G. Appendix G: Summary of Public Comments

This section summarizes public comments received on the draft version of this report at one of the three public meetings held on March 20, March 27 and April 2, 2012, or submitted via email or U.S. mail to DENR. Comments are organized by subject matter below. Where appropriate, a response to the comment or a description of how the comment was incorporated into the final version of the report is included.

General comments

1. The majority of people (more than 450 individuals and organizations) who spoke at the public meetings or submitted comments on the draft report are opposed to the development of natural gas extraction using horizontal drilling and hydraulic fracturing in North Carolina. Many who commented on the draft report feel that the benefits of shale gas extraction using horizontal drilling and hydraulic fracturing do not outweigh the risks. Commentators were concerned that these activities are unsafe, that our drinking water supplies will be contaminated, that our water resources will be depleted, that the accidents evidenced by this industry in other states will be repeated in North Carolina, that public health will be threatened, and that North Carolina cannot adopt regulations and provide enforcement activities sufficient to prevent damage to the environment and human health.

   One individual wrote, “Most important is our precious water, which we cannot live without. I rely on well water and I am terrified of the risk to my property, [and the] opportunity to sell my property in the future, should nearby contamination from fracking scare potential Chatham County residents away, leaving me with damaged goods for which I have worked and saved to afford, all my working life.”

   Another individual wrote, “Since the 1980s, North Carolina has protected our groundwater as a future drinking water resource, prohibiting the injection of pollutants into groundwater…Few other states have made our policy choice, and clean groundwater is becoming increasingly rare across the nation. Allowing fracking would require weakening the state laws that currently protect groundwater – both to allow injection of fracking fluids in gas wells, and to allow the disposal of used fluid in deep injection wells. Both of those changes are a betrayal of North Carolina’s proud tradition of protecting groundwater, and economically short-sighted, as the groundwater resource, once polluted, is effectively lost permanently.”

   One individual wrote, “I oppose Fracking in North Carolina…I do not trust the legislature which seems to want to create more jobs and income for NC than care for the health of our ecology and people.” Another wrote, “The risks listed in the draft report on shale gas extraction in NC clearly outweigh the small potential benefits that the people and state of North Carolina would see. North Carolinians need jobs but shale gas extraction would provide very few opportunities for them.

2. Many people (more than 175 individuals and organizations) spoke at the public meetings or wrote in during the public comment period to express support for the development of oil and natural gas resources in North Carolina because of the economic benefits. The North Carolina National Federation of Independent Business wrote, "By opening our state up to hydraulic fracturing we will see more jobs and higher incomes for North Carolinians, and that is good for small business." The Southeast Energy Alliance wrote that their organization "strongly believes that shale gas production utilizing horizontal drilling and hydraulic fracturing can proceed safely." The North Carolina Chamber wrote, "We can lead the nation in an 'all of the above' energy strategy that creates jobs, greater energy independence and increased revenue for our state. AND we can go about it in the right way, with protective measures and tough standards that safeguard our quality of life values." Piedmont Natural Gas wrote, "Piedmont believes that the benefits of developing the abundant and clean natural gas energy resources in North Carolina can and should be realized." Piedmont Natural Gas also notes, "Consumers benefit enormously from the tremendous growth of this new natural gas supply source, which has made natural gas prices reliably low and stable [and] benefits the environment through lower emissions of carbon dioxide, nitrogen oxide and sulfur dioxide."

   Others wrote, "The economic benefits such drilling would bring to the state will be immense, and with the right safeguards there will be no negative environmental impact on North Carolina…As we see in other states with shale gas drilling, there is significant job creation from the natural gas industry and many businesses in the drilling area, such as restaurants and hotels, see their business grow substantially."

3. More than 75 people expressed interest in the pursuit of renewable sources of energy in place of shale gas. One individual wrote, "we can create the same amount of jobs and a MUCH cleaner form of energy if we pursue truly renewable energy sources such as wind or solar, and these jobs will last forever, as opposed to the fracking jobs which will disappear as soon as the gas is gone."

4. More than 50 individuals and organizations wrote in support of a "go slow" approach, encouraging the General Assembly to hold off on legislation that would enable horizontal drilling and hydraulic fracturing until further research is completed. The Orange County Department of Environment, Agriculture, Parks & Recreation cautioned that North Carolina should not rush to begin oil and gas exploration and development because of "the current price of natural gas and the abundant resources that are known to exist in the United States." The City and County of Durham Environmental Affairs Board expressed support for recommendations 4, 7, 11 and 12 in the draft report while recommending a "thoughtful and deliberate approach be taken regarding hydraulic fracturing processes in North Carolina."

   Similarly, the Orange Water and Sewer Authority (OWASA), Sierra Club Capital Group and many others noted that the EPA's study of the potential effects of hydraulic fracturing on drinking water resources will not be released until 2014. NCCN writes that it makes sense to postpone legalization of hydraulic fracturing or creation of a

regulatory program at least until the USGS' study of the Triassic Basin shale gas resources is released.

One individual wrote, "Really, the safest, most conservative approach is to move slowly on this issue. It would be a mistake to move quickly to approve a process that is so poorly understood." The T. Gilbert Pearson Chapter of the National Audubon Society states, "we believe that the time allotted for preparation and completion of this Shale Gas Study has been grossly inadequate. We therefore respectfully ask that the May 2012 deadline be extended significantly in order to allow for a thorough study to occur."

RESPONSE: DENR agrees that more time would have allowed us to collect more information and incorporate information from as-yet-unpublished sources, including the EPA reports. DENR felt an obligation to provide as much information as possible to both the public and the General Assembly by the May 1, 2012, deadline so that decisions could be informed by the information that is available.

Conclusion of the report

5. Nearly 300 individuals and organizations have commented on the conclusion of the report and feel that, in the words of North Carolina Conservation Network, "the body of the study contradicts the claim that shale gas extraction can be conducted safely if adequate regulation is in place." The draft study "clearly states that significant research and investigation must be undertaken before a full understanding can be achieved of the unique set of risks that fracking would pose to North Carolina." Food & Water Watch states, "Precisely because of these fundamental open questions about the potential impact fracking would have on North Carolina, Food & Water Watch maintains that the leading conclusion of the draft study – that 'DENR believes that hydraulic fracturing can be done safely as long as the right protections are in place' – is problematic."

   Food & Water Watch goes on to say, "Despite the draft study's clearly stated limitations and despite the open questions it raises, proponents of fracking have taken the leading conclusion of the draft study out of context, using it to misrepresent the overall findings of the draft study as endorsing of the oil and gas industry's effort to reverse North Carolina's current ban on fracking." Food & Water Watch recommends that DENR "offer a lead conclusion that does justice to the thrust of its findings."

   A joint letter from Southern Environmental Law Center, Sierra Club and Environment North Carolina notes that the list of recommendations DENR proposed in the draft study "represents a significant number of detail-filled tasks which are interdependent and whose outcome is uncertain." The authors write that because of the study's limitations and because "entire programs must be created or overhauled to deal with fracking, it is not possible to say that the state can safely regulate fracking." Orange County offered similar comments, writing, "it is probably not reasonable to pronounce fracking as 'safe' if we do not yet know the regulatory environment that will ultimately govern this activity." The North Carolina Conservation Network advises DENR to "avoid projecting false confidence in the power of regulation to make shale gas extraction safe."

Many who wrote comments about the draft report felt the right protections for shale gas extraction do not exist because no other state has safely regulated the industry. Some said that no state can adequately regulate shale gas industry until the federal exemptions from are revoked and suggest that North Carolina should not moved forward until Congress overturns these.

RESPONSE: The first sentence of the draft report's conclusion has received a great deal of attention and has not been interpreted exactly as we intended. DENR did not mean to imply that shale gas extraction can be done safely in North Carolina at the current time, since a regulatory program has not been developed. Instead, the intent of the statement was to say that the information gathered in our research did not suggest that the process of hydraulic fracturing is impossible to conduct in a manner that is protective of the environment and public health. The report very clearly stated, however, that the ability to achieve that result is dependent on adequate environmental protection standards and a well-developed regulatory program. The report also clearly noted that those elements do not currently exist in North Carolina. We have revised this sentence in the final version of the report to more accurately reflect this concept.

Shale gas resource

6. Some people commented that the 160-acre well spacing used in the report as a basis for the analysis of potential impacts was flawed. One person wrote, "The 160-acre spacing is a good beginning estimate for initial development, but individual well production rates and economics will probably play a key role in determining well-spacing requirements." Another individual wrote, "what I have heard is that DENR is suggesting a well located every 160 acres!!!! Holy Cow! Where did that come from?"

   RESPONSE: The 160-acre well spacing was only an estimate used for the purposes of assessing potential impacts. This number was chosen based on research that showed 160-acre well spacing is common in some other states. This figure was not intended to be used as a recommended well spacing unit for North Carolina, nor as a prediction of what is likely to occur in North Carolina based on economic or other considerations. Determining recommended well spacing units would require additional work, and would be done as part of the development of a regulatory program.

7. One individual asked why only the two wells drilled in the late 1990s were used to develop an estimate of technically recoverable gas when 126 wells have been drilled in North Carolina before 1998. She comments that the 126 unproductive wells are underrepresented in the report, "as they show that the vast majority of exploratory wells did not produce commercial quantities of methane."

   RESPONSE: The 120 wells drilled before 1974 were drilled in exploration of conventional oil and gas resources in the Coastal Plain. After 1974, exploration turned to the Sanford sub-basin, where eight wells were drilled looking for unconventional or continuous natural gas. Since these early wells were not drilled in exploration of commercial quantities of methane, the fact that the wells never produced should not be taken as an

indication that commercial quantities of methane did not exist in those locations. Of the eight wells drilled after 1974 in search of unconventional natural gas, petrophysical reports are only available for two. This data is necessary to estimate productivity.

8. As the North Carolina Conservation Network (NCCN) notes, the DENR study uses a back-of-the-envelope calculation to estimate how gas might ultimately be recovered in North Carolina, and the draft study "is not explicit about the basis for the estimated ultimate recovery (EUR) it assigns to the two wells." NCCN calls upon DENR to articulate the rationale for the 4.2 Bcf estimate.

   RESPONSE: Additional detail on the rationale for this estimate has been added to the report in Section 1.C.

9. The City of Durham Joint City-County Planning Committee wrote, "The JCCPC is concerned that there is limited or no data, and the study contains no analysis, of the oil and gas resource in the Durham sub-basin."

   RESPONSE: At this time there is no data available for the Durham sub-basin. DENR has recommended that additional study be conducted to gather seismic reflection data for the Triassic Basins.

10. NCCN says that DENR's "estimate of 368 wells is wildly optimistic. In other shale gas plays, drillers have consistently found that most wells are losers. Only a few hotspots within a basin pay off, and it is impossible to tell where until wells are drilled. This makes a small play particularly risky, and will deter companies with any better options elsewhere."

    RESPONSE: We agree with this comment. The estimate of 368 wells represents the absolute maximum number of wells that could be supported in the Sanford sub-basin. It does not take into consideration local conditions (natural and man-made) that would make drilling infeasible in some areas of the sub-basin. We used this estimate to analyze the potential impacts of shale gas extraction in the area because we did not have sufficiently detailed information to refine the number further. We also did not want to downplay either the potential economic benefits or the environmental impacts by underestimating the number of wells.

Geology

11. Several people expressed concerns about the relationship between hydraulic fracturing and earthquakes. For example, BREDL recommends that "Before the Study is finalized, potential effects from fracking induced seismic activity must be analyzed including causing possible emergencies at Shearin-Harris" [*sic*].

    RESPONSE: The section of the report discussing the potential for increased seismic activity has been revised to include more recent information (see Section 2.F). Initial research on this issue indicates that earthquakes may have been induced in the Midwest United States by the underground injection of wastewater produced from

hydraulic fracturing processes. Research does not indicate that hydraulic fracturing itself has triggered large earthquakes. DENR has recommended that the General Assembly prohibit underground injection of wastewater.

12. Several commentators were concerned about the vertical movement of water between horizontal rock layers and requested scientific evidence that hydraulic fracturing fluids could not migrate upwards through diabase dikes. SELC, North Carolina Sierra Club and Environment North Carolina want DENR to "Conduct thorough analyses regarding the geology of the Triassic Basin, including a detailed fracture and fault study as well as an analysis of the effect of diabase dikes on migration of fracking fluids."

    RESPONSE: The report has been revised to include more explicit reference to the risks of vertical geological structures such as dikes and faults. DENR is also recommending additional study of groundwater in the Triassic Basins and thorough hydrogeological characterization prior to permitting any hydraulic fracturing.

13. A few peopled asked about the potential for natural gas extraction activities to cause an increase in explosive levels of gas that could lead to explosions in barns, homes or other structures.

    RESPONSE: There has been no history of explosions and fires at buildings due to the concentration of stray natural gas in the Triassic Basins of North Carolina. Explosive levels of natural gases are naturally occurring in some areas and are not likely to increase with the development of a natural gas industry, unless natural gas wells are not properly abandoned.

14. Some people commented that natural gas exploration and production would be dangerous in this part of the state because mining accidents occurred in this area in the early 1900s.

    RESPONSE: There are several historic incidents of underground gas explosions in coal mines in North Carolina. Natural gas is a routine hazard in underground coal mines and explosions are still causing mining disasters today. The presence of shale gas may have made it more difficult for miners during the early 20th century to keep the mine well ventilated. The mines have long since closed and the mine entrances have been filled-in and sealed. It is likely that oil and gas exploration would seek to avoid drilling into underground mines. Information on the location and extent of the abandoned mines is available from the N.C. Division of Land Resources.

Water supply impacts

15. Some people commented that if the groundwater is allowed for use in hydraulic fracturing then groundwater levels should be monitored closely in those areas.

    RESPONSE: DENR agrees, and references to this have been added to the revised report. In addition, the recommendation for baseline data collection has been modified to add monitoring of groundwater levels as another parameter.

16. One person commented, “The population projections for Chatham County do not appear to include the development of the 8,000 acres owned by Preston Development. Preliminary estimates project up to 50,000 people in this development. This needs to be factored in.”

    RESPONSE: The forecasts of populations to be served by local water utilities are provided by the local water utilities. Some residential developments placed on the outskirts of existing water systems may be supplied by privately-operated groundwater-based community water systems. To the extent the potential residents of a Preston Development were factored into the local water supply plan provided by Chatham County to DENR, their water demands are included in the analysis.

17. Several people commented on the water withdrawals for fracking during times of drought. As Orange County notes, “If a drought were to occur in this area, the removal of 3 to 5 million gallons of water per event – (not just per well) – could be profound. This could also be the case if several wells were fracked in mid-summer, which is likely the reason why the draft report also includes some discussion of the importance of the timing of fracking water withdrawals in the Triassic Basin.” Another commentator asked, “If fracking is allowed in North Carolina and when we next face a serious drought, will we too [like Texas] have to let citizens, farmers, small businesses and shops and our communities bear full consequences while fracking companies are free to withdraw and intentionally contaminate our dwindling water supplies without restrictions?”

    In a joint letter, American Rivers, Environmental Defense Fund and North Carolina Conservation Network note, “There is nothing in DENR’s present ability to register or manage water use that tracks cumulative uses and impacts. Thus, even if all water withdrawals were reported, all were permitted, and all were regulated to prevent withdrawals in excess of 20% of the 7Q10 (three very, very big if’s), only six pipes withdrawing only 16% of the 7Q10 would be required to dry the river up during a ten-year low flow. Second, DENR’s analysis does not take into account the fact that the greatest demand for agricultural water is during droughts, when water is least available.”

    RESPONSE: DENR has recommended that drilling operations be required to operate under an approved water management plan as part of a comprehensive update of North Carolina gas well development regulations. Along with the recommendation to limit withdrawals to 20% of the 7Q10 flow, DENR has modified the recommendation to expressly state that new withdrawals for gas well development should be prohibited during droughts and low flows.

18. The joint letter from American Rivers, Environmental Defense Fund and North Carolina Conservation Network takes issue with DENR’s scenario for water use by hydraulic fracturing wells in Section 3 of the draft report, calling it “seriously flawed” and “fanciful” and saying that it “bears no resemblance to the much more probable scenario of little or no development unless and until the price of gas rises significantly in response to developing scarcity in more well-endowed shale plays.” Southern

Environmental Law Center, North Carolina Sierra Club and Environment North Carolina want DENR to "Prepare a realistic estimate of the number of wells North Carolina would support, identify water sources for those wells, and evaluate the potential effect on human and environmental uses of existing water supplies."

RESPONSE: There is little evidence to define one development scheme as "more probable" than another at this time. Given the current prohibitions on horizontal drilling and underground injection of wastes, no gas well development will occur in the absence of legislative changes. To provide the required analysis, however, DENR had to use theoretical development scenarios in order to estimate potential water withdrawals and quantify the range of possible impacts if gas wells are developed in North Carolina. As more technical information on the geology and potential productivity of these areas becomes available, water use scenarios can be improved. If gas well development does occur in North Carolina it will be within the context of new policies that have yet to be constructed and which should include specific rules managing water withdrawals and use in the industry.

19. American Rivers, Environmental Defense Fund and North Carolina Conservation Network disagree with the use of 20 percent of the 7Q10 as protective of environmental quality and ecological integrity. They note that the Ecological Flows Scientific Advisory Board has observed that maintaining the 7Q10 as a minimum flow fails to protect most guilds and species from very significant losses of habitat. They note, "If water resources are to be protected in a basin where natural gas exploration and exploitation require hydraulic fracturing, DENR must have a complete inventory of water uses in the basin and must have the authority to balance and periodically rebalance the volume and timing of all of those existing and all proposed new uses." They also recommend replacing the 20 percent of the 7Q10 approach with the safe presumptive standard proposed by Richter et al,[585] which they define as allowing modification of daily flow by no more than 10 percent.

    The U.S. Fish & Wildlife Service (USFWS) comments that the section on water supply "lacks information on the 2010 legislative directive for DENR to develop hydrologic models for each river basin in NC, including the determination of the flows needed to maintain ecological integrity in surface waters." USFWS therefore concludes that limiting withdrawals to 20 percent of the 7Q10 stream flow is "unsubstantiated as DENR has not yet determined if this threshold provides adequate flows to maintain ecological integrity."

    RESPONSE: DENR thanks the commenters for identifying specific criteria for possible inclusion in a water withdrawal management strategy for hydraulic fracturing in North Carolina. Developing comprehensive water resource management policies will be beneficial from a broad range of perspectives. Under current water management

[585] Richter, B.D. and M.M. Davis, C. Apse, and C. Konrad. "A Presumptive Standard for Environmental Flow Protection." *River Research and Applications*, 2011. Published online in Wiley Online Library.

protocols, limiting withdrawals to 20 percent of the 7Q10 is assumed to be protective of aquatic habitats except during extreme low-flow events. DENR has modified the withdrawal recommendations to prohibit new withdrawals for gas well development during drought and low-flow conditions. The details of the specific thresholds that would trigger such a prohibition will need to be specified during the development of a targeted water withdrawal management scheme for the industry. The recommendations of the Ecological Flows Science Advisory Board will provide valuable information to be considered during the development of any changes to current water withdrawal management schemes that are adopted to provide for hydraulic fracturing and shale gas production.

20. Some people commented that the recommendation requiring water management plans was too weak to protect water resources. Clean Water for North Carolina writes, "Calling for mere 'water management plans' for gas operators that will be unenforceable would provide a carte blanche for operators to carry out withdrawals at their convenience."

    RESPONSE: Although it is too early to define all the specific criteria and standards for the recommended water management plans, the intent of the DENR recommendation is to have enforceable water management plans. If DENR finds in its review of a water management plan that surface water supplies are threatened by the proposed withdrawals, DENR would not permit the activity.

21. One individual wrote, "Agricultural water use was severely under-reported. Table 3-6 cannot possibly be a reliable indicator of the water needs of our agricultural community. Chatham County data for agricultural water use is most certainly under-reported. Agriculture is the largest industry in Chatham County, and it is clearly not limited to 12 farms…This data must be researched further with consultation of more accurate sources."

    RESPONSE: The data in this table on agricultural water use comes directly from the North Carolina Department of Agriculture and Consumer Services' annual *Agricultural Water Use Survey.* The water use figures are not related to or dependent on the estimate of the number of agricultural operations in these counties reported in the first draft of the shale gas study. (Those figures have since been corrected.) Table 3-6 shows the number of unique agricultural operations that used 10,000 gallons or more of water on any day in 2010. The intent of this table is to show the magnitude of withdrawals that may be made at the farmer's discretion and for which we do not have a specific location or source information. There are likely additional agricultural operations not counted in these two sets of data. Although the data in the *Agricultural Water Use Survey* does have limitations, to our knowledge, it is the best data available on agricultural water use in North Carolina.

Roads

22. BREDL states, "NC DOT should calculate the costs to North Carolina taxpayers for road damage." The North Carolina Conservation Network urges the study authors to "locate

the increased infrastructure burden within the context of the NC Department of Transportation's prioritization system and gradual abandonment of many rural roads."

RESPONSE: Although there was not enough time to calculate this cost in time to meet the General Assembly's May 1, 2012, deadline for this report, DENR has made a recommendation within the study that the NCDOT look into this issue further. Some information on NCDOT's prioritization system has been added to the report.

Pipelines

23. North Carolina Conservation Network (NCCN) noted that pipeline safety is a serious unsolved problem for shale gas development. NCCN also suggested that there should be a recommendation related to closing the gaps in regulatory authority over the siting, construction and operation of gathering lines.

    RESPONSE: DENR agrees, and has added more information on this subject to the report in Section 3.C. and has added a recommendation to this effect.

Hydraulic fracturing fluids

24. Some people requested analysis of the potential environmental impacts from mining sand for proppant.

    RESPONSE: Sand mining is an existing industry with an existing regulatory program in North Carolina. It is too soon to say how much additional sand mining we could expect to support from hydraulic fracturing in the state.

25. Halliburton Energy Services Inc. (HESI) supports the approach to hydraulic fracturing fluid disclosure recently adopted by the Colorado Oil and Gas Conservation Commission (COGCC) because it "represents a reasonable balance between public disclosure of the makeup of frac fluids and the need to protect trade secrets to provide continued incentives for innovation. These rules also ensure access to trade secret information for regulators and health professionals when the information is needed to respond to a spill or for medical diagnosis or treatment purposes while minimizing the significant burdens on regulators associated with managing trade secret information."

    While some people who reviewed the draft report applauded DENR's recommendation relating to chemical disclosure, some called for full disclosure to the public. The Environmental Defense Fund (EDF) calls for full public disclosure of hydraulic fracturing chemicals, "presented in formats that are useful and user-friendly for the public." They also note the need for disclosure of all chemicals, not just those reported on MSDSs, "should be stated more clearly in DENR's recommendations." EDF notes that "A high bar should be set for trade secret protections…The public deserves assurance that trade secrecy claims cannot be used inappropriately." EDF suggests trade secret claims should be documented and substantiated, and citizens should be allowed to challenge these claims.

The Durham Environmental Affairs Board is opposed to any exemption for trade secret information and writes, "The public should be able to know the concentrations and mass of the hydraulic fracturing chemicals and constituents. To prevent this knowledge from being public would inhibit further research on the role that hydraulic fracturing chemicals and constituents have in impacting the environment.

One individual wrote, "I work in the Food Industry; we are required to disclose everything that is in our products. And we are not allowed by law to put anything out there that is known to cause harm to consumers. Other industries should have no less stringent standards, particularly when our ground water, streams and rivers can become contaminated."

RESPONSE: The recommendation with respect to disclosure of chemicals used in hydraulic fracturing has been modified to more clearly require disclosure to state regulatory and emergency response agencies of all chemicals and not just those reported on a MSDS. The recommendation has also been revised to encourage full public disclosure on a voluntary basis and to otherwise provide for disclosure consistent with North Carolina's public records law, which already includes a provision protecting trade secrets. The text of Section 4 has been revised to include a brief discussion of North Carolina law concerning disclosure of trade secrets under the state's Public Records Act.

26. The Durham Environmental Affairs Board applauds Recommendation 8 but "would like to suggest that the recommendation … include diesel fuel, its toxic constituents, and other known carcinogens like naphthalene in hydraulic fracturing fluids." Clean Water for North Carolina writes, "Instead of the extensive effort required to regulate these substances, or providing for limited public disclosure, companies should be restricted to a list of approved, non-toxic additives for use in wells, such as that provided for in current UIC rules for remedial injections." A joint letter from Southern Environmental Law Center, North Carolina Sierra Club and Environment North Carolina says, "Any regulation of fracking fluids should also require the use of increasingly common non-toxic substitutes – an issue that was not addressed in the Draft Study and must be analyzed before judging whether fracking can be done safely."

    RESPONSE: DENR has revised the recommendation related to hydraulic fracturing fluids to recommend that the General Assembly encourage environmentally friendly and non-toxic alternatives where feasible.

27. EDF also suggests "chemical characterizations, tracking and reporting of all wastes must be made part of any regulatory regime to help ensure the safe handling, transportation, storage and disposal of the materials."

    RESPONSE: DENR agrees. These issues would be incorporated as part of the development of waste management standards for the industry.

28. The U.S. Fish & Wildlife Service encourages DENR to add the "costs, staff and timelines needed to develop" water quality criteria and standards for the chemicals involved in hydraulic fracturing.

    RESPONSE: DENR feels that it is premature to know what standards would need to be developed, and thus the cost to develop those standards is unknown at this time.

29. One individual suggested that public disclosure be required before drilling takes place.

    RESPONSE: DENR agrees, and has modified this recommendation to include this suggestion.

Groundwater impacts

30. Some commentators wrote that because there is a lack of understanding in the scientific community of how thermogenic methane contaminated groundwater in other areas, it is not possible to design regulations to prevent methane migration. For example, one individual wrote, "The mechanism that brought that thermogenic methane from shale deposits to the aquifer has not been identified. The scientific community has neither the scope of scientific knowledge in fracture dynamics nor the ability to analyze the subsurface with enough resolution to see cracks and fractures. Both of these would be required to determine the mechanics by which this thermogenic methane was introduced to the aquifers. North Carolina is moving forward with the assumption that increased regulation can prevent these problems. We cannot prevent problems that we do not understand."

    RESPONSE: The report has been edited to more clearly reflect the uncertainty in recent studies of stray gas migration and the fact that certain potential sources of stray gas may not be possible to regulate directly.

31. BREDL recommended that DENR examine the work of the Wake/Chatham low-level radioactive waste (LLRW) dump to determine if "the movement of contaminants in groundwater and where that groundwater will go can possibly be predicted."

    RESPONSE: We agree that a high level of hydrogeologic characterization will be necessary before any hydraulic fracturing should be permitted in North Carolina.

32. Halliburton Energy Services Inc. (HESI) states that "regulators from around the country have continually reaffirmed that there are no confirmed instances anywhere in the country of hydraulic fracturing causing contamination of drinking water aquifers; this conclusion has been repeatedly confirmed by a number of other key organizations such as the Ground Water Protection Council and the Interstate Oil and Gas Compact Commission." HESI goes on to say they do not believe "that the draft report issued by the U.S. Environmental Protection Agency ("EPA") regarding its investigation of groundwater contamination in the Pavillion, Wyo., area should be considered as providing any evidence to the contrary. The EPA report is only a draft and has not been subject to peer review. Moreover, the Draft Report has been subject to substantial

criticism, and HESI's own review of the Draft Report indicates that there are serious questions about the design of EPA's study, the validity of the data it collected and the basis for EPA's conclusions. In fact, EPA and the State of Wyoming announced last month that EPA would be undertaking another round of sampling to 'clarify questions about the initial sampling results.' Therefore, EPA's Draft Report should not serve as the basis for any conclusions regarding hydraulic fracturing."

However, others were disappointed that the study did not fully review the EPA's report on Pavillion. Clean Water for North Carolina states that a full review of this report should have been included "as both the geological conditions of fracturing of shallow and discontinuous shale formations in close proximity to current or potential water supplies, and regulatory conditions with an under-resourced, poorly monitored program may [be] highly relevant to NC conditions if a quickly developed and inadequately staffed program were to emerge from this effort."

RESPONSE: The Pavillion investigation has some relevance to North Carolina, but it still is a draft report and there is some uncertainty about the similarity of hydrogeological, operational and regulatory conditions in Pavillion as compared to North Carolina. As a result, the degree of its relevance is still uncertain. Our report has been revised to clarify this point.

33. One person commented that an article in *The New York Times* ("A Tainted Water Well, and Concern There May be More," by Ian Urbina, dated Aug. 3, 2011) states that documented cases of groundwater contamination due to hydraulic fracturing exist but that the EPA was "unable to investigate many suspected cases because their details were sealed from the public when energy companies settled lawsuits with landowners. Based on this article, one commenter requested that DENR "Subpoena the sealed settlements with landowners from industry."

    RESPONSE: DENR does not have subpoena power. DENR staff will continue to follow emerging research on this issue.

Wastewater

34. Several who commented on the report said that DENR should strongly encourage the recycling and reuse of "flowback" water from hydraulic fracturing operations.

    RESPONSE: DENR has edited its recommendation related to wastewater. It is now recommended that recycling and reuse of flowback water be required to the maximum extent feasible.

35. Many were concerned that there is no way to dispose of wastewater from hydraulic fracturing without ultimately discharging treated hydraulic fracturing wastewater to surface waters. North Carolina Conservation Network writes, "there are no affordable treatment technologies that will make fracking wastewater safe for surface discharge, at a central facility or anywhere else." EDF writes, "we are not persuaded that the combination of a wastewater pretreatment program with centralized wastewater

processing will be sufficient to protect the health of North Carolina's waterways or public water supplies. North Carolina should not allow treatment and discharge to surface waters of wastewater from oil and gas operations through public or privately operated treatment plants or centralized wastewater treatment facilities until such time as technology is developed, demonstrated and installed that can provide for the safe processing of this kind of wastewater." Waterkeepers Carolina echoes that concern, specifically pointing to chemicals in wastewater that may be trade secrets. Southern Environmental Law Center, North Carolina Sierra Club and Environment North Carolina write, "Ohio has recently become more cautious about underground injection in the aftermath of several fracking-related earthquakes. The Draft Study does not provide a solution to this persistent wastewater program, yet the conclusion that fracking can be done safely assumes that one exists – even though other states have been unable to discover it."

RESPONSE: It is true that treated wastewater from hydraulic fracturing may ultimately be discharged to surface waters. However, a number of mechanisms are in place to ensure that sufficient treatment is in place prior to discharge and prior to a POTW receiving the wastewater. The report has been edited to clarify these mechanisms. Additionally, the report now recommends requiring a wastewater management plan that will demonstrate protection of receiving wastewater treatment plants, receiving waters, and downstream water users.

36. Several organizations and individuals, including OWASA, the North Carolina Rural Water Association, the City of Durham Department of Water Management, and the Orange County Department of Environment, Agriculture, Parks & Recreation, remarked on the need to account for appropriate wastewater disposal prior to the start of fracking and suggested expanding the recommendation for requiring a DENR-approved Water Management Plan so that a DENR-approved Water and Wastewater Management Plan is required. Such a plan should "require, to the maximum extent possible, use of recycled and/or reclaimed water for the hydraulic fracturing process." The City of Durham Department of Water Management writes, "Durham supports the development of a regulatory program to address the unique characteristics of the wastewater generated from the hydraulic fracturing process which would encourage the recycling and reuse of fracking fluids and require on-site pretreatment of such fluids."

    RESPONSE: DENR agrees. The recommendation calling for a water management plan has been revised to recommend requiring a water and wastewater management plan.

37. The North Carolina Conservation Network (NCCN) says that recommendation 6(c), which calls for North Carolina to retain the current prohibition on deep well injection of wastes, is "good public policy." NCCN notes, "For decades, North Carolina has treated our groundwater as a valuable economic resource. In the 1970s, an experiment with deep well injection of sewage into a saline aquifer near Wilmington ended disastrously, with pollutants migrating into supposedly unconnected drinking water aquifers. Since then, North Carolina has prohibited deep well injection of wastes. In the meantime, as

other states have allowed their groundwater to become contaminated, our protected resource has become an increasingly important competitive advantage in economic recruitment."

38. The City and County of Durham Environmental Affairs Board commented, "On-site wastewater must be stored in closed tanks in order to minimize potential health risks to humans and ecosystems due to accidental releases. This will also help to protect wildlife (birds, frogs, snakes, turtles, etc.)." Several individuals also commented that DENR should require closed-loop systems and prohibit open pits.

    RESPONSE: More research and analysis is needed to examine this issue, and a recommendation has been added to this effect.

39. A few people commented that land application of waste should not be allowed. One commentator said that there is a loophole for the land application of wastes via public wastewater treatment plants.

    RESPONSE: The report has been edited to better distinguish between the land application of mud and cuttings and the land application of wastewaters. Land application of wastewaters could be allowed, provided there is adequate treatment and a demonstration that the wastewater and its application could meet performance standards (i.e., sustaining vegetative cover and meeting groundwater standards). However, site evaluation, predictive modeling for protection of groundwater, determination of appropriate agronomic rates, and availability of suitable and adequate land for disposal all pose potential challenges for land application of wastewater generated by hydraulic fracturing. These challenges will likely make land application of the wastewater more expensive than other wastewater management options.

40. The Durham Environmental Affairs Board writes, "Any wastewater resulting from hydraulic fracturing operations must be subject to stringent, verified, third-party treatment. As such, the level of water treatment would be subject to well-established protocols and contaminant limits that have been established through permitting for other industrial activities."

    RESPONSE: Onsite treatment and nearby disposal by land application will become more likely the further the wastewater needs to be hauled to a third-party treatment system (CWT). As noted above, there are many challenges in permitting an onsite wastewater treatment and disposal system via land application, but the feasibility of such a system is highly dependent on the availability of other wastewater management systems and the suitability of onsite conditions to handle the wastewater.

41. One individual commented, "as wells age they continue to produce wastewater even for decades after being fracked. The wastewater flow from a well becomes more toxic over time. It is therefore important that abandoned wells be monitored by the State of NC for decades after fracking to assure that plugs and casings are intact."

RESPONSE: Specific requirements for monitoring of abandoned wells would be determined as part of the development of a modern oil and gas regulatory program.

Surface water impacts and stormwater management

42. Some suggested that North Carolina should use a network of real-time monitors to collect and transmit water quality information along surface waters that could be impacted by a discharge or spill, using parameters such as temperature, conductance, dissolved oxygen, pH and turbidity.

    RESPONSE: It is too early to specify the detailed technical requirements necessary for monitoring this industry. Additionally, there are ways of implementing the necessary monitoring that will be influenced by the density of wells and the time period over which drilling occurs.

43. The North Carolina League of Conservation Voters comments that land-disturbing activities should at a minimum fall under the stormwater conditions of the General Construction Stormwater permit and the state Sedimentation Pollution Control Act, and "Local municipalities with more stringent requirements for both stormwater and sedimentation and erosion control should be allowed to continue the implementation of those programs for activities associated with oil and gas exploration."

    RESPONSE: Local government control is addressed in DENR's recommendations.

44. Some commentators noted the potential for sedimentation of streams from the development of thousands of acres of land for hydraulic fracturing wells. As one person writes, "Without sedimentation regulations, large volumes of mud, silt, and other sediments are almost completely inevitable." Another person said that current enforcement of sedimentation regulations is inadequate, which does not bode well for enforcement of sedimentation violations from oil and gas activities.

    RESPONSE: The existing North Carolina Sedimentation and Pollution Control Act would apply to oil and gas activities in the same way as it applies to other types of land disturbing activities. DENR agrees that more inspectors are needed to adequately enforce sedimentation and erosion control regulations, both for the current programs and for any future oil and gas activities.

45. A few people, including the organization Liberty NC, asked DENR to review the Google map that lists accidents related to fracking, or to include each of the accidents listed on the "fraccidents" map (http://maps.google.com/maps/ms?ie=UTF8&source=embed&oe=UTF8&msa=0&msid=209825270514233970353.0004899ff5c6ef5ddf104).

    RESPONSE: DENR acknowledges within the report that accidents will occur with any shale gas development. DENR was not able to independently verify each of the accidents on the "fraccidents" map. However, specific instances of spills or other accidents are cited in the report, including cases where animals may have come into contact with hydraulic fracturing chemicals (see Spills of fluids related to gas drilling

operations for examples). Accidents are a possibility with any industrial activity, however, DENR believes that because of the nature of the chemicals used by the shale gas industry, safeguards should be in place to protect public health and the environment from possible spills of hydraulic fracturing fluids and wastes, gas well blowouts and other potential accidents.

Setbacks and areas prohibited from drilling

46. Many individuals desired more specificity in the recommendation for setbacks, including identifying who should establish the setbacks – DENR or the General Assembly. A number of comments recommended setbacks from a number of specific activities or features, such as setbacks from water supply wells, residences, farms, crops, pastures, farm ponds, homes, barns and schools, among others. Several people commented that regulations need to be in place to specify setbacks of oil and gas wells from public water supply wells and surface water intakes.

    RESPONSE: DENR recognizes that development of these setbacks will be a detailed process, and that a large number of setbacks are needed. DENR believes that it is premature at this stage to identify the specific setbacks and prohibited areas that would be needed to protect the public, the environment, and fish, wildlife and important natural areas. DENR supports the development of specific setbacks and areas prohibited from drilling with the assistance of local governments, other state and federal agencies, nonprofit organizations, industry representatives, and members of the public.

Air quality impacts

47. Several individuals and groups commented on the need for DENR to incorporate recent air quality research into the draft report, such as a recent study in Colorado and a recent NOAA study.

    RESPONSE: DENR agrees with this comment and has added in Section 4.G. a summary of the air quality research that was identified during the public comment period.

48. On the issue of air quality, EDF encourages DENR to "consider key areas where federal rules fail to adequately protect public health and the environment and where state programs may need additional authority to limit emissions of dangerous air pollutants produced by oil and gas development activities." EDF also suggests "strategies to monitor and minimize methane emissions from oil and gas operations," which will not only protect air quality but also reduce waste of the natural gas resource.

    RESPONSE: DENR will continue to evaluate whether the appropriate authority exists in North Carolina to ensure the protection of public health by limiting emissions of dangerous air pollutants from oil and gas operations. Currently, DENR believes that the combination of federal rules and the state air toxics rules should be sufficient authority. With regard to monitoring and minimizing methane emissions from oil and gas operations, DENR agrees with the recommendation. The report now addresses methane emissions in more detail.

49. Proposed changes to the state's Air Toxics Programs made some readers question the state's ability to regulate air emissions from oil and gas activities. North Carolina Conservation Network wrote, "Draft changes to the state air toxics program would exempt any source required to comply with 40 CFR parts 61 or 63, thereby granting a blanket exemption to sources that are also not limited by federal rule…proposed changes to the state air toxics program will exempt sources from control under the state program if they are already controlled for any other hazardous air pollutant under a federal standard. Since virtually all sources of hydrogen sulfide will also be sources of other hazardous air pollutants, they will almost all fall out of the state program. The state program will thus provide no defense against hydrogen sulfide released from shale gas facilities." Moreover, NCCN notes that shale gas development has the potential to release many toxics…that are not on either the state air toxic or federal hazardous air pollutant lists." BREDL recommended that "DENR, along with DHHS should assess public health impacts of proposed changes to North Carolina's air toxics standards, and how they may affect communities in the shale basin. The Legislature must hold back the air toxics 'reform' bill, and not reintroduce SB781, which could effectively tie DENR's hands in efforts to protect public health and the environment."

    Southern Environmental Law Center, North Carolina Sierra Club and Environment North Carolina note that the STRONGER report said North Carolina's air toxics program "would be helpful if fracking were to come to North Carolina," but the proposed amendment to the program would eliminate that benefit. These groups call for DENR to evaluate measures to ensure the minimization of the release of toxic chemicals and greenhouse gases, assess North Carolina's air toxics rules in conjunction with EPA's proposed regulations for the oil and gas industry, reassess the use of property boundaries as the measuring point for ambient air levels for air toxics, assess the potential ozone impacts of hydraulic fracturing, and evaluate emission increases from mobile sources associated with oil and gas activities.

    RESPONSE: Draft legislation is currently being developed to make changes to the state air toxics program. The primary effect of the proposed legislation would be to exempt sources subject to federal hazardous air pollution requirements from the state air toxics program. Under the proposal as currently drafted DENR would, however, retain the authority to evaluate ambient impacts of state regulated air toxics through the permitting program. If the Division of Air Quality found that a particular source would pose a threat to public health, the division director could require the proposed operation to comply with the state air toxics program, even if it met federal requirements. The proposed legislation will likely be considered by the General Assembly in the upcoming May legislative session.

    DENR agrees that the existing procedure for assessing ambient concentrations at the property boundary will need to be evaluated for situations where a well could be located on a piece of property that also contains a home, a farm, etc. This issue is now included as a recommendation in the report.

DENR agrees that an assessment of the emissions from hydraulic fracturing operations, as well as the increase in emissions from the resulting truck traffic, needs to be done to understand the impact on ozone in North Carolina, and has included a recommendation to that effect.

50. The section on potential air quality impacts does not discuss flaring, despite the fact that it's in the heading "Air emissions, including fugitive emissions and flaring."

    RESPONSE: DENR agrees with the comment and has added a discussion of flaring in Section 4.G.

Impacts on fish, wildlife and important natural areas

51. The T. Gilbert Pearson Chapter of the National Audubon Society, based in Guilford County, states that the report's recommendations do not mention "how to protect the wildlife of the state." They mention specifically the need for the recommendations to "include setback limits for light pollution measured in lumens, not feet." A joint letter from American Rivers, Environmental Defense Fund and North Carolina Conservation Network says "There are no recommendations at all in Section 9 intended to protect fish, wildlife and important natural areas."

    RESPONSE: One of DENR's recommendations is to "Develop setback requirements and identify areas (such as floodplains) where oil and gas exploration and production activities should be prohibited." The protection of fish, wildlife and important natural areas would be taken into consideration in the development of setback requirements if the state were to move forward with shale gas development. This recommendation has been revised to clarify this intent. However, as discussed under the heading "Setbacks and areas prohibited from drilling," DENR believes that it is premature to identify the specific setbacks. The development of these standards should be done in consultation with experts and with input from stakeholders.

    An additional recommendation has been added to the report to address secondary and cumulative impacts through the review of drilling unit management plans.

52. The T. Gilbert Pearson Chapter of the National Audubon Society states that the draft report does not discuss the impacts of support infrastructure for natural gas, such as pipelines, access roads, metering stations and compressor stations. The impacts noted by the Audubon Society are habitat destruction and fragmentation as well as noise, light, air and water pollution.

    RESPONSE: The draft report discusses impacts from the development of pipelines, access roads and compressor stations on pages 164 and 165. These sections have been revised to clarify that these impacts result from all phases of natural gas development, not just from the construction of the well pad.

53. The T. Gilbert Pearson Chapter of the National Audubon Society comments that the impact to wildlife from light pollution should be considered in the report. Others suggested discussion of the impact to wildlife from noise pollution.

RESPONSE: A discussion of these potential impacts has been added to the final report.

54. The U.S. Fish and Wildlife Service (FWS) expressed interest in "the evaluation of the extent of secondary and cumulative impacts of permitted actions."

    RESPONSE: Research in this area is currently limited. DENR staff will continue to monitor emerging research on the extent of secondary and cumulative impacts from the shale gas industry, such as the effects of forest fragmentation.

55. Based on recommendations of the Secretary of Energy Advisory Board (SEAB) Natural Gas Subcommittee, EDF recommends that state and local governments create development plans for areas affected by natural gas drilling and production to avoid or minimize the adverse cumulative environmental and community impacts from shale gas development. Such plans can optimize the use of multi-well drilling pads to minimize transport traffic and needs for new road construction, characterize important landscapes, habitats and corridors to inform planning, prevention, mitigation and reclamation of surface impacts, and mitigate noise, air and visual pollution. These plans should incorporate community participation.

    RESPONSE: DENR appreciates this suggestion, and has recommended that the General Assembly require the submittal of drilling unit management plans under the broader recommendation for the development of a modern oil and gas regulatory program.

56. The T. Gilbert Pearson Chapter of the National Audubon Society states that the recommendations in the draft report for baseline data collection are inadequate to measure the effects of natural gas development on wildlife and do not mention "biological survey data collection prior to commencement of drilling and/or infrastructure installation operations."

    RESPONSE: Based on public comment, DENR considered adding such a recommendation. Ultimately, DENR decided against recommending a biological survey. DENR staff believes the greatest threats to fish, wildlife and important natural areas from natural gas exploration and production are secondary and cumulative impacts, such as habitat fragmentation. Collecting site-specific biological survey data would not offer much information to minimize these impacts. DENR staff felt that requiring a review of drilling unit management plans would better address these potential impacts.

Waste management

57. Because wastewater recycling from hydraulic fracturing operations creates residual waste streams that can be highly concentrated with salts, metals and organics, EDF urges DENR to "develop specific technical criteria for the safe management and disposal of all exploration and production wastes, including wastes associated with recycling."

    RESPONSE: Additional work would be required to develop specific technical criteria and would occur as part of the development of a regulatory program for oil and gas.

Management and reclamation of drilling sites

58. EDF notes, "it is critical that operators be required to restore well sites to their original condition."

    RESPONSE: We agree that reclamation is very important, but it is premature to develop specific standards for reclamation at this time.

Naturally Occurring Radioactive Materials

59. BREDL comments "There is no safe level of radiation exposure." BREDL recommends that the shale gas study be withheld from the Legislature "until all geochemical test results have been evaluated and included. Discussion of how the highly radioactive metal piping and other well pad materials should be handled and transported safely should be included in the Study. Additionally, potential impacts to workers and the surrounding community should be assessed."

    RESPONSE: The Radiation Protection Section of the Department of Health and Human Services has always strived to keep the radiation dosage from human activities as low as possible, and will continue to analyze test results as they become available. Specific standards for storage and transportation of radioactive materials would be established as part of the development of a modern oil and gas regulatory program.

Public health impacts

60. BREDL requests a "multi-disciplinary health risk assessment" be performed in the areas potentially impacted by shale gas extraction, including both physiological and psychological effects. NCCN and others pointed out the public health impacts of exposure to endocrine-disrupting toxins, and suggested that the final study "call for much more detailed analysis of these diffuse but potentially very expensive impacts."

    RESPONSE: DENR staff will continue to monitor research relating to the public health impacts of natural gas extraction and production as it becomes available. A discussion of endocrine-disrupting toxins was added to the study (see Endocrine disruptors).

Economic impacts

61. Many people felt that the economic benefits reported in the draft study were not worth the potential environmental and public health impacts of the shale gas industry, or the costs to develop a regulatory program for the industry. A group of business leaders writes to say the study "does not evaluate shale gas against a longer term view of sustainable economic development." This group also noted the recoverable resource is "tiny: perhaps 309 billion cubic feet, just *one year and two days* of gas at North Carolina's modest 2010 rates of consumption. That is not energy independence by any definition." Another person wrote, "State resources squandered on the pipe dream of shale gas could be better invested in creating a favorable climate for sustainable businesses that hire locally and do not leave and do not damage the environment." Food & Water Watch commented that "fracking for shale gas will do little to ensure American energy security." North Carolina Conservation Network (NCCN) states, "There

is no economic upside to legalizing fracking or horizontal drilling now, as shale gas development is not economically viable in North Carolina and is not likely to become viable for at least a generation, if ever."

NCCN also points out, "Legalizing fracking now would impose lasting costs on the local economy and taxpayers…the final study should recommend that North Carolina defer further discussion of legalizing fracking for at least five to ten years, while monitoring the economics of the natural gas industry. During that time, technology and regulatory tools in states with active production may improve, and it may someday be appropriate for North Carolina to revisit the issue." NCCN states shale gas is seen "as a source of jobs and energy independence, even as its supporters privately admit it will deliver neither for the foreseeable future. The text of the study lays this bare; the final executive summary should also." Clean Water for North Carolina notes "the very modest, likely overly optimistic estimate of the resource provides no justification for the agency moving ahead with a very time-intensive and costly process of developing a regulatory program for oil and gas." NCCN states, "The current price of natural gas is far below the break-even price needed to justify a new well in an existing play, and is expected to remain low for years…North Carolina lacks the infrastructure for shale gas extraction: processing plants, pipelines, compressor stations, waste disposal facilities. Construction of that infrastructure would raise the break-even cost of drilling in North Carolina relative to existing plays in other states." One individual commentator summarized these concerns by saying, "How many more teachers must be laid off in order to hire a paltry number of inspectors for these well sites? From which well do you propose to mine those dollars?"

RESPONSE: The Department of Commerce used the limited information available on the natural gas resource and jobs associated with natural gas drilling to prepare an economic analysis of shale gas development in the Sanford geologic sub-basin. The information available did not allow the Department of Commerce to prepare a detailed statewide cost/benefit analysis for development of North Carolina's shale gas resource. Several sections of the report identify potential costs associated with shale gas development (including development of a modern oil and gas regulatory program; modification of existing environmental standards to address drilling activities; demands on local infrastructure and services; and impacts to state roads), but quantifying those costs would be extremely speculative. Quantifying the likely statewide economic benefits would also be speculative at this time.

All agencies involved in the study agree that the current price of natural gas and uncertainty about the natural gas resource in North Carolina compared to other regions of the United States make it unlikely that North Carolina will see a flurry of activity in the oil and gas industry soon. However, price forecasting is only the result of modeling, and forecasts such as the EIA reference case noted in the study only represent one possible outcome out of a range of possibilities.

62. A number of commentators, including North Carolina Conservation Network, have called on the Department of Commerce to modify the impacts section to account for potential costs related to the environment or community development activity. For example, one individual noted in Chatham County, farming is growing and has great potential, but in the draft report, "There was no mention of the effects of displacing food-growing with shale-gas exploration." The growing local foods industry in this area was also noted as an area of deficiency by several commentators. One commentator wrote, "I am very concerned about the chemicals used in fracking and the effects on farms and water supplies. Please do not allow fracking to come to North Carolina which is one of the few states in our country with a robust organic agriculture movement that absolutely depends on clean water." Others called for estimates of remediation costs or the external costs from accidents, spills, and explosions.

    RESPONSE: The Department of Commerce does not have the data or in-house expertise to model these economic effects. In addition, creating a model for many of these issues would require assumptions about specific industry standards such as closed or open waste pits, standards for disposition of wastewater, weight limits on trucks versus rated capacity of roads, and the intensity of activity affecting air quality, and quantifying assumptions of accidents or violations and their consequences. The report recommends that such issues be examined and standards developed to prevent or mitigate risks.

63. Several people noted that the agriculture industry in Lee and Chatham Counties was not accurately described in the draft report. A number of people also talked about the recent surge of sustainable agriculture in the Triangle area and the Triangle's local food culture. As one person notes, "many more new businesses are springing up around the production, distribution, and culture of organic food production. In this Cape Fear River basin where shale formations have been located, we now are nurturing a nascent small, vital, sustainable, organic farm explosion."

    RESPONSE: We have made revisions to more accurately capture the agricultural industry in this part of the state.

Regulatory agency funding and staffing

64. Many commentators noted that the safety of hydraulic fracturing is in part dependent on the resources North Carolina invests in inspections and enforcement. Southern Environmental Law Center, North Carolina Sierra Club and Environment North Carolina point out, "Even if DENR were able to design a program that included regulatory standards that were universally determined to be protective of public health and the environment, those standards would only be as good as the inspection and enforcement program." Commentators are concerned that because of recent budget cuts to DENR, it would be difficult for the department to adequately monitor oil and gas activities or enforce violations without significantly greater resources. One individual wrote, "The biggest problem with the study is the statement that gas exploration and extraction can be done safely IF there is an inspector at each site to ensure proper safety and compliance with regulations. This logic is severely flawed. DENR has already been

reduced by 40% in the last year. Other state agencies and county services have suffered unprecedented cuts in staff and budgets, as well. Implying that there will be a qualified government inspector at each gas extraction site to ensure compliance is a grave flaw. As it is, there aren't enough inspectors for anything in this state to ensure compliance with current regulations on water quality, zoning compliance, food and health inspections, animal welfare, soil conservation, or even traffic violations."

SELC, North Carolina Sierra Club and Environment North Carolina call for DENR to develop and evaluate each of the additional regulatory programs and to develop an inspection and enforcement scheme that ensures the state has sufficient inspections and that companies that consistently violate environmental regulation pay fines and restrictions that deter future violations. The North Carolina League of Conservation Votes calls for additional detail "on the frequency of inspections and the number of inspectors per well needed to ensure permit compliance."

RESPONSE: We agree that a rigorous inspection program with significant enforcement efforts would be needed if shale gas development were permitted in North Carolina. DENR believes, however, that defining the extent and needs of such a program is premature at this time and should be done as part of the development of a modern oil and gas regulatory program.

65. If North Carolina chooses to allow shale gas development using hydraulic fracturing and horizontal drilling, "DENR is the right agency" to provide environmental oversight. Rob Jackson and Bill Holman of Duke University's Nicholas School for the Environment note that "Not to put DENR in charge of environmental oversight of oil and gas development would be a step backwards." Putting DENR in charge of environmental oversight "will avoid conflicts of interest, reduce duplication and bureaucracy, and promote independent oversight of the industry. In contrast, history shows that creating a new, politically appointed oil and gas commission to promote and regulate oil and gas activities will lead to conflicts of interest and trouble." The North Carolina League of Conservation writes that the organization, "strongly agrees that the environmental permitting program for oil and gas activities remain in DENR where it will benefit from the expertise of the state geological staff and the ability to coordinate air, land and water quality permitting." Clean Water for North Carolina writes, "Keeping any oil and gas permitting within DENR, with adequate funding and staffing, will provide the most comprehensive and credible approach to natural resource protection and be in the public interest." These statements were echoed by Orange Water and Sewer Authority and the Orange County Department of Environment, Agriculture, Parks & Recreation.

RESPONSE: DENR concurs with these comments.

66. Piedmont Natural Gas notes, "State and local government entities have an obligation to implement regulatory constructs that protect the environment and consumer interest. To accomplish these ends, we respectfully suggest that the final report recommends adequate funding to provide proper oversight." The Orange County Department of Environment, Agriculture, Parks & Recreation points out that "Since DENR, and

especially DWQ, has lost funding and staff positions in recent years, these trends must be reversed if adequate regulatory programs have any chance of being implemented and maintained."

North Carolina Conservation Network (NCCN) points out, "The cost of establishing a regulatory program will fall on North Carolina taxpayers" because without an active oil and gas industry in the state, there are no permit fees or severance taxes to provide revenue at this time, and there may not be for the foreseeable future. NCCN also notes that until the industry comes to North Carolina, "taxpayers will have to foot the bill for an unnecessary program to regulate an industry that is not there."

An individual wrote, "If the legislature eventually decides to go ahead with this industry, then we would need DENR to be fully funded to regulate any natural gas activities in our state. It is not okay for the legislature to say that it will regulate the natural gas industry, then to inadequately fund the regulating entity." Another person wrote, "Regulations currently in place cannot be enforced because of lack of staff. How can we trust our General Assembly to fund getting this new, extremely complicated technology properly regulated, when it doesn't support the enforcement of regulations where the science is much better understood and the regulations have been in place for years?"

RESPONSE: We are adding a recommendation to this effect.

Social impacts

67. Some people expressed concerns about property values. One individual wrote, "I'm also very concerned about what I'm hearing is happening in other states with contaminated drinking water and loss of value of property near contaminated sites, as well as Fannie Mae and the Agriculture Dept. not backing mortgages for property with leased mineral rights."

    RESPONSE: The Secretary of the U.S. Department of Agriculture has stated that the USDA "will not require an extensive environmental review before issuing mortgages to people who have leased their land for oil and gas drilling" because rural housing loans are excluded under the National Environmental Policy Act.[586] Like any other loan program administered by the federal government, taxpayers stand to either lose or gain, depending on the direction of the values of the property. A data analysis described in Section 6B, Potential Impacts on Property Values, shows that property values in Oklahoma and Pennsylvania increased in the most heavily-drilled areas, while property values decreased in Colorado's most heavily-drilled areas.

68. The City and County of Durham Environmental Affairs Board is "concerned that counties with large populations of low- or fixed-income renters could be impacted the most by the increased housing costs of extensive shale gas development. In Durham, with a rental rate of 44%, [DENR's report] predicts that a significant number of residents would

[586] Urbina, Ian. "U.S. Rejects Environmental Reviews on Mortgages Linked to Drilling." *The New York Times*. March 23, 2012. Retrieved April 16, 2012 from http://www.nytimes.com/2012/03/23/us/usda-wont-review-mortgages-linked-to-drilling.html.

bear the economic impacts, while not sharing in the economic benefits. We note that they may also bear more of the environmental impacts, such as increased road traffic and air pollution. There is nothing in the recommendations to remedy this inequity, nor further discussion in the summary, yet it is an important issue for the wellbeing of all Durham citizens. There must be steps taken to ensure that vulnerable citizens are not disproportionately adversely affected by these activities."

RESPONSE: DENR agrees, and has modified this recommendation to reflect this.

Environmental justice

69. Several people commented that there is no discussion of the potential environmental justice impacts. The Blue Ridge Environmental Defense League (BREDL) points out that "Many of the mostly rural shale communities have a significant number of minority residents." BREDL recommends that before the shale gas study is finalized, DENR "identify the potential for disproportionate impacts from this industry on People of Color and the Poor." Waterkeepers Carolina also notes that environmental justice is not examined fully. BREDL requests that DENR "evaluate the demographics of renters in the basin to see if people of color and the poor will stand to be disproportionately affected. Additionally, the Attorney General's office should be consulted on possible protections from unscrupulous landlords."

    The West End Revitalization Association (WERA) requests that the final report "fully incorporate the National Environmental Protection Action (NEPA), Title VI of the Civil Right Act of 1964, and Federal Environmental Justice Strategies of 18 branches of Federal government" [sic]. The authors of this letter request that the U.S. EPA not renew North Carolina's Memorandum of Agreement on primacy for the Underground Injection Control program until environmental justice concerns are incorporated into the draft report. WERA also requests that the North Carolina Research Triangle Environmental Collaborative's Environmental Inequities / Environmental Justice Workgroup (EI/EJWG) "organize and facilitate information and training sessions on environmental inequities and environmental justice disparities in North Carolina and related EPA, NEPA, and Title VI of the Civil Rights Act of 1964 laws for preparers of [the draft report] and committee members of [the North Carolina Legislature] prior to submission, action, and voting. This would include delay of any legislative votes until after the EPA final 2014 study is completed on the impacts on environmental health, public health, and economic and social stressors."

    RESPONSE: Section 6A of the report provides a variety of demographic characteristics of the counties that could be impacted if shale gas development occurs in North Carolina. While racial characteristics are not described in detail, Tables 6-1, 6-2, 6-3, and 6-4 describe demographic "risk factors" that could make certain areas more vulnerable to increased housing costs. Additionally, a new paragraph has been added to Section 6, Distributional Impacts, which discusses how renters in a community may be impacted negatively by shale gas development.

DENR agrees that this is not a complete discussion of the potential environmental justice impacts from natural gas extraction and production, but feels that it is premature to address environmental justice on a site-specific basis at this time. DENR's permitting programs incorporate an environmental justice process consistent with state and federal laws.

70. WERA also requests that a bipartisan panel be established "to determine current elected officials and those running for local, county, state and federal positions representing citizens, taxpayers, and voters of North Carolina who have received campaign contributions from oil and gas industry agencies. This is necessary in order to comply with existing Federal and state open/public records, 'sunshine', and election laws and statutes."

    RESPONSE: The State Ethics Act has specific criteria that would apply to this situation.

71. The City and County of Durham Environmental Affairs Board and others commented on the risk of increased housing costs. The Environmental Affairs Board wrote, "We are concerned that counties with large populations of low- or fixed-income renters could be impacted the most by the increasing housing costs of extensive shale gas development." Clean Water for North Carolina noted that increased property values may have negative impacts, for example, "for smaller landowners in drilling areas, or those who have not leased their mineral rights, the higher assessed property values will result in a higher tax burden with no compensating income. This impact will fall particularly disproportionately on low-income residents, seniors, disabled persons or others on limited incomes."

    RESPONSE: It is important to note that increased housing costs are not inevitable if shale gas development occurs in North Carolina. In some rural communities in the United States, new drilling projects have led to rapidly increasing housing costs; however, those communities are significantly more rural than North Carolina (see Table 6-9), and have seen a far greater amount of drilling than is expected in North Carolina. An additional paragraph has been added to Section 6.A. discussing the potential impacts to renters in North Carolina.

72. The City and County of Durham Environmental Affairs Board commented, "the report predicts that a significant number of residents would bear the economic impacts, while not sharing in the economic benefits. We note that they may also bear more of the environmental impacts, such as increased road traffic and air pollution. There is nothing in the recommendations to remedy this inequity, nor further discussion in the summary."

    RESPONSE: The Environmental Affairs Board is correct that renters are less likely to see the economic benefits of shale gas development than landowners who lease to natural gas operators. While renters may benefit from the employment opportunities generated by the development of shale gas in North Carolina, they would not receive leasing bonuses or royalty payments. Renters may also experience the negative impacts

of development, including impacts from noise, traffic or environmental pollution; however, they are not necessarily more likely to experience these impacts than property owners. Low-income residents may be less able to cope with potential negative impacts than wealthier residents. DENR agrees that policymakers should attempt to minimize any impacts that would disproportionately impact vulnerable residents, but DENR feels that it is premature to address environmental justice on a site-specific basis at this time. DENR's permitting programs incorporate an environmental justice process consistent with state and federal laws.

Regulatory framework

73. The North Carolina League of Conservation Voters, the U.S. Fish & Wildlife Service and others commented on the Rules Reform Act and its effect on the ability of state agencies to regulate hydraulic fracturing. Specifically, the League of Conservation Voters notes, "The passage of the Rules Reform Act significantly limits the discretion of agencies in promulgating and enforcing administrative rules, environmental regulations in particular are dependent on adopting and enforcing many complex rules." The U.S. Fish & Wildlife Service "encourages DENR to seek resolution on its ability to regulate and enforce an oil and gas industry in NC given the constraints set forth in NC Session Law 2011-398."

    RESPONSE: It is true that North Carolina's already lengthy rulemaking process will likely become somewhat more time-consuming as a result of new requirements (such as expanded cost-benefit analysis) enacted in 2011. Prior to the 2011 changes, the process for adopting a new rule of any significance took between 12 and 18 months. It is not clear how much additional time the new requirements will add. The 2011 amendments also put new constraints on agency rulemaking powers and expressly limit the power of a state agency to go beyond federal standards in the absence of express rulemaking authority from the General Assembly. Those provisions may affect development of oil and gas production rules since in a number of cases state rules will be needed specifically because Congress has exempted exploration and production activities from federal regulation. DENR assumes that the General Assembly will be cognizant of the impact that new APA requirements may have on adoption of oil and gas production rules and will provide sufficient authority for rule development.

74. One commentator requested "a complete analysis of all industry influences in the 2005 Energy Policy Act which exempted fracking from the Clean Air Act and the Safe Drinking Water Act. Not following these important safety regulations helps explain why fracking cannot be done completely safely."

    RESPONSE: Although we consider analyzing the industry influences in the development of these federal laws outside the scope of this particular report, we have noted the exemptions afforded the oil and gas industry by these laws in this report. We considered these exemptions while drawing up our recommendations for how North Carolina could govern shale gas extraction, and we agree that additional protections would need to be in place in North Carolina to fill in those gaps.

Water use laws

75. One commenter requested more discussion of water use laws, specifically riparian law and the reasonable use of groundwater.

    RESPONSE: The text of the report references the basic rule of reasonable use for both riparian property owners and groundwater users. The report focused on the lack of any water withdrawal permitting authority because the reasonable use rule in itself provides no environmental protection and leaves resolution of any conflict between competing water users to the courts.

Consumer protection

76. Several people commented on the lack of a consumer protection section. BREDL states that "The Study should have been held until all mandated parts were complete."

    RESPONSE: S.L. 2011-276 directed the Department of Justice to work on the consumer protection section of the report in consultation with RAFI-USA and DENR. The Department of Justice did not provide the Department of Environment and Natural Resources with a draft version of this section in time for the release of the study to the public, because the Department of Justice did not believe that section was ready to be released for public comment. DENR made the decision to release the rest of shale gas study, because we felt it was important for the public to have an opportunity to comment on as much of the report as possible before the study was submitted to the General Assembly by the legislatively mandated deadline of May 1, 2012.

77. Clean Water for North Carolina (CWFNC) also commented on the lack of a consumer protection section in the draft report. CWFNC states "The failure to release the critical Consumer Protection section of the report with the remainder of the draft report is completely unacceptable [and CWFCNC calls for] at least a 15 day comment period" after that section is released. Several individuals who commented on the draft report expressed similar concerns. One individual wrote that a major issue with the study "is that it has come to public input without Section 8, the statement of landowner and consumer rights. This is a grave disservice to the residents of North Carolina. **I urge you to request an extension of the deadline for DENR to submit this study to the State Assembly because the citizens of North Carolina have the right to comment on landowner and consumer recommendations that will be impacted by this study.** It is clear that the state and gas corporations are waiting to act on this study as quickly as possible. This is the only opportunity we citizens will have to comment on what the politicians do with our rights concerning this controversial issue. Please give us the chance to comment on our landowner and consumer rights. This is our future."

    RESPONSE: DENR has shared with our colleagues in the Department of Justice the concerns about the lack of a public comment period on the consumer protection section of the study.

Local government authority

78. Several local governments have passed or are working to pass resolutions related to hydraulic fracturing. This includes the town of Butner, which has proposed a resolution to urge the General Assembly "to maintain current laws in North Carolina that prevent hydraulic fracturing and horizontal drilling in the State and to take no action that would weaken these laws before it is fully demonstrated that North Carolina public health, waters, land, air, economy, and quality of life can be fully protected from impacts of allowing shale gas development in the State." The town of Cary and town of Pittsboro passed a resolution "urging prudence and demanding that before we green light a new industry in our region and state that we ensure that we are very confident that the air we breathe and the water we drink is safe and protected from the encroachments of 'fracking.'"

    The Lee County Board of Commissioners passed a resolution supporting efforts to develop sound legislation and polices for the extraction of natural gas in North Carolina, including support for legislation that is a model for other states, protects the environment and "preserves Local Governments' authority to protect the property rights, mineral rights and surface rights of its citizens and the jurisdiction's infrastructure, including land use regulation."

    RESPONSE: DENR feels that this issue should be addressed by the General Assembly and has recommended that the General Assembly clarify the extent of local government regulatory authority over oil and gas exploration and production activities.

79. The City of Durham Joint City-County Planning Committee commented, "Local government should retain its ability, through zoning and its general police power, to assure that hydraulic fracturing, if legally authorized and feasible, is performed in a manner that minimizes negative impacts to local communities." The Durham Environmental Affairs Board recommended that Durham "***maintain the authority***, through local zoning or other means, to determine exactly ***where*** and ***when*** hydraulic fracturing might be done safely, and to apply more stringent requirements if necessary for Durham." Some individuals who commented on the report agreed, including one person who wrote, "Local communities should have authority to block and regulate fracking, which would damage citizens' water resources and roads and drive up the cost of living as new workers come to the area."

    RESPONSE: DENR feels that this issue, while important, reaches beyond environmental and public health impacts and should be addressed by the General Assembly.

80. The City of Durham Joint City-County Planning Committee commented, "Revenues received from oil and gas proceeds must be shared with local governments to fully compensate the costs that will be incurred by local governments in addressing the local impacts of hydraulic fracturing.

RESPONSE: DENR has recommended that local governments be included in the distribution of revenues from oil and gas proceeds. Determining the exact distribution of revenues will require further work with assistance from stakeholders.

Comments about draft recommendations

81. Some people commented that the recommendation to require oil and gas operators to collect baseline data on water is a conflict of interest, and that DENR should collect this data.

    RESPONSE: The use of monitoring data collected by regulated parties is a routine and cost-effective component of regulatory programs throughout DENR.

82. The Durham Environmental Affairs Board says that the recommendation on baseline data collection "lacks important details on the collection of baseline data such as the number of samples and length of time required to accurately capture existing conditions, distance from the well, and sample patter density. Additionally, the recommendation does not require ongoing monitoring of the drilling site through the drilling, pumping, or closure of the site."

    RESPONSE: DENR believes that it is premature at this stage to identify such specific criteria and requirements. The development of specific criteria and requirements for baseline data collection would be a detailed and lengthy process. DENR supports the development of these standards with the assistance of stakeholders, including other government agencies, nonprofit organizations, industry representatives, and members of the public.

83. The Durham Environmental Affairs Board "whole-heartedly concur[s] with the need of a robust data management system. The EAB encourages that this data management system be easily accessible by the general public."

    RESPONSE: DENR has hired a database contractor to develop a new database to house all groundwater data in DENR, including groundwater monitoring data from contaminated sites, permitted waste application sites, and ambient groundwater monitoring stations. The new system, known as the Groundwater Decision Support System, or GWDSS, will ultimately allow electronic submission of data from well contractors and laboratories and could be used to manage groundwater data from oil and gas operations.

    The original request for proposals for the GWDSS included a GIS-enabled website for sharing groundwater data with the public, as well as a number of other features that DENR did not have sufficient funds to include in the final contract. Bids for everything in the RFP were in the range of $1 million to $2 million; DENR was ultimately able to assemble about $600,000 to fund the core of the system without the public interface.

Additional data management systems, and funding to build them, will be necessary in order to manage and publicize data related to exploration and production permits, production and tax data, and waste tracking.

84. The Durham EAB commented that Recommendation 10 omits the cost for additional or special equipment that may be required to combat emergency situations related to fracking, costs which "should be borne by the industry through permitting fees, severance taxes, or other cost recovery methods."

    RESPONSE: DENR agrees, and this recommendation has been revised to reflect the need for additional or special equipment.

85. The Durham EAB commented, "Recommendation 19 should be changed to language that clearly assigns liability and cleanup responsibility to the industries that lease and operate gas and oil wells. The citizens of North Carolina should not ever have to pay for industry negligence."

    RESPONSE: DENR agrees that consistent with existing law, the oil and gas industry should be held responsible for damages that it causes. This recommendation has been revised to include that note.