.aspx)
Public lands	NYS GIS Clearinghouse (www.nysgis.state.ny.us)
Watershed boundaries	NYS GIS Clearinghouse (www.nysgis.state.ny.us)
Rivers, steams, and water bodies	NYS GIS Clearinghouse (www.nysgis.state.ny.us)
Wetlands	New York State Freshwater Wetlands (http://cugir.mannlib.cornell.edu) US Fish & Wildlife National Wetlands Inventory - (http://www.fws.gov/wetlands/Data/DataDownload.html)
Floodplains	FEMA Map Service Center (http://www.msc.fema.gov)
Aquifer boundaries	NYS GIS Clearinghouse (www.nysgis.state.ny.us)

Baseline information regarding ground water resources is available by county through the USGS (see for example Berden, 1954; Frimpter, 1972; McPherson, 1993; Soren, 1963). The USGS also provides links to "real-time" and historic surface water and ground water gauging and quality data on its website (http://waterdata.usgs.gov/nwis/gw).

ARCADIS' suggestion to discuss the effects of surface water and ground water resources in the WOH watershed is not needed in light of the NYSDEC's decision to exclude the WOH and the Skaneateles watersheds from the SGEIS.

3.0 COMMENTS ON ECONOMIC IMPACTS

ARCADIS suggests that the economic benefits and risks of natural gas development should be described in more detail. Alpha understands that comments regarding economic impacts are being addressed by others under contract to NYSERDA at the request of NYSDEC.

4.0 COMMENTS ON LOSS OF WELL CASING INTEGRITY

ARCADIS commented (Section 4.2.3.1) that the potential loss of integrity of well casings should be better addressed in the dSGEIS.

4.1 Accuracy and Completeness

Arcadis cites as an example of potential casing integrity issues, the natural gas, petroleum condensate, and drilling fluids release from the Crosby 25-3 well on August 2006 in Clark, Wyoming. The Crosby 25-3 incident is not representative of potential impacts resulting from HVHF, but occurred during the drilling phase. The cause of incident was determined to be a weakness in the surface casing at a depth of approximately 225 to 250 feet (Terracon, 2008).

4.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, casing and cementing requirements are relevant statewide.

4.3 Supporting Information

The reference to information describing the Crosby 25-3 incident cited by ARCADIS is (http://wyomingoutdoorcouncil.org/html/what_we_do/public_lands/shoshone.shtml). This single reference is not comprehensive and provides little technical information to determine the cause and scope of the release. More complete information on the incident and remedial measures is found on the Wyoming DEQ website (http://deq.state.wy.us/volremedi/clarkwell.htm) and the Wyoming Oil and Gas Conservation Commission website (http://wogcc.state.wy.us/Crosbywell.htm).

4.4 Mitigation Measures

No mitigation measures were proposed relative to this comment.

4.5 Proposed SGEIS Revisions

ARCADIS suggests that the potential loss of well casing integrity should be better addressed in the SGEIS.

Response:

The existing GEIS and dSGEIS acknowledge and comprehensively discuss the importance of well casing integrity. The requirements, conditions, and specifications for conductor, surface, intermediate, and production casing installation and cementing, inspection, monitoring, and documentation are addressed in the GEIS in Chapter 9 and in the dSGEIS (Appendix 8). Additional requirements for drilling in primary and principal drinking aquifers are included in the GEIS (Section 17) and the dSGEIS (Appendix 9) and provide additional protections for those areas. Proposed permit conditions specific to HVHF are included in dSGEIS (Appendix 10), including cement bond logging requirements for intermediate casing (if installed based on specific conditions), and production casing.

The 2006 incident in Wyoming highlights the need for preparedness at the drilling site, including requiring a sufficient volume of mud available at the well site in the event of an unforeseen subsurface condition. The NYSDEC requires additional mitigation measures where subsurface conditions are not proven by drilling experience (i.e., "wildcat" wells). The Wildcat Supplementary Permit Conditions include notification of DMR and local emergency management personnel prior to drilling, penetration of target formation, and prior to flaring, treatment, or testing; equipment requirements, such as blowout preventors and primary and backup mudpumps; and requirements to have appropriate amounts of water and drilling mud additives on site to make up, weight, and/or condition drilling fluids to combat fluid loss or to aid in well control.

5.0 COMMENTS ON LOSS OF CIRCULATION IN UNCASED PORTIONS OF WELLS

ARCADIS commented (Section 4.2.3.2) that drilling fluids can be lost during drilling, which can result in contamination of ground water aquifers.

5.1 Accuracy and Completeness

The comment is statement of a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

5.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts to drinking water aquifers is relevant statewide.

5.3 Supporting Information

The comment does not provide references specific incidents or references.

5.4 Mitigation Measures

No mitigation measures were proposed relative to this comment.

5.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The potential for loss of circulation is a recognized concern and is relevant during the drilling phase. Loss of circulation can result in the release of drilling fluids into the formation. This is a particular concern when drilling through fresh water aquifers. A description of the drilling fluids is included in dSGEIS (Section 5.2.3). Air or fresh water-based drilling mud is required when drilling through freshwater aquifers (GEIS Chapter 9). Surface casing then is cemented in place below the base of the fresh water zone to seal fresh water zones and prevent the introduction of drilling fluids and deep formation water into fresh water zones. Supplemental permit conditions are included in the dSGEIS in Appendix 9 for all wells drilled in principal and primary aquifers. Chapter 9 (GEIS) and Section 7.1.4.2 (dSGEIS) describe the provisions and requirements for ensuring wellbore integrity, including lost circulation.

The dSGEIS acknowledges almost all "fresh" water occurs within 850 feet of the ground surface in New York, and provides for a minimum of 1000 feet of vertical separation between the top of the target zone and the base of a known fresh water supply. Additionally, Chapter 3, Section 3.2.3 of the dSGEIS proposes requiring a site-specific environmental assessment and SEQR determination for projects that fall under any of several conditions, regardless of the formation or number and type of wells.

Some of the conditions include those projects where: the proposed top of the target zone for HVHF is less than 2000 feet deep; the vertical separation between the top of the target formation and base of a fresh water supply is less than 1000 feet along any point of the entire proposed length of the borehole; or, any propose well pad is within 150 feet from a private water well, domestic-use spring, among other resources. The NYSDEC may use the provisions, flexibility, and discretion in Section 3.2.3 to require additional ground water protections and mitigation, or to deny the project, per the required site-specific environmental assessment and determination.

6.0 COMMENTS ON REDUCED SURFACE WATER FLOWS DUE TO WATER USE

ARCADIS commented (Section 4.2.3.3) that reduced surface water flows could occur due to water withdrawals for fracturing operations.

6.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

6.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts to surface water flow is relevant statewide.

6.3 Supporting Information

The comment references no specific incidents or references.

6.4 Mitigation Measures

ARCADIS proposes a general mitigation measure of "a network of surface water monitoring stations" (Section 4.3, p.19).

6.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The dSGEIS acknowledges and discusses the potential environmental impacts of reduced surface water flow (dSGEIS Section 6.1.1). Section 3.2.2.2 requires the operator to identify the water source for hydraulic fracturing and provide information for any new sources, including the withdrawal location, size of the upstream drainage area, and stream gauge data to demonstrate compliance with existing regulation 6 NYCRR 703.

Mitigation measures are provided in the dSGEIS (Section 7.1.1) to address degradation, potential reduced flows, and impacts to aquatic ecosystems and wetlands. The mitigation measures include those from existing jurisdictions and regulatory programs that already are in place to address cumulative impacts of significant surface water withdrawals for any purpose.

The dSGEIS describes three accepted methodologies for evaluating and mitigating surface water withdrawal impacts in Section 7.1.1.4, including those used by the DRBC and SRBC, and the "Natural Flow Regime Method". In addition, Delaware River Basin Commission (DRBC) and Susquehanna River Basin Commission (SRBC) have authority over water withdrawals in those respective watersheds.

7.0 COMMENTS ON CONTAMINATION OF SURFACE WATER DUE TO BREACHES IN PITS, TANKS, OR IMPOUNDMENTS

ARCADIS commented (Section 4.2.3.4) that contamination of surface waters could occur as a result of breaches or leaks from pits, tanks, or impoundments containing source water, drilling fluids, hydrofracturing fluids, or produced water.

7.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

7.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts resulting from spills is relevant statewide.

7.3 Supporting Information

The comment references no specific incidents or references.

7.4 Mitigation Measures

ARCADIS proposes general mitigation measures (Section 4.3), including requirements for closed-loop systems for drilling, extensive secondary containment, and rigorous monitoring of SWPP measures.

7.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The potential impacts and mitigation measures due to potential releases from pits, tanks, and impoundments are discussed in the GEIS (Chapters 8 and 9). The dSGEIS acknowledges the greater volumes of fluids used in HVHF operations (Section 6.1.3). Mitigation measures specific to HVHF operations pertaining to potential spills at the drilling site are discussed in the dSGEIS (Section 7.1.3). The requirements include, where applicable; secondary containment for tanks; manually monitoring fueling and certain related activities; using physical controls and catchments; detailed material requirements for impermeable liners; required tank containment of flowback; closure requirements for pits and impoundments; and detailed spill prevention,

response, and reporting requirements in accordance with the Storm Water Pollution Prevention Plan (SWPPP).

Chapter 17 of the GEIS also provides reporting and mitigation requirements for spills and activities related to drilling rig fuel tanks and tank refilling. The GEIS provides for tank fluid level monitoring and tank tightness requirements under certain conditions, enforcement against flowback discharges to the ground, and proper disposal of waste fluids.

Additional mitigation measures are identified in dSGEIS Sections 7.1.7 and 7.7 for centralized flow back impoundments; setbacks from surface water resources (Section 7.1.12.2); floodplains (Section 7.2); wetlands (Section 7.3); and ecosystems and wildlife (Section 7.4). Section 7.2 includes proposing the requirement for closed-loop systems when drilling in floodplain areas to manage fluids and cuttings.

The dSGEIS Sections 5.2.2.1 (reserve pits), Section 5.6 (storage and handling fracturing additives), Section 5.7.2 (centralized impoundments) describe the existing time frames, regulations, and requirements for handling and storing fluids, and constructing impoundments including the comprehensive Dam Safety Regulations (6 NYCRR §673) that apply to surface impoundments.

In addition, Chapter 3, Section 3.2.3 of the dSGEIS proposes requiring a site-specific environmental assessment and SEQR determination for projects that fall under any of several conditions, regardless of the formation or number and type of wells. Some of the conditions include those projects where: any centralized flowback surface water impoundment is proposed, with additional requirements within specific distances of a reservoir, perennial or intermittent stream, wetland, lake, pond, storm drain, private or public supply spring; and, any proposed well pad within specific distances of the same resources listed above, and other surface water resources. The NYSDEC may use the provisions, flexibility, and discretion in Section 3.2.3 to require additional surface water protections and mitigation, or to deny the project, per the required site-specific environmental assessment and determination.

8.0 COMMENTS ON CONTAMINATION OF SURFACE WATER BY SPILL EVENTS INVOLVING TRUCK ACCIDENTS

ARCADIS commented (Section 4.2.3.5) that the SGEIS would benefit from an analysis of potential contamination of surface water resulting from spills involving truck accidents.

8.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

8.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts to surface water is relevant statewide.

8.3 Supporting Information

The comment references no specific incidents or references.

8.4 Mitigation Measures

ARCADIS proposes a general mitigation measure (Section 4.3) of extensive secondary containment.

8.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The potential for truck accidents cannot be completely abated. Trucks carrying hazardous materials (such a gasoline) routinely travel public and private roads. As with any hazardous material, the transport of fracturing fluid additives, drilling fluids, flowback, and production fluids or wastes that are hazardous is already required to be performed in accordance with existing USDOT, NYSDOT regulations (dSGEIS Section 5.5). These regulations mandate that vessels and containers on registered vehicles must meet specific requirements for construction, material compatibility, testing, inspection, and maintenance.

The GEIS and SGEIS cannot regulate transportation on off-site roads and highways. The NYSDEC's well-established regulatory programs for spill reporting, emergency response, and remediation govern potential truck accidents off-site of any type or magnitude where soil, surface water, or ground water is impacted.

Hazardous materials are temporarily staged on-site in the same approved trucking vessels and containers as used in transport, and are present only for short periods, typically less than one week (Section 5.6). The existing NYSDEC programs for solid waste, hazardous materials and hazardous wastes, and spill reporting and remediation also apply to transporters and those handling solid and hazardous wastes.

Where potential exclusions may apply, the potential impacts from, and mitigation measures for spills related to drilling and hydraulic fracturing waste transport are discussed in the dSGEIS sections for waste transport, Sections 5.13, 6.1.6, and 7.1.6. The provisions include detail tracking of drilling and production waste disposal by permitted haulers. The requirements are similar to those for medical wastes, and documentation is required regardless of the waste disposal or treatment method.

The response in Section 7.5 of this document cites other measures for mitigating potential spills that also may apply to trucks and containers. Mitigation measures specific to HVHF operations at the drilling site are discussed in the dSGEIS Section 7.1.3. The requirements include, where applicable; secondary containment for tanks; manually monitoring fueling and certain related activities; conditions when tank containment of fluids is required; and detailed spill prevention, response, and reporting requirements in accordance with the SWPPP.

Chapter 17 of the GEIS also provides reporting and mitigation requirements for spills and activities related to drilling rig fuel tanks and tank refilling, and provides for tank fluid level monitoring and tank tightness requirements under certain conditions.

Chapter 3, Section 3.2.3 of the dSGEIS proposes requiring a site-specific environmental assessment and SEQR determination under any of several conditions, regardless of the formation or number and type of wells. Some of the conditions include any proposed well pad within specific distances of all types of surface water bodies. The NYSDEC may use the provisions, flexibility, and discretion in Section 3.2.3 to require additional protections and mitigation measures, or to deny the project, based on the required site-specific assessment and determination that may be used to evaluate truck and containment vessel operations on-site.

9.0 COMMENTS ON CONTAMINATION OF SURFACE WATER BY STORMWATER RUNOFF AND SEDIMENTATION OR FLOOD EVENTS

ARCADIS commented (Section 4.2.3.6) that surface waters could be contaminated as a result of stormwater runoff. The increase in land disturbance such as access roads, well sites, staging areas, pits, and impoundments could increase erosion resulting in increased sediment loads, turbidity, and nutrients (phosphorous) entering streams and reservoirs.

9.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

9.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System. Issues relating to increased sediment load, turbidity, and phosphorous are a particular concern in FAD watersheds; however, the potential for impacts resulting from stormwater runoff is general concern that is relevant statewide.

9.3 Supporting Information

The comment references no specific incidents or references.

9.4 Mitigation Measures

ARCADIS proposes general mitigation measures (Section 4.3) of rigorous monitoring of storm water pollution prevention (SWPP) measures, disturbed-area reclamation, and construction activities; and preventing drilling in locations of greater concern (e.g., near surface water, on steep slopes).
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9.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The dSGEIS discusses stormwater runoff in Section 6.1.2 and gas development-related activities in floodplains in Sections 2.4.9 and 6.2. As noted by ARCADIS, the primary mitigation measure for potential impacts is provided through Stormwater Pollution Prevention Plans (SWPPP), which are discussed in dSGEIS Section 7.1.2 for construction and industrial activities. The SWPPP addresses potential erosion, sedimentation, peak flows, contaminant discharge, and nutrient pollution. Covered activities include access roads, drill pads, impoundments, staging areas, and pipeline routes.

The NYSDEC has established technical criteria for planning, constructing, operating, and maintaining stormwater controls, including temporary, permanent, structural and non-structural measures. Permit information to be submitted includes detailed topographic and geographic information and mapping. Proximity to water bodies, slopes, and potential down-gradient receptors all can be assessed in the SWPPP.

Development activities within a 100-year floodplain require a permit issued by the local government (dSGEIS Section 7.2). The mitigation measures prohibit above-ground conveyances and surface impoundments. Guidelines for construction in flood-prone areas also are discussed in the GEIS (Chapter 8), and mitigation measures (Chapter 17) include restricting well and access road locations, among others. Measures to protect wetlands are provided in Section 7.3, which include setbacks, secondary containment tanks, and detailed fluid disposal plans.

10.0 COMMENTS ON CONTAMINATION OF SURFACE WATER AND GROUND WATER BY NATURALLY OCCURRING RADIOACTIVE MATERIAL #9

ARCADIS commented (Section 4.2.3.7) that naturally occurring radioactive material (NORM) that is brought to the surface during gas development activities can impact surface water and ground water.

10.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

10.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts related to NORM is relevant statewide.

10.3 Supporting Information

The comment references no specific incidents or references.

10.4 Mitigation Measures

ARCADIS proposes a general mitigation measures (Section 4.3) of prohibiting land disposal or burying drilling cuttings.

10.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

Existing data for concentrations of NORM is presented in the dSGEIS for Marcellus shale cuttings (Section 5.2.4.2) and flowback water (5.11.3.3). The database of cutting analyses demonstrates levels of radiation essentially are background values and do not present an exposure concern for workers or the general public. The dSGEIS Section 5.13 (waste disposal) states that except cuttings generated by air drilling, drill cutting from oil-based or polymer-based mud must be removed by a permitted hauler. The wastes must be disposed off-site at a permitted facility, based on measured levels of NORM and/or other contaminants.

The environmental and human health concerns to workers are discussed in Section 6.8. Section 7.1.4 outlines baseline water quality testing, including analysis of radiological parameters of water supply wells within a specified distance of a proposed gas well.

Additional mitigation measures are presented in Section 7.8, including existing state and federal regulations on the handling and disposing radioactive material. Section 7.8.2 discusses regulation of NORM specific to New York. The results of initial production water and scale from the Marcellus indicate variability but acknowledge the potential for regulating NORM waste in accordance with existing licensing and discharge limitations. Further, testing for NORM concentrations will be required prior any discharge of effluent.

11.0 COMMENTS ON CONTAMINATION OF SURFACE WATER AND GROUND WATER BY GAS AND FLUID MIGRATION CAUSED BY DRILLING, WELL STIMULATION, OR INJECTION OF WASTEWATER

ARCADIS commented (Section 4.2.3.8) that surface water and ground water could be contaminated by migration of natural gas, saline formation water, drilling and/or stimulation fluids, or the injection of waste water via natural or induced fractures.

11.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

11.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts to ground water and surface water is relevant statewide.

11.3 Supporting Information

The comment references no specific incidents or references.

11.4 Mitigation Measures

No specific mitigation measures were proposed relative to this comment.

11.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The potential for fluids and gas to migrate and impact ground water and surface water resources as a result of natural gas drilling activities is discussed in the GEIS in Chapters 9, 10, and 16. The potential for impacts related to HVHF is discussed in the dSGEIS in Section 6.1.4 and mitigation measures are discussed in 7.1.4.

The results of ICF International (2009) analysis, though generalized and rely on oversimplified assumptions, show that hydraulic fracturing does not present a reasonably foreseeable risk of

significant adverse impact to freshwater aquifers (dSGEIS Section 5.18.2 and Appendix 11). The Marcellus and black shales are not part of, and are not connected to, the regional hydrogeological systems where shale gas development potential exists. The baseline geologic evidence that fluid migration to overlying fresh water aquifers is improbable includes studies that show the Marcellus shale has remained isolated from overlying formations for millions of years. The primary evidence that the rock layers between the Marcellus and relatively shallow fresh water aquifers are sufficiently impermeable and create a barrier between the gas producing target zones and ground water aquifers are the facts that these units are "overpressured" and that natural gas and saline water has remained trapped in these formations for millions of years (API, 2009; GEIS p. 5-4; USDOE, 2009). Overpressuring occurs where fluid pressure cannot be transmitted through impermeable beds to the surface (Selley, 1998) and can be maintained only if there is no hydraulic connection. Even at shallower depths, lithostatic pressures exert sufficient force to effectively close natural fractures. The fact that hydrofracturing is commonly performed in many shallow (<1000 feet) water wells in New York is additional evidence that natural fractures and structures are not necessarily transmissive.

The Devonian shales north of approximately the Pennsylvania-West Virginia border are generally considered over-pressured (Billman, 2008). Reservoir pressure data for the Marcellus in New York is limited. Eight research wells were completed in the Marcellus in 1983, which had reported pressure gradients of 0.46 to 0.51 psia/ft, which is greater than the hydrostatic pressure gradient of 0.433 psia/ft (Hill, et al, 2002). Industry representatives report that the Marcellus shale is slightly to moderately overpressured in northern Pennsylvania and anticipate that similar conditions will be found in New York State (Chesapeake, 2009; East, 2009).

The propagation of fractures is controlled by the local rock mechanics. The hypothetical pathway for fluid migration to ground water is along faults and fractures that intersect the Marcellus or induced fractures that extend beyond the target formation. Physical controls that limit the growth of induced fractures include in-situ stresses exerted by the rock mass, which control the orientation of fractures, and the contrast between adjacent rock layers. The extent that the induced fracture will propagate in the vertical direction beyond the target formation is controlled by contrasting physical properties of adjacent stratigraphic units. This contrast limits the vertical growth of a fracture because it either possesses sufficient strength or elasticity to contain the pressure of the injected fluids (API, 2009).

It is acknowledged that fracture growth cannot be completely controlled; however, fracture growth can be predicted and monitored. Fracture growth has been extensively researched and studied by U.S. Department of Energy (DOE), through the Gas Research Institute (GRI). Several direct and indirect diagnostic methods have been verified to predict and monitor the results of hydraulic fracture stimulation. The attached table indicates several of these available tools and methods (GRI/DOE, 2010); these concerns and methods also are presented and discussed in the 2009 ICF report (Sections 1.1.2 – 1.1.5.4). The short-term act of hydrofracturing is the mechanism when fractures are induced; fractures that extend beyond the target zone become part of the shale system and fluids (gas and liquid) within that system are under the pressure gradient from the borehole to the extent of those fractures. After

hydrofracturing, induced fractures do not continue to propagate to paleofeatures beyond the point of the hydrofracturing influence.

In addition, the existing GEIS and dSGEIS discuss the importance and mitigation factors to maintain well casing integrity. The requirements, conditions, and specifications for conductor, surface, intermediate, and production casing installation and cementing, inspection, monitoring, and documentation are addressed in the GEIS in Chapter 9 and in the dSGEIS (Appendix 8). Proposed permit conditions specific to HVHF are included in dSGEIS (Appendix 10), including cement bond logging requirements for intermediate casing (if installed based on specific conditions), and production casing. Section 7.1.4.2 (dSGEIS) also describes the provisions and requirements for ensuring wellbore integrity, including lost circulation.

The potential for loss of circulation also is a concern that is relevant during the drilling phase. Loss of circulation can result in the local release of drilling fluids into the formation, which is a particular concern when drilling through fresh water aquifers. Supplemental permit conditions are included in the dSGEIS in Appendix 9 for all wells drilled in principal and primary aquifers to provide additional protections for those areas. Air or fresh water-based drilling mud is required when drilling through freshwater aquifers (GEIS Section 9). Surface casing is cemented in place below the base of the fresh water zone to seal fresh water zones and prevent the introduction of drilling fluids and deep formation water into fresh water zones.

The dSGEIS provides for a minimum of 1000 feet of vertical separation between the top of the target zone and the base of a known fresh water supply. Chapter 3, Section 3.2.3 of the dSGEIS proposes requiring a site-specific environmental assessment and SEQR determination for projects that fall under any of several conditions, regardless of the formation or number and type of wells. Some of the conditions include those projects where: the proposed top of the target zone for HVHF is less than 2000 feet deep; the vertical separation between the top of the target formation and base of a fresh water supply is less than 1000 feet along any point of the entire proposed length of the borehole; or, any propose well pad is within 150 feet from a private water well, domestic-use spring, among other resources. The NYSDEC may use the provisions, flexibility, and discretion in Section 3.2.3 to require additional ground water protections and mitigation, or to deny the project, per the required site-specific environmental assessment and determination.

12.0 COMMENTS ON CONTAMINATION OF GROUND WATER BY BREACHES OR LEAKS IN PITS, TANKS, WELLS, OR IMPOUNDMENTS

ARCADIS commented (Section 4.2.3.9) that contamination of ground waters could occur as a result of breaches or leaks from pits, tanks, or impoundments containing source water, drilling fluids, hydrofracturing fluids, or produced water.

12.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

12.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts resulting from spills is relevant statewide.

12.3 Supporting Information

The comment references no specific incidents or references.

12.4 Mitigation Measures

ARCADIS proposes a general mitigation measure (Section 4.3) for a network of ground water monitoring wells.

12.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The potential impacts and mitigation measures from releases from of pits, tanks, and impoundments are discussed in the GEIS (Chapters 8 and 9). The dSGEIS acknowledges the greater volumes of fluids used in HVHF operations (Section 6.1.3). Mitigation measures specific to HVHF operations that pertain to potential spills at the drilling site are discussed in the dSGEIS (Section 7.1.3). The requirements include, where applicable; secondary containment for tanks; manually monitoring specific activities; physical controls and catchments; detailed material requirements for impermeable liners; conditions for tank containment of fluids; closure requirements for pit/impoundments; and detailed spill prevention, response, and reporting requirements in accordance with the SWPPP.

The GEIS also provides in Chapter 17, specific requirements to mitigate the potential for spills, and provide spill response for activities related to drilling rig fuel tanks and tank refilling, drilling fluids, hydraulic fracturing additives, and production/flowback water. The GEIS includes tank fluid level monitoring and tank tightness requirements where applicable, enforcement against flowback discharges to the ground, and containment of waste fluids, particularly in aquifer areas. In primary and principal aquifers, pit fluids also must be removed from the site immediately when operations are suspended or the site is unmanned, or within seven days of drilling and/or stimulation operations (dSGEIS Section 7.1.3.4).

Potential impacts from drilling and production fluids are addressed in Section 7.1.4 of the dSGEIS, which identifies issues including baseline water quality testing, ensuring the adequacy of well casings and construction, and preventing pressure build-up in annular spaces between protective casings. Appendices 8, 9, and 10 contain Supplemental Permit Conditions to augment the standard construction and cementing practices and further protect and isolate fresh ground water zones. Section 7.1.4.1 describes measures for protecting private water wells and specifies the radius of monitoring, testing and analysis parameters, and monitoring schedule.

The dSGEIS does not propose a monitoring well network. Existing and proposed measures are sufficient to identify and isolate fresh ground water resources, considering the casing requirements cited previously and the fact that there will be 1000 feet of vertical separation between the base of any fresh water encountered and the top of the target zone.

In addition, Chapter 3, Section 3.2.3 of the dSGEIS proposes requiring a site-specific environmental assessment and SEQR determination for projects that fall under any of several conditions, regardless of the formation or number and type of wells. Some of the conditions include those projects where: the proposed top of the target zone for HVHF is less than 2000 feet deep; the vertical separation between the top of the target formation and base of a fresh water supply is less than 1000 feet along any point of the entire proposed length of the borehole; or, any proposed well pad is within 150 feet from a private water well, domestic-use spring, among other water resources. The NYSDEC may use the provisions, flexibility, and discretion in Section 3.2.3 to require additional ground water protections and mitigation, or to deny the project, per the required site-specific environmental assessment and determination.

13.0 COMMENTS ON DRAWDOWN OF GROUND WATER AQUIFERS FROM WATER USE

ARCADIS commented (Section 4.2.3.10) that drawdown of ground water aquifers could occur due to water withdrawals for fracturing operations.

13.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

13.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts to surface water quantity is relevant statewide.

13.3 Supporting Information

The comment references no specific incidents or references.

13.4 Mitigation Measures

ARCADIS proposes general mitigation measures (Section 4.3) that include monitoring nearby water wells and a network of ground water monitoring wells.

13.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The dSGEIS addresses the potential environmental impact of aquifer depletion in Section 6.1.1.6. Mitigation measures are discussed in Section 7.1.1. Mitigation measures include those regulatory programs and existing jurisdictions that already are in place to mitigate cumulative impacts of significant water withdrawals for any purpose. Furthermore, the DRBC and SRBC have authority over water withdrawals (both surface water and ground water) in the Delaware and Susquehanna River Basins, respectively. Monitoring nearby water wells (Section 7.1.4.4, private water well testing) includes analyzing changes in static water level and considers well characteristics, history and use, and precipitation (recharge) and seasonal variations. As currently proposed, however, the water well monitoring is within specified distance of wells and may or may not be near water withdrawal locations. For this reason, the NYSDEC is assessing the potential for aquifer depletion from increased ground water use. The NYSDEC will use its existing pumping test procedures in conjunction with the SRBC's aquifer testing protocol to evaluate proposed ground water withdrawals for HVHF.

14.0 COMMENTS ON THE POTENTIAL NEED FOR FILTRATION/TREATMENT OF NYC'S WHO WATERSHED RESOURCES

ARCADIS commented (Section 4.2.3.11) that there is an apparent contradiction in the dSGEIS stating that more than 1000 square miles of the WOH watershed may be available for development, but that the NYC watershed is adequately protected by existing authorities for water resources in general and the NYC watershed in particular.

14.1 Accuracy and Completeness

The comment states a potential issue, referencing pages 2-22 and 7-63 of the dSGEIS. The comment does not provide supporting information or references.

14.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System. The comment presents an issue that is unique to the requirements of the FAD which must be met to avoid costly filtration of NYC's water supply.

14.3 Supporting Information

The comment references no specific incidents or references.

14.4 Mitigation Measures

ARCADIS proposes evaluating by RFD scenario, either prohibiting development or implementing a phased approach that would delay natural gas development in the WOH watershed.

14.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The proposed prohibition or phased approach is not needed to complete the SGEIS due to the NYSDEC's decision to exclude the WOH and Skaneateles watersheds from the SGEIS until the FAD related issues can be evaluated and addressed.

The requirements of a FAD that are not related to environmental concerns are due to the distinct and unique issues that focus on closely and comprehensively managing and coordinating activities in those designated watersheds between multiple administrative and regulatory entities. A permit applicant cannot rely upon the generic requirements of the SGEIS in a FAD watershed. An applicant currently is required to prepare an independent, site-specific, environmental assessment for proposed drilling in the WOH and Skaneateles watersheds.

15.0 COMMENTS ON THE EFFECTS ON AQUATIC HABITATS

ARCADIS commented (Section 4.2.3.12) that aquatic habitats could be affected as a result of changes in surface water quality and quantity and increased sedimentation.

15.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

15.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the potential for impacts to aquatic habitats is relevant statewide.

15.3 Supporting Information

The comment references no specific incidents or references.

15.4 Mitigation Measures

No mitigation measures were proposed relative to this comment.

15.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

The dSGEIS does address the potential environmental impact of reduced surface water flow and impacts to aquatic ecosystems (dSGEIS Section 6.1.1). Mitigation measures are presented in dSGEIS Sections 7.1.1 through 7.1.4 to address and evaluate surface water withdrawals, potential degradation of use, protection of stream flows, and the potential impacts to aquatic ecosystems and wetlands. The mitigation measures include existing jurisdictions and regulatory programs that already are in place to address cumulative impacts of significant surface water withdrawals for any purpose. The dSGEIS also outlines three specific acceptable methodologies for mitigating surface water withdrawal impacts. Furthermore, the Delaware River Basin Commission (DRBC) and Susquehanna River Basin Commission (SRBC) have authority over surface water withdrawals in those respective watersheds.

The dSGEIS discusses stormwater runoff in Section 6.1.2, which could result in increased sediment loads to surface water bodies. The primary mitigation measure for negative impacts related stormwater runoff is through detailed Stormwater Pollution Prevention Plans (SWPPP) (Section 7.1.2), for construction and industrial activities. The SWPPP addresses potential erosion, sedimentation, peak flows, contaminant discharge, and nutrient pollution. Covered construction and drilling activities include access roads, drill pads, impoundments, staging areas, and pipeline routes.

The NYSDEC has established technical criteria for planning, constructing, operating, and maintaining stormwater controls, including temporary, permanent, structural and non-structural

measures. Required permit information will include detailed topographic and geographic information and mapping. Proximity to water bodies and potential down-gradient receptors all can be assessed in the SWPPP.

16.0 COMMENTS ON THE RELEASE OF OIL & GAS WASTEWATER TREATED AT EXISTING WASTEWATER TREATMENT FACILITIES

ARCADIS commented (Section 4.2.3.13) that existing wastewater treatment plants may not have the capability to treat wastewater from oil and gas operations.

16.1 Accuracy and Completeness

The comment states a potential issue and does not provide supporting information or reference specific sections in the GEIS or dSGEIS.

16.2 Applicability to Non-FAD Watersheds

The comment specifically discusses potential development within the NYC Water Supply System; however, the disposition of waste fluids from gas development is relevant statewide.

16.3 Supporting Information

The comment references no specific incidents or references. The comment apparently refers to treating wastewater at publicly owned treatment works (POTWs).

16.4 Mitigation Measures

No mitigation measures were proposed relative to this comment.

16.5 Proposed SGEIS Revisions

Alpha recommends no revisions to the SGEIS based on this comment.

Disposal of industrial wastewater (drilling fluids, flowback water, and production water) and the potential environmental impacts are discussed in the dSGEIS Sections 5.13 and 6.1. Mitigation measures are presented in Sections 7.1.8 and 7.1.8.1. Section 8.2.2 (other DEC permits and approval) summarizes the interagency departments and roles in evaluating the potential impacts of proposed POTW discharges.

The dSGEIS summarizes the requirements and regulatory authority for POTWs, including types of pretreatment programs and standards, and addresses both direct and indirect discharges to those facilities. Both the NYSDEC Division of Water and the USEPA have regulatory authority for discharges to the environment from POTWs (and privately-owned facilities in NY). The proposed EAF (dSGEIS Appendix 6) includes requiring an attachment to comprehensively describe in advance, the details of the applicant's plan to dispose flowback water.

Discharge permits issued through the State Pollution Discharge Elimination System (SPDES) program are subject to regulatory notifications, modifications, and routine monitoring and reporting including reviewing new discharges or changes in discharge volume or characteristics. The mitigation measures acknowledge the potential high volumes, total dissolved solids, and diverse chemicals in the wastewater and identify operational program components to evaluate and mitigate potential impacts.

The dSGEIS acknowledges that the POTW may detetermine that a specific discharge to the treatment plant may be unacceptable to the biological treatment process. Specific characteristics and required testing information includes chemical composition, aquatic toxicity, general chemistry, and radiological scans. .

17.0 LIST OF REFERENCES

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