

Louisiana Hydraulic Fracturing State Review

March, 2011



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INTRODUCTION

In 1990, the Interstate Oil Compact Commission (IOCC) and the U.S. Environmental Protection Agency (USEPA) jointly published a Study of State Regulation of Oil and Gas Exploration and Production Waste, which contained guidelines for the regulation of oil and gas exploration and production wastes by the IOCC member states (the “1990 Guidelines”). The published guidelines, developed by state, environmental and industry stakeholders, provided the basis for the State Review Process, a multi-stakeholder review of state exploration and production (E&P) waste management programs against the guidelines. The purposes of the State Review Process are to document the successes of states in regulating E&P wastes and to offer recommendations for program improvement. In 1994, the guidelines were updated and revised (the “1994 Guidelines”) by the IOCC, now named the Interstate Oil and Gas Compact Commission (IOGCC).

In 1999, administration of the State Review Process devolved to a non-profit, multi-stakeholder organization named State Review of Oil and Natural Gas Environmental Regulations, Inc. (STRONGER). STRONGER again revised, expanded and updated the Guidelines, which were accepted by the IOGCC and published in June 2000 as Guidelines for the Review of State Oil and Natural Gas Environmental Regulatory Programs (the “2000 Guidelines”). In 2005, STRONGER again revised, expanded and updated the Guidelines (the “2005 Guidelines”).

In 2009, STRONGER formed a Hydraulic Fracturing Workgroup consisting of stakeholders to review issues associated with hydraulic fracturing and develop guidelines for state regulatory programs to address identified issues. After several meetings and a round of public comment, the workgroup submitted to STRONGER a set of guidelines that represented the consensus of the workgroup. In 2010, STRONGER distributed the workgroup’s guidelines (the “2010 Hydraulic Fracturing Guidelines”) for state regulation of hydraulic fracturing. Those guidelines were used as the basis of this review.

In September 2010, the Louisiana Department of Natural Resources (DNR), Office of Conservation volunteered to have its hydraulic fracturing program reviewed by STRONGER. The Louisiana oil and gas regulatory program has undergone two prior reviews. The report of the initial review of the Louisiana oil and gas regulatory program was published in 1994. A report of actions taken in response to recommendations from the 1994 review as well as a review of the program against guidelines revisions was published in 2004.

The current review began with a questionnaire that was sent to the Office of Conservation. The questionnaire had been prepared by the STRONGER Board. STRONGER intended the questionnaire to capture the status of the Louisiana program relative to the 2010 Hydraulic Fracturing Guidelines. The Office of Conservation prepared a response to the questionnaire, which was then sent to the review team.

In November 2010 to February 2011 a six-person team appointed by STRONGER conducted a review to evaluate the Office of Conservation program compared to the 2010 Hydraulic Fracturing Guidelines. The review team consisted of three team members and three official observers. The three team members were: Lori Wrotenbery, Oklahoma Corporation

Commission; Bruce Baizel, Earthworks Oil and Gas Accountability Project; and Jim Collins, Independent Petroleum Association of America. The official observers were: Gil Bujano, Texas Railroad Commission; Richard Metcalf, Louisiana Mid-Continent Oil and Gas Association; and Doug Daigle, a Conservation Consultant from Baton Rouge.

The review team conducted a meeting, the in-state portion of the review, in the conference facilities of the DNR in Baton Rouge, Louisiana on November 8, 2010. Commissioner Jim Welsh, Chris Sandoz, Gary Ross, Blake Canfield and Gary Snellgrove of the Office of Conservation presented an overview of hydraulic fracturing requirements in Louisiana, and Professor Gary Hanson presented an overview of a partnership to address water issues in the Haynesville Shale. Commissioner Welsh and the staff from the Office of Conservation and Jeffrey Meyers and Sam Phillips of the Louisiana Department of Environmental Quality responded to questions from the team members and official observers. In addition to the Louisiana state government and university representatives who participated in the review and the review team, there were seven industry and six environmental attendees who observed the proceedings. Following the meeting and after reviewing the written materials provided by the Office of Conservation, the team members compiled this review report.

This is the report of the review of the Louisiana program against the 2010 Hydraulic Fracturing Guidelines of STRONGER. Appendix A is a glossary of acronyms used in the report. Appendix B contains Louisiana's written response to the STRONGER questionnaire.

EXECUTIVE SUMMARY

An in-depth review of the Louisiana hydraulic fracturing regulatory program has been completed by a multi-stakeholder review team. The review team has concluded that the Louisiana program is, over all, well-managed, professional and meeting its program objectives. The review team also made recommendations for improvements in the program.

Program Strengths

During the 2010 review of Louisiana's regulation of hydraulic fracturing, the review team and observers were granted full access to Office of Conservation staff, and all questions were answered in a responsive and open manner. During the review, the review team identified strengths of the Louisiana program, which also are noted in several of the report's findings. The following offers an overview of some of the Louisiana program's strengths.

1. Prompt review of policies and adjustment of regulations in response to Haynesville Shale development

As development has occurred in the Haynesville Shale, the agency staff has worked to identify and respond to issues as they arose. Following are three examples:

- During the development of the Haynesville Shale, Office of Conservation staff recognized, through review of publications and experience, the potential impacts on domestic water use by use of the Carrizo-Wilcox aquifer for hydraulic fracturing purposes. Initially nearly all water used for hydraulic fracturing in the Haynesville Shale was groundwater. Hydraulic fracturing accounts for nearly 90 percent of the water demand for E&P purposes.

The Red River Alluvial is a source of groundwater of lower quality that is suitable for hydraulic fracturing purposes. There are also several surface water sources available in the area of the Haynesville Shale, including the Red River, Toledo Bend Reservoir, and other lakes and bayous. Both the Toledo Bend reservoir and the Red River have yield capacities that far exceed projected demand for hydraulic fracturing purposes in the Haynesville Shale.

In response to the impacts on domestic water use of the Carrizo-Wilcox aquifer, in 2008 the Office of Conservation advised operators to use alternative sources of water for hydraulic fracturing. The advisory stated:

“... Therefore, if ground water must be used for drilling or hydraulic fracturing stimulation purposes, it is recommended that the Red River Alluvial aquifer be utilized for these purposes, where feasible, as the source of ground water supply in lieu of the Carrizo-Wilcox aquifer. ... The Commissioner further encourages oil and gas operators to use the

available surface water resources or other acceptable alternative water sources in Northwest Louisiana where practical and feasible. ...”

- The Office of Conservation issued Order No. U-HS effective August 1, 2009. The order establishes practices, safeguards and regulations relating to the exploration and production of gas from the Haynesville Shale in urban areas. The order addresses issues such as well setbacks from buildings, fencing, site maintenance, dust, vibration, odors, site lighting, muffled exhaust, venting and flaring of gas, activities limited to daytime hours, noise, water and road use.
- Until recently, Office of Conservation rules did not allow the recycling of flowback fluids. Recent changes encourage source reduction and recycling of produced water, rainwater, and drilling, workover, completion and stimulation fluids for frac supply purposes (*e.g.*, LAC 43:XIX.313.J).

2. Water resource use monitoring and reporting

In addition to advising operators to use sources of water other than the Carrizo-Wilcox aquifer, in a separate letter to operators, the Commissioner instituted the requirement that:

“... the water source and associated volume must be reported on page two (2) of the „Well History and Work Resume Report“ (Form WH-1) which must be filed within twenty days after completion or recompletion operations. The water sources must be identified by either the water well number or water body name, as appropriate. Separate water volumes for rig supply use and stimulation operation use must be provided.”

As a result of those actions, water demand for the year from October 1, 2009 to September 30, 2010 was met primarily (78 percent) by surface water. Through these actions, the Office of Conservation is confident that long-term adverse impacts to the Carrizo-Wilcox aquifer have been prevented.

3. Actions to increase recycling opportunities

The use of alternate sources of water and recycling of E&P waste fluids for hydraulic fracturing in the Haynesville Shale are encouraged. Until recently, Office of Conservation rules did not provide specific regulatory protocol for offsite (commercial) waste treatment and disposal facility operators to recycle flowback. Regulatory changes have been adopted to further streamline permitting of commercial waste fluid treatment and reclamation operations for frac water supply purposes (LAC 43:XIX.565).

4. Public education/outreach

The Office of Conservation has a good public outreach program in place that includes participation in industry meetings, workshops for the public, and the DNR web site. The Office of Conservation has been involved in a number of local meetings and forums on well construction, water use, and hydraulic fracturing operations.

The agency web site includes a dedicated page providing up-to-date information on the Haynesville Shale. The web site includes a link to an API video that demonstrated the hydraulic fracturing process as well as memos, advisories, notices of rulemaking and presentations prepared by the Office of Conservation. The site also includes maps and spreadsheets with well information.

Program Recommendations

The following are the primary areas where recommendations are made by the review team for improvements of the Louisiana hydraulic fracturing program. Discussion and findings for these recommendations can be found in the various sections of the report. Readers are encouraged to review the specific discussion and finding for each recommendation

1. Review of casing and cementing standards, including surface casing requirements

The minimum depth of surface casing is based on the total depth of the well. In the Haynesville Shale area, wells may be drilled through the underground sources of drinking water (USDW) and through at least one known productive zone before surface casing is set.

The Office of Conservation has contracted with the Louisiana State University to assist in the review of well construction standards.

The review team recommends that, in order to protect groundwater, the Office of Conservation should consider the depth of the USDW and the depths of any saline or productive zones, in addition to the total depth of the well, in setting surface casing requirements. The review team recommends that the Office of Conservation develop casing standards to meet anticipated pressures and protect other resources (including treatable groundwater) and the environment.

2. Immediate reporting of problems and subsequent reporting of volumes, pressures, and materials used

After completion of the well, a Well History and Work Resumé Report (WH-1) is required to be submitted. This report summarizes the work performed on the well. The

report includes cement returns to the surface which are witnessed by the field inspector or an offset operator. Information including the origin and volume of water used is required. Aggregate volumes of fracturing fluids, proppant types and pressures are usually included on the DM-4-R and/or the WH-1. Hydraulic fracturing materials used, aggregate volumes of fracturing fluids and proppant used, and fracturing pressures are not required to be reported to the DNR.

The review team recommends that reporting should include the identification of materials used, aggregate volumes of fracturing fluids and proppant used, and fracture pressures recorded. (STRONGER Guidelines Section 9.2.2.)

3. Structured training for field inspectors

Professional technical staff (geologists and engineers) receives training through technical workshops and seminars. Field staff training usually occurs during quarterly meetings, and is usually in a discussion format concerning issues raised by field staff. More structured training for field staff is being developed.

The review team recommends that field staff should receive more structured training to stay current with new and developing hydraulic fracturing technology.

4. Spill Prevention and Control Plan

DEQ regulations (LAC 33:IX. Subpart 1, Chapter 9) require the development and implementation of a Spill Prevention and Control plan. The regulations require the operator to prepare the plan within 180 days after the facility becomes operational and to be fully implemented within one year after the facility begins operation. Consequently, there is a gap in time between the drilling and hydraulic fracturing of a well and the time that the Spill Prevention and Control Plan is required.

The review team recommends that the State of Louisiana develop contingency planning and spill risk management procedures for hydraulic fracturing that meet the requirements of Section 4.2.1 of the STRONGER guidelines.

HYDRAULIC FRACTURING

I. BACKGROUND

Oil and gas have been produced commercially in Louisiana since the drilling of an oil gusher on the Evangeline Salt Dome near Jennings in southern Louisiana in 1901. However, since much of southern Louisiana is covered with marshy terrain, future development was concentrated in northern Louisiana where the Caddo and Monroe fields were discovered in 1906 and 1916 respectively.

More recently, the Haynesville Shale has become a target of interest. The Haynesville Shale lies more than 10,000 feet below the surface. It is a consistent 500-foot thick layer underlying an area approximately 80 miles south to north by 60 miles east to west across the Louisiana – Texas border. It contains an estimated 251 TCF of recoverable natural gas. As of October 28, 2010, there were 1,691 permitted wells in the Haynesville. It is estimated that about 10,000 wells will be needed to produce all of the recoverable gas from the Haynesville Shale.

More than 220,000 wells have been drilled in all of Louisiana. Hydraulic fracturing has been conducted in Louisiana since the 1960s. Wells in the Haynesville Shale must be fractured to be commercially productive. The State of Louisiana has not identified any instances where hydraulic fracturing has harmed groundwater.

The Louisiana Commission for Conservation of Natural Resources was created in 1908 to address the conservation of oil and gas. In 1912 the Conservation Commission (renamed in 1910), was reorganized and given the authority to adopt regulations to protect state resources. Some of the early regulations required drilling permits to be filed along with maps of well locations, required the use of surface casing and cement, and required the plugging of abandoned wells.

In 1916 the Louisiana Department of Conservation was created. The Department of Conservation conducted its duties under the supervision of the Commissioner of Conservation.

Legislation enacted in 1924 made it illegal to pollute the waterways of the state with salt water, oil, and other substances. In 1940 additional conservation legislation was enacted that was subsequently adopted as Title 30 of the Revised Statutes of 1950. Comprehensive regulations were promulgated in 1943 as Statewide Order No. 29-B. Saltwater disposal well regulations were added in 1961. The first regulations concerning commercial facilities were promulgated in 1980. The rules were amended to include language necessary for EPA approval of the Underground Injection Control (UIC) Program in 1982. The first pit rules were added in 1986.

In 1976 the state government in Louisiana was reorganized and the Department of Natural Resources (DNR) was formed. The Office of Conservation was placed in the DNR. The Office

of Conservation retained much of its jurisdiction over the oil and gas industry. That jurisdiction includes the drilling and production of oil and gas wells and disposal of oil and gas exploration and production waste.

II. GENERAL

The Department of Natural Resources, Office of Conservation is responsible for the regulation and conservation of oil, gas, lignite, and other natural resources. The Commissioner of Conservation oversees all activities involving the conservation and development of the natural and mineral resources of the state.

The Executive Division within the Office of Conservation administers and coordinates the functions of the office, including administrative and technical matters. The Commissioner oversees five technical divisions: Engineering, Geological Oil and Gas, Environmental, Injection and Mining, and Pipeline. The Engineering Division is responsible for the conservation of oil and gas located underground, in storage and in transportation, and is responsible for the protection of property rights related to oil and gas exploration and production. The Geological Oil and Gas Division prevents the drilling of unnecessary wells, protects individual property rights and conserves the state's natural resources in a geologically approved manner. The Environmental Division is responsible for exploration and production waste management, abandoned site remediation and ground water resources. The Injection and Mining Division permits underground injection wells, the surface mining of coal and lignite, and commercial exploration and production waste storage, treatment and disposal facilities. The Pipelines Division is responsible for pipeline safety and pipeline operations.

The Office of Conservation rules are contained in Title 43 of the Louisiana Administrative Code. The Division of Administration, Office of the State Register, is the official authority responsible for Executive Orders issued by the Governor, the Louisiana Administrative Code, and the monthly Louisiana Register. The State Register posts Office of Conservation rules on its Web site.

The Department of Environmental Quality (DEQ) is generally responsible for environmental protection through its regulatory programs protecting air, land and water. The DEQ is organized into 17 divisions. It is responsible for 24 programs and initiatives. DEQ activities related to hydraulic fracturing include spill mitigation and clean-up and radiation protection. DEQ rules are contained in Title 33 of the Louisiana Administrative Code.

STANDARDS

The Louisiana Office of Conservation has developed regulatory standards that relate to hydraulic fracturing. These standards are found in various sections of the Louisiana Administrative Code. They include standards developed to prevent groundwater contamination (LAC 43:XIX.303.C).

The Office of Conservation requires that a work permit application (DM-4-R) be filed and approved before the beginning of well construction operations, including hydraulic fracturing. When an operator applies for a Work Permit, the application includes a plan for the construction and stimulation of the well. The Work Permit is reviewed for adequacy and approved in the district office. It is issued by the Conservation District Manager.

The Office of Conservation issued Order No. U-HS effective August 1, 2009. The order establishes practices, safeguards and regulations relating to the exploration and production of gas from the Haynesville Shale in urban areas. The order addresses issues such as well setbacks from buildings, fencing, site maintenance, dust, vibration, odors, site lighting, muffled exhaust, venting and flaring of gas, activities limited to daytime hours, noise, water and road use.

Standards are in place for the placement and pressure testing of casing and cement (LAC 43:XIX.109). The minimum surface casing depth is based on the total depth of the well. District managers can require more than minimum casing based on the regional or local geology and other factors. A minimum of 1,800 feet of surface casing is required for Haynesville Shale wells.

Operators are required to provide at least 12-hours notice to the district office prior to hydraulic fracturing operations (LAC 43:XIX.105.A). This provides the opportunity for the state to witness the activity.

If an unanticipated operational or mechanical problem is identified, the operator is required to notify the district manager. Compliance orders are issued as appropriate to assure that the problem is investigated, assessed and remedied. Office of Conservation staff were aware of one compliance order being issued in response to a question about a possible hydraulic fracturing or casing/cementing failure.

The majority of fluids used in hydraulic fracturing are stored in tanks. Some impoundments are built for fresh water storage. Flowback from hydraulic fracturing activities must be stored in tanks or in lined pits. Flowback from hydraulic fracturing is defined in Louisiana as E&P Waste, Waste Type 04, Completion workover and stimulation fluids (LAC 43:XIX.501). Pit standards, including requirements for siting above the 100-year flood level, construction, liners, levee or berm adequacy, freeboard and closure are in place (LAC 43:XIX.307.A.1). Pits used for temporary containment during well drilling and completion must be closed within six months.

Standards for soil testing before and after pit closure ensure the protection of surface water and groundwater (LAC 43:XIX.311 and 313). The primary parameter of concern when testing is salinity. Documentation pertaining to testing and closure is maintained by the operator for at least three years. Closure data is routinely requested by the Office of Conservation.

Waste generators are responsible for the transportation of waste disposed at commercial or centralized facilities (LAC 43:XIX.503.D). Waste characterization includes, but is not limited to, testing for metals, Total Petroleum Hydrocarbons (TPH), electrical conductivity, chlorides and pH (LAC 43:XIX.503.A). A manifest system is in place to document each waste shipment (LAC 43:XIX.545)

Until recently, Office of Conservation rules did not allow the recycling of flowback fluids. Recent changes encourage source reduction and recycling of produced water, rainwater, and drilling, workover, completion and stimulation fluids for frac supply purposes (e.g., LAC 43:XIX.313.J).

Complaints related to hydraulic fracturing are tracked in the DNR database (SONRIS). Most complaints received by the Office of Conservation are associated with groundwater withdrawal. The number of complaints have been reduced over the last two years as a result of actions taken (discussed in the Water and Waste Management section of this report) to shift from use of the Carrizo-Wilcox aquifer to primarily surface water resources as the source of water for hydraulic fracturing. People registering complaints receive copies of all correspondence related to the complaint.

The Office of Conservation provided funding for a study by Louisiana State University to investigate any needed rule changes related to oil and gas well construction. Recommendations are currently being considered.

DEQ regulations (LAC 33:IX. Subpart 1, Chapter 9) require the development and implementation of a Spill Prevention and Control Plan. The regulations require the operator to prepare the plan within 180 days after the facility becomes operational and to be fully implemented within one year after the facility begins operation.

Spills and releases are reported to the Louisiana State Police hotline. The Louisiana State Police are the lead agency in incident response while the DEQ has the lead in mitigation and clean-up. The Office of Conservation involvement in spill and release incident response is in a supporting role.

DEQ also is responsible for radiation protection, including Naturally Occurring Radioactive Materials (NORM) that may be associated with E&P. Commercial facilities that receive solids must test for NORM. Readings above action levels trigger refusal and notification requirements. If levels are found to be above action levels, the facility must conduct surveys for worker protection. The DEQ reported that no E&P solids from the Haynesville Shale have triggered refusal or notification.

Finding 9.2.1.1.

The Work Permit application and approval process provides for the permitting of hydraulic fracturing activities.

Finding 9.2.1.2.

The minimum depth of surface casing is based on the total depth of the well. In the Haynesville Shale area, wells may be drilled through the underground sources of drinking water (USDW) and through at least one known productive zone before surface casing is set.

Recommendation 9.2.1.2.

The review team recommends that, in order to protect groundwater, the Office of Conservation should consider the depth of the USDW and the depths of any saline or productive zones, in addition to the total depth of the well, in setting surface casing requirements

Finding 9.2.1.3.

There are no specific standards or requirements for cement used in well construction.

Recommendation 9.2.1.3.

The review team recommends that the Office of Conservation develop cement standards to meet anticipated pressures and protect other resources and the environment. (STRONGER Guidelines, Section 9.2.1.)

Finding 9.2.1.4.

The Office of Conservation provided funding for a study by Louisiana State University to investigate any needed rule changes related to oil and gas well construction. Recommendations are currently being considered. The review team commends the DNR for initiating this review.

Recommendation 9.2.1.4.

The review team recommends that the Office of Conservation develop casing standards to meet anticipated pressures and protect other resources (including treatable groundwater) and the environment. (STRONGER Guidelines, Section 9.2.1.)

Finding 9.2.1.5.

DEQ regulations (LAC 33:IX. Subpart 1, Chapter 9) require the development and implementation of a Spill Prevention and Control Plan. The regulations require the operator to prepare the plan within 180 days after the facility becomes operational and to be fully implemented within one year after the facility begins operation. Consequently, there is a gap in time between the drilling and hydraulic fracturing of a well and the time that the Spill Prevention and Control Plan is required.

Recommendation 9.2.1.5.

The review team recommends that the State of Louisiana develop contingency planning and spill risk management procedures for hydraulic fracturing which meet the requirements of Section 4.2.1 of the STRONGER guidelines. (STRONGER Guidelines Section 9.2.1.)

Finding 9.2.1.6.

Operators are required to notify the district manager if an unanticipated operational or mechanical problem is identified during hydraulic fracturing operations.

Finding 9.2.1.7.

Compliance orders are issued as appropriate to assure that problems identified during hydraulic fracturing operations are investigated, assessed and remedied.

Finding 9.2.1.8.

Recent changes to the regulations encourage source reduction and recycling of produced water, rainwater, and drilling, workover, completion and stimulation fluids.

Finding 9.2.1.9.

Complaints related to hydraulic fracturing are tracked in the DNR database. People registering complaints receive copies of all correspondence related to the complaint.

REPORTING

The Office of Conservation requires that a work permit application (DM-4-R) be filed and approved before the beginning of well construction operations, including hydraulic fracturing. After approval, the district manager must be notified at least 12 hours prior to the initiation of any work under the Work Permit.

After completion of the well, a Well History and Work Resumé Report (WH-1) is required to be submitted. This report summarizes the work performed on the well. The report includes cement returns to the surface which are witnessed by the field inspector or an offset operator.

Information including the origin and volume of water used is required. Aggregate volumes of fracturing fluids, proppant types and pressures are usually included on the DM-4-R and/or the WH-1.

If the Office of Conservation needs to know the chemical constituents of hydraulic fracturing fluids, they have the authority to request the information from the operator. The Louisiana State Police and the DEQ have authority to ensure that MSDS and other information are made available on-site.

Louisiana has an open records law. Most exemptions are agency-specific. DEQ allows proprietary exemptions for processes or equipment, but not for chemicals or other potential pollutants. DEQ has procedures for keeping proprietary formulations confidential. In the event of an emergency, requests for confidential information from medical personnel would be channeled through DEQ.

Finding 9.2.2.1.

Operators are required to provide prior notification of hydraulic fracturing operations,

Finding 9.2.2.2.

Hydraulic fracturing materials used, aggregate volumes of fracturing fluids and proppant used, and fracturing pressures are not required to be reported to the DNR.

Recommendation 9.2.2.2.

The review team recommends that reporting should include the identification of materials used, aggregate volumes of fracturing fluids and proppant used, and fracture pressures recorded. (STRONGER Guidelines Section 9.2.2.)

STAFFING AND TRAINING

The Office of Conservation indicated that staffing levels are sufficient to address hydraulic fracturing and other oil and gas activities. Field staff levels were increased prior to the development of the Haynesville Shale. There is no expectation of staff cuts due to budget issues.

There are 38 oil and gas field inspectors, in addition to environmental, injection, and pipeline inspectors. District offices of the Office of Conservation are located in Lafayette, Monroe and Shreveport. There are 18 oil and gas inspectors assigned to the Lafayette District, seven to the Monroe district, and 13 to the Shreveport District, which includes the Haynesville Shale. Inspectors typically work from their homes and report to the district office once each week. The

Office of Conservation is satisfied with this arrangement and the current allocation of field staff to each district.

Professional technical staff (geologists and engineers) receives training through technical workshops and seminars. Field staff training usually occurs during quarterly meetings, and is usually in a discussion format concerning issues raised by field staff. More structured training for field staff is being developed.

Finding 9.2.3.1.

Inspectors visit well locations on the average of three to five times during drilling and completion.

Finding 9.2.3.2.

Field staff training usually occurs during quarterly meetings, and is usually in a discussion format concerning issues raised by field staff.

Recommendation 9.2.3.2.

The review team recommends that field staff should receive more structured training to stay current with new and developing hydraulic fracturing technology. (STRONGER Guidelines, Section 9.2.3.)

PUBLIC INFORMATION

The Office of Conservation has been involved in a number of local meetings and forums on well construction, water use, and hydraulic fracturing operations.

The agency web site includes a dedicated page providing up-to-date information on the Haynesville Shale. The web site includes a link to an API video that demonstrated the hydraulic fracturing process as well as memos, advisories, notices of rulemaking and presentations prepared by the Office of Conservation. The site also includes maps and spreadsheets with well information.

Finding 9.2.4.1.

The Office of Conservation has a good public outreach program in place that includes participation in industry meetings, workshops for the public, and the DNR web site.

III. WATER AND WASTE MANAGEMENT

As mentioned above, the Office of Conservation is responsible for the regulation and conservation of oil, gas, lignite and other natural resources. As such, they have responsibilities regarding the sources of water used in hydraulic fracturing operations. During the development of the Haynesville Shale, Office of Conservation staff recognized, through review of publications and experience, the potential impacts on domestic water use by use of the Carrizo-Wilcox aquifer for hydraulic fracturing purposes. Initially nearly all water used for hydraulic fracturing in the Haynesville Shale was groundwater. Hydraulic fracturing accounts for nearly 90 percent of the water demand for E&P purposes.

In addition to the Carrizo-Wilcox, Upland Terrace and Sparta aquifers, the Red River Alluvial is a source of groundwater of lower quality that is suitable for hydraulic fracturing purposes. There are also several surface water sources available in the area of the Haynesville Shale, including the Red River, Toledo Bend Reservoir, and other lakes and bayous. Both the Toledo Bend reservoir and the Red River have yield capacities that far exceed projected demand for hydraulic fracturing purposes in the Haynesville Shale.

In response to the impacts on domestic water use of the Carrizo-Wilcox aquifer, in 2008 the Office of Conservation advised operators to use alternative sources of water for hydraulic fracturing. The advisory stated:

“... Therefore, if ground water must be used for drilling or hydraulic fracturing stimulation purposes, it is recommended that the Red River Alluvial aquifer be utilized for these purposes, where feasible, as the source of ground water supply in lieu of the Carrizo-Wilcox aquifer. ... The Commissioner further encourages oil and gas operators to use the available surface water resources or other acceptable alternative water sources in Northwest Louisiana where practical and feasible. ...”

In addition, in a separate letter to operators the Commissioner instituted the requirement that:

“... Specifically, the water source and associated volume must be reported on page two (2) of the „Well History and Work Resume Report“ (Form WH-1) which must be filed within twenty days after completion or recompletion operations. The water sources must be identified by either the water well number or water body name, as appropriate. Separate water volumes for rig supply use and stimulation operation use must be provided.”

As a result of those actions, water demand for the year from October 1, 2009 to September 30, 2010 was met primarily (78 percent) by surface water. Through these actions, the Office of Conservation is confident that long-term adverse impacts to the Carrizo-Wilcox aquifer have been prevented.

Act 955 of 2010 encourages, through environmental permitting and cooperative agreements approved by the DNR Office of Mineral Resources, the establishment of protocols for the use of

surface water bodies in the public domain. These agreements provide information about the body of water and its uses.

The use of alternate sources of water and recycling of E&P waste fluids for hydraulic fracturing in the Haynesville Shale are encouraged. Until recently, Office of Conservation rules did not allow the recycling of flowback. Recent changes allow operators to use their own E&P Waste fluids, including produced water, rainwater, and flowback, for frac supply purposes (LAC 43:XIX.313.J). Additional changes have been adopted to provide specific permitting protocol for off-site (commercial) waste fluid treatment and reclamation for frac water supply purposes (LAC 43:XIX.565).

Wastes associated with hydraulic fracturing are either disposed of on-site in a manner that protects public health and the environment or are transported to permitted waste disposal facilities. Transported waste documentation and tracking by waste type and volume from the point of generation to the point of disposal is required.

On-site and regional offsite commercial injection wells are used for disposal of hydraulic fracturing wastes. In addition, waste is transported to Texas and Arkansas for disposal. Recently there has been an increase in the number of applications for disposal wells in north Louisiana as a result of development of the Haynesville Shale.

Finding 9.3.1.

The review team supports the Office of Conservation actions to protect the Carrizo-Wilcox aquifer and encourage the use of surface water or poorer-quality groundwater sources for hydraulic fracturing.

Finding 9.3.2.

There is adequate surface water available for anticipated hydraulic fracturing needs in the Haynesville Shale. Both the Toledo Bend reservoir and the Red River have yield capacities that far exceed projected demand for hydraulic fracturing purposes.

Finding 9.3.3.

The use of alternate sources of water and recycling of E&P waste fluids for hydraulic fracturing in the Haynesville Shale are encouraged. Recent amendments to the regulations allow E&P Waste fluids, including produced water, rainwater, and flowback, to be used for frac supply purposes.

Appendix A Acronyms

DEQ	Department of Environmental Quality
DNR	Department of Natural Resources
E&P	Exploration and Production
EPCRA	Emergency Planning and Community Right-to-Know Act
IOCC	Interstate Oil Compact Commission
IOGCC	Interstate Oil and Gas Compact Commission
NORM	Naturally Occurring Radioactive Material
RBDMS	Risk Based Data Management System
STRONGER	State Review of Oil and Natural Gas Environmental Regulations, Inc.
TCF	Trillion Cubic Feet
TPH	Total Petroleum Hydrocarbons
UIC	Underground Injection Control
USDW	Underground Source of Drinking Water
USEPA	U.S. Environmental Protection Agency

Appendix B Hydraulic Fracturing Questionnaire

(Note: Written responses to questions should be brief (i.e., 1 paragraph in length). Additional information may be requested by the review team during the in-state portion of the review.)

General [X.2]

Has the state evaluated potential **risks associated with hydraulic fracturing**, taking into account factors such as depth of the reservoir to be fractured, proximity of the reservoir to fresh water resources, well completion practices, well design, and volume and nature of fluids?

Yes. The geologic relationship in Louisiana between the freshwater aquifers and the reservoirs and formations that are being hydraulically fractured make potential risks extremely low. Typically, the freshwater aquifer is vertically separated from the reservoir/formation by at least one mile of sediments including massive confining (impermeable) clays that are several hundred feet thick. For the Haynesville Shale, this vertical separation is approximately two (2) miles. These conditions make wellbores the only potential conduit for contamination of freshwater aquifers. Minimum requirements for the setting and testing of casing and cement specified in LAC 43:XIX.109 ensure well integrity.

Has the state developed **standards to prevent the contamination** of groundwater and surface water from hydraulic fracturing?

No specific standards for hydraulic fracturing operations have been developed. However, contamination of a groundwater aquifer or an Underground Source of Drinking Water (USDW) with E&P Waste is strictly prohibited (LAC 43:XIX.303.C). Also, minimum requirements exist for the setting and testing of casing and cement to ensure well integrity (LAC 43:XIX.109). The storage of produced fluids and frac flowback fluids in tanks or lined production pits is also required to prevent possible surface water or groundwater contamination. For earthen pits, minimum liner specifications are required by LAC 43:XIX.307.A.1. Pre- and post-pit closure soil analytical requirements ensure that all onsite E&P Waste storage, treatment and disposal activities do not impact groundwater or surface water resources (LAC 43:XIX.311 & 313). In addition, a Spill Prevention Control and Countermeasure (SPCC) plan shall be developed and implemented in accordance with L.A.C. 33:IX. Subpart 1, Chapter 9, LDEQ Environmental Regulations.

Hydraulic Fracturing Standards [X.2.1]

Describe how state standards for **casing and cementing** meet anticipated pressures associated with hydraulic fracturing to protect other resources and the environment.

Minimum requirements for the setting and testing of casing and cement ensure that well integrity exists prior to conducting hydraulic fracturing operations (LAC 43:XIX.109). There are no

specific requirements for casing weights and grades used in hydraulic fracturing operations, but each Work Permit issued by the Conservation District Manager is reviewed for adequacy. DNR is currently funding a regulatory study by the Department of Petroleum Engineering at Louisiana State University to investigate potential rule changes related to oil and gas well construction. The first recommendations should be provided to DNR by December 2010.

Discuss how the program identifies and, where deemed appropriate, manages risks associated with **potential conduits for fluid migration** in the area of hydraulic fracturing.

With production beginning around 1910, there has been much prior geological information generated for Northwest Louisiana. This geologic information affords sufficient USDW protection as evidenced by the successful operation of 1,586 Class II injection wells in the Haynesville Shale region with no cases of USDW contamination attributed to those wells.

Describe program requirements that address actions to be taken in **response to unanticipated operational or mechanical changes** encountered during hydraulic fracturing that may cause concern.

Operators are issued Compliance Orders requiring investigation, assessment and remedial action to address any unanticipated operational or mechanical problems identified. In addition, the Office of Conservation acts as a support agency to the Louisiana State Police, Louisiana Department of Environmental Quality and local emergency response agencies.

Briefly describe how **surface controls** associated with hydraulic fracturing, such as dikes, pits or tanks, meet Sections 5.5 and 5.9 of the guidelines.

For protection of surface water and groundwater, E&P Waste derived from Hydraulic Fracturing Operations must be stored in tanks or in lined pits. Regulations for storage of E&P Waste in pits include liner design specifications and requirements to ensure adequate levees and freeboard during operation and proper closure (see LAC 43:XIX.307.A & 311). Pre- and post-pit closure soil analytical requirements ensure that all onsite E&P Waste storage, treatment and disposal activities do not impact groundwater or surface water resources (LAC 43:XIX.311 & 313).

Briefly describe how **contingency planning and spill risk management** procedures related to hydraulic fracturing meet Section 4.2.1 of the guidelines.

A Spill Prevention Control and Countermeasure (SPCC) plan shall be developed and implemented in accordance with L.A.C. 33:IX. Subpart 1, Chapter 9, LDEQ Environmental Regulations.

Briefly discuss how hydraulic fracturing **waste characterization requirements**, including, as appropriate, testing of fracturing fluids, are consistent with Section 5.2 of the guidelines.

Hydraulic fracturing fluid material that returns to the surface during fracture stimulation operations is by definition an exploration and production waste (E&P Waste), i.e., Waste Type 04, Completion workover and stimulation fluids, as defined in LAC 43:XIX.501. The General Requirements for Generators of E&P Waste under LAC 43:XIX.503.A requires generators to be “familiar with the components of the E&P Waste they generate” and provides that “E&P Waste characterization procedures should be undertaken to determine the constituents of E&P Waste prior to disposal” offsite. LAC 43:XIX.503 further provides a listing of constituents for which E&P Waste should be tested, at a minimum, prior to offsite disposal.

Briefly describe how the **waste management hierarchy** contained in Section 5.3 of the guidelines (source reduction, recycling, treatment and disposal), including the provisions relating to toxicity reduction, are promoted for hydraulic fracturing.

Source reduction and recycling are encouraged by recently promulgated regulations to allow the use of certain E&P Wastes (produced water, rainwater, drilling, workover, completion and stimulation fluids) as a component in hydraulic fracturing fluids used in the Haynesville Shale (see LAC 43:XIX.313.J)

Briefly describe how the **tracking of hydraulic fracturing waste** disposed at commercial or centralized facilities meets the requirements of Section 5.10.2.3 of the guidelines.

LAC 43:XIX.503.D states that “the generator is responsible for the proper handling and transportation of E&P Waste taken offsite for storage, treatment, or disposal to assure its proper delivery to an approved commercial facility or transfer station or other approved storage, treatment or disposal facility. Failure to properly transport and dispose of E&P Waste shall subject the generator to penalties provided for in R.S. 30:18.” Each shipment must be documented as required by the Manifest System requirements of LAC 43:XIX.545.

Briefly describe how procedures in place for receipt of **complaints** related to hydraulic fracturing are consistent with Section 4.1.2.1.

Public complaints are given top priority by the Office of Conservation. Information regarding the nature and handling of the complaint is maintained in the DNR SONRIS database. Complainants are copied on any agency correspondence regarding the complaint.

Reporting Associated with Hydraulic Fracturing [X.2.2]

Describe any required **notification** prior to, and reporting after completion of, hydraulic fracturing operations.

Notification is made through the filing of a work permit application (DM-4-R) prior to conducting hydraulic fracturing operations. Following completion operations, a 'Work Resumé and Well History Report' (WH-1) is required which summarizes the work performed on the well and the current well configuration.

Is notification sufficient to allow for the **presence of field staff** to monitor hydraulic fracturing activities?

Yes. Pursuant to LAC 43:XIX.105.A, the Conservation District Manager must be notified at least 12 hours prior to beginning any operations covered by a Work Permit in order to provide an opportunity for the agency to witness the operations. Additionally, copies of approved Work Permits are provided to field inspectors.

Describe **reporting requirements** for hydraulic fracturing activities and whether they include the identification of materials used, aggregate volumes of fracturing fluids and proppant used, and fracture pressures recorded.

Information regarding the origin and volume of water used for hydraulic fracturing operations is required from the operator. There are no additional reporting requirements; however, operators typically report aggregate volumes of fracturing fluids and proppant types on the work permit application (DM-4-R) and/or the 'Work Resumé and Well History Report' (WH-1). Conservation Commissioner Welsh is on the IOGCC Shale Gas Director's Committee that is working in cooperation with the GWPC to develop a national hydraulic fracturing fluid database to collect and report the contents of fracturing fluids used in shale gas wells.

Describe any mechanisms for **disclosure of information on chemical constituents** used in hydraulic fracturing fluids to the state in the event of an investigation or to medical personnel in the event of a medical emergency.

It is required that an employer using hazardous and/or regulated materials must maintain and make available to employees and responders the Material Safety Data Sheets for these materials in accordance with 29 CFR 1910.1200(g)(8 – 11), OSHA General Industry Regulations.

Briefly describe how hydraulic fracturing information submitted that is of a **confidential business nature**, is treated consistent with Section 4.2.2 of the guidelines?

No confidential information on hydraulic fracturing is required to be disclosed.

Staffing and Training [X.2.3]

Briefly discuss if, in addition to the personnel and funding recommendations found in Section 4.3 of the guidelines, **state staffing levels** sufficient to receive, record and respond to complaints of human health impacts and environmental damage resulting from hydraulic fracturing.

Current Conservation staffing levels have been sufficient to address the small number of complaints received regarding hydraulic fracturing operations.

Describe staff **training** to stay current with new and developing hydraulic fracturing technology.

The agency has and currently facilitates technical seminars scheduled throughout the year that are conducted by operators, service companies or consultants on various topics including reservoir evaluation, drilling optimization, and stimulation (including hydraulic fracturing). Licensed engineers and geologists on staff are also required to meet certain continuing education requirements as a condition of their licensure. Certificates of course completion are issued by the Commissioner of Conservation.

Public Information [X.2.4]

Briefly describe how the state agency provides for **dissemination of educational information** regarding well construction and hydraulic fracturing to bridge the knowledge gap between experts and the public as provided in Section 4.2.2.2 of the guidelines. This is especially important in areas where development has not occurred historically and in areas where high volume water use for hydraulic fracturing is occurring.

The agency has facilitated several local meetings and forums that include discussions of well construction requirements, water use, and hydraulic fracturing operations. A dedicated Conservation web page covering the latest information on the development of the Haynesville Shale was created by Conservation to help educate the public. The web page includes a link to an API video which demonstrates the hydraulic fracturing process and a link that allows the public to ask the agency questions. In addition, it should be noted that the entire Haynesville Shale region in Northwestern Louisiana has been subject to extensive oil and gas development since about 1910.

Water and Waste Management Associated with Hydraulic Fracturing [X.3]

Fundamental differences exist from state to state, and between regions within a state, in terms of geology and hydrology. Describe how the state evaluated and addressed, where necessary, the **availability of water for hydraulic fracturing** in the context of all competing uses and potential environmental impacts resulting from the volume of water used for hydraulic fracturing.

At the onset of Northwest Louisiana Haynesville Shale exploration and production activity using hydraulic fracture stimulation operations, the agency identified a real potential for adverse impacts to the Carrizo-Wilcox aquifer system due to the system's geophysical water withdrawal capacity limitations based on published literature and staff experience. Accordingly, in the Fall of 2008, the Commissioner of Conservation issued a ground water use advisory encouraging operators to seek alternative frac water supply resources to reduce reliance upon ground water derived from the Carrizo-Wilcox aquifer system. The agency is confident that: 1) issuance of the advisory, 2) development and implementation of an initial aggressive operator education campaign, 3) aggressive implementation and enforcement of water well notification requirements, 4) use of sound objective scientific ground water well location and use evaluation practices, 5) development and implementation of frac water supply water use reporting requirements, 6) amending E&P Waste regulations to allow for waste fluid recycling for frac water supply purposes, and 7) continuation of effective operator and public education activities, have collectively been effective in preventing both short and potentially long term adverse impacts to the Carrizo-Wilcox aquifer system and aquifer system users. Regarding surface water use, ACT 955 of 2010 provides for a means for all non-riparian surface water users to apply for departmental approval to withdraw running surface waters of the state through a environmental permitting and cooperative endeavor agreement process.

Describe how the availability and use of **alternative water sources** for hydraulic fracturing, including recycled water, is encouraged.

The use of alternative water sources is encouraged by recently promulgated regulations to allow the use of certain E&P Wastes (produced water, rainwater, drilling, workover, completion and stimulation fluids) as a component in hydraulic fracturing fluids used in the Haynesville Shale (see LAC 43:XIX.313.J)

Briefly describe how **waste** associated with hydraulic fracturing is managed consistent with Section 4.1.1. and Section 7 of the guidelines.

Regulations ensure that all E&P waste associated with hydraulic fracturing is either transported to properly permitted waste disposal facilities or disposed of onsite in a manner which is protective of the public health and environment. Certain E&P wastes may be used as a component in hydraulic fracturing fluids used in the development of the Haynesville Shale. In all cases, documentation is developed to allow tracking of waste types and volumes from the point of generation to the point of disposal.

Discuss how the state encourages the efficient development of adequate **capacity and infrastructure** for the management of hydraulic fracturing fluids, including the transportation, recycling, treatment and disposal of source water and hydraulic fracturing wastes.

At the onset of Northwest Louisiana Haynesville Shale exploration and production activity using hydraulic fracture stimulation operations, the agency assessed all available surface and ground

water resources in the region and identified more than ample surface water resource capacity for the anticipated life of the Haynesville Shale play in both the Red River and Toledo Bend Reservoir. The Red River Alluvial aquifer system was also identified as a prolific non-potable ground water resource in the area. However, the agency identified a real potential for adverse impacts to the Carrizo-Wilcox aquifer system due to the system's geophysical water withdrawal capacity limitations. Consequently, the agency issued a ground water use advisory encouraging operators to seek alternative frac water supply resources to reduce reliance upon ground water derived from the Carrizo-Wilcox aquifer system followed by implementation of both an aggressive operator source water education campaign and new water use reporting requirements. Due to the close proximity of adequate water resources, development of new infrastructure is expected to be minimal or temporary in nature.

In addition to operator (onsite) Class II injection well disposal, regional commercial offsite waste management options are available in Louisiana, Texas and Arkansas at, to our knowledge, a sufficient capacity to economically keep up with demand. However, the agency has experienced an increase in the number of commercial E&P Waste treatment and disposal facility permit applications in North Louisiana. Should industry determine the need for additional capacity, the agency stands ready to address those needs with existing regulation and experienced staff.

The agency further encourages both waste minimization and water conservation with; a) recently promulgated regulations to allow the use of certain E&P Wastes (produced water, rainwater, drilling, workover, completion and stimulation fluids) as a component in hydraulic fracturing fluids used in the Haynesville Shale (see LAC 43:XIX.313.J) and b) proposed commercial E&P Waste treatment facility regulations allowing for the use of these same E&P Waste fluids to be used as frac fluid supply at permitted hydraulic fracture stimulation operations.

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