

Appendix D: Potential Mitigation Measures

If natural gas development utilizing high-volume hydraulic fracturing were to proceed in the NYC watershed, mitigation measures would be necessary to reduce the risks to the water supply. Potential mitigation measures are described below. It should be noted that the risks associated with natural gas well development cannot be eliminated, and to be effective, all mitigation measures would require provision of sufficient regulatory and inspection staffing, increased coordination, and communication and information sharing with respect to natural gas, injection well and waste disposal permits and applications among NYSDEC, USEPA, NYSDOH and NYCDEP.

Water Withdrawals

Effective mitigation of cumulative water withdrawal impacts on system operations, supply reliability and in-stream habitat would entail development of appropriate monitoring, enforcement, and diversion permitting or other control mechanisms to curtail withdrawals during low flow conditions or when such withdrawals adversely impact existing uses. In principle, diversion permits should be based on an analysis of long-term stream flow data, in-stream habitat requirements, existing SPDES discharges, pre-existing consumptive withdrawals, and other pertinent parameters, on a stream-by-stream basis, to determine the allowable level of additional consumptive withdrawals while avoiding adverse impacts.

In the Delaware River Basin, the Delaware River Basin Commission has established an interim withdrawal permitting and approval process that addresses many of the concerns associated with cumulative water withdrawal impacts. This process provides some protection against excessive diversions in the Cannonsville, Pepacton and Neversink watersheds. It does not apply to Schoharie, Ashokan and Rondout Reservoirs, though it could potentially help inform the development of comparable protections in these basins. Furthermore, regulatory and administrative accommodations to natural gas industry priorities have been made to the Susquehanna River Basin Commission's water diversion permit approval process over the past year. To the extent that activities in Pennsylvania provide a guide to natural gas development in New York, it is possible that established Delaware River Basin Commission procedures may also be subject to change.

The City will require the following limitations be included in any water taking permit:

- The withdrawal of surface water for the exploration, development or operation of natural gas wells from the Delaware River, or any of its tributaries, affecting the flow at the USGS gage at Montague New Jersey shall be prohibited when the Delaware River Master, as required by his/her obligations under the 1954 U. S. Supreme Court Decree, is directing releases from New York City reservoirs to support the Montague flow objective.
- The withdrawal of surface water for the exploration, development or operation of natural gas wells from the Esopus Creek, or any tributaries, affecting the flow at the USGS gage at Allaben New York shall be prohibited when New York City is making required releases from the Schoharie Reservoir to meet a minimum combined flow of 160 mgd in the Esopus Creek in compliance with NYSDEC regulations, 6NYCRR, Chapter X, Part 670.3 and NYSDEC SPDES Permit # NY0268151.

Chemical Usage

Watershed pollution prevention is one of the most fundamental components of the multiple-barrier approach to protecting drinking water quality and human health. In light of the known pathways for chemical contamination of the water supply, as well as the public health community's limited understanding of the human health risks of chronic exposure to low doses of various contaminants, provisions that eliminate or limit the introduction of large volumes of hazardous and potentially hazardous chemicals into the watershed would represent a prudent mitigation measure.

The known and unknown environmental, water quality, and human health risks associated with introducing large volumes of hazardous chemicals into the watershed could be further reduced by provisions for sharing of complete chemical composition and usage data (by mass) for all drilling and fracturing additives used in the watershed, and provisions for use of drilling and fracturing additives that are non-toxic, or whose toxicity is at least well understood.

Surface Spills

The risk of water quality and operational impacts associated with acute and chronic spills in the watershed could be mitigated by the following measures:

- Provisions for establishing buffers around streams and reservoirs within which drilling and fracturing operations could not occur. Exclusion of spacing units within a 1,000 foot buffer of streams and a 2,000 foot buffer around reservoirs would substantially reduce the risk of adverse surface water quality impacts compared with dSGEIS setbacks, which would allow wellpads to be located 150 feet from streams and 300 feet from reservoirs (and could allow fracturing to occur directly underneath watershed streams and DEP reservoirs); and
- Provisions that would prohibit the transport of fracturing chemicals and waste products on roads adjacent to public water supply reservoirs or major inflow streams. This would reduce the risk of acute spills directly into reservoirs from vehicle accidents.

Subsurface Risks

Site-specific SEQRA reviews are required for issuance of a permit to drill any well subject to Article 23 of the Environmental Conservation Law, whose location is determined by NYCDEP to be within 1,000 feet of subsurface water supply infrastructure. The 1,000 foot infrastructure setback was developed in connection with vertical geothermal wells and was based on concerns associated with drilling through a NYC tunnel. While a similar precaution is appropriate for the vertical section of natural gas wells, there are overriding concerns associated with horizontal drilling and hydraulic fracturing that are entirely different:

- Horizontal well laterals can extend for over a mile from the actual well pad. The dSGEIS would allow hydraulic fracturing to occur underneath a DEP tunnel or reservoir. Isolation of water supply infrastructure from the hydraulically fractured strata depends entirely on the characteristics of the intervening rock.
- The hydraulic fracturing process is specifically designed to fracture rocks and intercept and enhance existing hydraulic pathways, and this process is difficult to predict accurately.
- Hydraulic fracturing operations in proximity to the naturally occurring fracture systems that intersect DEP tunnels will increase the risk of (a) contaminating drinking water with drilling

and fracturing chemicals and poor quality formation water; (b) methane accumulation around and within DEP subsurface infrastructure; and (c) tunnel liner structural failure.

Mitigation of risks to drinking water quality and infrastructure integrity will require revision of current setback provisions to reflect the occurrence of laterally extensive subsurface faults, fractures, and brittle structures. Based on the preceding analyses, it is recommended that natural gas well construction be precluded within a buffer zone of seven miles from NYCDEP subsurface infrastructure. Further, since the primary area of concern is not the vertical borehole but instead the well lateral and the hydraulic fracturing induced along its length, the buffer zone should be measured from the furthest extent of the lateral (or spacing unit boundary) and not the well pad or wellhead.

Waste Stream Risks

Mitigation of risks associated with the production of large volumes of high-strength wastes requires that the effectiveness of feasible waste treatment and management provisions be established before approval of initial well development or refracturing, and that gas well permit approvals be limited to the treatment/disposal capacity in place at the time of well permit approval. This will require a comprehensive assessment of regional waste production and disposal needs and capacities, and will mitigate impacts by assuring that the rate of gas well construction is limited to a rate that is matched by treatment/disposal capacity. It is noted that the provision of adequate treatment capacity and transport to such facilities will further industrialize the watershed, and that it will be necessary that the impacts associated with provision of waste management systems also be identified and mitigated.s

