

**Comments on the Draft Supplemental Generic Impact Statement  
submitted by the Cornell Law School Water Law Clinic  
December 2009**

**Overall Comment**

The Water Law Clinic's overall comment is that the dSGEIS fails to address the incapacities to perform the large number of tasks involving permitting, inspection, monitoring and other remediation measures set out in Chapter 7. There must be a practicable basis for the remediation measures to be performed. Therefore the current staffing incapacities must be remedied. For that purpose we urge the DEC to consider delegating technical guidance in the field to the Soil and Water Conservation Districts as provided under the NYS Soil and Water Conservations Districts Law.

To demonstrate the critical need for additional field staff, principal tasks specifically identified in the Chapter 7 of the dSGEIS are summarized in the 15-page Memorandum attached as an exhibit hereto.

Specific Comments follow with relevant rationales.

**7.1.1 Water Withdrawal Regulatory and Oversight Programs**

**Impacts to Wetlands**

- Recommendation #1: No permits for actions located within 100 feet of wetlands should allowed. The drilling pad and associated facilities and traffic would severely impair or destroy any wetland if such activities were within 100 feet of the wetland.
- Recommendation #2: In the rare case in which there is no alternative location, and after a SEQR review, a permit should only be granted with the condition that wetland mitigation would be required to fully compensate for the loss or impairment of the wetland.

**Rationale:** As stated in DEC regulations for wetlands, "For wetland Classes I, II, and III, the proposed activity must minimize degradation to, or loss of, any part of the wetland or its adjacent area and must minimize any adverse impacts on the functions and benefits that the wetland provides."

**Reduced Stream Flow**

- Recommendation #3: The registration of withdrawals for fracking purposes in excess of 100,000 gallons per day should be subject to Departmental approval after taking into account the source of water, projected withdrawal amounts, and information on rainfall and streamflow especially under low flow conditions.

**Rationale:** Hydrofracturing can use up many millions of gallons of water per treatment, which has caused regional and local water management agencies to question “where such large volumes of water will be obtained and what the possible consequences might be for local water supplies.”<sup>1</sup> The non-profit organization Clean Water Action reports that several streams in Pennsylvania have dried up due to hydrofracking’s intensive use of water.<sup>2</sup> Such large volumes of water withdrawals are a serious cause for concern.<sup>3</sup>

### **Aquifer Depletion**

- Recommendation #4: Proposed groundwater withdrawals for high-volume hydraulic fracturing should be subject to Departmental approval.

**Rationale:** See Rationale for Recommendation #3, above.

### **7.1.2 Stormwater**

- Recommendation #5: We recommend that the development, implementation, and maintenance of comprehensive Stormwater Pollution Prevention Plans (SWPPP) be performed in consultation with Soil and Water Conservation Districts (SWCDs).
- Recommendation #6: The location of access roads, drill pads, impoundments, staging areas, and pipeline routes associated with the subject operations should be determined in consultation with SWCD staff, taking into account the soils, topography and hydrological conditions of the site.
- Recommendation #7: SWCDs should be engaged to assist in monitoring SWPPPs to ensure that they are in strict compliance with the DEC general permit and associated technical standards and that they heighten the beneficial aspects of stormwater runoff while minimizing its potential deleterious impacts.

**Rationale:** It is apparent from the dSGEIS that there will be substantial disturbance of soils associated with gas drilling. Clearing, leveling, and construction activities for the pads, ancillary equipment or facilities, and access roads will all pose a risk of significant levels of stormwater runoff. SWCD staff are highly trained and experienced in managing drainage and runoff through stormwater best management practices. They also have local

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<sup>1</sup> Daniel J. Soeder and William M. Kappel, United States Geological Survey, *Water Resources and Natural Gas Production from the Marcellus Shale*, May 2009, at 4, <http://pubs.usgs.gov/fs/2009/3032/pdf/FS2009-3032.pdf> [hereinafter USGS Fact Sheet].

<sup>2</sup> Iris Marie Bloom, *Delaware River Drinking Water Threatened*, Weekly Press, Sept. 23, 2009, <http://tinyurl.com/mtafqp>.

<sup>3</sup> The Gas Drilling Task Force, Sullivan County, New York, *Preparing for Natural Gas Development: Understanding Impacts and Protecting Public Assets*, Feb. 13, 2009, at 9, <http://www.co.sullivan.ny.us/documentView.asp?docid=768> [hereinafter Sullivan Report].

knowledge of the soils, topography and hydrology. Hence they are the best qualified to provide the technical advice needed to ensure sound stormwater management.

#### **7.1.2.1 Construction Activities**

- Recommendation #8: We recommend that, through local SWCD review, an SWPPP meeting or exceeding the requirements of the Construction General Permit be developed as a stand-alone document and incorporated in a comprehensive SWPPP.

**Rationale:** See Rationale to Recommendations 5-7, above.

#### **7.1.3.2 Drilling Fluids**

- Recommendation #9: We recommend that, in consultation with SWCDs, pits for fluids used in the drilling, completion, and re-completion of wells be *located*, constructed, maintained, lined and monitored to prevent pollution of surface and subsurface waters and to prevent pit fluids from contacting surface soils or ground water zones.

**Rationale:** See rationale to Recommendations 5-7, above.

#### **7.1.4 Ground Water Impacts Associated with Well Drilling and Construction**

- Recommendation #10: To ensure the integrity of groundwater and its uses, baseline ground water quality should be determined by testing **every** private well within 1000 feet of the proposed well.
- Recommendation #11: Every private well within 1000 feet should be so monitored before drilling, between drilling operations, and after drilling or hydraulic fracturing operations, and an ongoing monitoring schedule be established for sampling and analysis not less than twice a year.

**Rationale:** The Congressional Research Service report released on September 9, 2009 examines gas drilling in the Marcellus Shale region. The report suggests that groundwater contamination from improper drilling and casing is a risk.<sup>4</sup> The Report describes scenarios where groundwater contamination could occur. First, fluid from the drilling well pumped back to the surface can contaminate shallow groundwater if disposed of improperly. The Report indicates that this potential contamination poses particular risk in the permeable “unconsolidated sand and gravel deposits” in northern Pennsylvania and southern New York because of the short distance from the land surface to the water table.<sup>5</sup> These water sources are

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<sup>4</sup> Congressional Research Service Memorandum to Honorable Eric J. J. Massa, *Natural Gas Drilling in the Marcellus Shale*, Sept. 9, 2009.

<sup>5</sup> *Id.*

listed as “primary” or “principal” aquifers in New York, meaning they “are highly productive and presently utilized as a significant source of water, or are a potentially abundant water supply.”<sup>6</sup> Second, fracking fluid can infiltrate domestic water wells that are not cased from the surface or properly constructed. Other processes that can lead to contamination include seismic testing to determine the thickness of shale and improper plugging of an abandoned well.<sup>7</sup>

The New York City Department of Environmental Protection (NYCDEP) is concerned about possible groundwater contamination.<sup>8</sup> Casing or grouting failures, pipe corrosion, or poor cementing could create pathways between water supply structures and fluids containing brine water, hydrocarbons, heavy metals, radionuclides or other potential contaminants.<sup>9</sup> It is also possible that chemicals in fracturing fluid may migrate beyond the fracture zone through naturally occurring fractures or induced fractures beyond the target formation.<sup>10</sup>

The USGS Fact Sheet also expresses concern over the possibility of contamination through spills or leaks of fluids or chemical additives as they are transported and handled.<sup>11</sup> Where fracking requires three million gallons of water, it will result in about 15,000 gallons of chemicals in the wastewater due to additives.<sup>12</sup> In late 2008 near Parachute, Colorado, about 1.6 million gallons of used fracking fluid leaked from a waste pit, soaked into the ground, and ultimately reached the Colorado River.<sup>13</sup> Similar leaks have occurred in Utah and New Mexico.<sup>14</sup> Manhattan Borough President Scott Stringer released a report in February 2009 that listed seven states with “serious incidents of water contamination near hydraulic fracturing drilling sites,” including Alabama, Colorado, Montana, New Mexico, Ohio, Texas and Wyoming.<sup>15</sup> The Penn State Cooperative Extension conducted a study of 200 private water wells in 2007 and found that 8 percent of such wells have experienced mild to severe impacts from natural gas drilling.<sup>16</sup> The study explains that this figure could be an overestimate due to stricter regulations in the 1980s or an underestimate due to the high volume of waste produced in hydraulic fracturing. “The bottom line is

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<sup>6</sup> *Id.*

<sup>7</sup> Stephen Penningroth, Community Science Institute, *Documenting Contamination of Private Water Supplies by Gas Well Drilling in New York State*, Apr. 2009, at 4, <http://www.communityscience.org/documents/Gas%20wells%20and%20water%20FAQ%20sheet%20-%20Documenting%20Contamination.pdf>.

<sup>8</sup> Rapid Impact Assessment Report: Impact Assessment of Natural Gas Production in the New York City Water Supply Watershed, prepared by NYCDEP and Hazen and Sawyer Environmental Engineers and Scientists, September 2009, at ES-4 [hereinafter NYCDEP Report].

<sup>9</sup> *Id.* at 33.

<sup>10</sup> *Id.* at 35.

<sup>11</sup> USGS Fact Sheet at 4.

<sup>12</sup> *Id.*

<sup>13</sup> Sarah Crean, *City Wants Answers, Input on Upstate Drill Plan*, City Limits WEEKLY #702, Sept. 21, 2009, [http://www.citylimits.org/content/articles/viewarticle.cfm?article\\_id=3805](http://www.citylimits.org/content/articles/viewarticle.cfm?article_id=3805).

<sup>14</sup> *Id.*

<sup>15</sup> Crean (quoting the Stringer report).

<sup>16</sup> Penningroth at 2.

that nobody can state with confidence what the probability is that a gas well will contaminate freshwater supplies.”<sup>17</sup>

Specific examples of groundwater contamination include:

### 1. Wyoming

“The federal Environmental Protection Agency found evidence of caustic chemicals associated with natural gas production in 11 private water supplies in the state of Wyoming.”<sup>18</sup> In Pavillion, Wyoming, residents smelled foul water, and the EPA began an investigation in March 2009.<sup>19</sup> Residents offer other stories linked to the contaminated water, including blinded animals, oil slicks on well water, and nervous system disorders.<sup>20</sup> The Agency recommends further testing to determine the source of high levels of arsenic, methane, 2-butoxyethanol, and other chemicals associated with gas drilling.<sup>21</sup>

In 2006, a gas well blew out in Clark, Wyoming, resulting in a 10 million cubic foot plume of contamination—the equivalent of 100 Olympic-sized swimming pools.<sup>22</sup> “The plume has contaminated drinking water aquifers, two private water wells and natural springs with benzene, diesel range organics, and an extensive list of toxic chemicals. The plume is also putting more than 20 downstream drinking water wells at risk.”<sup>23</sup>

### 2. Pennsylvania

Dangerous levels of methane have been found in private water wells near drilling sites in Dimock, Pennsylvania and in at least seven Pennsylvania counties since 2004.<sup>24</sup> The state hired a full-time inspector just to monitor methane in homeowners’ wells.<sup>25</sup> Methane is not toxic but can cause violent explosions.<sup>26</sup> In addition, “[w]hen methane is found in water supplies, it can also

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<sup>17</sup> *Id.*

<sup>18</sup> Tom Wilber, *EPA’s Study of Gas Drilling in Wyoming Could Impact Local Operations*, Binghamton Press & Sun-Bulletin, Sept. 13, 2009, at 1, <http://www.pressconnects.com/apps/pbcs.dll/article?AID=/200909132240/NEWS01/909130347> [hereinafter Wilber I]. See also Abraham Lustgarten, *EPA: Chemicals Found in Wyo. Drinking Water Might Be from Fracking*, Aug. 25, 2009, <http://www.propublica.org/feature/epa-chemicals-found-in-wyo.-drinking-water-might-be-from-fracking-825> (citing the presence of other contaminants such as oil, gas, or metals) [hereinafter Lustgarten I].

<sup>19</sup> Wilber I at 2.

<sup>20</sup> Lustgarten I.

<sup>21</sup> Wilber I at 2.

<sup>22</sup> *Drilling Contamination Spreads as Polluter’s Bankruptcy Looms*, EARTHWORKS and Powder River Basic Resource Council, Oct. 1, 2009, [http://www.earthworksaction.org/PR\\_ClarkWindsor.cfm](http://www.earthworksaction.org/PR_ClarkWindsor.cfm).

<sup>23</sup> *Id.*

<sup>24</sup> Wilber I at 3; Abraham Lustgarten, *Water Problems from Drilling Are More Frequent than PA Officials Said*, July 31, 2009, at 1, <http://www.propublica.org/feature/water-problems-from-drilling-are-more-frequent-than-officials-said-731> [hereinafter Lustgarten II].

<sup>25</sup> *Id.*

<sup>26</sup> Wilber I at 3.

signal that deeply drilled gas wells are linked with drinking water systems.”<sup>27</sup> The regional Pennsylvania Department of Environmental Protection (PADEP) oil and gas manager initially described the situation in Dimock as an anomaly; however, similar problems have occurred in Bradford, Pennsylvania, where PADEP found methane and metals in wells and required the drilling contractor to install water treatment systems at homes with contamination.<sup>28</sup> The methane leaks appear to have been due to nonexistent or poor casing and cementing around the well pipe.<sup>29</sup> Other instances of “methane migration” in Pennsylvania include the following:

- Bridgeville - two homes exploded due to methane seepage from a well casing failure;
- Dayton - residents evacuated after a well casing failure;
- Vandergrift - pressure from new drilling forced gas into abandoned adjacent wells, which percolated to the surface around homes in a heavily populated neighborhood; and
- Jefferson County - gas collected in a home until it exploded, killing the residents and shooting debris across the road and into trees.<sup>30</sup>

### 3. Ohio

On December 15, 2007, a family’s house exploded in Bainbridge, Ohio due to methane build-up through private water well. Nineteen other homes were subsequently evacuated due to high methane levels.<sup>31</sup> The state Division of Mineral Resources Management determined the source of the contamination to be natural gas drilling in the region’s “Clinton” sandstone, a formation of inter-bedded sandstones, siltstones, and shales.<sup>32</sup> The specific causes of the gas invasion included inadequate cementing of the production casing, hydrofracking with minimal cement behind the production casing, and shutting in of the annular space between the surface and production casings.<sup>33</sup>

#### 7.1.6 Waste Transport

- Recommendation #12: Fracking fluids, or flow backwater, brine-laden waters, and drilling muds contain toxic substances and should be regarded as hazardous fluids. The haulers of such fluids should ensure that all operations associated with the handling, loading, transportation, and disposal of these hazardous materials are in compliance with applicable New York State and US Department of Transportation

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<sup>27</sup> Lustgarten II.

<sup>28</sup> *Id.*

<sup>29</sup> *Id.*

<sup>30</sup> *Id.*

<sup>31</sup> Ohio Department of Natural Resources, *Report on the Investigation of the Natural Gas Invasion of Aquifers in Bainbridge Township of Geauga County, Ohio*, Sept. 1, 2008, at 3, [http://s3.amazonaws.com/propublica/assets/natural\\_gas/ohio\\_methane\\_report\\_080901.pdf](http://s3.amazonaws.com/propublica/assets/natural_gas/ohio_methane_report_080901.pdf) [hereinafter Ohio Report].

<sup>32</sup> *Id.* at 4.

<sup>33</sup> *Id.* at 5.

(USDOT) regulations, as well as all applicable NYS Department of Environmental Conservation and local regulations.

- Recommendation #13: The hauler should document the handling, testing, transportation and disposal of the drilling and fracking fluids.

**Rationale:** The weight and great volume of traffic that will be created by the gas drilling activities poses a significant risk to public welfare and safety. These risks include road spills and accidents. It is critical that state and local emergency response units be aware of the waste materials being transported to ensure their safe treatment.

#### **7.1.11 Protecting the Quality of New York City's Drinking Water Supply**

Recommendation #14: *The NYS DEC should protect the drinking water supplies of New York State equally as well as it proposes to do for the water supplies of New York City.* Therefore the following requirements should apply to **all** the watersheds in New York State that contain drinking water supplies.

- Recommendation #15: DEC should monitor and prohibit centralized flowback water surface impoundments within the boundaries of the watershed.
- Recommendation #16: DEC should monitor and ensure that fluids are removed in an unfiltered watershed from any reserve pit or on-site tanks within seven days of completing drilling and stimulation operations at the last well on the pad, or immediately if operations are suspended and the site will be left unattended.
- Recommendation #17: DEC should conduct site-specific SEQRA determination for any proposed well pad within 300 feet of a reservoir stem or controlled lake or within 150 feet of a watercourse.

**Rationale:** The argument that the New York City water supplies are distinguishable from those elsewhere in the state because New York City does not provide filtration is invalid with respect to the treatment of flowback waters. The provision of filters does not remove all contaminants from flowback waters.

##### **7.1.12.1 Setbacks from Ground Water Resources**

- Recommendation #18: We recommend that operators of proposed wells *shall* determine the existence of public or private water wells and domestic-supply springs within half a mile of any proposed drilling location.

**Rationale:** Evidence of diligent efforts by operator of proposed well to determine the existence of public or private water wells and domestic-supply springs within half a mile of any proposed drilling location is an inadequate threshold to protect the security of drinking water supplies and public health.

#### *Private Water Wells and Domestic Supply Springs*

- Recommendation #19: *No well pad should be allowed within 150 feet of a private water well or domestic-supply spring, and for any proposed centralized surface flowback impoundment within 300 feet of a private water well or domestic-use spring.*

**Rationale:** Private water wells and drinking water wells are vulnerable to contamination from activities on adjacent land. The specified setbacks are minimal distances to protect the water supplies from leaks, seepage, and accidental spills that could occur during gas drilling and gas production.

### **7.1 Protecting Floodplains**

Recommendation #20: *We strongly recommend that no drilling or any associated activities be permitted in any floodplain.*

**Rationale:** *As the dSGEIS states, New York State is prone to serious floods. By definition floodplains are where floods happen. It is inconceivable that drilling and its associated activities be permitted on land subject to such known probability of flooding.*

### **7.10 Mitigating Noise Impacts**

- Recommendation #21: We commend the requirement to use the DEC guidance document *DEP-00-01 Assessing and Mitigating Noise Impacts* along with a site plan for the purpose of properly locating and planning the wellpads. However, it should be made clear that excessive noise from drilling and all related activities, including the use of compressors, will not be permitted. Given the high levels of noise commonly experienced in gas drilling and its associated activities, we urge the DEC to develop and publish criteria with respect to noise. Such criteria should reflect the scientific knowledge most useful in indicating the effects on the public health or welfare which may be expected from differing quantities and qualities of noise consequent to gas drilling and gas production.

**Rationale:** According to the dSGEIS, “moderate to significant noise impacts may be experienced within 1,000 feet of a well site during the drilling phase” where

operations continue for 24 hours a day.<sup>34</sup> Noise sources that continue for 24 hours a day include “drilling rig operations, pipe handling, compressors, and operation of trucks, backhoes, tractors and cement mixing.”<sup>35</sup> A resident in Van Etten, New York described her family’s experience this way: “24-hour-a-day drilling, ramming noise, lit up all night.”<sup>36</sup> Residents in DISH, Texas have complained about the noise and vibrations of compressor stations on drilling sites, which, among other complaints, led to an ambient air quality investigation.<sup>37</sup> “Considerable noise was present in all directions favorable with the wind patterns. Compressors exhibited both the operation high pitch whirl as indicated by elevated decibel readings and heavy low decibel vibration tones.”<sup>38</sup> Noise pollution is a significant concern of the Allegheny Defense Project<sup>39</sup> and was highlighted in a recent documentary on natural gas development in Colorado.<sup>40</sup> Residents featured in the film experienced 200–300 trucks traveling per day during construction of the well.<sup>41</sup>

### 7.11 Mitigating Road Use Impacts

- **Recommendation #22:** Each operator should be required to submit to the DEC a road use agreement between the operator and the municipality where the trucking will take place. A trucking plan along with documentation of the efforts of the operator to reach a road use agreement is not sufficient to ensure the protection of the integrity of local roads.

**Rationale:** The dSGEIS estimates the number of truck trips throughout the life of a well at 890–1340, with mitigation possible through multi-well pads, reused flowback water, and centralized water impoundments that may make it economically feasible to pipe water to the site.<sup>42</sup> The United States Geological Survey (USGS) Fact Sheet expresses concern that transporting equipment, vehicles, and supplies to drill sites over rural roads could cause erosion and the release of sediment into local water systems.<sup>43</sup> The same effect is possible due to drill pad and

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<sup>34</sup> New York State Department of Environmental Conservation Division of Mineral Resources, Draft Supplemental Generic Environmental Impact Statement (dSGEIS) on the Oil, Gas and Solution Mining Regulatory Program, Sept. 2009, at 7-107, <ftp://ftp.dec.state.ny.us/dmn/download/OGdSGEISFull.pdf> [hereinafter dSGEIS].

<sup>35</sup> *Id.* at 7-108.

<sup>36</sup> Candace Mingis, *Farm Family’s Nightmare: ‘Gas Drillers Cut Corners from Day One,’* Sierra Atlantic, Vol. 36, Fall 2002, at 1, <http://newyork.sierraclub.org/Sierra%20Atlantic/SierraAtlantic-2009-Fall.pdf>.

<sup>37</sup> Town of DISH, Texas Ambient Air Monitoring Analysis Final Report, Prepared by Wolf Eagle Environmental Engineers and Consultants, LLC, Sept. 15, 2009, at 3, [http://www.townofdish.com/objects/DISH\\_Air\\_Study.pdf](http://www.townofdish.com/objects/DISH_Air_Study.pdf) [hereinafter DISH Report].

<sup>38</sup> *Id.*

<sup>39</sup> Press Release, Allegheny Defense Project, Pennsylvania Plans to Auction off Half a Million Acres of State Forest and Park Lands for Oil and Gas Drilling, Apr. 5, 2002, [http://www.alleghenydefense.org/press/release\\_020405.shtml](http://www.alleghenydefense.org/press/release_020405.shtml).

<sup>40</sup> Rural Impact! (Two Cent Films and Crestone Media), <http://www.tiogagaslease.org/environment.html>.

<sup>41</sup> *Id.*

<sup>42</sup> dSGEIS at 6-138–6-139.

<sup>43</sup> USGS Fact Sheet at 4.

pipeline construction.<sup>44</sup> While such impacts are not certain due to the relatively low level of drilling at this time, road damage and traffic disruption have already been reported in areas where drilling construction has begun.<sup>45</sup> A study from Denton, Texas, where natural gas drilling is occurring in the Barnett Shale, revealed that during all three phases of drilling (pad site preparation, fracking, and maintenance) the average number of one-way truck trips was 592 per day per well, with some vehicles weighing 100,000 pounds.<sup>46</sup> “[T]his could be a significant problem if carried out across thousands of active drill sites.”<sup>47</sup>

## 7.12 Mitigating Community Character Impacts

- **Recommendation #23:** We applaud the requirement that, as a condition of approving any permit, the applicant review any existing comprehensive plan, open space and/or agricultural plan or similar policy documents. It should be made clear that the location of the pad and its associated activities must explicitly take into account and be in compliance with the relevant local plans.

**Rationale:** The area cleared for horizontal wells is about five acres and slightly larger for multi-well pads.<sup>48</sup> Pipeline easements vary in size from small to many meters;<sup>49</sup> they are often thirty feet wide for gathering lines and sixty feet for transmission lines.<sup>50</sup> Seismic lines to collect subsurface data about the location of gas deposits typically measure six to nine meters across and run for several miles at 400 to 100 meters apart.<sup>51</sup> New roads, whether in the form of unmanaged trails or paved paths, are “rarely decommissioned since there is a chance that the energy firm may return to re-activate the well, the public now uses the road and/or the cost of road deactivation and reclamation is too expensive.”<sup>52</sup>

Clearing swaths of land leads to habitat fragmentation, especially in forested areas, which in turn can introduce invasive species and impact native wildlife.<sup>53</sup> A study conducted in Alberta, Canada found reductions in populations of species dependent on old-growth forests and continuous forest habitat due to oil and gas drilling.<sup>54</sup> Cutting large openings into forests can subject trees to sunscald, frost

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<sup>44</sup> *Id.*

<sup>45</sup> *Id.*; Rural Impact!

<sup>46</sup> Sullivan Report at 12.

<sup>47</sup> USGS Fact Sheet at 4. *See also* Sullivan Report at 13.

<sup>48</sup> dSGEIS at 6-132.

<sup>49</sup> *Id.* at 26.

<sup>50</sup> Don Woodring, *Natural Gas Pipelines and Forest Fragmentation: Challenges for the Forest Landowner*, *Forest Leaves*, Vol. 18, No. 3, Winter 2009, at 1, <http://rnrext.cas.psu.edu/PDFs/FLWinter2009.pdf>.

<sup>51</sup> Thomas Braun and Stephen Hanus, *Forest Fragmentation - Effects of Oil and Gas Activities on Alberta Forests*, Feb. 14, 2005, at 4, [http://www.beg.utexas.edu/energyecon/thinkcorner/Forest\\_Fragmentation\\_Alberta.pdf](http://www.beg.utexas.edu/energyecon/thinkcorner/Forest_Fragmentation_Alberta.pdf) [hereinafter *Alberta Report*].

<sup>52</sup> *Id.* at 5.

<sup>53</sup> Woodring at 1.

<sup>54</sup> *Alberta Report* at 10.

cracking, windthrow, and wind snap, ultimately killing or felling them.<sup>55</sup>

The drilling rig for a horizontal well could be 140 feet tall or more and would be in place for four to five weeks for drilling and three to five days for fracturing; multi-well pads would likely have 170-foot rigs.<sup>56</sup> Other visual features include construction equipment, trucks, compressors, pipe racks, temporary work sheds, lined pits, and tank trucks holding fluids. Longer-term visual impacts include “an assembly of wellhead valves and auxiliary equipment such as meters, a dehydrator, a gas-water separator, a brine tank and a small fire-suppression tank.”<sup>57</sup>

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<sup>55</sup> Woodring at 2.

<sup>56</sup> dSGEIS at 6-132.

<sup>57</sup> *Id.* at 6-133.