

**Charge Questions for the SAB Review of the USEPA Report:
*Assessment of the Potential Impacts of Hydraulic
Fracturing for Oil and Gas on Drinking Water Resources*
Revised (October 8, 2015)**

Background

The purpose of this assessment¹, entitled *Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources*, was to synthesize available scientific literature and data on the potential for hydraulic fracturing for oil and gas to change the quality or quantity of drinking water resources, and to identify factors affecting the frequency or severity of any potential changes. In fiscal year 2010, the U.S. Congress urged the U.S. Environmental Protection Agency (EPA) to examine the relationship between hydraulic fracturing and drinking water. In response, EPA developed a research study plan² which was reviewed by the Agency's Science Advisory Board (SAB) and issued in 2011. A progress report³ on the study detailing EPA's research approaches and next steps was released in late 2012, and was followed by a consultation with individual experts convened under the auspices of the SAB in May 2013. EPA's study included original research, and the results from these research projects were considered in the development of this draft assessment report.

This assessment follows the hydraulic fracturing water cycle described in the Study Plan and Progress Report. The water cycle includes five stages: (1) water acquisition for hydraulic fracturing fluids; (2) chemical mixing to form fracturing fluids; (3) well injection of fracturing fluids; (4) flowback and produced water; and (5) wastewater treatment and disposal. Potential impacts on drinking water resources are considered at each stage in this cycle. Drinking water resources are defined broadly within this report to include any body of ground water or surface water that now serves, or in the future could serve, as a source of drinking water for public and private use.

EPA authors examined over 3,500 individual sources of information, and cited over 950 of these sources for this assessment. Sources evaluated included articles published in science and engineering journals, federal and state reports, non-governmental organization reports, oil and gas industry publications, other publicly-available data and information, and data, including confidential and non-confidential business information, submitted by industry to EPA. The assessment also included citation of relevant literature developed as part of the Study Plan.

This assessment is a synthesis of the science. It is not a human exposure or risk assessment, and does not attempt to evaluate policies or make policy recommendations. Rather, it focuses on the potential impacts of hydraulic fracturing activities, and factors affecting the frequency or severity of any potential changes. As such, this report can be used by federal, tribal, state, and local

¹ USEPA 2015. Assessment of the potential impacts of hydraulic fracturing for oil and gas on drinking water resources (External Review Draft). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-15/047, 2015.

² USEPA 2011. Plan to study the potential impacts of hydraulic fracturing on drinking water resources. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-11/122, November 2011.

³ USEPA 2012. Study of the potential impacts of hydraulic fracturing on drinking water resources: Progress Report. U.S. Environmental Protection Agency, Washington, DC, EPA/601/R-12/011, December 2012.

officials; industry; and the public to better understand and address vulnerabilities of drinking water resources to hydraulic fracturing activities.

EPA asks the SAB to review the hydraulic fracturing drinking water assessment and provides the following charge questions for that review. The charge questions follow the structure of the assessment. Charge question 1 asks about the introduction of the assessment (Chapter 1), and descriptions of hydraulic fracturing activities and drinking water resources (Chapters 2-3). Charge questions 2 through 6 ask about the individual stages in the hydraulic fracturing water cycle (Chapters 4-8). Charge question 7 asks about the identification and hazard evaluation of chemicals (Chapter 9); and charge question 8 asks about the synthesis of the material presented in the Executive Summary and Chapter 10.

Charge Questions

1. The goal of the assessment was to review, analyze, and synthesize available data and information concerning the potential impacts of hydraulic fracturing on drinking water resources in the United States, including identifying factors affecting the frequency or severity of any potential impacts. In Chapter 1 of the assessment, are the goals, background, scope, approach, and intended use of this assessment clearly articulated? In Chapters 2 and 3, are the descriptions of hydraulic fracturing and drinking water resources clear and informative as background material? Are there topics that should be added to Chapters 2 and 3 to provide needed background for the assessment?
2. The scope of the assessment was defined by the hydraulic fracturing water cycle, which includes a series of activities involving water that support hydraulic fracturing. The first stage in the hydraulic fracturing water cycle is water acquisition: the withdrawal of ground or surface water needed for hydraulic fracturing fluids. This is addressed in Chapter 4.
 - a. Does the assessment accurately and clearly summarize the available information concerning the sources and quantities of water used in hydraulic fracturing?
 - b. Are the quantities of water used and consumed in hydraulic fracturing accurately characterized with respect to total water use and consumption at appropriate temporal and spatial scales?
 - c. Are the major findings concerning water acquisition fully supported by the information and data presented in the assessment? Do these major findings identify the potential impacts to drinking water resources due to this stage of the hydraulic fracturing water cycle? Are there other major findings that have not been brought forward? Are the factors affecting the frequency or severity of any impacts described to the extent possible and fully supported?
 - d. Are the uncertainties, assumptions, and limitations concerning water acquisition fully and clearly described?
 - e. What additional information, background, or context should be added, or research gaps should be assessed to better characterize any potential impacts to drinking water resources from this stage of the hydraulic fracturing water cycle? Are there relevant literature or data sources that should be added in this section of the report?

3. The second stage in the hydraulic fracturing water cycle is chemical mixing: the mixing of water, chemicals, and proppant on the well pad to create the hydraulic fracturing fluid. This is addressed in Chapter 5.
 - a. Does the assessment accurately and clearly summarize the available information concerning the composition, volume, and management of the chemicals used to create hydraulic fracturing fluids?
 - b. Are the major findings concerning chemical mixing fully supported by the information and data presented in the assessment? Do these major findings identify the potential impacts to drinking water resources due to this stage of the hydraulic fracturing water cycle? Are there other major findings that have not been brought forward? Are the factors affecting the frequency or severity of any impacts described to the extent possible and fully supported?
 - c. Are the uncertainties, assumptions, and limitations concerning chemical mixing fully and clearly described?
 - d. What additional information, background, or context should be added, or research gaps should be assessed, to better characterize any potential impacts to drinking water resources from this stage of the hydraulic fracturing water cycle? Are there relevant literature or data sources that should be added in this section of the report?

4. The third stage in the hydraulic fracturing water cycle is well injection: the injection of hydraulic fracturing fluids into the well to enhance oil and gas production from the geologic formation by creating new fractures and dilating existing fractures. This is addressed in Chapter 6.
 - a. Does the assessment clearly and accurately summarize the available information concerning well injection, including well construction and well integrity issues and the movement of hydraulic fracturing fluids, and other materials in the subsurface?
 - b. Are the major findings concerning well injection fully supported by the information and data presented in the assessment? Do these major findings identify the potential impacts to drinking water resources due to this stage of the hydraulic fracturing water cycle? Are there other major findings that have not been brought forward? Are the factors affecting the frequency or severity of any impacts described to the extent possible and fully supported?
 - c. Are the uncertainties, assumptions, and limitations concerning well injection fully and clearly described?
 - d. What additional information, background, or context should be added, or research gaps should be assessed, to better characterize any potential impacts to drinking water resources from this stage of the hydraulic fracturing water cycle? Are there relevant literature or data sources that should be added in this section of the report?

5. The fourth stage in the hydraulic fracturing water cycle focuses on flowback and produced water: the return of injected fluid and water produced from the formation to the surface and subsequent transport for reuse, treatment, or disposal. This is addressed in Chapter 7.
 - a. Does the assessment clearly and accurately summarize the available information concerning the composition, volume, and management of flowback and produced waters?
 - b. Are the major findings concerning flowback and produced water fully supported by the information and data presented in the assessment? Do these major findings identify the potential impacts to drinking water resources due to this stage of the hydraulic fracturing water cycle? Are there other major findings that have not been brought forward? Are the factors affecting the frequency or severity of any impacts described to the extent possible and fully supported?
 - c. Are the uncertainties, assumptions, and limitations concerning flowback and produced water fully and clearly described?
 - d. What additional information, background, or context should be added, or research gaps should be assessed, to better characterize any potential impacts to drinking water resources from this stage of the hydraulic fracturing water cycle? Are there relevant literature or data sources that should be added in this section of the report?

6. The fifth stage in the hydraulic fracturing water cycle focuses on wastewater treatment and waste disposal: the reuse, treatment and release, or disposal of wastewater generated at the well pad. This is addressed in Chapter 8.
 - a. Does the assessment clearly and accurately summarize the available information concerning hydraulic fracturing wastewater management, treatment, and disposal?
 - b. Are the major findings concerning wastewater treatment and disposal fully supported by the information and data presented in the assessment? Do these major findings identify the potential impacts to drinking water resources due to this stage of the hydraulic fracturing water cycle? Are there other major findings that have not been brought forward? Are the factors affecting the frequency or severity of any impacts described to the extent possible and fully supported?
 - c. Are the uncertainties, assumptions, and limitations concerning wastewater treatment and waste disposal fully and clearly described?
 - d. What additional information, background, or context should be added, or research gaps should be assessed, to better characterize any potential impacts to drinking water resources from this stage of the hydraulic fracturing water cycle? Are there relevant literature or data sources that should be added in this section of the report?

7. The assessment used available information and data to identify chemicals used in hydraulic fracturing fluids and/or present in flowback and produced waters. Known physicochemical and toxicological properties of those chemicals were compiled and summarized. This is addressed in Chapter 9.
 - a. Does the assessment present a clear and accurate characterization of the available chemical and toxicological information concerning chemicals used in hydraulic fracturing?
 - b. Does the assessment clearly identify and describe the constituents of concern that potentially impact drinking water resources?
 - c. Are the major findings fully supported by the information and data presented in the assessment? Are there other major findings that have not been brought forward? Are the factors affecting the frequency or severity of any impacts described to the extent possible and fully supported?
 - d. Are the uncertainties, assumptions, and limitations concerning chemical and toxicological properties fully and clearly described?
 - e. What additional information, background, or context should be added, or research gaps should be assessed, to better characterize chemical and toxicological information in this assessment? Are there relevant literature or data sources that should be added in this section of the report?

8. The Executive Summary and Chapter 10 provide a synthesis of the information in this assessment. In particular, the Executive Summary was written for a broad audience.
 - a. Are the Executive Summary and Chapter 10 clearly written and logically organized?
 - b. Does the Executive Summary clearly, concisely, and accurately describe the major findings of the assessment for a broad audience, consistent with the body of the report?
 - c. In Chapter 10, have interrelationships and major findings for the major stages of the hydraulic fracturing water cycle been adequately explored and identified? Are there other major findings that have not been brought forward?
 - d. Are there sections in Chapter 10 that should be expanded? Or additional information added?