

Table 1. SAB Specific Comments on the Draft Study Plan and EPA Responses.

SAB Comment	EPA Response
1. “EPA should make certain adjustments to the [lifecycle] framework, including consideration of water quantity impacts on the local watershed mass balance...”	EPA intends to study the impacts of water withdrawals for hydraulic fracturing on water availability by using existing data to calculate water balances, with particular focus on the Susquehanna River Basin and Garfield County, Colorado.
2. “EPA should make certain adjustments to the [lifecycle] framework, including consideration of [...] the post-closure/well abandonment phase within the lifecycle.”	Due to the time constraints of this study, it is not feasible for EPA to study closure/abandonment practices associated with hydraulically fractured wells. However, EPA will use scenario evaluations to study the role of nearby closed/abandoned wells as potential pathways for contaminant migration from the fracture zone to an aquifer.
3. “...EPA should assess the potential release of volatile contaminants to the air, and their potential for subsequent deposition to surface water resources.”	While EPA recognizes that this is a potential exposure pathway of hydraulic fracturing-related contaminants to surface drinking water resources, it is currently outside of the scope of this study. This study is more focused on direct contamination pathways.
4. “...the SAB recommends that EPA consider the four steps of the risk assessment paradigm [...] to assess and prioritize research activities for each water lifecycle stage presented in the draft Study Plan and to focus research questions.”	In the final study plan, EPA will discuss how risk assessment was considered to frame and prioritize research activities.
5. “The SAB recommends that EPA first focus on hazard identification and potential human exposure in the current research effort.”	The initial focus of the research is, in fact, on the identification of potential sources and pathways of exposure, and on hazard identification of contaminants of concern.
6. “The SAB further recommends that none of the proposed comprehensive toxicity testing be conducted at this time due to time and cost constraints. Rather, EPA should evaluate available databases to understand the toxicity of selected constituents determined to have a high potential for exposure.”	EPA agrees that comprehensive toxicity testing is outside the scope of the current study. EPA will apply a tiered approach to assess the toxicity of hydraulic fracturing-related chemicals. Existing databases will be used to obtain information on the chemical, physical, and toxicological properties of chemicals related to hydraulic fracturing. For key chemicals with limited or no toxicity information, quantitative structure-activity relationships will be used to estimate toxicity. EPA may conduct ToxCast screening and develop provisional peer reviewed provisional toxicity values for a selected set of hydraulic fracturing-related chemicals.

7. “The SAB does not agree that developing analytical methods for detecting chemicals associated with HF is an appropriate goal for this study.”	EPA will not develop analytical methods for all chemicals associated with hydraulic fracturing. Research will focus on using or modifying existing analytical methods for chemicals of concern. New analytical methods will be developed only as needed.
8. “EPA should assess the capacity of microseismic data to provide detailed information about the extent of fracturing and to assist in the hydraulic fracturing modeling.”	EPA is not planning to assess microseismic data, but rather will focus efforts on other research questions. The use of microseismic data to determine fracture locations and characteristics is an active area of research by others (e.g., DOE).
9. “Potential impacts to drinking water resources that may be the result of particular management practices should be identified as being linked to those management practices.”	EPA will be clear about the causes of any impacts to drinking water resources, including the extent to which specific management practices resulted in a reported impact.
10. “The SAB recommends that EPA take a long view, and consider what kind of data will be desired in ten years in order to design the data collection protocols for the prospective studies.”	EPA agrees. Although the research activities described in the plan will address near-term questions about the potential impacts of hydraulic fracturing on drinking water resources, consideration is being given to the kinds of data that will be helpful in the design and interpretation of future prospective studies.
11. “...SAB notes that the selected case study locations must be chosen based on reasonable, mechanistically possible contamination scenarios, incorporating uncertainty.”	EPA agrees. The retrospective case study locations were identified, prioritized, and selected based on a rigorous set of criteria. These locations represent a wide range of conditions and impacts that may result from hydraulic fracturing activities. EPA will appropriately discuss uncertainty associated with the results of all research identified in the draft study plan.
12. “The SAB recommends that EPA explicitly identify or estimate the uncertainty or confidence in all research conclusions, and in the assessment of cause and effect associated with potential HF impacts to drinking water supplies.”	All research results will explicitly identify or estimate the uncertainty or confidence in the conclusions reached, including assessments of cause and effect associated with impacts to drinking water resources from hydraulic fracturing activities.
13. “EPA should specify whether the research focus is strictly on hydraulic fracturing in shale gas production or will include fracturing in conventional natural gas production, coalbed methane production, or other types of natural gas and oil extraction activity.”	Based on stakeholder input and the expected growth in shale gas development, this study plan emphasizes hydraulic fracturing in shale formations. Portions of the proposed research, however, may provide information on hydraulic fracturing in other types of oil and gas reservoirs, and EPA will pursue these research opportunities when possible.
14. “EPA should also collect baseline hydrologic and water quality data in a given case study area before HF activity begins...”	EPA is planning to do this at our prospective case studies in DeSoto Parish, Louisiana, and Washington County, Pennsylvania.

15. "The Study Plan should address the cumulative consequences of carrying out multiple HF operations in a single watershed or region."	EPA will assess cumulative impacts of multiple hydraulic fracturing operations through scenario evaluations
16. "EPA should gather currently available information on the composition of post-fracturing produced water from the hydraulic fracturing process, and proprietary information on all additives included in any injected water."	EPA will be gathering this information from a variety of sources, including hydraulic fracturing service companies, oil and gas operators, state reports, and existing literature.
17. "The SAB recommends that EPA not automatically exclude from consideration potential impacts on a water source having more than 10,000 mg/L of total dissolved solids if it could reasonably be anticipated to be a viable source of water supply in the future."	For this study, EPA defines "drinking water resources" to be any body of water, ground or surface that could currently, or in the future, produce an appropriate quantity and flow rate of water to serve as a source of drinking water for public or private water supplies. This includes, but is not limited to, Underground Sources of Drinking Water (USDWs) as defined in the Safe Drinking Water Act.
18. "EPA should include the following constituents in EPA's analysis of impacts of water acquisition and other HF processes on water quality: hydrogen sulfide, ammonium, radon, iron, manganese, arsenic, selenium, total organic carbon, and bromide, in addition to HF fluid constituents and formation chemicals"	The study will include these constituents as well as analyses of chemicals that are found in hydraulic fracturing fluid, shale rock, or flowback/produced waters. Chemicals will be targeted based on site-specific characteristics.
19. "SAB does not conclude that case studies alone will provide sufficient information regarding effectiveness of mitigation approaches in reducing impacts to drinking water resources. SAB recommends that EPA analyze data from HF service companies and states in order to provide additional insight."	EPA agrees with this assessment and will remove research related to identifying effective mitigation approaches from the final study plan.
20. "EPA should assess the potential of constituents in HF-impacted waters to form disinfection byproducts during drinking water treatment."	EPA will be conducting research to identify hydraulic fracturing fluid chemical additives that may form brominated disinfection byproducts during drinking water treatment.
21. "EPA should also include consideration of water quality parameters for which Maximum Contaminant Levels (MCLs) have not been established under the Safe Drinking Water Act, in addition to the proposed parameters for which MCLs have been established."	EPA agrees. We will consider water quality impacts to be any change in water quality, regardless of whether or not an MCL has been established. MCLs for new water quality parameters will not be developed as part of this study.

22. "EPA should focus study of treatment of post-fracturing produced water constituents on literature searches of municipal and industrial wastewater management practices with similar waters..."	EPA intends to gather existing data on the treatment efficiency and contaminant fate and transport through treatment trains applied to hydraulic fracturing wastewaters. In particular, EPA has performed initial literature reviews on pollutants and technologies and gathered data from HF wastewater analyses in the Marcellus region. These key sources of information will allow us to begin prioritizing target analytes for study and give us realistic ranges of pollutant concentrations.
23. "...the consensus of the Panel is that well drilling and cementing practices be researched separately from the hydraulic fracturing process itself."	Well drilling practices <i>per se</i> are outside of the scope of this study. However, EPA believes that the potential for impacts to drinking water resources from hydraulic fracturing is integrally related to well design and construction, including casing and cementing practices.
24. "...SAB recommends that EPA clearly define flowback and produced water in the main body of the Study Plan."	EPA will define flowback and produced water as clearly as possible earlier in the main body of the final study plan.
25. "The SAB recommends the collection of water quality data before, during, and after injection, and from carefully selected locations, including the ongoing studies of quality of surface waters in the regions with significant hydraulic fracturing activity."	EPA will monitor changes in water quality before and after hydraulic fracturing at the prospective case study locations in the Haynesville and Marcellus Shales. Both locations are in areas with significant hydraulic fracturing activity. EPA will also evaluate any additional, relevant available information from other studies of the quality of surface water in regions with significant hydraulic fracturing activity.
26. "EPA should evaluate QA/QC aspects of the studies that would be assessed or conducted by EPA."	All EPA-funded research projects will be conducted using the Agency's most stringent quality assurance guidelines. All new or existing data will be required to meet specific QA criteria for each project in the study plan.
27. "The Panel strongly recommends the use of scenario modeling, in concert with both retrospective and prospective case studies, to 'define the boundaries' for activities under this portion of the water lifecycle."	EPA agrees. Scenario modeling will be used in the case studies to help identify possible sources of the reported contamination, which will help to define the boundaries for sampling activities at the case study locations.
28. "EPA should [...] assess the need for any special storage, handling, management, or disposal controls for solid residuals after treatment."	Due to constraints of time and resources, EPA will use laboratory-scale studies to focus on determining the fate and transport of hydraulic fracturing water contaminants through wastewater treatment processes, including partitioning in treatment residuals.

29. “EPA should conduct a thorough literature review to identify existing treatment technologies that are currently being used to treat HF wastewater, to identify knowledge relevant to hydraulic fracturing return flows, and identify constituents of HF return waters that might merit additional attention.”	EPA will gather information on common treatment and disposal methods for hydraulic fracturing wastewaters, and will also compile a list of chemicals found in these wastewaters. This list will then be used to identify chemicals of concern that may merit additional attention.
30. “SAB recommends that EPA review the documented data in retrospective case studies to assess the efficacy and success of industrial wastewater treatment operations and pre-treatment operations for hydraulic fracturing return flows.”	Due to lack of available data, it would be not practical to use retrospective case studies to assess industrial wastewater treatment operations and pre-treatment operations for hydraulic fracturing return.
31. “EPA should assess whether land application...of hydraulic-fracturing associated wastewaters or residuals from treatment of these waters...has the potential to affect drinking water resources.”	EPA plans to identify hydraulic fracturing-related chemicals that may be present in treatment residuals. However, due to time constraints, land application of hydraulic fracturing wastes and disposal practices associated with treatment residuals is outside of the scope of the current study.
32. “EPA should develop one or more focused research outcomes related to the planned research pertaining to environmental justice issues.”	EPA agrees. We recognize the importance of developing focused research outcomes relating to the environmental justice work described in the draft study plan, and will include this in the final study plan.
33. “For the case studies, EPA should also assess demographic information [...] to screen whether hydraulic fracturing disproportionately impacts some citizens near sites used for the case studies.”	EPA will assess the demographics in case study areas to determine whether the populations near them have disproportionate numbers of persons with environmental justice concerns.