

**Summary Minutes of the
U.S. Environmental Protection Agency
Science Advisory Board Hydraulic Fracturing Research Advisory Panel
Public Teleconference, February 1 and February 2, 2016**

Date and Time: Monday, February 1, 2016, 11:00 a.m. – 6:15 p.m. ET.; and Tuesday, February 2, 2016, 11:00 a.m. – 4:45 p.m. ET

Location: Teleconference Only.

Purpose: The purpose of the February 1 and February 2, 2016 teleconferences was to hear public comments and discuss the Panel’s comments on the Science Advisory Board Panel’s January 7, 2016 draft report¹ regarding SAB’s review of the EPA’s draft *Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (External Review Draft – June 2015)*.

Participants:

SAB Hydraulic Fracturing Research Advisory Panel (See Roster, Attachment A):

Dr. David A. Dzombak, Chair	Dr. Bruce D. Honeyman
Dr. Stephen W. Almond	Mr. Walter R. Hufford
Dr. E. Scott Bair	Dr. Richard F. Jack
Dr. Peter Bloomfield	Dr. Dawn S. Kaback
Dr. Steven R. Bohlen	Dr. Abby A. Li
Dr. Elizabeth W. Boyer	Mr. Dean Malouta
Dr. Susan L. Brantley	Dr. Cass T. Miller
Dr. James V. Bruckner	Dr. Laura J. Pyrak-Nolte
Dr. Thomas L. Davis	Dr. Stephen J. Randtke
Dr. Joseph J. DeGeorge	Dr. Joseph N. Ryan
Dr. Joel Ducoste	Dr. James E. Saiers
Dr. Shari Dunn-Norman	Dr. Eric P. Smith
Dr. Katherine Bennett Ensor	Dr. Azra N. Tutuncu
Dr. Elaine M. Faustman	Dr. Paul K. Westerhoff
Mr. John V. Fontana	Dr. Thomas M. Young
Dr. Daniel J. Goode	

Drs. Steven Bohlen, James Bruckner, and Joseph Ryan could not participate during the February 1-2, 2016 public teleconferences.

EPA SAB Staff:

Mr. Edward Hanlon, Designated Federal Officer, SAB Staff Office

Other Attendees: A list of persons present on the teleconference, who requested information on accessing the teleconference line, or who noted via email that they participated on the teleconference, is provided in Attachment B.

Materials Available: The agenda and other teleconference materials are available on the SAB website (www.epa.gov/sab) at the following SAB Hydraulic Fracturing Research Advisory Panel February 1, 2016 teleconference page:

Teleconference Summary

The public teleconference was announced in the Federal Register² and was conducted according to the teleconference agenda.³ A summary of the public teleconference follows.

February 1, 2016

Opening Statements

Mr. Edward Hanlon, the Designated Federal Officer (DFO), opened the public teleconference, and made a brief opening statement noting that the SAB Hydraulic Fracturing Research Advisory Panel operates in accordance with the Federal Advisory Committee Act (FACA). He noted the teleconference was open to the public and that teleconference materials were posted on the SAB website. He noted that the purpose of the Panel teleconference was for the Panel to review and discuss the Science Advisory Board Panel's January 7, 2016 draft report¹ regarding SAB's review of the EPA's draft *Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources*, which was released in June 2015. Mr. Hanlon noted that most of the Panel members were serving as Special Government Employees, with one Panel member already being a regular government employee employed at the U.S. Geological Survey. He noted that Panel members were appointed to provide individual expertise and advice, not to represent any organization. He stated that 360 sets of unique written public comments were received by the EPA Docket as of February 1, 2016 for the Panel's consideration, and that 40 members of the public had requested to present oral comments during the teleconference. He stated that the SAB Staff Office had identified no financial conflicts of interest or appearance of a lack of impartiality for any Panel members for this review. He also noted that minutes of the teleconference were being taken to summarize discussions and action items in accordance with the requirements of FACA.

Dr. David Dzombak, Chair of the Panel, then welcomed everyone. Dr. Dzombak noted that the goals and objectives for this teleconference were to hear public comments and discuss the Panel's comments on its January 7, 2016 draft SAB Report. He noted that the SAB Panel's draft report and other teleconference materials were available on the Panel's February 1, 2016 website for consideration by the Panel and the public, and that the outcome that the Panel was seeking was a consensus SAB report of advice to the EPA Administrator. He also noted that a discussion of next steps would be provided at the end of the teleconference.

Dr. Dzombak noted that during the October 30, 2015 Panel meeting in Washington D.C. and the Panel's December 3, 2015 teleconference, the Panel completed discussions on the draft list of areas of consensus and key points for all eight charge questions for which the EPA had requested SAB advice. He noted there would be an update from three Panel members (Drs. Elizabeth Boyer and Sue Brantley, and Mr. Walt Hufford) on additional written public comments submitted to the EPA's Docket. He also noted there were forty requests from members of the public to present oral public comments during the teleconference, and that members of the public who registered to present oral comments were asked to keep their comments to three minutes or less.

Summary of Written Public Comments

Dr. Dzombak noted that since the Panel's December 3, 2015 public teleconference, approximately 75 additional public comments were received and posted to the EPA's Docket for the EPA's Draft Hydraulic Fracturing Assessment Report and the Panel's January 7, 2016 draft SAB Report. He stated that to assist the Panel in its consideration of public comments as it continues to refine responses to charge questions, SAB Panel members Dr. Elizabeth Boyer, Dr. Susan Brantley, and Mr. Walt Hufford prepared a table of public comments that was posted onto the Panel's teleconference website. He stated that the table included check marks for relevance of the comments to each charge question and chapter of the draft Assessment Report. He stated that as of February 1, 2016, approximately 360 sets of unique written public comments were received and posted to the EPA's Docket for the Panel's consideration. He noted that instructions on how to access these public comments in the EPA's Docket were posted on the SAB Panel's teleconference website.

Mr. Walt Hufford provided an update to the Panel on the additional public comments that have been received and posted in the EPA's Docket for the Panel's consideration. Mr. Hufford noted that the 360 unique comments that were posted to the EPA's Docket represented comments from approximately 106,300 members of the public. Many of the comments received were identical or nearly identical and were from organized mass mailings. Such comments were considered as one unique comment. Mr. Hufford noted that the table that he, Dr. Boyer and Dr. Brantley provided for review was similar to the earlier versions of this table posted on the Panel's earlier teleconference and meeting websites. He noted that about half of the most recent 75 posted public comments voiced support for the EPA draft Assessment Report as written, and about 20% of these recent public comments provided citations to new research and studies.

A Panel member noted that one public commenter referred to publications that had been completed and were not cited within the EPA's draft Assessment Report, but should be cited within the EPA's draft Assessment Report. Dr. Dzombak noted that the EPA Office of Research and Development staff had access to public written comments that were posted to the EPA's Docket website.

Public Comments

Dr. Dzombak noted that it was important for the Panel to consider public comments, and that Panel members would have an opportunity to request clarifying questions to the public commenters. He noted that 40 members of the public were registered to present oral comments during the teleconference. He stated that while the SAB was not obligated to respond to public comments received in its deliberations for the review, Panel members should keep these public comments in mind and consider points made in public comments as they deliberated during this SAB review.

Ms. Katie Brown, representing Energy In Depth, presented her oral statement, reading from a statement⁴ that was posted onto the SAB teleconference website. Ms. Brown commented that the Panel's January 7, 2016 draft SAB Report did not overturn the EPA's conclusions that the EPA did not find evidence that hydraulic fracturing activities have led to widespread, systemic impacts on drinking water resources in the United States. She commented that the SAB contradicted itself in its January 7, 2016 draft SAB Panel Report, since the SAB Panel noted in its draft report that spills from hydraulic fracturing operations have not impacted groundwater. She stated that the SAB is asking the EPA to change its finding that fracturing fluid spills have

not impacted ground water because the EPA has not provided “evidence of absence of impact.” She stated that the SAB was asking EPA to essentially prove a negative, which she noted was a difficult standard to meet. She stated that if there were any evidence to suggest widespread, systemic impacts to drinking water from hydraulic fracturing, that evidence would have been uncovered during the past decade of extensive research and the SAB would be able to cite this evidence in its recommendations. She noted there is nothing in the SAB's draft recommendations that suggests that the EPA's finding of “no widespread, systemic” groundwater impacts from hydraulic fracturing is incorrect. She stated that the SAB should maintain its role as a scientific body and base its recommendations on the science and the facts.

Mr. Erik Milito, representing American Petroleum Institute, presented his oral statement, reading from a statement⁵ that was posted onto the SAB teleconference website. Mr. Milito noted that he has known for some time that hydraulic fracturing was safe and environmentally protective, and provides environmental benefits. He noted that the U.S. Department of Energy (DOE) studied hydraulic fracturing and various other oil and gas technologies, and in 1999 released a report entitled “Environmental Benefits of Advanced Oil and Gas Exploration and Production Technology.” He stated that the DOE report identified several environmental benefits of hydraulic fracturing, including: a) optimized recovery of valuable oil and gas resources; b) fewer wells drilled, resulting in less waste requiring disposal; and c) protection of groundwater resources. He stated that in the late 1990s about 25,000 wells were being hydraulically fractured annually, and that according to DOE, at least 2 million wells have been hydraulically fractured. He noted that hydraulic fracturing has reduced greenhouse emissions to low levels, and that consumers have lower energy costs using natural gas. He stated that production of natural gas helps the U.S. address geopolitical concerns, and that the science in support of EPA’s conclusion of no widespread, systemic impacts is credible and clear. He noted that any other conclusion would ignore science.

Mr. Hugh MacMillan, representing Food and Water Watch, presented his oral statement, reading from a statement⁶ that was posted onto the SAB teleconference website. Mr. MacMillan noted that people in Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas did not consider their cases closed, and called upon the EPA to resolve these cases. He stated that the original comments that he submitted for the Panel’s consideration requested that the EPA define and quantify what it meant by “widespread, systemic impact”. He noted that this statement involved quantitative and scale issues. He noted that in Flint Michigan, lead poisoning in the water was widespread and systemic. He also stated that at the Aliso Canyon storage facility in Porter Ranch, California, there was widespread and systemic aging and deterioration of Sempra Energy’s fleet of natural gas storage wells. He noted that in both cases there were numbers that quantified the meaning of “widespread” and “systemic.” He requested information on how the ‘widespread, systemic’ statement was inserted into the EPA’s draft Assessment report. He stated that the energy industry has noted that hydraulic fracturing is part of energy security, and noted that true energy security would only come when energy needs are met without destabilizing the climate, and without giving up health and welfare.

Mr. Anthony Ingraffea, representing Cornell University, presented his oral statement, reading from a statement⁷ that was posted onto the SAB teleconference website. Mr. Ingraffea noted he had participated in three hydraulic fracturing workshops, and stated that from the beginning of the study’s scoping activity the oil and gas industry sought to limit the study scope. He stated that he applauded the EPA for resisting this approach and for assessing the full hydraulic fracturing water cycle (HFWC) in its Assessment Report. He stated that the EPA’s draft Assessment report failed to address problems of scale and spatial intensity associated with

HFWC operations. He noted that over a million oil and gas wells were hydraulically fractured long before public concern about hydraulic fracturing arose and the Congress mandated the EPA's Assessment. He noted that approximately 70,000 shale gas and oil wells were hydraulically fractured over the last 20 years, and that the total amount of water and chemicals used when those 70,000 wells were hydraulically fractured far exceeded the total amount used in the million conventional wells that previously were hydraulically fractured. He also noted that the total amount of waste flowback and produced water emanating from those 70,000 wells far exceeded the total from those million wells that had previously been hydraulically fractured. He also stated that the rate of leakage from faulty casing and cement jobs in modern shale gas wells was not better than historical leak rates. Regarding the EPA's statement that there were no widespread, systemic impacts to drinking water resources from hydraulic fracturing, he noted that the loss of wellbore integrity is inherently systemic in hydraulically fractured wells. He also noted that in Pennsylvania alone, there were over 1250 formal complaints by landowners that there were impacts to their drinking water from hydraulic fracturing.

Mr. Yuri Gorby, representing Rensselaer Polytechnic Institute, presented his oral statement, reading from a statement⁸ that was posted onto the SAB teleconference website. Mr. Gorby noted his comments and opinions presented were his own and did not necessarily represent the opinions or positions of Rensselaer Polytechnic Institute, its administration, or board of trustees. He noted that for more than 15 years he was a research scientist for the U.S. Department of Energy National Laboratory at the Hanford Nuclear Reservation in Richland, Washington, where he investigated the mechanisms and potential applications for bacteria that can transform uranium species in anaerobic respiration. He noted that bacterial uranium reduction affected transport of uranium in groundwater where a high amount of hydraulic fracturing occurred. He noted that the EPA had limitations imposed upon it through exemptions provided by the 2005 Energy Policy Act, and that the EPA should describe how removal of these exemptions would allow the agency to better perform its duties to protect the environment and citizens. He also noted that the EPA's Assessment Report should provide a complete description of the drilling process associated with hydraulic fracturing, including air and rotary drilling methods, chemicals used in the drilling process, and procedures and chemicals used to seal the gap that forms between the geological formations and the outside of the casing. He further noted that the EPA's draft Assessment Report should include a full list of chemicals used during the drilling process associated with hydraulic fracturing, the potential for and intentional injection of these chemicals into aquifers during drilling, and associated hazards and risk for contamination of groundwater resources. He also stated that the EPA's draft Assessment Report should address migration of gases and liquids along the outside of the casing.

Ms. Michelle Bamberger presented her oral statement, reading from a statement⁹ that was posted onto the SAB teleconference website. She noted she is a veterinarian, researcher and author and has been studying the impacts of hydraulic fracturing for oil and gas since 2009. She noted she collected information on industrial operations, environmental test results and health records from 24 animal owners in six states and described how exposures and health effects may occur from gas drilling. She stated that water quality and quantity changes in water wells, springs, ponds and creeks were reported after well drilling and hydraulic fracturing occurred. She noted that upper respiratory symptoms and burning of the eyes were commonly reported in people, and reproductive problems were most common in food animals. She stated that after 25 months, her followup research noted that health impacts dropped for families and animals that were moved away from intensively drilled areas or who remained in areas where drilling activity decreased. She also noted that food animal reproductive failures fell significantly when cattle were moved away from contaminated pastures or away from contaminated drinking sources. She stated that

drinking water resources such as well water, ponds, creeks, and pasture run off that were used by food animals were not assessed in the EPA's draft Assessment Report and should be included. She stated there were food safety concerns because no monitoring of food products or tracking of animals is being done in areas of intensive hydraulic fracturing and related extraction activity.

Mr. Lou Allstadt had registered to speak but was not available to present his oral statement on the public teleconference line during February 1, 2016.

Ms. Helen Slottje presented her oral statement. Ms. Slottje noted she was a lawyer who was awarded a 2014 environmental award for her work assessing impacts of hydraulic fracturing. She commented that hydraulic fracturing industry representatives who claimed that there are no widespread impacts from hydraulic fracturing should immediately stop making non-disclosure agreements with people so that these people could speak about impacts from hydraulic fracturing. She noted she represented Mr. Lipsky and commented that the Texas Railroad Commission stated there was a problem with the Lipsky well. She stated that full reporting on hydraulic fracturing activities in Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas is needed, and that it is not sound or defensible to exclude these case studies from the EPA Assessment Report.

Mr. Albert Appleton had registered to speak but was not available to present his oral statement on the public teleconference line.

Ms. Larysa Dyrszka, representing Concerned Health Professionals of NY, presented her oral statement, and referred to a statement¹⁰ that was posted onto the SAB teleconference website. Ms. Dyrszka noted she was a Board-certified pediatrician practicing in New York, and that she was concerned with health impacts of exposure to contaminated water from hydraulic fracturing activities. She noted that the third edition of a compendium report issued by the *Physicians, Scientists and Engineers for Healthy Energy* presented findings on problems associated with hydraulic fracturing. She stated that this compendium report compiled findings from the government, journalists, and other sources of information, was fully referenceable, and referred to a database that included analysis of over 500 studies. She commented that of these 500 studies, 48 provided information on water contamination and 68% indicated potential releases to and contamination of water. She stated that the Independent Petroleum Association of America letter from December 2015 was not accurate, and that the emerging science discussed in the compendium report that was posted in the EPA's Docket showed current water problems associated with hydraulic fracturing. She noted that in Pennsylvania alone hundreds of private drinking wells are contaminated from hydraulic fracturing activities, and that there is evidence across the United States that there are groundwater problems from hydraulic fracturing activities. She further noted that a report that she cited in her written comments indicated that shallow wells need special safeguards, and that hydraulic fracturing well blowouts and spills are significant.

Ms. Nichole Saunders, representing Environmental Defense Fund, presented her oral statement, reading from a statement¹¹ that was posted onto the SAB teleconference website. Ms. Saunders noted that the EPA developed a good report that could be improved but should not be expected to answer all questions. She encouraged the EPA to finalize the Assessment Report and act on the findings within the Assessment Report. She commented that the EPA's statement that the Agency "did not find evidence of widespread, systemic impacts" does not fairly represent the full scope of the EPA's draft Assessment Report, and overlooked key uncertainties, data gaps, limitations, and local impacts. She urged the SAB to retain and strengthen this important criticism in their final response to EPA. She stated that this EPA statement was not a scientific

finding, but rather was an observation about a lack of evidence that focused, perhaps in error, on an attempt to reach a uniform conclusion about a set of activities and impacts that were not uniform. She stated that hydraulic fracturing activities can have significant, localized impacts on the environment and communities, and noted that these impacts do not happen at every site and do not happen all the time. She noted that since impacts do occur, they must be acknowledged and addressed, and stated that further research is needed to fill the large number of data gaps, uncertainties, and limitations that have hindered this analysis.

Ms. Elizabeth Tatham presented her oral statement. Ms. Tatham noted she was speaking as a citizen, and was following up on her previous oral statement on this topic. She noted she fully agreed with the January 7, 2016 draft SAB Panel Report, including the SAB's concerns regarding the EPA's major findings as presented in the draft Assessment Report. She stated she agreed with the January 7, 2016 draft SAB Panel Report's statement of concerns regarding the EPA's high-level conclusion that the EPA did not find evidence of systemic widespread impacts as it conducted its study. She noted there has been evidence since 2012 of health impacts in some areas, and encouraged the EPA to look at study sites to see information on such impacts. She stated she visited the Dimmock, Pennsylvania site twice, and met with members of the public whose wells have become undrinkable. She noted that the Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas sites had problems from hydraulic fracturing, and noted that in 2010 the EPA ordered a company in Dimmock, Pennsylvania to shut down three wells due to contamination caused by the wells and fined the company \$250,000.

Mr. Jeff Zimmerman, representing Damascus Citizens for Sustainability, NYH2O, and Citizens for Water, presented his oral statement. Mr. Zimmerman noted that the EPA's statement within its draft Assessment Report that the EPA did not find evidence of widespread, systemic impacts to drinking water resources from hydraulic fracturing activities was unsupported. Mr. Zimmerman noted that over 400 families in Pennsylvania signed nondisclosure agreements with hydraulic fracturing companies, and that there were 6,000 hydraulic fracturing wells near these families. He stated that there are thousands of hydraulic fracturing sites elsewhere in the United States, according to figures developed by Dr. Anthony Ingraffea of Cornell University, and that the available data clearly indicate that there is a widespread, systemic impact to drinking water resources from hydraulic fracturing.

Ms. Kathleen Nolan, representing Catskill Mountainkeeper, presented her oral statement. Ms. Nolan noted she was a pediatrician, and that the SAB Panel was correct in noting that the EPA's draft Assessment Report was accurate and comprehensive. She stated that regarding the EPA's statement that the EPA did not find evidence of widespread, systemic impacts to drinking water resources from hydraulic fracturing activities, the EPA should consider this statement in a normative rather than in a predictive manner. She noted that this statement was complicated by data gaps, and that information was not available on these potential impacts. She stated that the SAB Panel correctly identified these as problematic data gaps and correctly requested that the EPA conduct more research on hydraulic fracturing chemicals, particularly on radioactive contaminants. She noted that the EPA should use bioassays to provide relevant information on exposure and indicate potential impacts to humans and animals from hydraulic fracturing activities.

Mr. Bryce Payne, representing Gas Safety Inc., presented his oral statement, reading from a statement¹² that was posted onto the SAB teleconference website. He noted that the EPA's draft Assessment Report states in Chapter 6 that fractures created during hydraulic fracturing can extend out of the target production zone and upwardly migrate, and that the SAB Panel's draft

report noted this conclusion should be deleted from the draft Assessment Report unless the EPA supported these statements with data or modeling. Regarding this SAB Panel recommendation, he noted that literature on out-of-zone hydraulic fracturing was not rare, and that available literature clearly suggest a substantial likelihood that contamination of overlying shallow aquifers could occur when out-of-zone hydraulic fracturing contacts a pre-existing fault or fracture system. He further noted that the subject of hydraulic fracturing beyond the target production zone merited more thorough and explicit consideration within the draft Assessment Report and that the SAB Panel should not recommend that such consideration be dismissed. He noted that industry had conducted modeling which without exception indicated that such fractures extend upwards. He further noted that research indicated that the probability of the longest fracture in a single hydraulic fracturing stage extending over 350 meters vertically upward from the lateral well bore was about 1% of all fractures. He also noted that using this 1% figure, on average there would be an out-of-zone fracture at least 350 meters long during at least every 12.5 hydraulic fracturing lateral well bores. He further noted that fluid communication effects within these fractures may extend for kilometers from the point of application of stimulated hydraulic fracturing.

Mr. Robert Ackley, representing Gas Safety Inc., presented his oral statement. Mr. Ackley noted he used spectrometers to test methane, and can plot time and spatially marked data with use of a Global Positioning System. He noted this testing method can function in cities and rural environments where hydraulic fracturing and non-hydraulic fracturing oil and gas operations have occurred. He noted there were broad methane emissions in hydraulic fracturing areas, and noted that methane could sometimes be detected in water supplies. He stated that if he were provided access to water supply pipelines he could test the liquids in these pipelines for methane. He requested that more studies of hydraulic fracturing operations be conducted on a widespread area (e.g., 600 acres), and that the area be surveyed for methane releases using sampling and a spectrometer. He asked that water in these supplies be tested to assess methane levels before and after hydraulic fracturing activities.

Ms. Angel Smith presented her oral statement, reading from a statement¹³ that was posted onto the SAB teleconference website. Ms. Smith noted she lived in Clearville, Bedford County, Pennsylvania, next to a 12-billion cubic feet underground natural gas storage reservoir with a 5,000 horsepower compressor station, 13 injection/withdrawal wells and related pipelines. She stated that her artesian water well ran over the well casing for months and that her animals died after the compressor went into operation. She stated that the Pennsylvania Department of Environmental Protection (PA DEP) tested her water supply and that the PA DEP noted that drilling did not affect her water supply. She noted that her water supply had high levels of iron, manganese, arsenic, toluene, and methane. She stated that Spectra Energy, who runs the nearby storage reservoir and pipelines, has had more than 60 shutdowns and related incidents at its facility. She stated that she installed a \$10,000 water treatment system in her house and for her animals, and watched water levels in her pond go up and down in synch with the nearby injection and withdrawal of gas. She noted she, her husband, and livestock have had health issues, and that there is no interest from potential buyers for neighboring homes because of the water contamination and air pollution driven by releases at the Spectra Energy compressor station. She stated that people should not say that drilling does not affect her water and air, and noted that no one should ever have to live through what she and her husband live through.

Mr. Jack Kruell presented his oral statement. Mr. Kruell stated that he lived next to landfills where wastes from hydraulic fracturing have been disposed. He noted that nearby radon levels go up when such wastes are disposed into these landfills. He noted that volatile organic

chemicals were present in landfill leachate, which was collected and piped into a nearby sewage treatment plant. He noted that the EPA placed compressors into these landfills and that collected gas was burned and released into the air. He stated that radium cannot be burned off.

Mr. John Kerekes, representing Energy Nation, presented his oral statement, reading from a statement¹⁴ that was posted onto the SAB teleconference website. Mr. Kerekes noted he was a 28-year veteran of the oil and gas industry, and supported the EPA's Assessment Report finding that hydraulic fracturing was not a widespread, systemic problem. He noted that the EPA's Report represented the findings of a five-year effort, included approximately 950 sources of credible scientific findings and analysis, was based on peer-reviewed scientific studies, papers and technical reports, met reasonable criteria for scientific and technical adequacy, and should now be finalized and adopted. He stated that he supported the EPA's draft Assessment Report's conclusion that the states are effectively regulating hydraulic fracturing, and noted that safe, responsible hydraulic fracturing has been occurring commercially in the United States for 65 years and that at least two million oil and natural gas wells have been hydraulically fractured in the United States. He also noted that the EPA recently rejected a vital pipeline project for reasons based on symbolic and international prestige, and not for reasons based on science or fact.

Mr. Ray Beiersdorfer, representing Youngstown State University, had registered to speak but was not available to present his oral statement on the public teleconference line.

Ms. Melissa Troutman representing Pennsylvania's The Public Herald, presented her oral statement. Ms. Troutman noted she was Executive Director of The Public Herald, which has been investigating hydraulic fracturing since 2011. She stated that after this four year investigation, it was clear that there was widespread systemic impact to water where hydraulic fracturing occurs. She stated she appreciated that the SAB Panel pointed out the discrepancy with the EPA's finding on this point, and noted that the public could better understand the true scale of hydraulic fracturing impacts by viewing maps created by the Public Herald of complaint investigations related to hydraulic fracturing. She stated that the Public Herald was the first entity to investigate this issue, and noted that other entities also kept records of complaint investigations related to unconventional oil and gas development. She noted that the maps of these complaints that have been generated provided a clear picture of many water contamination complaints, and noted that this was more than the Pennsylvania DEP had investigated.

Mr. Geoffrey Thyne had registered to speak but was not available to present his oral statement on the public teleconference line.

Ms. Kathleen Blankenship presented her oral statement, reading from a statement¹⁵ that was posted onto the SAB teleconference website. Ms. Blankenship supported the EPA's draft Assessment Report. She noted that the EPA's draft Assessment Report was a scientifically exhaustive report that included extensive evidence that states are effectively regulating hydraulic fracturing and that hydraulic fracturing has not led to widespread, systemic impacts on drinking water. She stated that the oil and gas industry has been hydraulically fracturing wells safely for over 50 years without damaging water resources. She noted that the EPA's draft Assessment Report's conclusions were correctly based on extensive peer-reviewed scientific studies, papers, and technical reports. She commented that as a member of the energy sector for the past ten years who worked in shale gas, she knew that the industry was responsible in protecting the environment and public health, and noted it was gratifying to see that independent, peer-reviewed research confirms that hydraulic fracturing is a safe process. She strongly urged the SAB and the SAB Panel to stand behind the science of the EPA's draft Assessment Report, and

not stand behind politics. She stated that hydraulic fracturing occurs thousands of feet below the water table and does not affect the water table. She noted that hydraulic fracturing has occurred for years before methane problems in Pennsylvania were indicated.

Mr. George Watson presented his oral statement, reading from a statement¹⁶ that was posted onto the SAB teleconference website. Mr. Watson noted he lived in Waynesburg, Pennsylvania, and that he lost his voice in 2005 and has had seven surgeries for lung cancer. He noted that in 2007 he moved into a new home on a 200 acre farm, and that the water became contaminated in both his new home and his rental house. He stated that he installed Culligan water treatment systems in both homes and a new water supply. He noted that it would cost him \$500,000 to bring a public water supply to his house. He noted that since moving in, several of his cows and heifers died. He noted that his veterinarian tested the dead cows and heifers and could not find the cause of death. He noted that the former owner of Allan's Waste Water Service Inc. entered a guilty plea to illegally dumping millions of gallons of wastewater from natural gas drilling, sewage sludge and restaurant grease into streams and mine shafts in a six county area, and noted that this business was located near his farm.

Ms. Karen Foster, representing Independent Petroleum Association of New Mexico, had registered to speak but was not available to present her oral statement on the public teleconference line.

Ms. Barbara Arrindell, representing Damascus Citizens for Sustainability, presented her oral statement, reading from a statement¹⁷ that was posted onto the SAB teleconference website. Ms. Arrindell noted that the American Petroleum Institute has asked for explanation of the science to support the SAB Panel's draft recommendations to remove the EPA's statement from the draft Assessment Report that there were no widespread, systemic impacts to drinking water resources from hydraulic fracturing. She commented that that science was supplied by the oil and gas industry's publications within the Society of Petroleum Engineers and by industry's research. She stated that the oil and gas industry used its lobbyists to receive exemptions from protective environmental laws in 2005, based in part on a flawed EPA study. She stated that wastes from gas and oil operations were declared 'special' under the Resource Conservation and Recovery Act (RCRA) and therefore toxic materials from such operations were not required to be tracked, manifested, analyzed or mandated to be disposed properly. She stated that oil and gas companies do not have liability for much pollution as a result of these exemptions since their pollution was mostly hidden. She noted that the SAB Panel has an opportunity to speak clearly about the science and act on truth and not on the desires and wishes of political lobbyists. She stated that the removal of the Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas investigations from the EPA's draft Assessment Report was also a parallel to the EPA's 2004 report that should not be repeated.

Mr. John Noel, representing Clean Water Action, presented his oral statement, reading from a statement¹⁸ that was posted onto the SAB teleconference website. Mr. Noel noted that Clean Water Action strongly agreed with the recommendations and main themes in the SAB Panel's draft report. He stated that the EPA should prioritize an effort to revise its statement in the Assessment Report that the EPA did not find evidence that hydraulic fracturing mechanisms have led to widespread, systemic impacts on drinking water resources. He noted that this statement did not reflect uncertainties and data limitations and was ambiguous. He stated that the EPA should incorporate the SAB's recommendations into the Assessment Report and commit to finalizing its Assessment Report without delay and without stifling progress that has been made. He noted that the EPA should discuss upfront in the Assessment Report the myriad of

uncertainties implicit in any discussion of impacts to drinking water. He also noted that the EPA must include the analysis and status of three investigations that were already underway by EPA in Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas into its Assessment Report.

Mr. Steve Miller had registered to speak but was not available to present his oral statement on the public teleconference line.

Mr. Ivan Dubrasky presented his oral statement, reading from a statement¹⁹ that was posted onto the SAB teleconference website. Mr. Dubrasky noted that he refused to sign a lease with Hilcorp, and Hilcorp installed a well pad directly across the road from his house in 2014. He noted that during 2015, hundreds of trucks per day traveled by his home, and that these trucks generated noise and generated dust that was impossible to keep from his windows. He stated that a company hired by Hilcorp tested all wells in the area before drilling began in 2014. In 2015, after hydraulic fracturing ended, he noted his water supply was tested by the company hired by Hilcorp and also by the Pennsylvania DEP, and the results indicated unacceptable levels of methane and total suspended solids. He stated that Hilcorp provided bottled water to his home. He stated that Hilcorp and the Pennsylvania DEP downplayed the test results and stated that his water was fine. He noted that he has filed a lawsuit against Hilcorp and that that lawsuit was ongoing.

Mr. George Miklasevich presented his oral statement, reading from a statement²⁰ that was posted onto the SAB teleconference website. Mr. Miklasevich noted he lived in Pulaski Township, Warren County, Pennsylvania, and that his water supply well was tested by a gas company in February 2012 and that the testing indicated good quality water. He noted that in July 2012, after drilling activity occurred on a neighbor's property, his water well indicated the presence of flammable gases in the well's headspace and dissolved in the well water. He noted that the gas company stated that the pre-drill water testing was not conducted correctly, and that the company stated the methane was present at pre-drill test time. He stated that 2015 testing of his well indicated presence of several flammable gases. He stated he no longer trusts his water supply, and that he may have possible long term health problems later in life. He noted similar events have occurred to others in Western Pennsylvania who deal with the hydraulic fracturing industry.

Ms. Bernadette Comfort had registered to speak but was not available to present her oral statement on the public teleconference line.

Mr. Nicholas Haden, representing Reserved Environmental Services, LLC, presented his oral statement. Mr. Haden noted that his Pittsburgh company recycles water for the hydraulic fracturing industry, and began this operation in April 2010. He noted that since 2010 his company has recovered 12 million gallons of water and returned that recycled water to drillers. He noted that this reduced the water withdrawn from Pennsylvania waterways. He stated that it is against the law in Pennsylvania to discharge water to the Commonwealth's waterways without treating the water such that total dissolved solids do not exceed a maximum of 500 mg/l. He asserted that Pennsylvania was the only State in the lower 48 United States that did not require a permit to drill for drinking water at a residence. He noted that the Pennsylvania DEP was providing sound, strong regulations in this drilling industry, and stated that paternalistic meddling from the EPA in this industry was not needed.

Ms. Marigrace Butela presented her oral statement. Ms. Butela noted she strongly disagreed with the EPA's high-level conclusion that the EPA did not find evidence of systemic widespread

impacts as it conducted its study. She stated she was an elected official, and that she was aware of a case where a farmer had hydraulic fracturing chemicals in his well. She stated that the farmer signed a non-disclosure agreement with a company that conducted hydraulic fracturing, and then received a water buffalo, filtration system, and connection to public water supply from the company. She stated that this bargaining was corrupt and was affecting water supplies. She stated that the water supplies of several nearby water authorities had regulatory violations of allowable levels of many chemicals used in the hydraulic fracturing process. She noted that in 2011, the Pennsylvania DEP sent a letter to the town of Carmichaels, Pennsylvania noting it should boil its water. She stated that bromide was present in the Monongahela River, and that the bromide formed tri-halomethanes in the river.

Ms. Carol Kwiatkowski, representing The Endocrine Disruption Exchange, presented her oral statement, reading from a statement²¹ that was posted onto the SAB teleconference website. Ms. Kwiatkowski noted she was Executive Director of The Endocrine Disruption Exchange (TEDX). She stated that the TEDX website provide a reference list of 48 peer-reviewed articles published since 2009 related to health impacts of unconventional oil and gas. She noted that one study in 2016 evaluated the potential reproductive and developmental toxicity of 240 chemicals in hydraulic fracturing fluids and wastewater. She also noted that in a recent *in vitro* study, when a mixture of oil- and gas-related chemicals was given to pregnant mice, their male offspring had decreased sperm, increased serum testosterone, and increased organ weights. She further reported that scientists at the University of Colorado conducted a study of birth records from 57 rural Colorado counties that revealed that pregnant women living near oil and gas development were more likely to give birth to babies with congenital heart defects. She stated that another study found that babies born near oil and gas wells had a greater likelihood of being born small for gestational age and had significantly lower birth weights. She described another study conducted in Central and Northeast Pennsylvania by scientists at Johns Hopkins University that found that proximity to oil and gas development was associated with an increased likelihood of high-risk pregnancy in the mothers, and preterm birth in the babies. She requested widespread, systemic corrective action on these issues.

Mr. Ed Ireland, representing Barnett Shale Energy Education Council, had registered to speak but was not available to present his oral statement on the public teleconference line.

Ms. Carolyn Knapp presented her oral statement. Ms. Knapp stated that she was an organic farmer in Bradford County, Pennsylvania and that she was in constant fear that her drinking water was undrinkable. She stated that many people, including her daughter in Leroy Pennsylvania, live near hydraulic fracturing wells and have undrinkable water. She noted that the Pennsylvania DEP issued a violation notice to a company who drilled a hydraulic fracturing well near her daughter's home for not drilling the well properly. She noted her daughter lost her water supply in 2014 and was without water for weeks, and that her daughter's water supply quality had changed. She noted that the Pennsylvania DEP determined that the company who drilled a hydraulic fracturing well near her daughter's home was not responsible for her daughter's water problems, and that her daughter has not received compensation for the problems with her water supply. She stated that the EPA should revise its draft Assessment Report, and should conduct a more thorough investigation and review all available information and files. She stated that the EPA should demand more information from industry, and that industry should put chemical tracers in wells, particularly those that have been problematic, in order to determine that there is no problem associated with these wells.

Mr. Ray Kemble presented his oral statement. Mr. Kemble noted there was a failed water supply well 500 feet from his home in Pennsylvania. He noted there was nothing wrong with the well before hydraulic fracturing occurred in the area. He asked why the ‘Halliburton loophole’ prevented the investigations at the Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas sites from being discussed in the EPA’s draft Assessment Report. He stated that several nearby homeowners have gag orders preventing them from speaking about the problems at their homes associated with hydraulic fracturing activities. He stated that he was a former gas worker who worked for industry, and noted there was a nine square mile moratorium on drilling in Dimock Pennsylvania. He stated that hydraulic fracturing occurred in Dimock Pennsylvania in three wells in 2012, and that since that time six new wells have been contaminated. He noted that in 2014 and 2016 arsenic and barium levels were above regulatory limits. He noted that he would make the data available to the SAB.

Mr. John Fenton presented his oral statement. Mr. Fenton stated that it was very important that the investigations at the Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas sites be discussed in the EPA’s draft Assessment Report. He noted that it has been stated that hydraulic fracturing occurs so far below the water table that there is no pathway to water supplies. He noted that the situation in Pavillion, Wyoming disproved this statement, since hydraulic fracturing occurred in Pavillion between 45 and 1000 feet below the ground surface. He noted that on the Wind River Reservation in Wyoming, hydraulic fracturing fluids can be dumped onto the ground surface. He noted he would provide more details on this in written comments for the Panel’s consideration. He stated that there were members of the SAB Panel who represented the energy sector. He asked these Panel members to request that energy companies release members of the public from their non-disclosure agreements and allow these members of the public to enter their stories into evidence.

Mr. Ken Dufalla had registered to speak but was not available to present his oral statement on the public teleconference line during February 1, 2016.

Ms. Kimberlie McEvoy presented her oral statement, reading from a statement²² that was posted onto the SAB teleconference website. Ms. McEvoy noted she lived in Butler Pennsylvania in 2011 when she and her neighbors noticed a change in their water supplies. She stated that out of 143 people, 56 people noticed changes in the water after Marcellus Shale drilling occurred. She noted that after drilling occurred, her water color changed from crystal clear to gray then to black, and that she could no longer bathe in or drink her water. She noted that if she tried to bathe in the water from her supply after drilling occurred, she would become light-headed and felt like she might pass out. She stated that her boyfriend complained of headaches and pains in his legs and sinus. She noted that after drilling occurred, she bathed her three-year old daughter in store-bought water. She stated that she contacted the gas company who conducted the nearby drilling, and that the company gave her a water buffalo. She noted that after the company removed the water buffalo, she did laundry at a nearby home and hauled water to her home from work. She stated that she received a letter from the EPA that her water and air were safe. She noted that she lost her home through foreclosure, and felt she was insulted by and disappointed with all levels of government and industry who she believed thought she had no common sense and was expendable.

Dr. Dzombak then reiterated the names of registered speakers who did not respond when their name was called to speak, and no additional registered public commenters voiced their request to make an oral statement.

Dr. Dzombak then asked if any Panel members had any clarifying questions for the public commenters who presented oral comments during the teleconference. One Panel member noted that the public commenters should supply the Designated Federal Officer with the county and location where they resided, and Dr. Dzombak asked all public commenters to inform the Designated Federal Officer of their locational information.

Discussion on the Panel's Draft Report

Dr. Dzombak noted that based on preliminary comments received from Panel members on the Panel's January 7, 2016 draft SAB Panel Report, he prepared a January 28, 2016 'Suggested Topics for Discussion'²³ that was posted on the Panel's February 1, 2016 teleconference website. He stated that he would use these suggested topics as a guide for the Panel's discussion on the Panel's January 7, 2016 draft SAB Panel Report.

Dr. Dzombak noted that the usual SAB process for this stage of Panel deliberations was to have the Chair seek consensus on points made in draft SAB Panel Reports where that was possible. He stated that where there are differences of opinion within Panel members, the SAB report might note 'most members concluded that ...' or 'one (or several) Panel members concluded that ...' He also noted that sometimes there were instances when a Panel member strongly disagreed with the majority of the Panel's findings. He stated that in such instances, the Panel member may author a minority view that would be included as an Appendix to the consensus SAB report. He noted that such a minority statement would clearly indicate authorship, and the majority SAB report would reference the minority viewpoint.

A Panel member noted that the EPA spent a significant amount of time developing the Assessment Report, but did not find many examples of impacts to drinking water supplies. The Panel member noted that monitoring of HFWC stages was not typically occurring and thus searching for more data on this topic may not result in a change to the information base that would provide examples of impacts to drinking water supplies. The Panel member expressed concern that if the Assessment Report was finalized before additional studies were conducted, the general understanding would be that the EPA's work on this topic was completed.

Another Panel member stated that the SAB Panel Report should recommend that the EPA improve its discussion on the regulatory processes associated with hydraulic fracturing, and how state regulatory agencies conduct sampling of hydraulic fracturing and respond to spills. Dr. Dzombak noted it would be a large undertaking to summarize these regulatory requirements and the regulatory framework surrounding hydraulic fracturing activities, and noted this topic has both scientific and non-scientific aspects associated with it. Dr. Dzombak stated that the Panel is challenged to identify what can be done by the EPA Office of Research and Development in a relatively short-term manner and in a long-term manner. Dr. Dzombak suggested that the Panel try to identify priorities for short-term work which will help improve the final Assessment Report. Several Panel members agreed with this approach.

Another Panel member suggested that the EPA could review regulatory standards/requirements applicable to hydraulic fracturing in a subset of states (e.g., ten states) to identify overlapping standards within those ten states. The Panel member suggested that the investigations that were occurring in Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas were early efforts and the Panel member noted that these sites suffered from a lack of regulatory controls. The Panel member suggested that if the EPA described the additional regulations that are now in place and the timeline associated with recent progress in such regulations in the Final

Assessment Report, such descriptions might assist states in preventing the problems that may have occurred or may be occurring at such sites.

Another Panel member noted that the State Review of Oil, Natural Gas, Environmental Regulations, Inc. (STRONGER) organization has tried to improve hydraulic fracturing operations, and suggested that STRONGER's work should be cited in the SAB Report.

Dr. Dzombak then commenced Panel discussion on his suggested 'Suggested Topics for Discussion' on the Panel's January 7, 2016 draft SAB Panel Report²³ that were posted on the teleconference website. Dr. Dzombak separately read through each suggested topic for discussion, then encouraged discussion by the Panel members on each topic after he read that topic. After discussion occurred by the Panel members on each topic, Dr. Dzombak then tried to reach consensus by the Panel on whether wording changes to text within the January 7, 2016 draft SAB Panel Report were warranted.

During the Panel's discussion of each topic noted in Dr. Dzombak's 'Suggested Topics for Discussion' document, Panel members discussed possible alternative language and also whether any changes were needed to the draft SAB Panel Report. Panel members also identified additional topics for discussion by the Panel during the teleconference. Wording changes to the text of the January 7, 2016 draft SAB Panel Report were agreed upon by the Panel for most of the topics that were discussed by the Panel. Dr. Dzombak noted that he and Designated Federal Officer Ed Hanlon would keep track of the wording changes that were discussed during the teleconference, and that these changes would be provided to the Panel in an updated second draft SAB Report that would be sent to the Panel for review on or about February 15, 2016 and posted onto SAB's website.

A summary of the Panel discussion on each of the topics noted in Dr. Dzombak's 'Suggested Topics for Discussion' document is provided below.

Topic 1, General Comments, of 1/28/16 'Suggested Topics' document:

Dr. Dzombak stated that the Panel's January 7, 2016 draft SAB Panel Report draft Panel report included a number of recommendations that appeared to provide general advice that could perhaps be bolstered with specific advice or suggestions from the Panel on how the EPA could or should address the issue. Dr. Dzombak noted that he identified several of these recommendations in Appendix 1, on pages 21 through 27, of his suggested 'Suggested Topics for Discussion' document dated January 28, 2016. Dr. Dzombak requested that the Panel should review the recommendations provided on these pages of his 'Suggested Topics for Discussion' and send Designated Federal Officer Ed Hanlon any suggestions for specific advice on these recommendations after the teleconference. Dr. Dzombak noted that these suggestions would appear in the updated second draft SAB Report.

Topic 2, General Comments, of 1/28/16 'Suggested Topics' document:

Dr. Dzombak noted that in their individual Panel member comments on the January 7, 2016 draft SAB Panel Report that were sent to the Designated Federal Officer in late January 2016, some suggestions from Panel members would result in wording changes that the EPA could make before finalizing its Assessment Report. He also noted that some suggestions from Panel members would require an extended effort by the EPA to address and more resources and time which would delay issuance of the EPA's final Assessment Report. Dr. Dzombak noted that a

Panel member suggested that the EPA's Assessment Report be finalized as expeditiously as possible with minimum resources, and that the EPA should consider conducting follow-on studies after the Assessment Report was finalized. Dr. Dzombak noted that this was a common situation that develops in SAB advisory activities, and noted that the Panel may have different ideas on how the EPA report could be strengthened. He summarized this discussion by noting that some SAB Panel recommendations to strengthen the EPA draft Assessment Report would therefore either be 'short term' (i.e., could be conducted before the Assessment Report was finalized) or 'long term' (i.e., could be conducted after the Assessment Report was finalized.) Dr. Dzombak suggested that each lead writer of the Panel, in consultation with their writing teams, review their team's draft responses to their assigned charge question in the January 7, 2016 draft SAB Panel Report, and identify short vs. long term recommendations. Dr. Dzombak suggested that each team could add words after such recommendations to clarify whether those recommendations could be conducted over the short or long term.

Topic 1, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document: SAB's general finding that the EPA's overall approach was appropriate and comprehensive

A Panel member suggested that the Panel discuss the statement made on p. 1, lines 36-42, of the January 7, 2016 draft SAB Panel Report that noted that the SAB found the EPA's overall approach to assess the potential impacts of hydraulic fracturing for oil and gas on drinking water resources to be appropriate and comprehensive. Several Panel members noted that sentences that followed this text in the SAB Panel's draft report described various concerns that the SAB had regarding the appropriateness and comprehensibility of the EPA's draft assessment. Several Panel members stated that while the EPA's draft assessment was comprehensive in the scope of literature considered, the assessment was not comprehensive in other aspects and the EPA should have but did not conduct various activities as part of the assessment.

Upon discussion, the Panel agreed that additional clarifying language would be added to this section of the cover letter to further describe the SAB's concerns regarding various aspects of the draft Assessment Report and recommendations for changes to the EPA's draft assessment and follow-on activities to address gaps that the SAB has identified.

Topic 2, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document: Key finding on widespread systemic impacts

Several Panel members identified concerns regarding the SAB Panel's draft report's statements regarding the EPA's conclusion statement that the EPA did not find evidence that hydraulic fracturing mechanisms have led to widespread, systemic impacts on drinking water resources in the United States. One Panel member stated that as written, the EPA's conclusion statement was correct. Several Panel members stated that unless systemic, widespread and impact were defined and supported by scientific references, it was unclear whether one could agree or disagree with the EPA's conclusory statement.

Several Panel members agreed that the SAB Panel's draft report's language on this topic was clear and should not be revised. One Panel member stated that the EPA was not requested by Congress to make conclusions on widespread, systemic impacts, but did request that the EPA define impacts from hydraulic fracturing. Another Panel member stated that the term 'impact' was defined in Chapter 1 of the draft Assessment Report. A Panel member suggested that the EPA should emphasize and describe the uncertainties that occur throughout each phase of the HFWC, and deemphasize its statement regarding widespread, systemic impact.

A Panel member stated that based on statements from public commenters, there are some places in the United States where there are widespread problems associated with hydraulic fracturing, and there are also a number of places in the United States where there are no identified problems associated with hydraulic fracturing. The Panel member suggested that the EPA discuss both of these situations within its Assessment Report. The Panel member noted it would be inappropriate to condemn hydraulic fracturing across the United States since in many areas hydraulic fracturing was being conducted safely without problems.

Several members provided alternative options for revising the text within the SAB Panel's draft report in order to reflect the concerns that the Panel had raised. Dr. Dzombak noted that several Panel members had offered wording changes to the SAB Panel's draft report in their strike/shade comments to the January 7, 2016 draft SAB Panel Report that they emailed to the Designated Federal Officer that would potentially address several of the concerns discussed on the teleconference. A Panel member stated that it would be helpful to see the revised language on this topic before the revised language could be agreed upon.

Upon discussion, the Panel agreed to revise the statements regarding widespread, systemic impacts within this section of the cover letter to note that the EPA's statement does not clearly describe the system(s) of interest nor the definitions of "systemic" and "widespread", to note that the EPA's statement has been interpreted by members of the public in many different ways, and to conclude that the statement requires clarification and additional explanation.

Topic 3, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document: Recommendations to add an additional major finding

The Panel discussed the SAB Panel's draft report recommendation to include an additional major finding that: (a) large severe hydraulic fracturing flowback and produced water-related contaminant release incidents such as blowouts, and smaller common incidents (usually containment leaks) may cause effects on drinking water resources on a volume basis; and (b) blowouts are more severe in terms of impact due to the high-volume, short-duration characteristics of the release. Several Panel members noted they did not understand this recommendation, and also asked what the term "on a volume basis" meant. After discussion, the Panel agreed to delete this draft recommendation from the SAB Panel's draft report.

Topic 4, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document: Studies at Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas

The Panel discussed the SAB Panel's draft report recommendation that the agency should include and explain in the Assessment Report the status, data on potential releases, and findings if available for the EPA and state investigations conducted in Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas. A Panel member noted there was a large difference between summarizing studies that have occurred at these locations vs. conducting and describing a critical evaluation of the studies that have occurred at these locations. Dr. Dzombak noted that this recommendation requested that the EPA summarize work that has been conducted at these locations. A Panel member suggested that the EPA work with the three states where these investigations are located, since these states have information on these ongoing studies. Another Panel member stated that the EPA should discuss in the Assessment Report what mistakes were made in these investigations.

Upon discussion, the Panel agreed to revise the SAB Panel's draft report statements regarding the investigations at the three locations to recommend that the agency critically analyze the findings from the related EPA and state investigations, to identify lessons learned if any for the different stages of the HFWC, and to identify what additional work should be done to improve the understanding of these sites and the HFWC.

Topic 5, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document: Recommendation to add another key point to the cover letter:

A Panel member requested that the cover letter of the SAB Panel's draft report note the SAB Panel's concern that the EPA's recommendation to limit consideration of water treatment plants within a 1 mile radius of hydraulic fracturing activities was arbitrary and irrelevant. A Panel member noted that the one mile radius selected by the EPA was arbitrary since hydraulic fracturing activities could have influence in surface waters more than a mile downstream of such activities. After Panel discussion, the Panel agreed to add language to the cover letter that asked that the EPA clarify the basis for its selection of a one mile radius on this topic. A Panel member suggested that this language also be added in the SAB Panel's draft report's Executive Summary, and the Panel agreed this would be appropriate to do.

Topic 6, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document: Clarify reasoning for distinguishing potential impacts unique to hydraulic fracturing from impacts from conventional non-hydraulic fracturing development:

The Panel discussed the SAB Panel's draft report recommendation that the EPA should distinguish between hydraulic fracturing chemicals injected into a hydraulic fracturing well vs. compounds that come back out of the hydraulic fracturing well in flowback and produced water. One Panel member noted that members of the public raised this concern in their comments. Another Panel member noted that it was important to understand what goes into the ground and what comes out of the ground, since salts, uranium and other pollutants were generally not added to hydraulic fracturing fluids before they entered the ground. Several Panel members suggested adding text to note that such distinctions would help inform the public of the different characteristics of hydraulic fracturing fluids.

Upon discussion, the Panel agreed to revise the SAB Panel's draft report statements regarding distinguishing injection and flowback/produced fluids to note that chemicals/constituents that are naturally occurring in the formation waters of the zone being exploited should be distinguished, and to note that this effort would help inform the public regarding the differences between these fluids.

Topic 7, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document: Most likely exposure scenarios and hazards

The Panel discussed the SAB Panel's draft report recommendation that the EPA should identify the most likely exposure scenarios and hazards in order to obtain toxicity information relevant to particular situations. A Panel member suggested that this recommendation should be highlighted earlier in the SAB Panel's draft report. The Panel agreed to include additional language earlier in the body of the SAB Panel's draft report on this recommendation, and note that more emphasis is needed on identifying the most likely durations and routes of exposures of concern so that the EPA can determine what toxicity information is most relevant and focus research and monitoring efforts on the most important and/or likely scenarios.

*Topic 8, Cover Letter to the Administrator, of 1/28/16 'Suggested Topics' document:
Background and pre-existing baseline chemistry of surface and groundwater*

The Panel discussed the SAB Panel's draft report recommendation that additional discussion on background and pre-existing baseline chemistry of surface and groundwater should be included in the draft Assessment Report. Several Panel members emphasized that the assessment of background and pre-existing baseline chemistry of surface and groundwater was complex. One Panel member stated that non-disclosure agreements signed by members of the public would prevent release of relevant information on this topic. A Panel member suggested that while state regulatory agencies have gathered information on this topic, often the source of such data cannot be disclosed.

The Panel agreed to further revise the SAB Panel's draft report recommendations to add clarifying language to describe the public's concern on this topic, recommend that the EPA discuss how background and pre-existing baseline chemistry of surface and groundwater data are used to better understand the impacts of hydraulic fracturing-related spills and leaks, and recommend that the EPA describe the scientific complexity of baseline sampling and data interpretation.

*Topic 1, Executive Summary and Chapter 10, of 1/28/16 'Suggested Topics' document:
Prospective Studies*

Regarding the SAB Panel's draft report recommendation that the EPA should continue research on expanded case studies and long-term prospective studies, a Panel member stated that this would be a large effort that would take years to complete if this work was conducted by the EPA. Several Panel members stated that the EPA had agreed earlier to do this work, did not do the work and should discuss why these studies were not conducted in the draft Assessment Report, and should conduct this work. One Panel member stated that this prospective study work was not needed and should not be conducted. A Panel member stated that in his comments on the SAB Panel's draft report, he provided information on why the EPA did not include language on this topic in the draft Assessment Report.

The Panel agreed to modify language in the SAB Panel's draft report to clarify the meaning of its recommendation, and note that such new data that could be gathered through these studies would enable EPA to reduce current uncertainties and knowledge gaps regarding the relationship between hydraulic fracturing and drinking water, particularly for localized stresses to surface or groundwater resources as associated with different stages of the HFWC. The Panel also agreed that the agency may consider the issue of prospective case studies as an item for longer-term future activity.

Topic 2A, Executive Summary and Chapter 10, of 1/28/16 'Suggested Topics' document: Data availability discussion regarding well file review

The Panel discussed the SAB Panel's draft report recommendations that the EPA further examine and assess more or all of the 20,000 well files referenced in the draft Assessment Report in order to increase the amount of information that the agency considered when assessing the magnitude and frequency of spills related to hydraulic fracturing. A Panel member stated it would require a significant amount of work and effort to assess additional well files, and that such efforts may not result in changes to the EPA's conclusions on this topic. Another Panel member stated that the data sets from the states of Colorado and Pennsylvania were likely to be

the best available data sets and noted that these data sets were used by the EPA in its analysis on this topic. A Panel member noted that geologies differ among states. Another Panel member stated that the EPA should describe the approaches it took on this topic within the Assessment Report.

Dr. Kathy Ensor, a Panel member, noted that the draft Assessment Report did not fully discuss or provide specifics on the statistical analyses that the EPA conducted regarding this topic. Upon further discussion, Dr. Ensor agreed to further consider the SAB Panel's draft report recommendations on this topic in light of the Panel's concerns, and raise the topic again during the Panel's February 2, 2016 teleconference.

At 6:15 pm Eastern Time, Dr. Dzombak noted that the teleconference would suspend for the day, and continue on February 2, 2016. The Designated Federal Officer noted that the teleconference was in recess until February 2, 2016 at 11:00 am Eastern Time.

February 2, 2016

At 11:00 am Eastern Time on February 2, 2016, the Designated Federal Officer resumed the teleconference. Dr. Dzombak noted there were two additional public speakers who had registered to present their oral comments during the February 1, 2016 Panel teleconference but who had informed the Designated Federal Officer Ed Hanlon that they could not present their comments during the February 1, 2016 Panel teleconference due to technical difficulties. Dr. Dzombak noted that these two registered speakers would present their oral comments during the February 2, 2016 Panel teleconference.

Mr. Lou Allstadt presented his oral statement, reading from a statement²⁴ that was posted onto the SAB teleconference website. He noted he lived in Cooperstown, New York, was a retired former Executive Vice President of Mobil Oil Corporation, and supported the Panel's work. He stated that lax state laws and regulations, and current industry practices, have repeatedly failed to protect water resources from hydraulic fracturing activities. He noted that the hydraulic fracturing process needs to be viewed in its entirety, and not viewed for just the short period during well completions when the actual hydraulic fracturing takes place. He stated that industry statements claiming that the hydraulic fracturing process has been used for decades were misleading at best, and that the current hydraulic fracturing process uses 50 to 100 times the amounts of fluids and chemicals than the earlier conventional wells used. He commented that the EPA's draft Assessment Report seriously understated impacts on drinking water and greenhouse gas emissions. He noted that the EPA's draft Assessment Report should be revised to reflect the preponderance of the most recent peer-reviewed data, and include full reporting on hydraulic fracturing activities in Dimock, Pennsylvania; Pavillion, Wyoming; and Parker County, Texas.

Mr. Ken Dufalla, representing Izaak Walton League, presented his oral statement. Mr. Dufalla noted that he has developed a citizen water monitoring system that contained a significant amount of data. He noted that after hydraulic fracturing water entered drinking water supplies, trihalomethanes (THM) are formed. He noted that the levels of THM and other contaminants in such waters were over allowable regulatory limits for drinking water. He commented that thousands of people would be affected if hydraulic fracturing waters that enter drinking water supplies were not controlled. He stated that various universities including Duquesne University were investigating this issue. He stated that counties where hydraulic fracturing occurred were rural and that these counties had a 31% higher cancer rate than counties that did not conduct hydraulic fracturing. He noted that counties where hydraulic fracturing occurred were not

receiving assistance from the Pennsylvania DEP. He stated that he feared for his life in his work and needed help with his efforts.

Dr. Dzombak then continued the discussion from the February 1, 2016 teleconference regarding his ‘Suggested Topics for Discussion’ document. Dr. Dzombak separately read through each of his remaining suggested topic for discussion that were not discussed during the Panel’s February 1, 2016 teleconference, then encouraged discussion by the Panel members on each topic after he read that topic. After discussion occurred by the Panel members on each topic, Dr. Dzombak tried to reach Panel consensus on wording changes, if any, to text within the January 7, 2016 draft SAB Panel Report.

Continuation of Topic 2A, Executive Summary and Chapter 10, of 1/28/16 ‘Suggested Topics’ document: Data availability discussion regarding well file review

Dr. Dzombak continued the discussion from the February 1, 2016 teleconference regarding the statistical analyses that the EPA conducted regarding its well file analysis. Dr. Ensor noted that she considered this topic further following the Panel discussion on February 1, and she observed that the draft Assessment Report did not summarize information regarding the EPA’s well file review. She stated that she did not review the EPA’s sampling plan associated with the EPA’s well file review. She stated further that based on her review of EPA’s analysis, it would be difficult for the EPA to assess more or all of the 20,000 well files. She noted that the EPA followed its sampling plan, and did not communicate uncertainty well in the draft Assessment Report. A Panel member asked whether review of another sampling of 300 well files would assist EPA’s statistical analysis on this topic. Another Panel member responded that the EPA was limited on individuals it could contact to gather information due to the Paperwork Reduction Act requirements.

A Panel member stated that as noted in the EPA’s Study Plan, the EPA had planned to but did not provide a dataset on spills from hydraulic fracturing operations within the EPA’s well file report, and had planned to but did not evaluate whether such spills involved impacts on drinking water resources. The Panel member noted that the well file review was not used by the EPA as planned. The Panel member stated that the SAB Panel’s draft report’s wording on this topic adequately reflected the Panel’s concerns regarding the inadequacy of the EPA’s well file review. The Panel member noted that uncertainties could be reduced if the EPA reviewed more than 323 well files, and suggested that perhaps the EPA could conduct this work in the future. The Panel member also observed that the EPA’s well file review report stated that some hydraulic fracturing operators provide all requested information, and some operators did not provide all requested information, to the EPA, and noted this raised a possible issue of concern. The Panel member stated that the EPA should have sufficient time and money to conduct this additional well file analysis.

Another Panel member stated that the EPA was confined in how it reached out to industry to gather information, and was concerned about a Panel recommendation that the EPA conduct an analysis on all 20,000 well files. The Panel member noted that state regulations have dramatically changed over the past several years on well construction and well integrity, and that since industry practices have changed significantly over the past six years, the 20,000 well files were now stale. The Panel member stated it would be helpful if the EPA discussed improvements that have taken place over the past six years of the EPA study regarding these regulatory improvements that that relate to the well review file.

A Panel member suggested including the SAB Panel's draft report wording on regulatory practices related to well integrity within the SAB Panel's draft report Executive Summary. Another Panel member stated that the EPA should also assess how representative the 20,000 wells assessed in its well survey are with respect to the nation. The Panel agreed that the language in the SAB Panel's draft report should be revised to address these comments.

Two statisticians from the Panel noted they needed additional information from the EPA's Office of Research and Development on the EPA's well file review to assist the Panel in updating the January 7, 2016 draft SAB Panel Report on this topic. It was agreed that these Panel members would work through the Designated Federal Officer after the teleconference to develop questions for the EPA associated with this request for additional information.

Topic 2B, Executive Summary and Chapter 10, of 1/28/16 'Suggested Topics' document: Data availability discussion regarding synthesis of information collected by states

The Panel discussed the SAB Panel's draft report recommendation that the EPA should synthesize information collected by the states but that is not available in readily accessible databases. A Panel member noted that the EPA should summarize which state agencies collected what information, since this was not clear in the draft Assessment Report. One Panel member noted that in Pennsylvania, it is easy to identify what agencies are collecting in certain counties but not easy to identify what is being collected in other counties. Another Panel member noted that many states do not have database systems in place, and that there was no centrally formatted database system to collect this information for the hydraulic fracturing industry. Dr. Dzombak suggested that the EPA should clearly describe the challenge of acquiring and analyzing data from the states.

Several Panel members stated that while synthesizing information collected by the states would be a challenging task, there was a need to gather more information to assess the severity of potential impacts from hydraulic fracturing, and recommended that the EPA describe these issues and why the EPA could not gather more data to assess severity.

The Panel agreed to add text to encourage the EPA to describe what it learned from state data, describe the scale of the task of synthesizing information collected by the states, and describe the most critical issues that the EPA has learned in its review of this state data.

Topic 2C, Executive Summary and Chapter 10, of 1/28/16 'Suggested Topics' document: Data availability discussion regarding FracFocus data

The Panel discussed the SAB Panel's draft report recommendation that the draft Assessment Report include data from more recent versions of FracFocus. A Panel member stated that it was important to use more recent FracFocus data because the EPA's Assessment Report would be obsolete if it cut off data from 2013 and put out a report in 2016. Another Panel member stated that it was not clear that use of more recent FracFocus data would change the fundamental conclusions that the EPA would draw regarding whether or not there are impacts associated with hydraulic fracturing activities. A Panel member stated that since current hydraulic fracturing industrial practices are improving, it was important to use more recent FracFocus data in light of these improving practices. A Panel member stated that the FracFocus database was not uniformly voluntary, since 20 states currently require reporting to FracFocus.

A Panel member suggested that the EPA note that while the data in FracFocus and new industrial practices continue to evolve, the EPA necessarily had to restrict data collection to a certain date

in order to complete the Assessment Report. Several Panel members discussed the practical merits, limitations, and difficulties regarding whether a comprehensive identification of chemicals of most concern and trends towards use of environmentally protective chemicals (i.e., ‘green chemistry’) could occur based on the EPA’s review of FracFocus.

The Panel agreed to modify language in the SAB Panel’s draft report to clarify the text regarding this recommendation, and request that the agency discuss the current status, use and changes to the FracFocus platform and outline what follow-on analyses should be done with the FracFocus database. The Panel also agreed to recommend that the agency consider conducting analyses on trends in green chemical usage in hydraulic fracturing, and consider conducting some preliminary analyses of trends. The Panel also agreed that the text should note that the EPA should discuss the current status of FracFocus and changes that have been made to the FracFocus platform and system, and note that the current version of FracFocus also provides some additional insights into the confidential business information (CBI) associated with chemicals used during hydraulic fracturing operations.

Topic 2D, Executive Summary and Chapter 10, of 1/28/16 ‘Suggested Topics’ document: Data availability discussion regarding flowback water composition

The Panel discussed the SAB Panel’s draft report recommendation that the EPA conduct its own analysis of flowback water for organic compounds. A Panel member noted that this was a difficult, costly, and time consuming task. After Panel discussion, the Panel agreed this was a worthwhile task for the EPA to conduct and that this effort should be a long term recommendation. The Panel agreed that the agency should outline a plan for analyzing organic compounds in hydraulic fracturing flowback and produced waters in collaboration with state agencies.

Topic 2E, Executive Summary and Chapter 10, of 1/28/16 ‘Suggested Topics’ document: Data availability discussion regarding industry data on mixing and delivery operations

The Panel discussed the SAB Panel’s draft report recommendation that the EPA gather data and reference information regarding mixing and delivery operations that are common and employed in other industries. The Panel discussed whether the experience of other industries was relevant to the hydraulic fracturing industry. A Panel member suggested that data were available from operators of or suppliers to of hydraulic fracturing wellpads. Another Panel member stated that spills were reportable and states have different regulations for spill reporting. The Panel member stated that the EPA should gather spill information from states and not industry. Another Panel member suggested that the EPA may collect a large amount of useless information from the states in conducting this effort. After discussion, the Panel agreed to delete this draft recommendation from the SAB Panel’s draft report.

Topic 2F, Executive Summary and Chapter 10, of 1/28/16 ‘Suggested Topics’ document: Data availability discussion regarding databases from analogous operations

The Panel discussed the SAB Panel’s draft report recommendation that the EPA use existing databases from analogous operations to assess the likelihood of hydraulic fracturing mixing and delivery operation failure, leading to spills. Several Panel members stated that similar to the recommendation to gather data and reference information regarding mixing and delivery operations that are common and employed in other industries, this recommendation may result in the agency’s collection of a large amount of useless information from the states in conducting

this effort. After discussion, the Panel agreed to delete this draft recommendation from the SAB Panel's draft report.

*Topic 3, Executive Summary and Chapter 10, of 1/28/16 'Suggested Topics' document:
Statement on extent of fracture zone*

The Panel discussed the SAB Panel's draft report recommendation that the EPA delete its conclusory discussion in Chapter 6 regarding how fractures created during hydraulic fracturing can extend out of the target production zone and upwardly migrate. Several Panel members noted that it was unclear where in the draft Assessment Report that the EPA included discussion indicating transport of fluids to the ground surface, and that there was discussion on how upward fluid migration to drinking water resources would be unlikely. After discussion, the Panel agreed to delete this draft recommendation from the SAB Panel's draft report's Executive Summary and body of the SAB Panel's draft report.

*Topic 4 Executive Summary and Chapter 10, of 1/28/16 'Suggested Topics' document:
Discussion on fate of un-recovered fracture fluids*

The Panel discussed the SAB Panel's draft report recommendation that the EPA assess what happens to un-recovered fracture fluids that are injected into hydraulic fracturing wells, and where these fluids go if they do not come back to the surface. A Panel member stated that it was unclear where data could be gathered to respond to this recommendation. Another Panel member stated that some of the injected fluids move into other zones due to poor cementing of the well, and noted that once the fluids are injected underground the fluids may not stay in the location where injection occurs. Another Panel member noted that while it was appropriate for the SAB to ask what is known and not known regarding the fate of these fluids in the subsurface, EPA is unlikely to be able to conduct more simulations to assess this topic.

The Panel agreed to adjust the text to request that the EPA discuss what is known to happen on the fate of injected fluids in the subsurface. The Panel also agreed that the EPA should describe the challenge of monitoring and modeling the fate of injected fracture fluids over time, and describe the differences between milli-darcy, microdarcy and nanodarcy permeability rocks to help the reader understand the variability in fluid recovery under various geologic scenarios if the agency is not able to describe what is known to happen on the fate of these fluids in the subsurface with any rigor.

*Topic 5, Executive Summary and Chapter 10, of 1/28/16 'Suggested Topics' document:
Discussion on deep well injection siting proximity to water intakes/supply*

The Panel discussed the SAB Panel's draft report recommendation that the EPA further assess how deep-well injection siting proximity to production wells, water intakes and water supply wells may influence potential impacts on drinking water quality. The Panel discussed whether this recommendation was requesting that the EPA articulate how such siting decisions were currently being made, and to what extent regulations cover this topic.

After discussion, the Panel agreed to delete the bullet on this topic from page 83 of the draft SAB Panel Report, and to also adjust the text in this location of the draft SAB Panel Report to focus the topic being discussed on transportation to the production well. The Panel also agreed to add text noting that transport of wastewater from a wellsite to a disposal injection well poses risks for spills, and that longer distances increase the likelihood of crossing surface waters where spills

could impact surface water intakes or spills could impact water supply wells. The Panel also suggested that the draft SAB Panel Report recommend that the agency summarize state permitting efforts related to the proximity and potential impacts of injection wells to water supplies. A Panel member (Dr. Paul Westerhoff) agreed to send the Designated Federal Officer draft text after the teleconference to incorporate these suggestions.

Topic 1, Chapters 1, 2 and 3, of 1/28/16 'Suggested Topics' document: Hydraulic fracturing stage vs. hydraulic fracturing water cycle

The Panel discussed the SAB Panel's draft report recommendation that the EPA include additional explanation of the rationale for its choice to use the HFWC to assess impacts of hydraulic fracturing on drinking water resources. Dr. Dzombak noted that the EPA decided to focus on the five stages of the HFWC in the EPA's Research Scoping Document and in the detailed Study Plan, and stated that the SAB supported this approach in previous SAB advisory reports. The Panel agreed with the substance of this recommendation and agreed to modify the language slightly to clarify this recommendation.

Topic 2, Chapters 1, 2 and 3, of 1/28/16 'Suggested Topics' document: FracFocus data

The Panel discussed the SAB Panel's draft report recommendation that referred to certain limitations of the FracFocus database (i.e., the absence of information considered proprietary for certain chemicals, and lack of information on the identity, properties, frequency of use, magnitude of exposure, and toxicity potential for a substantial number of chemicals).

After discussion, the Panel agreed that this clause was not relevant to the discussion on water use, and that this clause appears to contradict the Charge Question 7 response which disagreed with EPA's characterization of the toxicology data by not taking full advantage of relevant data. The Panel agreed to delete this clause from the SAB Panel's draft report.

Topic 3, Chapters 1, 2 and 3, of 1/28/16 'Suggested Topics' document: Inconsistent use of terms describing temporary or limited events

The Panel discussed the SAB Panel's draft report statement that stresses on water resources from water acquisition for hydraulic fracturing were expected to be local and temporary. Several Panel members expressed concern regarding the use of the term 'temporary' since terms used to designate time or space should be discussed in relation to size, time, time, and scale of an event as well as in terms of impact (size, time and scale). One Panel member suggested that the language was clear and should remain unaltered. Another Panel member noted that the Panel's recommendations on this topic implied that any water withdrawal would be considered an impact under the current wording within the SAB Panel's draft report, and stated that this was not accurate. A Panel member stated that the draft Assessment Report defined impact as any observed change in drinking water resources regardless of severity that results from a mechanism, and noted that this was a very broad definition of impact.

After discussion, the Panel agreed not to change the wording on this topic within the SAB Panel's draft report. The writing team for Charge Question 7 agreed to assess whether its draft response to Charge Question 7 should be revised to further discuss the timing and severity of health impacts.

Topic 4, Chapters 1, 2 and 3, of 1/28/16 ‘Suggested Topics’ document: Expanded case studies and prospective studies

The Panel discussed the SAB Panel’s draft report statements noting that the EPA should continue research on expanded case studies and long-term prospective studies. Upon discussion, the Panel agreed to revise the text consistent with edits agreed upon earlier by the Panel during the February 1, 2016 teleconference discussion regarding prospective studies.

Topic 1, Chapter 5, of 1/28/16 ‘Suggested Topics’ document: Physical/chemical properties of chemicals in hydraulic fracturing fluids

The Panel discussed the SAB Panel’s draft report recommendations regarding the extent of the chemical data record that the EPA relied upon in developing its draft Assessment Report, and the Panel’s suggestions for the EPA to utilize other sources of available physical/chemical property information before making final conclusions on what data are available. A Panel member noted that the concern raised in this Panel comment related to the need for the EPA to be critical about what is not known regarding its chemical assessment. Several Panel members suggested that references to having data on only 453 chemicals should be deleted from the draft SAB Panel report; the Panel agreed to this recommendation. The Panel also agreed that the draft SAB Panel report should not reiterate the need for the same data throughout the draft SAB Panel report. Dr. Dzombak stated that he and the Designated Federal Officer would review the draft SAB Panel report to remove such repeated text.

Topic 2, Chapter 5, of 1/28/16 ‘Suggested Topics’ document: Need details regarding complexities for many processes described in the EPA’s draft Assessment Report

The Panel discussed including an additional statement to the SAB Panel’s draft report recommendations noting that the EPA did not include details in its discussion of complexities for many fate and transport processes, including discussion of subsurface migration relative to different conditions in the subsurface such as geology, hydrogeology, and heterogeneity. The Panel agreed to add statements to the SAB Panel’s draft report noting that fate and transport processes associated with movement of chemicals in the subsurface are very complex, and that the discussion in the draft Assessment Report on this topic provided a broad overview of the processes involved.

Topic 3, Chapter 5, of 1/28/16 ‘Suggested Topics’ document: Impacts of Spills

The Panel discussed including additional statements to the SAB Panel’s draft report recommendations regarding impacts of spills with a focus on duration. Upon discussion, the Panel agreed that there was no need to include such additional statements since the SAB Panel’s draft report adequately addressed this topic of concern.

Topic 1, Chapter 6, of 1/28/16 ‘Suggested Topics’ document: StimPlan Modeling

The Panel discussed including an additional statement to the SAB Panel’s draft report recommendations noting that while models such as “StimPlan” have been used to explore conditions that allow a fracture to grow to intersect geologic units bearing potable water, abandoned wells of questionable integrity can also provide a conduit to freshwater sources. The Panel agreed to change the SAB Panel’s draft report to acknowledge that abandoned wells can provide conduits to freshwater sources near the ground surface.

Topic 2, Chapter 6, of 1/28/16 ‘Suggested Topics’ document: Bainbridge Ohio and Kildeer North Dakota Case Studies

The Panel discussed the SAB Panel’s draft report recommendations regarding the draft Assessment Report’s discussions of two case studies in the chapter: Bainbridge, Ohio and Kildeer, North Dakota. Several Panel members suggested that the EPA should more clearly describe these case studies within the draft Assessment Report. Several Panel members also expressed concern that the SAB Panel states in its draft SAB Panel Report that these cases were not related to hydraulic fracturing activities. The Panel agreed to revise the draft SAB Panel Report recommendations to focus the recommendations on what did occur at these locations, and to adjust the draft SAB Panel Report’s statements that these cases were not related to hydraulic fracturing activities.

Topic 3, Chapter 6, of 1/28/16 ‘Suggested Topics’ document: Background Monitoring

The Panel discussed the SAB Panel’s draft report recommendations for the EPA to assess and describe background/baseline or pre-drilling activity water quality data measurements. Several Panel members stated that background sampling is a difficult task to conduct, and recommended that the EPA should evaluate and summarize existing baseline monitoring efforts and discuss what data need to be collected for such efforts to be useful and effective. The Panel agreed to revise the draft SAB Panel Report recommendations to acknowledge the importance of baseline monitoring practices, add references, and recommend that the EPA summarize best practices in this area. The Panel also agreed to recommend that the EPA include descriptions regarding what data would allow the EPA to make a careful assessment of background water quality.

Topic 4, Chapter 6, of 1/28/16 ‘Suggested Topics’ document: Distinction between Flowback and Produced Waters

The Panel further discussed the SAB Panel’s draft report recommendations on the importance of distinguishing between hydraulic fracturing flowback water and produced water. Upon discussion, the Panel agreed to revise the text consistent with edits agreed upon earlier by the Panel during the February 1, 2016 teleconference discussion regarding this topic.

Topic 1, Chapter 7, of 1/28/16 ‘Suggested Topics’ document: Seismicity

The Panel discussed the SAB Panel’s draft report recommendations regarding including recommendations on whether/how seismic activity could impact cement seals in hydraulic fracturing wells. Upon discussion, the Panel agreed to add language to the SAB Panel’s draft report recommending that the EPA discuss the potential effects of natural and induced seismicity on wellbore integrity and the challenges of studying this phenomenon. The Panel also agreed to include references and citations relevant to this topic within this recommendation.

Topic 2, Chapter 7, of 1/28/16 ‘Suggested Topics’ document: Line age and corrosion

The Panel discussed the SAB Panel’s draft report recommendations that the EPA describe whether leakage rates are smaller for operations at unconventional wells considering that hydraulic fracturing facilities and operations are generally newer. The Panel agreed to add language to the SAB Panel’s draft report noting that the EPA should also describe whether the

well casing materials being used today are subject to more corrosion or breakage when compared with those materials used in the past.

Topic 3, Chapter 7, of 1/28/16 ‘Suggested Topics’ document: Long-term effects of Leroy Township, Bradford County, PA event

The Panel discussed the SAB Panel’s draft report recommendation that the EPA describe whether long-term effects were reported for the event described in the draft Assessment Report regarding potable water wells in Leroy Township, Bradford County, Pennsylvania. The Panel discussed whether there was sufficient information for the EPA to provide additional details regarding this incident. Several Panel members stated that the SAB Panel’s draft report recommendations on this topic were clear and not overly burdensome to address. After discussion, the Panel agreed not to change this draft recommendation within the SAB Panel’s draft report.

Topic 4, Chapter 7, of 1/28/16 ‘Suggested Topics’ document: Data on bromate, chlorate/chlorite, perchlorate or iodate

The Panel discussed the SAB Panel’s draft report recommendation that the EPA describe whether bromate, chlorate/chlorite, perchlorate or iodate were ever found in hydraulic fracturing waters, and whether data are available on this topic. A Panel member noted that while bromate, chlorides and hypochlorate are used on stimulation treatments, iodate is not used. The Panel agreed to revise statements on this topic consistent with the Panel member’s statement.

Topic 5, Chapter 7, of 1/28/16 ‘Suggested Topics’ document: Discussion on halogens

The Panel discussed the SAB Panel’s draft report recommendation that the EPA’s discussion in the draft Assessment Report on halogens, which is mostly limited to chloride, is inadequate. Several Panel members agreed that this recommendation was incorrect since it was not accurate that the EPA’s discussion was limited to chloride. The Panel agreed to remove the clause stating that the EPA’s discussion on halogens in the draft Assessment Report was limited to chloride.

Topic 6, Chapter 7, of 1/28/16 ‘Suggested Topics’ document: Discussion on natural brine movement in the subsurface

The Panel discussed the SAB Panel’s draft report recommendation that the EPA should explain that there can be natural pathways of brines to the surface, that these natural pathways are not necessarily related to shale gas development, and that brine salts can contaminate aquifers and surface waters naturally. A Panel member stated that this recommendation was confusing and should be rewritten. Upon discussion, the Panel did not recommend changing the existing wording within the SAB Panel’s draft report on this topic.

Topic 7, Chapter 7, of 1/28/16 ‘Suggested Topics’ document: Description of microbial processes regarding adsorption, absorption and precipitation of hydraulic fracturing chemicals

The Panel discussed the SAB Panel’s draft report recommendation that the EPA describe microbial processes assessed through the EPI Suite models that the EPA described within the draft Assessment Report, and how such processes can affect adsorption, absorption, and precipitation. A Panel member stated that while there were gaps in the understanding of the effects of microbial processes on adsorption, absorption, and precipitation, there were gaps in

understanding of other effects on these aspects of chemical fate and transport. The Panel agreed that the Panel's draft recommendations on this topic were generally acceptable, but that the text of the SAB Panel's draft report would be clarified by breaking the text into two paragraphs and by adding language recommending that the agency consider the effects of the use of biocides on microbial processes.

Topic 1, Chapter 9, of 1/28/16 'Suggested Topics' document: Toxicity Data Availability

The Panel discussed the SAB Panel's draft report recommendation that the draft Assessment Report should limit data that the agency should consider on compounds identified in hydraulic fracturing fluids to data from government sources or sources that have been peer reviewed by the government. The Panel agreed to revise the SAB Panel's draft report to recommend that the agency consider toxicity data available from or used by U.S. or state governments or international non-governmental organizations used for risk assessment purposes, or publicly available peer-reviewed data.

Topic 2, Chapter 9, of 1/28/16 'Suggested Topics' document: Threshold of Toxicological Concern

The Panel discussed the SAB Panel's draft report recommendation that the EPA use threshold-of-toxicological-concern concepts in assessing the mitigation of hazards. Several Panel members stated that the SAB Panel's draft report should specify how the agency should use threshold-of-toxicological-concern concepts, and suggested that the SAB Panel's draft report could suggest that compounds below these thresholds could be deprioritized as contaminants of concern in these fluids. The Panel agreed to this approach, and the Panel's Charge Question 7 writing team agreed to revise this section of the SAB Panel's draft report to incorporate this recommendation and send that revised text to the Designated Federal Officer after the teleconference.

Topic 3, Chapter 9, of 1/28/16 'Suggested Topics' document: Toxicity Data Availability

The Panel discussed the SAB Panel's draft report recommendation that the EPA should fully utilize the in vivo toxicology and physicochemical data available through the ACToR database. Several Panel members recommended that the EPA consider other available information regarding bioavailability, lipid solubility, and potential for exposure associated with hydraulic fracturing chemicals, and use this information together with toxicology data to identify possible exposure boundaries that would allow the agency to prioritize chemical exposures of concern. Upon discussion, the Panel agreed that additional language would be added to the SAB Panel's draft report to incorporate this recommendation.

Upon completion of discussion on the above noted topics for discussion, Dr. Dzombak then noted that several Panel members and/or writing teams of the Panel agreed to develop revised language for certain sections of the January 7, 2016 draft SAB Panel Report. The sections of the January 7, 2016 draft SAB Panel Report that these writing teams agreed to revise after the teleconference are noted below. Dr. Dzombak noted that these revisions would appear in the updated second draft SAB Report:

- a) Discussion in the Executive Summary, page 14, lines 45-46, and on page 83, regarding deep well injection siting proximity to production wells.
- b) Discussion on page 57, lines 18-25, regarding background/baseline or pre-drilling activity water quality data measurements.

- c) Discussion on page 62, lines 20-34, regarding the distinction between flowback and produced waters.
- d) Discussion on page 98, lines 7-11, regarding use of threshold-of-toxicological-concern concepts.

Dr. Dzombak stated that the Panel's January 7, 2016 draft SAB Panel Report draft Panel report included a number of recommendations that appeared to provide general advice that could perhaps be bolstered with specific advice or suggestions from the Panel on how the EPA could or should address the issue. Dr. Dzombak noted that he identified several of these recommendations in Appendix 1, on pages 21 through 27, of his suggested 'Suggested Topics for Discussion' document dated January 28, 2016 that were being discussed on the teleconference. Dr. Dzombak requested that the Panel should review the recommendations provided on these pages of his 'Suggested Topics for Discussion' and send Designated Federal Officer Ed Hanlon any suggestions for specific advice on these recommendations after the teleconference. Dr. Dzombak noted that these suggestions would appear in the updated second draft SAB Report.

Upon completion of the discussion of topics noted within Dr. Dzombak's 'Suggested Topics for Discussion' document, Dr. Dzombak then asked if the Panel members had any additional questions or comments. One Panel member stated that the EPA did not take advantage of available data in developing its draft Assessment Report. The Panel member noted that that the EPA developed a multi-criteria decision analysis (MCDA) approach to analyze hydraulic fracturing constituents and identify/prioritize constituents of most concern. The Panel member stated that this MCDA approach could not be appropriately used by the EPA within the Assessment Report unless the agency incorporated additional, available toxicity data. The Panel member noted that the Organisation for Economic Co-operation and Development (OECD) came to different conclusions than the EPA did based on the same list of chemicals within the FracFocus database. Another Panel member noted that this topic was raised as point 3 on page 97 of the Panel's January 7, 2016 draft SAB Panel Report, and stated that the EPA would need to conduct significant efforts to appropriately address this recommendation. Dr. Dzombak responded that the Panel's writing teams that were assigned to respond to each charge question should review their team's draft responses to their assigned charge question in the January 7, 2016 draft SAB Panel Report, and clarify whether the SAB Panel's recommendations within the responses to charge questions could be conducted by the EPA over the short or long term.

Upon hearing no additional Panel member questions or comments, Dr. Dzombak summarized next steps. He requested Panel members to send to he and Designated Federal Officer Ed Hanlon the following by February 8, 2016: (a) any additional comments on the Panel's January 7, 2016 draft SAB Panel Report; (b) any suggested specific advice or suggestions on how the EPA could or should address issues that Dr. Dzombak identified in Appendix 1 of his 'Suggested Topics for Discussion' document; and (c) clarifications on whether the SAB Panel's recommendations within the responses to charge questions in the January 7, 2016 draft SAB Panel Report could be conducted by the EPA over the short or long term.

Dr. Dzombak noted that he and Designated Federal Officer Ed Hanlon would incorporate changes discussed during the Panel's February 1 and February 2, 2016 teleconference, and information submitted by Panel members to himself and Ed Hanlon by February 8, 2016, into an updated second draft SAB Report. He also stated that he would consider all suggested changes received from Panel members to the January 7, 2016 draft SAB Panel Report, and would use his judgement in deciding which Panel member comments should be incorporated into the updated second draft SAB Report, based on consideration of consistency with consensus views of the

Panel. Dr. Dzombak noted that the second draft SAB Report would be sent to the Panel for review on or about February 15, 2016 and posted onto SAB's website. He noted that the Panel members should review the second draft SAB Report and plan to discuss their comments on this second draft SAB Report during the Panel's March 7 and March 10, 2016 teleconference.

Dr. Dzombak noted that a public Panel teleconference call would occur on March 7, 2016, in order to hear public comments and discuss the Panel's comments on the second draft SAB report. He stated that this teleconference was scheduled to run between 11am-6pm Eastern Time, with two 15 minute breaks in the middle of the teleconference. He noted that a followup teleconference call was scheduled for March 10, 2016, between 12 noon-6pm Eastern Time, in the event that the Panel did not complete agenda items on the March 7th teleconference. He stated that a notice was published in the Federal Register and on the SAB website that provided the logistics for these March 7 and March 10 teleconferences.

Dr. Dzombak noted that once Panel consensus was reached on sending the draft SAB Panel Report to the chartered SAB for quality review, the updated draft SAB Panel Report would be posted on SAB's website, and then discussed on a public teleconference or meeting of the chartered SAB, where public comments will be heard and comments from the chartered SAB will be discussed. He stated that the SAB would provide notice in the Federal Register and on the SAB website on the logistics for this quality review teleconference.

Dr. Dzombak then asked if the Panel members had any additional questions or comments. Hearing none, Dr. Dzombak thanked the Panel members, the EPA staff, and SAB Staff Office. With the teleconference business concluded, the Designated Federal Officer adjourned the teleconference at 4:45 pm Eastern Time.

Respectfully Submitted:

/Signed/
Mr. Edward Hanlon
Designated Federal Officer

Certified as Accurate:

/Signed/
Dr. David A. Dzombak, Chair
SAB Hydraulic Fracturing Research
Advisory Panel

NOTE AND DISCLAIMER: The minutes of this public teleconference reflect diverse ideas and suggestions offered by Panel members during the course of deliberations within the teleconference. Such ideas, suggestions and deliberations do not necessarily reflect consensus advice from the Panel members. The reader is cautioned to not rely on the minutes to represent final, approved, consensus advice and recommendations offered to the Agency. Such advice and recommendations may be found in the final advisories, commentaries, letters or reports prepared and transmitted to the EPA Administrator following the public meetings or teleconferences.

Materials Cited

The following teleconference materials are available on the SAB website (www.epa.gov/sab) or through the following SAB Hydraulic Fracturing Research Advisory Panel February 1, 2016 public teleconference webpage:

<http://yosemite.epa.gov/sab/sabproduct.nsf/a84bfee16cc358ad85256ccd006b0b4b/5fca4c1a644cdc8085257f17006e7272!OpenDocument&Date=2016-02-01>

¹ Science Advisory Board Panel's January 7, 2016 draft report regarding SAB's review of the EPA's draft *Assessment of the Potential Impacts of Hydraulic Fracturing for Oil and Gas on Drinking Water Resources (External Review Draft – June 2015)*

² December 29, 2015 Federal Register Notice announcing the public teleconference (80 FR 81321 – 81323)

³ Agenda for February 1, 2016 public teleconference

⁴ Oral Statement submitted by Katie Brown

⁵ Oral Statement submitted by Erik Milito

⁶ Oral Statement submitted by Hugh MacMillan

⁷ Oral Statement submitted by Anthony Ingraffea

⁸ Oral Statement submitted by Yuri Gorby

⁹ Oral Statement submitted by Michelle Bamberger

¹⁰ Oral Statement submitted by Larysa Dyrszka

¹¹ Oral Statement submitted by Nichole Saunders

¹² Oral Statement submitted by Bryce Payne

¹³ Oral Statement submitted by Angel Smith

¹⁴ Oral Statement submitted by John Kerekes

¹⁵ Oral Statement submitted by Kathleen Blankenship

¹⁶ Oral Statement submitted by George Watson

¹⁷ Oral Statement submitted by Barbara Arrindell

¹⁸ Oral Statement submitted by John Noel

¹⁹ Oral Statement submitted by Ivan Dubrasky

²⁰ Oral Statement submitted by George Miklasevich

²¹ Oral Statement submitted by Carol Kwiatkowski

²² Oral Statement submitted by Kimberlie McEvoy

²³ 1/28/16 Suggested Topics for Discussion from Dr. David Dzombak, Chair of EPA Science Advisory Board (SAB) Hydraulic Fracturing Research Advisory Panel, In Preparation for the Panel's February 1, 2016 Teleconference

²⁴ Oral Statement submitted by Lou Allstadt

ATTACHMENT A – ROSTER

U.S. Environmental Protection Agency Science Advisory Board Hydraulic Fracturing Research Advisory Panel

CHAIR

Dr. David A. Dzombak, Hamerschlag University Professor and Department Head, Civil and Environmental Engineering, Carnegie Mellon University, Pittsburgh, PA

MEMBERS

Dr. Stephen W. Almond, Director of Research & Development, Fritz Industries, Inc, Houston, TX

Dr. E. Scott Bair, Emeritus Professor, School of Earth Sciences, Ohio State University, Columbus, OH

Dr. Peter Bloomfield, Professor, Statistics Department, North Carolina State University, Raleigh, NC

Dr. Steven R. Bohlen, State Oil and Gas Supervisor, and Head of the Division of Oil, Gas and Geothermal Resources (DOGGR), State of California Department of Conservation, Sacramento, CA

Dr. Elizabeth W. Boyer, Associate Professor, Department of Ecosystem Science & Management, Pennsylvania State University, University Park, PA

Dr. Susan L. Brantley, Distinguished Professor of Geosciences and Director, Earth and Environmental Systems Institute, Pennsylvania State University, University Park, PA

Dr. James V. Bruckner, Professor of Pharmacology and Toxicology, Department of Pharmaceutical and Biomedical Sciences, College of Pharmacy, University of Georgia, Athens, GA

Dr. Thomas L. Davis, Professor, Department of Geophysics, Colorado School of Mines, Golden, CO

Dr. Joseph J. DeGeorge, Global Head of Safety Assessment and Laboratory Animal Resources, Merck Research Laboratories, Lansdale, PA

Dr. Joel Ducoste, Professor, Civil, Construction, and Environmental Engineering Department, North Carolina State University, Raleigh, NC

Dr. Shari Dunn-Norman, Professor, Geosciences and Geological and Petroleum Engineering Department, Missouri University of Science and Technology, Rolla, MO

Dr. Katherine Bennett Ensor, Professor and Chair, Department of Statistics, Rice University, Houston, TX

Dr. Elaine M. Faustman, Professor, Department of Environmental Health, and Director, Institute for Risk Analysis and Risk Communication, School of Public Health, University of Washington, Seattle, WA

Mr. John V. Fontana, Professional Geologist and President, Vista GeoScience LLC, Golden, CO

Dr. Daniel J. Goode, Research Hydrologist, U.S. Geological Survey, Pennsylvania Water Science Center, Exton, PA

Dr. Bruce D. Honeyman, Associate Vice President for Research and Emeritus Professor of Environmental Science and Engineering, Colorado School of Mines, Golden, CO

Mr. Walter R. Hufford, Director of Government and Regulatory Affairs, Talisman Energy USA Inc. - REPSOL, Warrendale, PA

Dr. Richard F. Jack, Director, Vertical Marketing for Environmental and Industrial Markets, Thermo Fisher Scientific Inc., San Jose, CA

Dr. Dawn S. Kaback, Principal Geochemist, Amec Foster Wheeler, Denver, CO

Dr. Abby A. Li, Senior Managing Scientist, Exponent Health Sciences, Exponent, Inc., San Francisco, CA

Mr. Dean N. Malouta, White Mountain Energy Consulting, LLC, Houston, TX

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Dr. Stephen Randtke, Professor, Department of Civil, Environmental, and Architectural Engineering, University of Kansas, Lawrence, KS

Dr. Joseph N. Ryan, Professor of Environmental Engineering and Bennett-Lindstedt Faculty Fellow, Department of Civil, Environmental, and Architectural Engineering, University of Colorado-Boulder, Boulder CO

Dr. James E. Saiers, Clifton R. Musser Professor of Hydrology and Associate Dean of Academic Affairs, School of Forestry and Environmental Studies, Yale University, New Haven, CT

Dr. Azra N. Tutuncu, Professor and Harry D. Campbell Chair, Petroleum Engineering Department, and Director, Unconventional Natural Gas and Oil Institute, Colorado School of Mines, Golden, CO

Dr. Paul K. Westerhoff, Professor, School of Sustainable Engineering and The Built Environment, Ira A. Fulton Schools of Engineering, Arizona State University, Tempe, AZ

Dr. Thomas M. Young, Professor of Civil and Environmental Engineering, University of California – Davis, Davis, CA

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Mr. Edward Hanlon, Designated Federal Officer, U.S. Environmental Protection Agency, Science Advisory Board Staff, Washington, DC

ATTACHMENT B – Other Attendees

List of Members of the Public Who Requested Information on Accessing the Teleconference Line or Live Webcast, or Who Participated On the Teleconference or Live Webcast:

February 1 and February 2, 2016

Name	Affiliation
Ackley, Bob	Gas Safety Inc.
Adler, Kevin	No Affiliation Given
Albert, Jay	XTO Energy
Allstadt, Lou	No Affiliation Given
Alvarez, I.	No Affiliation Given
Anderson, Loren	No Affiliation Given
Appleton, Albert	No Affiliation Given
Arrindell, Barbara	Damascus Citizens for Sustainability
Baier, Bret	No Affiliation Given
Baker, Gerry	Interstate Oil and Gas Compact Commission
Baker, Tim	No Affiliation Given
Bamberger, Michelle	No Affiliation Given
Bazin, Abby	No Affiliation Given
Beaven, Lara	No Affiliation Given
Beiersdorfer, Ray	Youngstown State University
Bella, Peter	No Affiliation Given
Bennett, Micah	No Affiliation Given
Bergstrom, Michael	No Affiliation Given
Biles, Robert W.	ToxXolutions
Blankenship, Kathleen	No Affiliation Given
Bleiberg, Jake	No Affiliation Given
Bolaklas, John	Woodard & Curran
Boone, Rick	O'Brien & Gere
Borawski, Teddy	No Affiliation Given
Bradbury, Jim D.	James D. Bradbury, PLLC
Branch, Anita	U.S. Army Corps of Engineers
Briskin, Jeanne	EPA

Name	Affiliation
Bristow, Ann	Savage River Watershed Association
Brown, Katie	No Affiliation Given
Bruant, Robert	Pioneer Natural Resources
Buffone, Steven	No Affiliation Given
Burden, Susan	No Affiliation Given
Bush, Pamela	Maryland Department of Natural Resources
Butela, Marigrace	No Affiliation Given
Clayton, Brenda	Clayton, Brenda
Collins, Al	Occidental Petroleum
Comfort, Bernadette	No Affiliation Given
Cornue, Dave	ALL Consulting
Crayne, David	EQT
Crews, Jeffrey	No Affiliation Given
Crum, Jim	Van Scoyoc Associates
Dailor, Tom	No Affiliation Given
Daniels, Eric	Chevron Energy Technology Company
Datz, Amy	Environmental Caucus of Florida
Davis, Brian	No Affiliation Given
Dean, Nancy	No Affiliation Given
Dempsey, Stan Jr.	Colorado Petroleum Association
Dgif, Ernie	No Affiliation Given
DiCosmo, Bridget	No Affiliation Given
Diouhy, Jen	Bloomberg
Dodge, Erin	No Affiliation Given
Dryszka, Larysa	Concerned Health Professionals of NY
Dubrasky, Ivan	No Affiliation Given
Dufalla, Ken	No Affiliation Given
Duncan, Doug	No Affiliation Given
Dunkel, Michael	CH2M
Dunlap, David D.	Koch Companies Public Sector, LLC
Dyrszka, Larysa	No Affiliation Given

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Ehlers, Robert	No Affiliation Given
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Fenton, John	No Affiliation Given
Fereidoun, Khajehnouri	Eauservice Lausanne
Feridun, Karen	Berks Gas Truth
Fernley, Amanda	Antero Resources
Fikslin, Thomas	Delaware River Basin Commission
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Flansburg, Paul	No Affiliation Given
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Francis, Dick	Shell
Fujimura, Elaine	No Affiliation Given
Furey, Denise M.	Regent Square Advisors
Furlan, Ron	No Affiliation Given
Garvey, Megan	QEP Resources
Geltman, Liz	No Affiliation Given
Gibbons, Dayna	EPA
Glessel, Elaine	Kansas Sierra Club
Goldenberg, Suzanne	The Guardian
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Gorby, Yuri	Rensselaer Polytechnic Institute
Gratson, David	Environmental Standard
Gurung, Prarthana	No Affiliation Given
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Hahn, Carrie	No Affiliation Given

Name	Affiliation
Hansen, Susan	NRCS
Hardenbergh, Sabrina	Independent Health Researcher
Harmon, Shani	No Affiliation Given
Harris, Blake	Illinois Department of Natural Resources
Harris, Jesse	No Affiliation Given
Henry, Margaret	No Affiliation Given
Herbert, Thomas A.	Lampl Herbert Consultants, Inc.
Hetrick, Lloyd	No Affiliation Given
Howard, Wayne	No Affiliation Given
Hudon, Karen	No Affiliation Given
Huizenga, Robert	No Affiliation Given
Hutt, Jason	Bracewell & Giuliani
Ingraffea, Anthony	Cornell University
Ireland, Ed	Barnett Shale Energy Education Council
Itkin, Cheryl	EPA
Jackson, Tom	Baker Botts
Jameel, Maryam	No Affiliation Given
Jenna Bernstein	No Affiliation Given
Jerke, Bill	No Affiliation Given
Jester, Steve	ConocoPhillips
Job, Chuck	National Ground Water Association
Johnson, Rick N.	Environmental Strategy & Policy
Joice, Tim	No Affiliation Given
Jones, Rachel	Energy and Resources Policy
Kassotis, Chris	No Affiliation Given
Kelly, Sharon	DeSmog Blog
Kemble, Ray	No Affiliation Given
Kenney, James	EPA
Kerekes, John	Energy Nation
Kern, Gretchen	No Affiliation Given
Kern, Seri	No Affiliation Given

Name	Affiliation
King, George E.	Apache Corporation
Kirkbride, Greg	No Affiliation Given
Klewicki, Ken	The Cadmus Group
Knapp, Carolyn	No Affiliation Given
Knigh, Chris	No Affiliation Given
Knightes, Chris	EPA
Knoertzer, Douglas	No Affiliation Given
Kong, Deyuan	Chevron
Koplos, Jonathan	The Cadmus Group
Kothari, Yogin	UCS
Kovski, Alan	Bloomberg BNA
Kropatsch, Tom	Wyoming Oil and Gas Commission
Krueger, Mary	No Affiliation Given
Kruell, Jack	No Affiliation Given
Kwiatkowski, Carol	The Endocrine Disruption Exchange
LaFleur, Carolyn	No Affiliation Given
Lavizzo, Aubrey	No Affiliation Given
Leal, Gloria	Attorney at Law
LeDuc, Stephen	EPA
Lee, Stephen	Louisiana Department of Natural Resources
Lieberman, Ken	Scimed Consultants
Lipsky, David	nycdep
Lipsky, Steven	No Affiliation Given
Litvak, Anya	No Affiliation Given
Long, Michelle	EPA
Loveland, C.	No Affiliation Given
Lundin, Diane	No Affiliation Given
Lyons, Judy	No Affiliation Given
MacMillan, Hugh	Food and Water Watch
Maloney, Kelsey	EPA
Marks, Teresa	No Affiliation Given

Name	Affiliation
Marshall, Justin	Kansas University
Marshall, Michael F.	Marshall Energy Consolidation
Marshall, Steve	Phillips 66
Mascarenhas, Brendan	No Affiliation Given
Mathis, Mike	No Affiliation Given
Mazza, Kimberly	Devon Energy
McDevitt, Michael	No Affiliation Given
McEvoy, Kimberlie	No Affiliation Given
McKasson, Barbara	Sierra Club
McMahan, Oeter	U.S. Geological Survey
Meadows, Stephanie R.	American Petroleum Institute
Mickler, Patrick	No Affiliation Given
Miklasevich, George	No Affiliation Given
Milito, Erik	American Petroleum Institute
Miller, Steve	No Affiliation Given
Mintzes, Aaron	Earthworks
Moir, Korice	No Affiliation Given
Mordick, Briana	Natural Resources Defense Council
Morrison, Jessica	Chemical & Engineering News
Mumford, Beth Anne	Americans for Prosperity-PA
Musante, Ramola	Ecolab
Newman, Colleen	American Association of Petroleum Geologists
Ngure, Njoroge	TransCanada
Nicot, JP	The University of Texas
Noble, Mishelle	Fairfax Water
Noel, John	Clean Water Action
Nolan, Kathleen	Catskill Mountainkeeper
Novak, Stephanie	Mountain Watershed Association
Orbitz, Sixto	Industry
O'Reilly, James	University of Cincinnati
Oristaglio, Michael	No Affiliation Given

Name	Affiliation
Overbey, Diane	SandRidge Energy
Pallavi, P.	UCS
Panahi, Shereen Jennifer	Northeast-Midwest Institute
Patch, Melissa	No Affiliation Given
Paul, Jeff	No Affiliation Given
Paules, Mike	No Affiliation Given
Payne, Bryce	Gas Safety Inc.
Pearl, Richard	No Affiliation Given
Pechacek, Nathan	No Affiliation Given
Penoyer, Pete	U.S. Department of Interior, National Park Service
Perry, Dale	EPA
Peschman, Timothy	Evoqua Water Technologies LLC
Pierce, Larry	Missouri Geological Survey
Pings, Peggy	No Affiliation Given
Pope, Peter	No Affiliation Given
Price, Lowell	State of Nevada Division of Minerals
Prince, Lynn	No Affiliation Given
Public Herald	Public Herald
Rausenberger, Wyndy	U.S. Department of Interior
Revesz, Kinga	No Affiliation Given
Rhodes, Ileana	Shell
Richardson, Rachel	No Affiliation Given
Richardson, Stephen	GSI Environmental Inc.
Ridley, Caroline	No Affiliation Given
Rimbey, Shawn	Apache Corporation
Ring, Shari	The Cadmus Group
Rocco, James	International Association of Drilling Contractors
Rollins, Kelly	Ohio Department of Natural Resources
Ross, Mary	No Affiliation Given
Ruckel, Mari	Texas Oil and Gas Association

Name	Affiliation
Ruffer, Chris	HARC
Ryan, Vanessa	No Affiliation Given
Saji, Niffy	No Affiliation Given
Sanchez, JessLee	Nalco Champion
Sandilos, Robert	Chevron USA Inc.
Saunders, Nichole	Environmental Defense Fund
Savage, Leslie	Texas RRC
Saxton, John	No Affiliation Given
Schulz, Shane	QEP Resources, Inc.
Scroggins, Vera	Citizens for Clean Water
Shost, Steve	No Affiliation Given
Showen, Trip	No Affiliation Given
Showstack, Randy	American Geophysical Union
Sinagoga, LeeAnn	TetraTech
Slottje, Helen	No Affiliation Given
Smelko, John	Cabot Oil & Gas Corporation
Smith, Angel	No Affiliation Given
Solomon, Sarah	No Affiliation Given
Soraghan, Mike	EnergyWire
Standley, Jim	No Affiliation Given
Stanek, John	EPA
Stanek, John	No Affiliation Given
Stevens, Craig	Patriots from the Oil & Gas Shales
Stevens, William J.	Texas Alliance of Energy Producers
Stolz, John	Duquesne University
Striz, Elise	No Affiliation Given
Sturm, David	No Affiliation Given
Sutton, Heather	No Affiliation Given
Switzer, Victoria	Dimock Shalefield
Taliaferro, Lindsay III	Ohio Environmental Protection Agency
Tatham, Elizabeth	No Affiliation Given

Name	Affiliation
Teichman, Kevin	EPA
Thomas, Deborah	Shale Test
Thyne, Geoffrey	No Affiliation Given
Tohme, Alberto	No Affiliation Given
Tong, Scott	No Affiliation Given
Tredway, CJ	EPA
Tripp, Tabitha	No Affiliation Given
Tuccillo, Mary Ellen	The Cadmus Group
Usachak, Louise	League of Women Voters of NJ
VanBriesen, Jeanne	No Affiliation Given
Vicuna, Juan C.	No Affiliation Given
Walczak, Dave	No Affiliation Given
Waterman, Curtis	No Affiliation Given
Watson, George	No Affiliation Given
Weber, Anna	The Cadmus Group
Weber, Caitlin	No Affiliation Given
Weimer, Lisa	No Affiliation Given
White, Ruth	No Affiliation Given
Wikoff, Daniele	ToxStrategies
Wilber, Tom	No Affiliation Given
Williams, John	U.S. Geological Survey
Williams, Julie	No Affiliation Given
Wilson, Lloyd	N.Y. State Department of Health
Wiser, Nathan	EPA
With, Erik	No Affiliation Given
Wolff, Emma	Fluid Recovery Services, LLC
Wurth, Emily	Food & WaterWatch
Wydra, Dennis	Unified Sportsmen of PA
Yost, Erin	No Affiliation Given
Young, Maggi	Chesapeake Energy
Zamzow, Heidi	No Affiliation Given

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Zeller, Christi	LaPlata County Energy Council
Zhang, Harry	CH2M
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