

**WYOMING DEPARTMENT OF ENVIRONMENTAL QUALITY
SOLID AND HAZARDOUS WASTE DIVISION
VOLUNTARY REMEDIATION PROGRAM**

**RESPONSE TO PUBLIC COMMENTS FOR
REMEDIAL INVESTIGATION WORK PLAN – FINAL DRAFT**

September 14, 2007
Windsor Energy Group, L.L.C.
Crosby 25-3 Natural Gas Well Release

1. **“Why was so little done to remediate the site in a timely fashion before the contaminant plume(s) migrated off the drill pad and why were the concerns of Line Creek residents as to movement of the contaminant plumes(s) dismissed with obviously premature comments as to the safety of drinking water from their domestic wells?” (CRC)***

This question has been posed by numerous residents of the Line Creek Wilderness Subdivision. The standard approach for clean-up of sites in the VRP is to first complete a thorough site investigation and use that information to design the most effective and efficient remediation system. The implementation of a remedial system without a thorough understanding of site conditions can potentially cause the contamination to migrate in directions that may cause undesirable impacts. Based upon available site data and the distance of the private water wells from the site, with the exception of the King’s well, the WDEQ did not believe there was sufficient evidence indicating that contamination would reach private water wells. The WDEQ recognizes that our assumption was incorrect. However, the WDEQ believes that there was frequent enough groundwater sampling of the private water wells to detect any unanticipated migration of contaminants prior to adversely impacting human health.

2. **“With benzene contamination present in the domestic King well, the Work Plan urgently needs to address potential migration pathways and potential future risks to the domestic wells and Line Creek. Domestic water wells should be sampled on at least a monthly basis along with all monitor wells, Line Creek, the springs flowing into Line Creek, and Bennett Creek-Section 36 potable water well.” (CRC)**

Once the contamination was identified in the King well, the WDEQ required Windsor to immediately sample the downgradient private water wells in proximity to the site. In addition, groundwater monitoring wells were installed to determine the downgradient extent of the plume. There are currently a number of groundwater monitoring wells downgradient of the plume and upgradient of the private water wells, excluding the King’s well. These monitoring wells will be sampled monthly and the private water wells continue to be sampled quarterly. If contamination is identified in the downgradient monitoring wells, then the sampling frequency of the private water wells

will be increased accordingly. To date, all Line Creek surface water samples have been non-detect for all constituents. The WDEQ does not see a need to increase the sampling frequency to monthly for Line Creek. The springs continue to show elevated levels of benzene. The WDEQ does not believe that increasing the sampling frequency to monthly would result in any added environmental benefit. The WDEQ has requested Windsor to install monitoring points adjacent to Line Creek to more accurately determine if contamination is discharging into the creek. If it is determined that contamination is discharging into the creek, then it will be addressed in the remedy.

3. **“The Work Plan should include a survey of each domestic well casing top elevation and measurement of static and pump down water elevations (including the Bennett Creek pad potable well). Line Creek elevations should be surveyed along its reach. A groundwater flow map should be prepared across an area that includes the site, Section 36-Bennett Creek potable well, Line Creek and all domestic wells. The flow maps should be superimposed over the topographic map. These data should be used to determine if Line Creek is a gaining or losing stream. Permeabilities, transmissivity rates, specific capacity should be determined for each groundwater zone. Magnitude of the hydraulic gradient and variability of flow direction should be compared for different sites.”** (CRC) Also commented on by OGAP.

On October 9, 2007, the WDEQ requested that Windsor obtain static water levels and screen interval information from private water wells (between the Kings and Sands Dickson’s well) as soon as possible. Windsor replied on October 15, 2007 with the attached response. In summary, Windsor has both technical and legal concerns with obtaining static water levels from private water wells. These appear to be valid concerns. Windsor also asked to table this request until the investigation activities are completed due to the resources involved for both efforts. The WDEQ requests that, upon completion of the investigation, sampling and interim measures activities, Windsor initiate the WDEQ’s October 9, 2007 request. The WDEQ recognizes that carrying out the request is contingent upon technical and legal concerns being adequately resolved. If Windsor is able to obtain static water levels from private water wells, this information should be included in the “Report of Investigation – Phase 2” (ROI-2). In addition, the WDEQ requests that Windsor include in the ROI-2 aquifer characterization information, including but not limited to, flow direction and velocity, hydraulic conductivity, transmissivity, effective porosity and other pertinent information in accordance with the signed Preliminary Remediation Agreement (PRA). Groundwater flow maps should be constructed utilizing all locations where reliable static water levels are obtained. Separate groundwater flow maps should be constructed for each distinguishable aquifer. Data should also be evaluated to determine if Line Creek is a losing or gaining stream. Windsor has completed a survey of the center line of Line Creek.

4. **“Geologic cross sections should then be prepared showing the site, Line Creek, the Bennett Creek well and each domestic well.”** (CRC) Also commented on by OGAP.

The WDEQ agrees that all reliable available data should be utilized to construct geologic cross sections across the area of interest. Cross sections should be included in the ROI-2 and include appropriate legends, scales, and reference points.

5. **“....a geologic map should be prepared to document the locations of faults and the surface geology.”** (CRC) Also commented on by OGAP.

The WDEQ requests that Windsor conduct a literature search to determine if faults have been mapped in the area, including information from the United States Geological Survey. If available, this information should be included in the ROI-2 in both map and cross-section form. The WDEQ recognizes that this information may be on too large of a scale or too far from the site to be useful on this project. The WDEQ believes that it would be unreasonable and inconsistent from other sites to require Windsor to conduct detailed geologic mapping activities to construct a geologic map of the area.

6. **“...geologic cross sections based on Windsor’s 3D and 2D seismic data and well control (oil/gas wells) should be constructed.”** (CRC)

The WDEQ requests that Windsor evaluate their seismic and well data to determine if there is site specific fault data which would be useful in site characterization. If such data exists then it should be incorporated into the site geologic cross sections and maps.

7. **“Some effort should be made to identify orientations of fracture patterns and the associated faulting in the immediate area since this potential for anisotropy could influence contaminant plume migration and also aid as a predictive tool.”** (CRC) Also commented on by OGAP.

The WDEQ agrees that identifying fracture patterns would be useful for site characterization and to predict plume migration patterns. Based on site visits during drilling activities, the WDEQ also recognizes that reliably documenting fracture patterns from core samples is difficult because of the unconsolidated sediments, the conglomeratic nature of the formation, and the lack of intact core returns. In addition, the WDEQ is reluctant to require additional technologies be utilized in an attempt to identify fracture patterns because of the amount of work/resources required to obtain data which may or may not be useful in remedy implementation.

8. **“The Work Plan should provide a statement as to the remediation standards for soil and groundwater and surface water that are applicable and relevant and appropriate.”** (CRC)

All sampling data from the investigation should be included in the ROI-2. The data should be compared to the soil cleanup levels in the VRP Fact Sheet #12 (Soil Cleanup Level Look-Up Table), to the groundwater cleanup levels in the VRP Fact Sheet #13 (Groundwater Cleanup Levels Under the VRP), and to the surface water levels in the WDEQ, Water Quality Rules and Regulations, Chapter 1.

9. **“The Work Plan should state that the sonic soil core samples will be collected from the center of the cores where significant heat, if any, may not cause significant volatilization during the sampling. The Work Plan should also state the frequency of soil sample collection along the core length and the criteria and rationale used for determining the sample interval. Any indication of fracturing should be noted in the core descriptions along with fracture orientation, if possible.”** (CRC)

These items have been adequately addressed in the work plan. In addition, site visits by the WDEQ have ensured that these practices were being properly conducted during field activities. Also see item #7 above.

10. **“The Work Plan should include carbon isotope testing on methane encountered in the domestic wells to differentiate between biogenic and thermogenic sources.”** (CRC)

Dissolved methane in drinking water poses no toxic hazard to human health and is not regulated. Methane dissolved in groundwater cannot explode; however, methane gas can accumulate in an enclosed space such as a well pit, pump house or well casing and cause explosion. The solubility of methane in water is between 28 and 30 mg/L. The U.S. Department of the Interior, Office of Surface Mining (OSM) advises owners of wells with methane concentrations greater than 28 mg/L to immediately contact their local county health departments to obtain assistance and guidance in venting the well head and for other possible remediation alternatives. For methane concentrations less than 10 mg/L, the OSM recommends no action, other than periodic monitoring to see if methane concentrations are changing. The methane encountered to date in the domestic wells where no other hydrocarbon impacts have been detected has ranged from non-detect to 0.013 mg/L. Methane measured in the King well after other hydrocarbon impacts were detected ranged from 0.519 to 1.52 mg/L. The WDEQ believes that continuing to monitor methane in the domestic water wells and the groundwater monitoring wells provides sufficient protection of human health by monitoring for explosive levels of methane. Based on the current methane data available, the WDEQ does not believe that carbon isotope testing to determine if the methane is from a biogenic or thermogenic source would result in a substantial environmental benefit.

11. **“EPA Method 524.5 should be used for the water tests as this method is used for Safe Drinking Water Standards, provides good verification, and is a more accurate.”** (CRC)

The EPA test for Volatile Organic Compounds (VOCs) in water in accordance with the Safe Drinking Water Standards is Method 524.2 not 524.5. EPA Method 8260B is the analytical method being used to test for VOCs in water at the site. Method 8260B uses the same analytical method as 524.2 (GCMS), but runs more surrogates for internal standards and covers more analytes. Method 524.2 is not more accurate than Method 8260B. The WDEQ does not believe there are sufficient reasons to run Method 524.2 in place of 8260B.

12. **“Sediments and water trapped in the beaver dams on Line Creek should be evaluated for contaminants from the blowout. Due to the presence of benzene in the King domestic well, sediment and water should be sampled from the beaver dams on a monthly basis.”** (CRC)

The VRP requires (per W.S. 35-11-1605) some level of ecological risk assessment be conducted at all VRP sites. WDEQ uses a stepwise approach to ecological risk assessment. There are 4 potential steps in the process. Windsor must conduct an ecological risk assessment for the site in accordance with the VRP Fact Sheets #14 and

#19 and include the results in the ROI-2. The ecological risk assessment is the mechanism which will determine if additional monitoring is necessary for Line Creek and the associated beaver ponds.

13. **“The Work Plan states a forensic evaluation will be completed of potential relic contamination.....If the conclusions reached from the analysis are used in such a way that they impact cleanup or remediation plans for the site, we recommend our own experts review the data and evaluate the validity of the interpretations. In order to do that, we will require at a minimum the following information.....”**
(CRC)

To date, no forensic evaluation has been conducted for the site. In addition, the WDEQ has not reviewed or approved a work plan for forensic evaluation. If Windsor chooses to conduct a forensic evaluation to use in support of relic contamination, then the data and evaluation will be public record and open to public review.

14. **“A deep zone groundwater flow map should be included in the Work Plan together with the existing shallow zone flow map.”** (CRC)

The ROI-2 will include the results from the hydrogeologic testing and static water levels. That data will be used to determine if the upper and lower groundwater bearing zones are in communication or are separate aquifers. If the data indicates that the upper and lower zones are not in communication, then Windsor should include groundwater flow maps for both aquifers.

15. **“Contaminant plume maps should be constructed so they can be layered on the groundwater flow maps and topographic base map. Additionally, a contaminant plume model should be identified as a predictive tool. The methodology and statistical analysis required for fitting the plume model to the observed contaminant concentration data and estimating plume dimensions should be described.”** (CRC)

The WDEQ agrees that contaminant plume maps showing contaminant concentrations is a valuable tool for visualizing and evaluating plume movement. Contaminant plume maps should be included in the ROI-2. However, because there is an adequate groundwater monitoring network installed at the site which has defined the downward extent of the plume, the WDEQ is not, at this time, requiring Windsor to utilize a contaminant plume model for predictive purposes.

16. **“The MSDS sheets for all potential contaminants should be included in the work plan as an appendix, not just on the Windsor web page. The fact that a number of contaminants have been detected (p. 24 – Final Draft) but are considered of “minimal project value” since there are currently “no standards for comparison” is really worrisome. As testing continues, more and more of these compounds are being encountered. We recently learned that methyl ethyl ketone was found in the Hutton domestic water well.”** (CRC) Also commented on by OGAP.

Due to the volume of MSD sheets (approximately 200), the WDEQ is not requiring Windsor to include them in the work plan since everyone on the interested parties mailing list receives a copy of the final work plan. However, the WDEQ has requested that

Windsor provide the MSD sheets to all interested parties that request them and also to make them available to the public at the central repository. The contaminants referred to on p. 24 of the final draft are petroleum related contaminants for which there are no groundwater standards currently available. However, it is reasonable to assume that the remedy that will be utilized to address the petroleum contamination will ultimately cleanup all of the petroleum related contaminants, regardless if there is a cleanup standard available.

The methyl ethyl ketone detected in the Hutton well is not a contaminant associated with natural gas/condensate releases. Methyl Ethly Ketone is primarily used as a solvent and in house hold products such as lacquer, varnishes, paint remover and glues. Based on the fact that methyl ethyl ketone has only been detected once in the Hutton well and that it has not been detected in any other monitoring or domestic wells, it seems reasonable to assume that the source is not from the blowout. The WDEQ believes that there is adequate testing being conducted at the site to monitor for the contaminants of concern.

17. **“Problems with loss of circulation in the Crosby 25-3 well should also be addressed. The interval(s) affected should be identified and evaluated as possible contributors to the groundwater contamination.”** (CRC)

The WDEQ has requested that Windsor include in Section 1.3 of the work plan, any pertinent information on the drilling activities associated with the Crosby 25-3 well including specific intervals of lost circulation or abnormal pressures and how these issues were addressed.

18. **“Tests for radioactivity should be conducted on all groundwater samples. Radioactivity is picked up by the drilling muds in the circulation process.”** (CRC)

Naturally Occurring Radioactive Materials (NORM) associated with oil and gas activities originate in subsurface formations, in particular the formation water. NORM can be brought to the surface in the water produced in conjunction with oil and gas. NORM levels in produced waters are typically low unless it becomes concentrated in some manner. Typical ways that NORM can become concentrated are through pressure and temperature changes which causes the material to co-precipitate in pipes and surface equipment or in sludges in pits and tanks. High levels of NORM in produced water have historically not been an issue in Wyoming. Therefore, the WDEQ is not requiring Windsor to test groundwater at the site for radioactivity.

19. **“A more detailed description of the drilling history along Line Creek was prepared by the Wyoming Oil and Gas Conservation Commission, immediately following the Crosby 25-3 blowout. That description should be substituted for the limited paragraph - - 1.2 Site History or at least included as an appendix.”** (CRC)

The section **1.2 Site History** in the final draft includes 3 paragraphs discussing the history of the site. In addition, the WDEQ has requested that the final work plan also include information on all current and historical wells located on the Crosby well pad including the following production information: geologic production zones, timeframes of production, and types of hydrocarbons.

20. **“Description of the removal/remediation program and timetable for the impacted surficial soils should be included. All soil test results for the Crosby 25-3 site should be available.”** (CRC)

The impacted soils at the site are being addressed under the guidance of the Wyoming Oil and Gas Conservation Commission (WOGCC). Information on soil investigation, sampling results, and cleanup levels is available on the WOGCC web site under the Crosby Well 25-3 well record (API #2931114). The PRA requires that the site characterization report include results of the soil investigation. Windsor should include in the ROI-2 a map of the extent of the contaminated soils and a description of contaminant and soil chemical properties within the contaminant source area and any other factors that might affect contaminant migration and transformation. This information is necessary to determine if the soils are acting as a contaminant source to groundwater which is being cleaned up under VRP guidance.

21. **“We have to repeat and reemphasize that as a matter of good science, quantified data should not be devalued in a “subjective” qualitative table (i.e. Section 5.0 Conclusions, p. 16). If a summary is presented, the data should retain their quantitative status and presentation should be statistical (i.e. as percentile). All statements must be supported by data or referenced to data-supported scientific research.”** (CRC)

It is unclear what this comment is referring to since: 1) in the final draft work plan Section 5.0 is Quality Assurance/Quality Control Methods, 2) there is no Conclusions section, and 3) page 16 discusses monitoring well construction. On page 6 and page 7 of the final draft work plan there are tables with monitoring wells listed and noted changes in the sampling results between the 2nd and 3rd sampling events. However, these tables include language previously requested by the WDEQ (per CRC’s request) which states that the noted changes are subjective and not supported by statistical analysis. In addition, there have not been enough sampling events to conduct reliable statistical evaluations of the data set.

22. **“Full macroinvertebrate testing of Line Creek and correlation to the baseline macroinvertebrate testing done in 2000 should be performed along with macroinvertebrate testing of the springs feeding into Line Creek....”** (CRC)

The VRP requires (per W.S. 35-11-1605) some level of ecological risk assessment be conducted at all VRP sites. WDEQ uses a stepwise approach to ecological risk assessment. There are 4 potential steps in the process. Windsor must conduct an ecological risk assessment for the site in accordance with the VRP Fact Sheets #14 and #19 and include the results in the ROI-2. The ecological risk assessment is the mechanism which will determine if macroinvertebrate testing of Line Creek and the springs feeding Line Creek is necessary. Since the WDEQ/VRP did not approve the macroinvertebrate testing done in 2000, the data would need VRP evaluation and approval for decision making at the site.

23. **“....It would be prudent to include in the groundwater monitoring and remediation program a public health monitoring program, perhaps under the auspices of the**

Wyoming Department of Health, to identify potential health concerns and detect and document any health problems for Line Creek residents, Windsor employees and sub-contractors employed during the blowout and first responder to the blowout.” (CRC)

This request is beyond the scope of the WDEQ/VRP and should be addressed through the appropriate federal, state or local agencies.

24. **“No projected timetable or plan is presented in the draft for remediation and retiring of the monitoring wells after remediation is completed. These wells, until they are properly retired, and if not properly maintained, are conduits to the aquifers.” (CRC)**

It would be premature at this time to set up a timetable for plugging and abandoning the groundwater monitoring wells at the site since investigation and remedy implementation are not completed. Under the WDEQ, Water Quality Division (WQD) Rules and Regulations, Chapter 11, wells must be properly plugged and abandoned when they have not been used for a period of one year, unless the owner demonstrates his intention to use the well again by properly maintaining it. In accordance with item #9 of the PRA, the groundwater monitoring wells at the site will be constructed, maintained and plugged and abandoned in accordance with WQD Rules and Regulations, Chapter 11, Part G.

25. **“Costs for monitoring and remediation of the Crosby site, groundwater, springs, domestic wells and Line Creek should be revealed throughout the process and made a part of the public record. These should be the costs incurred by Windsor, the state, the county, and the public.” (CRC)**

The WDEQ does not have the authority to require Windsor, the county, or the public to provide the costs incurred for the monitoring and remediation activities at the site. The costs incurred by the state VRP are for oversight of the project which is billed to Windsor at \$50 per hour. The billing information is available from the WDEQ/VRP accounting department in Cheyenne. The public must request to inspect an agency file in accordance with Department Policy #10 (attached).

26. **“No explanation has yet been presented in the Work Plan as to what actually caused the blowout. An explanation should be provided.” (CRC)**

The WDEQ has requested that Windsor include in the final work plan (Section 1.3, **Chronology of Release**) a proposed explanation of how the blowout occurred and at what depth(s) the release left the well bore and entered the surrounding formation.

27. **“A number of important review comments were submitted to Windsor Energy Group, LLC by the WYDEQ on July 2, 2007. Not all of these comments have been incorporated into the Final Draft Plan. Will they be added?” (CRC)**

The WDEQ’s November 28, 2007, *Review Comments for the Remedial Investigation Work Plan – Final Draft* addresses any remaining comments that the WDEQ has on the work plan.

28. **“In light of the unfortunate discovery of benzene in the King’s well, what is the current plan/methodology and timetable for remediation?”** (CRC)

Interim measures have been implemented to address the contamination in the King’s well. An air sparge/soil vapor extraction system is in the process of being installed upgradient of the King’s well. The WDEQ’s has requested that Windsor complete the “Report on Interim Measures” by January 1, 2008 and provide a copy of the document to the interested parties mailing list. The next step for the site is for Windsor to submit a ROI-2 which will include the results from the additional investigation. The WDEQ has requested that Windsor include a Remedial Alternatives Evaluation in the ROI-2. The Remedial Alternatives Evaluation report will evaluate the cleanup options for the site. The WDEQ will use this report to choose the appropriate remedy for the site. This process will be open for public review and comment in accordance with the Public Participation Plan. Because of the amount of information to be included in the ROI-2 (including the Remedial Alternatives Evaluation) the WDEQ has requested that Windsor submit the draft document by May 1, 2008

29. **“What is the “track record” of the Terracon personnel for dealing with a monitoring and remediation program on the scale of the Crosby 25-3 blowout? A discussion of their credentials and experience should be included in the work plan.”** (CRC)

The review process is intended to address any deficiencies in quality or content of work submitted for WDEQ approval. The PRA requires the Volunteer employ sound scientific, engineering, construction and management practices and principles. It is the Volunteer’s responsibility to ensure that personnel and contractors carrying out the work required by the PRA possess the appropriate qualifications. Work that is defined as ‘practice of geology’ before the public must be certified by a Professional Geologist registered in the state of Wyoming and work that is defined as ‘engineering practice’ must be certified by a Professional Engineer registered in the state of Wyoming.

30. **“Mention has been made that no sourcing of contaminants is currently occurring. Data and rationale for either current sourcing or non-sourcing of contaminants should be presented. If there are no data, then a procedure should be developed for establishing a data base to scientifically derive a conclusion.”** (CRC)

The WDEQ has requested that Windsor include in the final work plan (Section 1.3, **Chronology of Release**) information on why they believe that there are no longer any releases occurring from deeper oil and gas zones into the shallower aquifers.

31. **“OGAP reiterates our request for the identification and public dissemination of complete chemical make-up of all drilling products, including volumes and concentrations. In Section 6.0 of the Work Plan, Windsor provides discussion of the products that are a threat to drinking water, but for which there is no analytic testing suite or regulatory standard for the active ingredients. However, there is no discussion regarding the complete chemical make-up, volumes and concentrations for products that are a threat to groundwater and for which there is an analytic testing suite for active ingredients.I am requesting that a narrative discussion**

of these products, including their complete chemical make-up, volumes, and concentrations be disseminated to the public.” (OGAP)

Appendix B in the draft work plan contains a table that lists all products used in the drilling of the Crosby 25-3 well, the contents (i.e. constituents) of the products, and the amounts used. The discussion in Section 6.0 was to provide more information on chemicals which are a potential threat to groundwater, but which are not be included in the sampling program. Some of the contents which are a potential threat to groundwater are included in the current analytical suite. At this time, the WDEQ does not see a compelling reason to include a detailed discussion on these chemicals. The WDEQ has requested that Windsor clarify the table and add a column with the chemical formulas of the contents.

*Comments from Clark Resource Council (CRC), Oil & Gas Accountability Project (OGAP); other comments from the public have either been incorporated into the work plan, will be incorporated into the Report of Investigation – Phase 2, or are covered by the above comments.