Additional Pre-Meeting Comments from Members of the EPA Science Advisory Board (SAB) Panel for the Review of EPA's Hydraulic Fracturing Study Plan

Additional Pre-Meeting Panel Member Comments Received on 3/6/11

In Preparation for Public Meeting, March 7-8, 2011

Westin Alexandria Hotel located at 400 Courthouse Square, Alexandria, VA, 22314

Purpose: To review and provide advice on the scientific adequacy and appropriateness of EPA's Draft Hydraulic Fracturing Study Plan that will assess the potential impacts of hydraulic fracturing on drinking water resources.

Pre-Meeting Comments from Dr. Jeanne VanBriesen of SAB Hydraulic Fracturing Study Plan Review Panel

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Comments from Dr. Jeanne VanBriesen

General Comments:

Section 2.3 suggests that research prioritization based on uniqueness will ensure that resources are provided for the areas that potentially pose the greatest risk to drinking water resources. It is difficult to see how this is a valid assertion. The fact that extensive research is already taking place on a given research question or potential drinking water impact does NOT suggest that it is of less potential risk than areas that are being less studied. Quite the opposite. The presence of a number of existing research projects in an area suggests that many scientists and engineers consider it a critical unanswered question. It does not seem wise for EPA to avoid studying areas that are the focus of existing expert attention.

Section 2.5. It is not clear to me why certain federal agencies provide comments through interagency review, while others sent comments through the public review process. It is difficult to understand how the interagency review comments have been incorporated into the plan.

It is not clear how the prospective and retrospective studies will be conducted across the different phases of water use in hydraulic fracturing. Each stage of the study indicates it will include prospective and retrospective studies, and in section 7 the case studies are described. Is it the case that these selected FIVE to EIGHT studies will be the basis for all prospective and retrospective studies described under each section?

The data management for this large a study will be complex and require a high degree of coordination among the participants. A description of the plan for this data management should be included in the research plan. The data, meta data, analysis, model simulation results, etc. must all be stored in a manner that allows access and utilization by the full scientific community as quickly as possible.

Charge Question 1: Water Use in Hydraulic Fracturing

EPA has used the water lifecycle shown in Figure 7 to characterize hydraulic fracturing and to identify the potential drinking water issues. Please comment on the appropriateness of this framework for the study plan. Within the context of the water lifecycle, does the study plan adequately identify and address the areas of concern?

It is critical that this study address how *cumulative* withdrawals might affect quantity and quality and how withdrawals might affect quantity and quality differently at different times of year. The spatial temporal uncertainty associated with water resources and with water withdrawals must be considered. Also, the study should include evaluation of the potential effects under unstable climate conditions. The development of shale gas resources will span decades during which significant changes in water resources may occur.

Water withdrawal is regulated in different ways in different parts of the country. Some areas have basin commissions that permit all withdrawals (like the Susquehanna River Basin). Others have state regulatory authority that is not basin-specific (like the western third of Pennsylvania in the Ohio Basin). These different regulatory structures lead to significant differences in how water is managed. These differences must be acknowledged and incorporated into planned studies of the effect of water use on drinking water resources.

A water basin approach is needed, and yet, that would require sophisticated knowledge of water resources, that for the most part, we do not have in most basins in the US. Insufficient water quantity and quality data for a baseline will severely limit the usability of the models suggested in this study as well as limit the conclusions that can be made from the case studies and scenarios evaluated.

Charge Question 2: Research Questions

EPA has identified both fundamental and secondary research questions in Table 2. Has EPA identified the correct research questions to address whether or not hydraulic fracturing impacts drinking water resources, and if so, what those potential impacts may be?

The fundamental research questions are sufficiently broad as to cover the objectives. The secondary research questions do not provide enough detail to evaluate if their answers will be sufficient to inform policy decisions. For example, what is meant by "water availability?" Does this refer just to quantity or to accessibility or both?

One area that is not adequately considered in the research questions is the role of multiple layers of gas resources. Are there any additional effects from hydraulically fracturing a layer under an already fractured layer? Are well casings used to separate gas layers already fractured?

Charge Question 3: Research Approach

The approach for the proposed research is briefly described in Chapter 5. Please provide any recommendations for conducting the research outlined in this study plan, particularly with respect to the case studies. Have the necessary tools (i.e., existing data analysis, field monitoring, laboratory experiments, and modeling) been identified? Please comment on any additional key literature that should be included to ensure a comprehensive understanding of the trends in the hydraulic fracturing process.

The plan specifically calls for a transdisciplinary research approach that includes the integration of expertise inside and outside EPA. No specifics are given for how experts across multiple disciplines or from agencies or organizations outside of EPA will be engaged in the study. Significant expertise exists in the private as well as public sectors, and it will be important to involve these experts.

The scope of the study includes the full life cycle of water use, which is good. But, the full life cycle of the *process* and its affect on drinking water sources is not included. For example, the fate and impact of the disposal of drilling tailings is not included and the fate and affects of liquid or solid waste produced during treatment of produced water (which can be road applied for deicing and dust control) is not included.

The approach includes retrospective case studies, prospective case studies, and scenario analysis. It is unclear that the specific case study approach will be sufficient to capture all potential problems. The scenario analysis approach "may" be able to capture issues such as dilution in large rivers, cumulative effects of multiple discharge points, and the effect of treatment choices in downstream drinking water plants. However, whether or not it DOES capture these issues is dependent upon the scenarios selected, and the study plan provides insufficient details about the selection of scenarios. Who will be involved in selection? Who will evaluate the scenarios once selected?

Retrospective case studies are a good idea, but this is difficult for large scale drinking water effects on surface water users as it is more difficult to identify "cases." In a large basin, there are multiple inputs that 'could' be the cause of 'cases,' thus complicating the identification of case/control systems for comparison.

Prospective case studies are a good idea, but the site selection methodology is unclear. After a site is selected, what boundaries will be placed? Will it track that wastewater to ALL the places it might go or just to all the places it is going now? Once a site is selected, it will be difficult to ensure that management of water at the selected sites will be representative of average industry practice rather than best practice under observation.

Since the full water cycle is complex and there are multiple aspects within a single basin, a comprehensive water balance approach should be used to evaluate the potential pathways.

The tools described begin with existing data evaluation. One concern I have is that data needed for a comprehensive water balance do not exist. Water management, at least within Pennsylvania, appears to be lacking in closure of the water mass balance and complete tracking of the wastewater produced. It is unclear that evaluating existing available data will be sufficient. Also, it is not clear how the nine hydraulic fracturing service companies that were asked to provide data were selected. Are they representative? Will their information provide a complete picture of the chemicals used in this activity? The others tools are not described in great detail.

Charge Question 4a: Proposed Research Activities – Water Acquisition

Proposed research activities are provided for each stage of the water lifecycle and summarized in Figure 9. Will the proposed research activities adequately answer the secondary questions listed in Table 2 for the Water Acquisition stage of the water lifecycle. Please provide any suggestions for additional research activities.

"EPA estimates that approximately 35,000 wells are fractured each year across the United States." It is not clear how this estimate was made as no citation is given. Further, it is unclear why this value would not be known exactly. Permits are issued for drilling and fracturing wells so a number should be verifiable. Since the amount of water used depends on the length of the lateral, it would be important to know how many frac stages were used in each well drilled.

The study areas should include the Marcellus in southwestern Pennsylvania as this area is not part of a basin commission and therefore water withdrawals are not regulated as extensively as in the Susquehanna River Basin in Pennsylvania.

The description of existing data analysis is simplistic and presumes that sufficient data are available to catalog existing water resources for a region. Unless a very small area is selected, and additional gauge stations are installed, there is unlikely to be sufficient quantity data. Similarly, few areas contain sufficient real time water quality data for the type of water and salt balance suggested. The suggestion that the assessment will take place at multiple spatial and temporal scales is likewise ambitious.

Charge Question 4b: Proposed Research Activities – Chemical Mixing

Proposed research activities are provided for each stage of the water lifecycle and summarized in Figure 9. Will the proposed research activities adequately answer the secondary questions listed in Table 2 for the Chemical Mixing stage of the water lifecycle. Please provide any suggestions for additional research activities.

Section 6.2.4 indicates that the extent to which best practices are utilized in the industry is unclear. In order to evaluate the potential for drinking water impacts from spills or accidents involving chemical mixing, it is important to understand common industry practices as well as the capability of the industry to meet best practices. Section 6.2.5.2 indicates EPA will collect information on the effectiveness of current management practices. It will also be important to compare the current practices with the best practices and to evaluate the distribution of material handling practices across the industry. This will enable predictive modeling of potential drinking water contamination at the watershed level.

Charge Question 4c: Proposed Research Activities – Well Injection

Proposed research activities are provided for each stage of the water lifecycle and summarized in Figure 9. Will the proposed research activities adequately answer the secondary questions listed in Table 2 for the Well Injection stage of the water lifecycle. Please provide any suggestions for additional research activities.

The issue of re-fracturing is important. Section 6.3.2 indicates this will not be part of the study due to a lack of a case-study partner. This issue is too important to leave out of the study on that basis.

Abandoned wells and their potential intersection with other formations are an important concern in regions like Pennsylvania and West Virginia, where nearer surface gas wells have been drilled for more than 100 years. Not cited in the report but worth reviewing is the gas migration report produced by NETL in 2007. http://www.netl.doe.gov/newsroom/versailles/

The approach of selecting representative sites to evaluate well failures is fine if the objective is to understand the frequency of different types of failures, but to understand failure itself and what conditions or activities contribute to its frequency, it would be better to review ALL failures rather than a selective sample of failure and non failure sites. Thus, retrospective case studies on well failure should be added in addition to retrospective case studies selected due to suspected water contamination.

Charge Question 4d: Proposed Research Activities – Flowback and Produced Water

Proposed research activities are provided for each stage of the water lifecycle and summarized in Figure 9. Will the proposed research activities adequately answer the secondary questions listed in Table 2 for the Flowback and Produced Water stage of the water lifecycle. Please provide any suggestions for additional research activities.

A lifecycle approach is an important component of this study. Flowback and produced water are distinct. While they share some potential drinking water issues, the significantly longer time period of production for "produced water" as well as the fact that it collects at the site when it is unintended rather than during active operations indicates this should be considered separately.

Several sources of existing data on produced water are to be reviewed. There are additional sources from all plants that are receiving flowback for treatment or dilution. These sources should be used to augment the study. Also, wastewater treatment plants receive information on the well location for the shipments they receive. This would enable a geographical analysis of the produced water enabling deeper understanding of variability in flowback and produced water expected from different parts of the formations. This information would enable better predictions of the long term water quantity and quality expected for new wells in existing formations.

Just as with source water, flowback and produced water must be considered within a spatial-temporal variability in the disposal options as well as the variability in the existing water quantity and quality that must be considered to understand the potential effects of wastewater disposal. These kind of issues are discussed briefly in section 6.1.2; however, they should be elucidated in Table 2.

Charge Question 4e: Proposed Research Activities – Wastewater Treatment and Waste Disposal

Proposed research activities are provided for each stage of the water lifecycle and summarized in Figure 9. Will the proposed research activities adequately answer the secondary questions listed in Table 2 for the Wastewater Treatment and Waste Disposal stage of the water lifecycle. Please provide any suggestions for additional research activities.

The focus on bromide and chloride removal in treatment of hydraulic fracturing wastes is important. It is critical that treatment options be evaluated in terms of their removal of these monovalent anions, and particularly that the removal of bromide, which is problematic at much lower concentrations than chloride, be evaluated. The evaluation of treatment methods and their potential effect within a watershed is only slightly described. Additional data are available from plants currently receiving flowback and produced water and these should be included with other flowback data discussed in section 6.4.2. This section does not include retrospective case studies; however, brine treatment from oil and gas wells has been ongoing in sections of Pennsylvania for decades. Retrospective studies of the affect of long term disposal of treatment residuals on downstream drinking water systems should be included. Particularly, long term studies of the presence of bromide and its role in DBP formation should be included in regions that have been receiving effluent from treated O&G brine for many years.