

Assessing the Environmental Effects of Marcellus Shale Gas Development: The State of the Science

User information needs¹

A key objective for the workshop is to identify specific needs for additional scientific or technical information to guide the processes of (1) assessing potential cumulative effects of shale gas development on other resources, and (2) developing standards or regulations that provide adequate assurance the appropriate steps are taken to protect environmental values during shale gas development. To facilitate this process, the following preliminary list of user information needs has been compiled based on input from representatives of regulatory agencies, land management agencies, and public interest organizations.

Please take a moment prior to the workshop to review this list, and consider sources of information that may help to address these needs. If there are additional information needs you would like to identify and add to this list, there will be opportunities to do so in the course of the workshop.

Questions about risks associated with gas development, especially from deep shales

1. What factors influence the short and long term integrity of wells?
 - a. Proportion of wells that are unsuccessfully cased from the beginning (detectable by pressure loss on fracking)
 - b. Corrosion potential and well failure in Marcellus Shale wells due to brines and geology
 - c. Cement longevity and additives/practices to promote longevity
 - d. Well susceptibility to seismic activity, is there a risk?
 - e. Well integrity and resistance to multiple hydraulic fracturing activities in the well and in adjacent wells.
2. What methods are available to track contaminants from wells/spills.
 - a. Is there a chemical signature for fracking and flowback fluids?
 - b. What types of tracers available? Purpose and benefits of tracers
 - c. Drawbacks of tracers – economic, ecological, and other
 - d. Evaluation of benefits to drawbacks

¹ Answers may vary for wells drilled when the surface estate and subsurface estate have same owner, vs. wells drilled when estates are owned by different entities.

3. What are air pollution effects 1) on humans (state concern, not DRBC), 2) on forests and secondarily on water quality
4. What is the potential toxicity of frack additives alone or in combination with naturally occurring compounds in the shales
 - a. Model analysis of probable molecular outcomes given chemistry, temperature and pressures.
 - b. 4NQ and other compounds that have been detected in produced water
5. Are there potential "green" alternatives - how should we analyze them and as they emerge how can we encourage their widespread adoption?
 - a. Haliburton has a "food-grade" hydraulic fracturing recipe
 - b. What is actually being used in most slick water fracs in PA.
6. What are the risks associated with nanoparticles and toxicity to humans?
7. What is the seismic risk and potential for earthquakes in the northeastern US and areas underlying the DRB
 - a. Is this risk increased by UIC wells and hydraulic fracturing activities?
 - b. Seismicity induced by hydraulic fracturing as compared to earthquakes
8. What are the specific risks associated with radioactivity and how can managers and regulators minimize that risk
 - a. Radioactive components in produced waters and equipment that handles produced waters, drilling wastes, and drill cuttings.
 - b. Radioactivity in drill cuttings, on-site disposal and landfill disposal

Questions about cumulative effects and methods/regulations for assessing and managing them

9. Should the current well development permit process be split into two parts: one focusing on the assessment of conditions relevant to the siting of well pads and ancillary infrastructure, and a subsequent phase focused on the well development operations?
10. What regulatory process should be used to identify and measure the cumulative impacts of multiple well development projects in a specified area?
 - a. By a single well development permittee?
 - b. By multiple well development permittees?
11. What is the role, if any, of non-regulatory comprehensive planning processes initiated by landowners' associations or communities?
12. Who should design and implement cumulative impacts assessments?
13. How should cumulative impacts assessment be funded?

Questions about ecological impacts and monitoring strategies

14. How can managers and regulators translate monitoring data and observations to workable and effective best management practices accepted and implemented by the industry?

15. What is the most cost-effective monitoring strategy and how to organize multiple organizations interested in monitoring to maximize the information return on multiple investments?
16. Understanding short- and long-term effects of oil and gas development on a myriad of forest uses and values (clearly similar but not identical to secondary impacts above):
 - a. Ecological resources
 - i. Landscape-level forest loss and fragmentation effects
 - ii. Plant communities, including species of concern, wetlands, and tree health
 - iii. Invasive species
 - iv. Wildlife and habitat conditions; winners and losers
 - v. Water and soil resources, including surface and groundwater quality and quantity, changes to local hydrology due to compaction and runoff, effects of spills, groundwater withdrawals in headwater areas
 - b. Social considerations (primarily in context of the State Forest)
 - i. Wild character of the State Forest
 - ii. Recreation opportunities, safety, and conflicts
 - iii. Noise and aesthetics
 - iv. State Forest infrastructure and maintenance
 - v. State Forest relationships with local communities
 - vi. Documenting and communicating positive social benefits
17. What are the potential secondary impacts by watershed of forest clearing and fragmentation.
 - a. What is the risk of invasions associated with increased vehicular traffic? What strategies are cost effective ways to minimize this risk?
 - b. How will changes in land value where private lands are developed for oil and natural gas affect land use, access for wood production and public recreation, and other ecosystem services?
 - c. How will oil and gas development on public lands affect land use, access for wood production and public recreation, and other ecosystem services.
 - d. How will oil and gas development affect the costs and feasibility of sustainable forestry operations (for example, prescribed fires)
 - e. What will be effects on wildlife habitat?
 - f. What will be the effects on erosion and sedimentation associated with increased right of way clearing and increased road density?

Questions about layout, landscape planning and pattern, and managing landscape/ecological effects

18. What is the appropriate width for buffers along streams and other surface water resources, and how do they vary with type of water body and ecological or community value?
 - a. How large should these setbacks be?
 - b. Quantifiable justification for setback distances; what constitutes a reasonable, but sufficiently protective setback?
 - c. Improved BMP's or BMP upgrades for encroachment inside setback limits
19. What factors should be considered in planning well pad spacing and well pad density
 - a. What is the intent of enacting well spacing/unitization regulations or BMPs?
 - b. What are the geologic constraints, and how do they vary across the affected region?
 - c. What are the political constraints, and how do they vary by region and ownership?
 - d. What are the property constraints, and how do they vary by region?

- e. What are the design factors that could/should influence pad spacing and layout
 - i. Corridor creation
 - ii. Specific micro-habitat avoidance
 - 1) Unique habitats
 - 2) Vernal pools
 - 3) Spring seeps
 - 4) Scrub oak/pitch pine communities
 - 5) Scree slopes/talus/boulder fields
 - 6) Sunny rock outcroppings
 - 7) Caves
 - 8) Wetlands
 - 9) Cliffs
 - 10) Exposed limestone or shale
 - 11) Stands of at least 100 trees with diameter at breast height > 30 inches
 - 12) Herbaceous openings in high-quality forage
 - 13) Other unusual or ecologically significant features
 - iii. PNDI hits
 - iv. Recreation and other high public use areas
 - v. Cultural resources
20. What factors should be considered in planning layout of pipelines and roads associated with oil and gas development (see above for details)?
21. Are there geographic areas that should be off limits due to issues of rarity, key habitat, geological faults, etc.
- a. How would these be designated?
 - b. PA Chapter 78 proposed designating areas such as these. What was the plan for including it in the rule.

Additional questions

22. What are the most promising options for partial and final site reclamation?
23. What is the outlook of other shale plays, such as the Utica; re-use of surface infrastructure and other implications
24. What are the information needs of private landowners and what is the most effective way to meet those needs?