REMEDIAL INVESTIGATION WORK PLAN – FINAL

Crosby 25-3 Natural Gas Well Release
Road 1AB
Clark, Park County, Wyoming

Submitted To:

Windsor Energy Group, L.L.C.
Oklahoma City, Oklahoma

1 February 2008

Terracon Job No.:
26067064

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Attention: Mr. William Liedtke

Subject: Remedial Investigation Work Plan – FINAL
Crosby 25-3 Natural Gas Well Release
Road 1AB
Clark, Park County, Wyoming
Terracon Project No. 26067064

Dear Mr. Liedtke:

Terracon Consultants, Inc. (Terracon) has prepared this *Remedial Investigation Work Plan – FINAL* presenting the final draft of our scope of work to complete remedial investigation activities at the Crosby 25-3 Natural Gas Well site (Site). This work plan is being prepared as one of the requirements of the Voluntary Remediation Program (VRP) and in response to:

- A letter from the Wyoming Department of Environmental Quality (WDEQ) entitled *Request for Workplan for Additional Investigation Activities – Crosby 25-3 Well Blowout – Clark, Wyoming* (VRP Site 58.093) dated May 18, 2007;

- A letter from the WDEQ entitled *WDEQ Review of Remedial Investigation Work Plan, June 15, 2007 – Crosby 25-3 Natural Gas Well Blowout; Clark Wyoming* dated June 25, 2007; and

- A letter from the WDEQ entitled *WDEQ Review of Remedial Investigation Work Plan – Amended Draft, July 2, 2007 - Crosby 25-3 Natural Gas Well Blowout; Clark Wyoming* dated August 17, 2007

- A letter from the WDEQ entitled *Review Comments for Remedial Investigation Work Plan – Final Draft, September 14, 2007 – Windsor Energy Group, LLC - Crosby 25-3 Natural Gas Well Release*

This document is also being transmitted to all interested parties who have previously requested to receive documents regarding the subject site and to all landowners in the Line Creek

Wilderness Subdivision. A public meeting was scheduled to discuss the contents of the *Final Draft* version of this document as well as the *Public Participation Plan – Final Draft* provided under separate cover. That meeting was held October 2, 2007 at the Clark-Pioneer Recreation Center.

The WDEQ requested that the final work plan only include information on site-specific field activities which had been completed at the time that the final draft work plan was completed. All subsequent field activities, including but not limited to, the installation of additional groundwater monitoring wells, additional hydrogeologic testing, additional groundwater sampling events with additional private water wells included, the installation of the air sparge/soil vapor extraction system (interim measures), and the installation of a carbon filter system on the King's domestic water well will be included in future documents.

We appreciate this opportunity to be of continued service to you. If you have any questions or comments regarding the findings in this document, please do not hesitate to contact us at your earliest convenience.

Respectfully submitted,
Terracon Consultants, Inc.

Michael J. Bullock, P.E.
Environmental Department Manager

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c.c.: Mrs. Kathy Brown, Wyoming Department of Environmental Quality
Mr. Carl Anderson, Wyoming Department of Environmental Quality

TABLE OF CONTENTS

1.0 SITE BACKGROUND 1
1.1 General Information 1
1.2 Site History 1
1.3 Chronology of Release 2
1.4 Terracon Activities – Report of Investigation 4
1.5 Terracon Activities – Monitoring Report-April 2007 6
1.6 Terracon Activities –Monitoring Report – May/July Sampling Event 7
1.7 Initial Hydrogeologic Testing 9
2.0 SCOPE OF WORK 11
2.1 Objectives 11
2.2 Project Mobilization 11
2.3 Health and Safety 11
2.4 Subsurface Explorations 12
2.5 Field Screening - Soil 14
2.6 Field Screening – Groundwater 14
3.0 PROPOSED ANALYTICAL SUITE 15
3.1 Soil/Bedrock Sampling 15
3.2 Monitoring Well Construction 16
3.3 Monitoring Well Development 17
3.4 Monitoring Well Sampling 18
3.5 Domestic Water Well Sampling 19
3.6 Drilling Water Sampling 20
3.7 Spring Sampling 21
3.8 Surface Water (Line Creek) Sampling 23
4.0 PROPOSED SAMPLING SCHEDULE 24
5.0 QUALITY ASSURANCE/QUALITY CONTROL METHODS 26
5.1 Sampling Frequency 26
5.2 Decontamination Procedures 27
5.3 Sample Labeling 27
5.4 Containers, Preservation, and Holding Times 27
5.5 Field Quality Control 28
5.6 Laboratory Quality Control 29
5.7 Site Observation and Well Maintenance 29
6.0 ADDITIONAL ANALYTICAL TESTING EVALUATION 29
6.1 ALDACIDE G 30
6.2 N-VIS L 30
6.3 ENVIRO TORQ 31
6.4 POLYAC PLUS 31
6.5 THERMA THIN 32
7.0 REFERENCES 33

LIST OF FIGURES

Figure 1: Site Location Map
Figure 2: Site and Exploration Plan
Figure 3: Private Water Wells/Surface Water Samples Location Map
Figure 4: Groundwater Contour Map – September 2006
Figure 5: Groundwater Contour Map – January 2007
Figure 6: Groundwater Contour Map – May 2007

LIST OF APPENDICES

Appendix A: Sampling and Analysis Plan (SAP)
Appendix B: Worksheet – Drilling Products Used at Site

1.0 SITE BACKGROUND

The Crosby 25-3 Natural Gas Well is located in Section 25, Township 58 North, Range 103 West, east of Park County Road 1AB, near Clark, Park County, Wyoming. The elevation of the drill pad is approximately 5,364 feet.[6] Line Creek is located approximately 1,250 feet due east of the Crosby 25-3 Natural Gas Well. Line Creek runs approximately northwest to the southeast in the vicinity of the subject site with an estimated gradient of 0.05 feet per foot. Several residences are located in the valley below the Crosby 25-3 site and one is located above the site. The location of the site is depicted on Figure 1.

1.1 General Information

The Crosby 25-3 Natural Gas Well is a directionally drilled well with a total vertical depth of 8,038 feet.[5] The first 2,500 feet of the well is nearly vertical with approximately a 100 foot drift to the southeast[1]. Below 2,500 feet the well was directionally drilled in an easterly direction and the bottom of the well is located horizontally approximately 1,300 feet east of the well head.[1]

Natural gas, petroleum condensate, and drilling fluids were released from the ground adjacent to the Crosby 25-3 Natural Gas Well located along Line Creek, northwest of Clark, Park County, Wyoming. We understand the release occurred over a period of about 58 hours between 11 and 13 August 2006.[1]

1.2 Site History

Prior to Windsor Energy Group, L.L.C. constructing the Crosby 25-3 Natural Gas Well, a previous natural gas and condensate well was installed on the site.[1] The previous natural gas well, identified as Terry Unit No. 1 is depicted on Figure 2. Limited information regarding specific site features and well installation history is available. However, according to a memo prepared by the Wyoming Oil and Gas Conservation Commission (WOGCC),[10] production of the well was established by Northern Pacific in 1966 in the Mowry Formation. However, prior to Northern Pacific operating the well, Carter Oil Company (Exxon Mobil) drilled Terry Unit No. 1 to a depth of 11,359 feet (API #2906397) then plugged the hole on August 17, 1957. The site was inspected by the WOGCC on September 5, 1957 and Carter's bond was released.

A reserve pit was located on site. Then, Northern Pacific Railway Company (now Conoco Phillips), took over the lease and ran 4½" casing to a depth of 9,354 feet in September 9, 1966. On June 30, 1969, Northern Pacific Railway plugged the well and the WOGCC inspected and released the bond on December 4, 1969. The production for the Northern Pacific Railway Company in nine months was 2,131 barrels of oil, 133 barrels of water, and 86,786 manufactured cubic feet of gas.

A pipeline was installed along Line Creek and operated until about 1969. Husky Oil purchased the pipeline for salvage, but according to the WOGCC, the right-of-way remains active. Unsubstantiated anecdotal information suggests that the Terry Unit No. 1 well had features such as a reserve pit associated with it. The other feature, identified on Figure 2 as "Crosby 25-2" is a second natural gas well later completed at the site.

To the northwest of the subject site, TP Production Company drilled a well in 1978 in Section 24, Township 58 North, Range 103 West. The TP Production well was active until 1991 and plugged in 1996.

In 1999, Enre Corporation purchased mineral rights in the area and drilled three wells from what is referred to in this document as the Bennett Pad. Gary Strong of the WOGCC monitored the installation of the three wells and "found no unusual formation pressures." In December 2003, Windsor Energy Group acquired the aforementioned wells and initiated drilling on the Bennett Pad in winter 2004.

1.3 Chronology of Release

The construction of the Crosby 25-3 Natural Gas Well was initiated on 1 July 2006 and began with the installation of a steel surface casing to a depth of 2,003 feet.[1] This surface casing is of a smaller diameter than the borehole, thus leaving an annulus around the casing.[5] Using standard drilling procedures, a pressurized cement grout was introduced into the bottom of the borehole and was circulated up and into the annular space between the well casing and borehole wall until grout appeared at the ground surface.[1] A smaller diameter bit was then used to drill out the grout within the surface casing and advance the well another six feet into the bedrock formation.[1] Before continuing the drilling, a pressure test of the grout seal was then conducted using a bottom pressure of 1,175 pounds per square inch.[1]

We understand that as the well was advanced, hydrocarbons were not encountered until the well reached below a depth of 7,300 feet.[1] While drilling to the total depth of 8,038 feet, natural gas and petroleum condensate reservoirs were encountered.[1] On Friday August 11, 2006, natural gas, petroleum condensate, and drilling fluids began to emanate along a series of cracks in the ground west of the well head.[1,2]

Figure 2 provides the approximate location of the ground cracking. The ground cracking trends along a North/South line and is concentrated in two areas that are about 500 feet apart. The ground cracking trend does not intersect the well head and, at the closest point, is located about 100 feet west of the well head. Very minor releases of natural gas were noted in the area of the well itself as evidenced by bubbling of surface water collected around the well casing at the ground surface.[2]

One area of ground cracking is located on the south end of the trend. The other area of ground cracking is located on the north end of the trend. No ground cracking was observed along the trend between the two areas. Both natural gas and petroleum condensate emanated to the surface in the area of ground cracking located on the south end of the trend.[1] Petroleum condensate impacted surficial soils at this location are estimated to cover an area of approximately 250 feet by 60 feet or approximately 15,000 square feet.

Another area with petroleum impacted surficial soils is east of the reserve pit where the "blooie line" directed natural gas which was being released from the Crosby 25-3 well casing.[2] The presence of petroleum condensate in the natural gas resulted in surficial soil impacts in an area estimated to cover approximately 25,000 square feet.

Initial response activities to remediate the petroleum impacted surficial soils involved the application of petroleum digesting microorganisms and surfactants by Verde Environmental of Houston, Texas and limited soil removal and disposition.[3] Terracon has been involved with some additional exploration and remedial excavation activities on and around the well pad. On 24 August 2007, Terracon submitted a sundry report to the WOGCC documenting the exploration of an area suspected to be a former reserve or production pit, the removal of petroleum impacted soils on the west side of County Road 1AB, near monitoring well MW-1, and the exploration of the old pipeline alignment which runs to the northwest of the pad.

Subsurface exploration activities supervised by Mr. Mike Quick, an environmental consultant from Cody, and Mr. Gary Strong, a representative of the WOGCC revealed the presence of a zone of impacted subsurface soils in the vicinity of monitoring well MW-8. Terracon is in the process of putting together a plan with Windsor and the WOGCC to remove the impacted soil zone in this area.

In addition, Terracon observed the overexcavation of the impacted soils identified on the attached site plan, west of Park County Road 1AB, near monitoring well MW-1. We observed the excavation advanced to approximately 12 feet below ground surface. Samples of soils collected from the sidewalls indicate that the impacted shallow soils appear to have been removed. The material was stockpiled on site in preparation for export The disposal of the impacted soils was under the purview of the WOGCC.

Terracon and WOGCC representative, Mr. Craig Eggerman advanced three test pits along the relict pipeline, which runs from the Crosby pad to the northeast. No indications of release from the pipeline were noted. In addition, the alignment did not appear to act as a preferential pathway for the migration of shallow petroleum products as a result of the release. No additional action was recommended as a result of the findings of these explorations.

The other area of ground cracking was located north of the Crosby 25-3 Natural Gas Well head. This narrow area is about 360 feet long and mostly consists of one or two intertwining ground cracks. No petroleum condensate impacted soils were observed at the surface. Based upon our observations, only natural gas appears to have emanated to the surface in this area.

Based upon conversations with personnel present during the release and well control activities[2] it appears that the unusually high pressures of natural gas entered the well bore and moved upwards. It appears that weaknesses in the surface casing at a depth ranging from 225 to 250 feet below ground surface became the preferential pathway for the drilling fluids and petroleum condensate. The remainder of the material moving up the well bore was exhausted at the surface through the blooie line. Once the material left the surface casing and entered the bedrock, it either followed existing fractures in the conglomerate bedrock or created new fractures as a result of the high pressures present. The subsurface information appears to suggest that bedding planes or fractures were relatively steeply pitched to the ground surface in the vicinity west of the well head and much shallower, perhaps nearly horizontal in the remaining directions.

The release of natural gas and petroleum condensate ceased upon completing well control measures including the placement of drilling mud into the bore.[1,2,3] No additional leakage of natural gas or petroleum condensate to the surface has been noted since the well control measures were instituted.[2] Approximately 58 hours elapsed from the discovery of the surfacing natural gas and petroleum condensate until the completion of the well control measures.[1]

Since the completion of well control measures, the Crosby 25-3 Natural Gas Well has been rehabilitated with an additional string of 7-inch diameter casing and 4 ½-inch diameter casing having been advanced to 2,434 feet and 8,024 feet below ground surface, respectively.[1] Each string of casing was grouted, and successfully pressure tested.[1] This grouting and successful pressure testing coupled with a cement bond-log demonstrates that the well bore does not act as a pathway for natural gas and condensate from the petroleum bearing zones to other zones, including drinking water aquifers.[2]

1.4 Terracon Activities – Report of Investigation

In response to the release, Terracon completed a Limited Subsurface Investigation (LSI) at the site. The LSI consisted of the advancement of nine borings, eight of which were completed as monitoring wells. The results of the investigation are presented in the document *Report of Investigation (ROI) – Amended – Crosby 25-3 Natural Gas Well Release – Road 1AB – Clark, Park County, Wyoming* (Terracon Project No. 26067064) dated 2 February 2007.

Petroleum condensate impact to the surficial soils in an area was estimated by Terracon to cover approximately 15,000 square feet on either side of Park County Road 1AB. Additionally, the venting of natural gas and condensate through the "blooie line" on the east side of the site resulted in minor surficial impacts in an area estimated to cover 25,000 square feet. No surficial impacts were noted in the vicinity of the surface cracking to the north of the wellhead.

The results of the soil/bedrock sampling program performed by Terracon confirmed the presence of petroleum condensate impacted surficial soils in the area of cracking west of County Road 1AB. This surficial impact is also likely representative of the area where blowdown was dispersed to the east of the drilling platform from the "blooie line."

Groundwater impacts appeared more widespread with concentrations of Gasoline Range Organics (GRO), Diesel-Range Organics (DRO), and Volatile Organic Compounds (VOCs) in concentrations exceeding regulatory standards in numerous monitoring wells.[7,8] However, due to the widespread impacts to shallow groundwater, the presence of many daughter products of VOCs, and the ratios of relatively volatile constituents to less volatile constituents of the petroleum condensate, Terracon opined that some of the impacts encountered in the groundwater appeared to represent relic impacts from previous oil and gas exploration and development on the site. However, it is the opinion of WDEQ that insufficient data exists to distinguish the observed petroleum impacts between relict contamination and contamination present as a result of the blowout.

Terracon concluded that soil and groundwater impacts with petroleum hydrocarbons as a result of the release that occurred between 11 August and 13 August 2006 were present on and off the Windsor drilling pad. Additionally, in Terracon's opinion, relic impacts of petroleum hydrocarbons as a result of past exploration and production activities were noted on and off the Windsor drilling pad. Specifically, the soil impacts noted in MW-1 and the groundwater impacts noted in MW-7S and MW-7D appeared to be directly related to the August 2006 release of petroleum condensate. The presence of petroleum hydrocarbon impacted groundwater noted in the other monitoring wells constructed, in Terracon's opinion, appeared to represent relic impact from previous petroleum exploration and development performed on site. However, it is the opinion of WDEQ that insufficient data exists to distinguish the observed petroleum impacts between relict contamination and contamination present as a result of the blowout.

Based upon pressure testing performed by Windsor's contractors, the release of natural gas and petroleum condensate appeared to have originated from a breach in the surface casing at approximately 255 feet below ground surface[1]. Subsequently, based upon observations made during the advancement of Boring B-6, natural gas and petroleum condensate preferentially followed near vertical bedding planes and/or fractures to the ground surface in the two locations observed.

Terracon recommended additional site characterization activities be performed in the vicinity of the Crosby 25-3 Natural Gas Well in order to define the lateral and vertical extent of groundwater impacts as well as to begin evaluating remedial options. Specifically, Terracon recommended additional borings be completed as monitoring wells surrounding the surficial cracking to the north of the drilling pad and bisecting Park County Road 1AB. Furthermore, additional monitoring wells located radially from the recently installed wells were recommended to be installed to define the horizontal extent of impacted groundwater. Terracon recommended that aquifer testing be completed in the vicinity of the subject site. Finally, Terracon recommended that the development and sampling of MW-1 be completed.

1.5 Terracon Activities – Monitoring Report-April 2007

Groundwater impacts with concentrations of Gasoline Range Organics (GRO), Diesel-Range Organics (DRO), and Volatile Organic Compounds (VOCs) were noted in concentrations exceeding regulatory standards in numerous monitoring wells located on the site.[7,8] The noted differences in reported concentrations between the September 2006 and January 2007 sampling events are presented below. (The changes listed are based upon subjective and qualitative observations of the observed changes of numerous chemical and hydrocarbon-range concentrations, and are not supported by any statistical analysis.)

Well No.	**Noted Changes** *(9/2006 to 1/2007)*
MW-3	Slight Increase
MW-4	Slight Increase
MW-4D	Significant Increase
MW-5S	Moderate Increase
MW-5D	Moderate Increase
MW-7S	Significant Decrease
MW-7D	Significant Decrease
MW-8S	No Change
MW-8D	Random Changes
MW-9	Significant Increase

The first sampling event of the springs located on the site (March 2007) indicated that petroleum hydrocarbons were present at concentrations exceeding regulatory standards.[7,8] These springs, which ultimately discharge to Line Creek, were reported with benzene exceeding regulatory standards and numerous light end petroleum hydrocarbons at concentrations below regulatory standards. Heavier end hydrocarbons such as DRO and Semi-Volatile Hydrocarbons were detected at concentrations below regulatory standards in two of the six samples submitted (*Spring 1* and *Spring 6*). In response, Terracon installed sorbent socks into the spring channels in an effort to minimize transport of impacted water to Line Creek and had the springs fenced to prevent livestock from consuming the water in the five impacted springs.

No detectable concentrations of petroleum hydrocarbons were reported in any of the water samples collected and submitted from private water wells or from Line Creek.

Terracon recommended that additional sampling of the springs, the monitoring wells, Line Creek, and a select number of private water wells be performed on a quarterly basis, in accordance with recommendations made by Wyoming DEQ.

Terracon also recommended additional site characterization activities be performed in the vicinity of the Crosby 25-3 Natural Gas Well in order to define the lateral and vertical extent of groundwater impacts as well as to begin evaluating remedial options.

1.6 Terracon Activities –Monitoring Report – May/July Sampling Event

Groundwater, spring water, surface water, and private drinking water samples were collected on May 14 and May 15, 2007. Not all samples were collected at that time due to access constraints and low water levels, so an interim report was issued. The final report will be issued approximately concurrently with this document.

Sampling ports were installed on the two wells at the Sonderman residence and were scheduled for the well at the Hutton residence. The Sonderman well sampling ports were installed, but were not operational at the time of sampling, so a cistern sample was obtained instead. Additionally, the Hutton family decided against installing the sampling port during the summer, as the water in the irrigation ditch may interfere with the installation process. Monitoring well MW-7S did not have sufficient water in it to sample at the time of sampling the other monitoring wells on site, so sampling was scheduled to coincide with sampling the Hutton Well or the Sonderman wells. Groundwater elevations were generally slightly lower than those measured in January 2007. The general changes in concentration as reported by the analytical laboratory are presented below. (The changes listed are based upon subjective and qualitative observations of the observed changes of numerous chemical and hydrocarbon-range concentrations, and are not supported by any statistical analysis.) :

Sample	Noted Changes
MW-3	Slight Decrease
MW-4S	Increase
MW-4D	Significant Increase
MW-5S	Significant Increase
MW-5D	Decrease
MW-7S	Decrease
MW-7D	Significant Increase
MW-8S	No Change
MW-8D	Increase
MW-9	Decrease
Spring 1	Increase
Spring 2	Decrease
Spring 3	Significant Increase
Spring 4	Increase
Spring 5	No Change
Spring 6	No Change

The concentrations of constituents in the surface water samples collected from Line Creek continue to remain at non-detectable levels. Additionally, with the exception of a reported concentration of bis(2-ethylhexyl) phthalate in the Hager well, no other samples were reported with any constituents.

Bis(2-ethylhexyl) phthalate is a common plasticizing additive used in the production of plastic products. Although not specifically determined by the laboratory employed on this project, this compound is considered a common laboratory contaminant in concentrations less than 100 ppb.

(*Laboratory Data Validation Functional Guidelines for Evaluating Organics Analysis*, Environmental Protection Agency (EPA) publication 9240.1-27). Other than the media used for sample collection and potential plastics employed in the construction of the Hager well, Terracon found no information which suggests a Crosby 25-3 site or Hager property source for phthalates.

1.7 Initial Hydrogeologic Testing

A series of pump tests were conducted at the site on August 16 and 21, 2001. The pump tests were performed to obtain an initial indication of the aquifer properties at the site and interconnection between near surface water bearing zones and deeper water bearing zones as part of siting and installing the monitoring wells. *These results should be considered initial until which time as Terracon completes additional testing.* Additional pump testing will be conducted once additional monitoring wells are installed and developed. The full study will include longer pumping periods to obtain additional data and will be provided in the *Remedial Investigation Report*. The data will also be used for the evaluation of remediation alternatives at the site.

Terracon personnel performed the initial water level monitoring and set up, coordinated the operation of the pump, installed and downloaded the electronic water level data. Discharge from the pumping wells during the test was conveyed through a hose to a temporary holding tank. The discharge water was disposed of in the reserve pit on the Crosby pad.

The test was conducted using a battery charged submersible pump. The pump tests varied from 5 minutes to 1 ½ hours. Discharge was monitored on a continuous basis using a stop watch and 5-gallon container.

Water levels were monitored before and during the pump tests in the pumping well and in the adjoining nested well, if present. The water levels were monitored using an In Situ Level Troll 700 electronic transducer with a reported 0.001 foot precision. The Level Troll 700 is a vented or "gauged" sensor. Vented pressure sensors include a vent tube in the cable that applies atmospheric pressure to the back of the strain gauge. Vented sensors thus exclude the atmospheric or barometric pressure component. Water levels in the monitoring wells were monitored on 15-second intervals during the aquifer testing. Recovery in the wells was not monitored as the battery powered pump used for the aquifer tests does not have a foot valve and allows the water in the pump and tubing to flow back into the well.

Drawdown data from the pumping wells was analyzed using the Cooper-Jacob[13] straight line method using AQTESOLV® to calculate estimates of aquifer transmissivities with accounting for partial penetration of the aquifer. The specific capacity of the wells during the pump tests were also calculated, and transmissivities were estimated based on general relationships provided in the literature.

A summary of the initial aquifer testing is provided in following table. Five of the wells immediately dried up once the casing was pumped dry.

Pumping Well	Observation Well	Discharge (ft^3/min)	Maximum Drawdown in Pumping Well (ft)	Maximum Drawdown in Observation Well (ft)	Estimated Transmissivity (ft^2/day)
MW-3	---	Dry	---	---	---
MW-4S	MW-4D	0.24	0.508	0.141	1,500 – 2,000
MW-4D	MW-4S	0.27	2.89	.0203	200 - 400
MW-5S	MW-5D	0.27	0.654	0.107	2,500 – 3,500
MW-5D	MW-5S	Dry	---	---	---
MW-7S	MW-7D	0.16	5.32	None	5 - 25
MW-7D	MW-7S	Dry	----	---	---
MW-8S	MW-8D	0.23[1]	14.704	0.038	5-25
MW-9	---	Dry	---	---	---

[1] MW-8S dried up after 60 minutes of pumping.

Terracon has reached several preliminary conclusions regarding groundwater flow at the site as a result of these limited, initial activities.

- The deposits forming the upper 40 to 60 feet in the vicinity of the site appear to contain pervious channels where most of the water is concentrated. The higher transmissivity values estimated from these pump tests is within the range of transmissivity typically found in alluvial aquifers within this region.

- The shallow groundwater appears hydraulically isolated from deeper water bearing zones. Monitoring wells MW-4S and MW-4D are separated by 10 feet of bentonite seal; MW-5S and MW-5D by 9 feet of bentonite seal; MW-7S and MW-7D by 60 foot of bentonite seal; and MW-8S and MW-8D by 25 feet of bentonite seal. A significant reaction to pumping of the adjoining nested well was observed in MW-4S, MW-4D and MW-5D. A very small reaction was observed in MW-8D to the pumping of MW-8S. No reaction was noted in MW-7D to the pumping of MW-7S.

- There appears to be little to no water in the deposits underlying the site below a depth of 40 to 60 feet.

The data collected from the initial testing was used to make the field decision to install nested wells, and that the data and conclusions from the additional hydrogeologic testing will be included in the *Report of Investigation – Phase II*.

2.0 SCOPE OF WORK

2.1 Objectives

The objective of this work plan is to attempt to define the horizontal and vertical extents of petroleum impacts in soil and groundwater at the subject site. Boring locations and depths have been evaluated for each portion of the subject site in which they are located. Terracon has been contracted by Windsor to provide the characterization services described herein. All work will be performed in accordance with the scope of services described herein, as well as the previously prepared *Sampling and Analysis Plan (SAP)* which was originally presented in Appendix E of the *Report of Investigation (ROI) – Amended* dated 2 February 2007 and prepared by Terracon. The SAP is also presented in this document in Appendix A.

It should be noted that this document represents the scope of work to complete the investigation phase of the remedial investigation. Future deliverables will be prepared as part of the Voluntary Remediation Program. These include, but are not limited to an Ecological Risk Assessment, Groundwater Monitoring Reports, a Remedial Alternatives Report, Interim Measures Report, Report of Investigation – Phase II, and a Remedy Agreement.

2.2 Project Mobilization

All field personnel will meet with the project manager (Michael Bullock) and discuss the requirements and objectives of their participation in the field. The field personnel will read and review the Sampling and Analysis Plan (SAP), the site Safety and Health Plan[4], and any previous published information regarding the site prior to arriving on site. These meetings will allow the field personnel to review and discuss issues such as project objectives; health and safety concerns; drilling; development and/or sampling procedures; decontamination procedures; communication policies; documentation requirements; chain-of-custody policies; and equipment usage and maintenance. The site specific Safety and Health Plan has been transmitted to WDEQ.

2.3 Health and Safety

Terracon previously prepared a site-specific Safety and Health Plan[4] for Terracon's employees and subcontractors involved in the field work completed and documented in the *Report of Investigation (ROI) – Amended*. All future work will be performed in accordance with the Safety and Health Plan[4] previously completed. Work will be accomplished in Level D personal protective equipment (PPE). Upgrades to PPE will be required as a result of air monitoring being performed utilizing a 4-way gas meter and PID during intrusive activities.

2.4 Subsurface Explorations

After utility clearances were obtained, the subsurface characterization program has commenced and is progress at the time of publication of this document. The subsurface exploration program consists of the advancement of the following explorations as shown on *Figure 2 – Proposed Additional Monitoring Wells*:

# of Wells	Well ID	Completion Type	Total Depth	Completed?
1	MW-10	Nested	155	Yes
2	MW-11	Nested	120	Yes
3	MW-12	Nested	143	Yes
4	MW-13	Single	196	Yes
5	MW-14	Nested	154	Yes
6	MW-15	Single	199	Yes
7	MW-16	Nested	145	Yes
8	MW-17	Nested	95	Yes
9	MW-18	Single	50	Yes
10	MW-19	Single	25	Yes
11	MW-20	Single	55	Yes
12	MW-D	Nested	~150	No
13	MW-H	Single	~200	No
14	MW-L	Single	~50	No
15	MW-T	Single	~50	No
16	MW-R	Single/Well Point	~10	No
17	MW-S	Single/Well Point	~10	No

The locations of the proposed wells, as depicted on Figure 2, have been adjusted in the field based upon subsurface conditions encountered, field screening results and other factors, such as access and hydrogeologic testing. Field screening as discussed in Section 2.5, will also include the collection of a pre-development (See Section 2.6) groundwater sample submitted to the analytical laboratory for analyses at 24-hour turnaround times.

The depth of the wells will be adjusted to intercept the shallow water table that is likely overlying the bedrock.

The type of wells (nested versus single wells) will be installed at the site based upon the findings of a hydrogeologic study (to be provided the *Remedial Investigation Report*) which provided initial, limited information regarding the level of communication between different groundwater bearing zones. Based upon the results of the findings of an initial survey completed on several wells previously installed, the shallow and deeper groundwater bearing zones appear to be in slight “communication” with each other. (See Section 1.7 above.)

In order to maximize the efficiency of advancing borings through loose valley fills and competent bedrock, often in the same exploration, to reduce the probability of additional groundwater impacts caused by subsurface explorations, and to minimize the generation of Investigation Derived Waste (IDW), Terracon has identified sonic drilling as the preferred alternative for boring advancement. Terracon subcontracted Boart Longyear, a drilling contractor who is often recognized as the leading provider of sonic drilling services across the Country.

Sonic drilling involves the application of high-frequency sinusoidal waves to a hollow drill string. The drill string is advanced through the subsurface using the sonic vibrations to “slice” through the soil or rock. Different diameter casing is used when advancing the drill string in order to seal off water bearing zones, to allow for the installation of nested wells, as described below, and to account for increasing difficulty when advancing the drill string at depth.

The use of casing advanced beyond the shallow groundwater bearing zone, in essence, seals off the zone to reduce the possibility of cross-contamination between groundwater bearing zones, if contamination is present. Additionally, the placement of bentonite between groundwater bearing zones as part of monitoring well construction reduces the possibility of cross-contamination, if contamination is present.

Cores of soil and bedrock are contained within the hollow drill rod and extruded at the surface into plastic sampling sheaths. The soil and bedrock conditions will be logged in the field using the United Soil Classification System (USCS). Logging will include recording relative densities, color, moisture condition, soil particle size descriptions, and other modifiers such as the presence of organic material, oversize material, and bedding planes. Should competent bedrock be encountered in the explorations and an intact core be extruded, the bedrock type as well as bedding plane geometry will be recorded. After field observations are completed, including field screening, sample collection, and photo documentation, the samples of soil/bedrock cores will be placed in core boxes and shipped to our Billings, MT office for storage until the completion of the signed *Remedy Agreement* at which time they will be disposed of at a permitted facility. It should be noted that due to the exposure of the materials to the ambient air as part of the extrusion, field screening, and sampling process; any moisture content, field screening, or analytical value is rapidly lost.

During the advancement of the drill string, water is often added to act as a coolant and to flush pulverized soil and bedrock to the surface. In general, the majority of the water used is flushed as part of the recirculation of the water-entrained drill cuttings to the surface. However, some water is lost to the formation. Development of the monitoring wells will take into account the addition of drilling water to the subsurface. Sampling of the drilling water will be conducted to determine whether impacts are present.

In addition to the monitoring wells as discussed above, and based upon the comments received by WDEQ regarding the collection of surface water (Line Creek) samples, up to two shallow borings completed as monitoring wells or well-points will be completed adjacent to Line Creek. The purpose of these installations is to collect samples at the groundwater/surface water interface. These installations have been identified by WDEQ as key to monitoring the groundwater/surface water interface.

2.5 Field Screening - Soil

Field screening will assist in the identification of petroleum impacted soils and bedrock. Field screening is accomplished with a Photoionization Detector (PID), and/or a Flame Ionization Detector (FID) and visual / olfactory indications of petroleum hydrocarbons.

The sample intervals are variable with up to 20 foot cores collected. Each soil or bedrock interval will be field screened for the presence of Volatile Organic Compounds (VOCs) to estimate if petroleum products or related hydrocarbons are present. This involves plunging the probe of a PID or FID through the sampling sheath containing the soil or bedrock extracted from the subsurface by the drilling subcontractor. The value presented by the PID or FID indicates the total vapor concentration of volatilized organic compounds in the air surrounding the soil/bedrock samples. These compounds include numerous constituents of petroleum hydrocarbons. However, the PID or FID does not determine the species of these compounds or their absolute concentrations in the soil samples. Consequently, it should be considered merely a screening tool that aided in detecting the presence of volatile soil contaminants. The PID or the FID will be calibrated with 100 parts per million (ppm) isobutylene each morning, prior to any field screening.

Due to the apparent presence of methane in the subsurface soils and the heat often generated as part of the drilling process, it is anticipated that field screening might yield false high readings. In most cases, olfactory indications would be the preferred method to screen the soil/bedrock to select appropriate samples for analytical laboratory testing. .

2.6 Field Screening – Groundwater

In order to accurately position monitoring wells in relation to petroleum constituents in groundwater at the site, a groundwater sample will be collected subsequent to the installation of the monitoring well and prior to the development of the well. This sample will be collected using a single-use, disposable, polyethylene bailer and submitted for analysis for the following compounds at a 24-hour turnaround time:

- Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015;
- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015; and
- Benzene, Toluene, Ethylbenzene, and Xylenes (commonly referred to as BTEX) by EPA Method 8021.

3.0 PROPOSED ANALYTICAL SUITE

The following table presents the analytical suites employed for each media to be sampled. This media may also be subject to forensic analysis in order substantiate the theory that some of the impacted groundwater observed at the site is a result of relic releases of petroleum hydrocarbons by past operators.

	VOCs by EPA Method 8260 (with Tentatively Identified Compounds (TICs)	SVOCs by EPA Method 8270 (with TICs)	Methane by RSK 175	Gasoline Range Organics (GRO) by EPA Method 8015	Diesel Range Organics (DRO) by EPA Method 8015	LEVEL IV Raw DATA
Monitoring Well Samples	X	X	X	X	X	
Spring Samples	X	X		X	X	
Line Creek Samples	X	X		X	X	
Private Drinking Water Well Samples	X	X	X	X	X	X
Soil Samples	X	X		X	X	

3.1 Soil/Bedrock Sampling

Soil/bedrock sampling will consist of filling two 9-ounce soil jars with soil/bedrock collected from the center of the extruded core. Selection of soil/bedrock samples to be collected and submitted for analytical laboratory testing will be based upon field screening and subsurface conditions encountered such as inferred or estimated confining layers. In general, those soils exhibiting the highest PID or FID readings, or those with significant olfactory indications of petroleum impact, as well as those at or above inferred confining layers will be submitted for laboratory analysis. Each section of extruded core, typically 5 to 10 feet, will field screened, and logged as described previously, however, not every core extruded will have analytical samples collected and submitted for analysis.

Water used during the drilling of unconsolidated fine gravels, sands, silts, and clays often flushes the soil/bedrock leaving only the coarser aggregate or competent bedrock layers. Soil/bedrock samples will not be collected from these intervals as they would not accurately represent the subsurface soil and/or bedrock conditions. However, when such conditions are encountered Terracon will attempt to quantify the sample recovery percentage and identify the geologic unit encountered.

The analyses performed will include the following suite of testing:

- Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015/8260;
- Volatile Organic Compounds by EPA Method 8260 (Long List) with Tentatively Identified Compounds (TICs);
- Semi Volatile Organic Compounds by EPA Method 8270 with TICs and
- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015.

After the samples are collected, they will be labeled, and packaged on ice to maintain a temperature near 4° C. Preservation, packaging, and transporting procedures will be in general accordance with ASTM D4220-95 (Reapproved 1995) *Standard Practices for Preserving and Transporting Soil Samples.* The samples will be hand-delivered or shipped under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

3.2 Monitoring Well Construction

All monitoring wells will be constructed with 2-inch diameter PVC casing. Diagrams of the well construction methods will be included with the boring logs presented in the report documenting installation. Some borings will be completed as “nested” monitoring wells. See *Figure 2*. Nested monitoring wells consist of two 2-inch diameter monitoring wells installed within the same borehole, but completed in apparent different groundwater bearing zones. These wells have different screened intervals in order to collect samples from different groundwater bearing zones and are sealed with bentonite clay to minimize communication between the zones.

A 0.01 inch (or alternate size as determined by the project manager) slotted PVC screen will be incorporated in each well. The elevation of the top of the screened interval will be selected such that any fluctuations in groundwater elevation should result in the top of the water level remaining within the screened interval. However, oftentimes the water levels encountered during drilling and those encountered after the construction of the well are higher than anticipated. The difference is often a result of artesian groundwater zones or confined groundwater zones which may result in a groundwater elevation above the screened interval.

Screened intervals in the monitoring wells completed as part of the previous investigatory activities as well as the current activities are generally based upon maximizing the groundwater available for the well, without screening across obvious confining layers. In order to provide for free-product, if present, screened intervals typically should include both saturated and unsaturated zones, if possible. Due to the soil/bedrock conditions at the site, the soil/bedrock sampling methodology, and the use of drilling water, saturated zones are sometimes difficult to accurately determine. In these cases, screened intervals are typically longer than if the groundwater conditions were more definitive. Screened intervals will be determined in the field, based upon the conditions encountered.

The annular space between the borehole wall and the slotted PVC will be backfilled with 10-20 silica sand (or other size as determined by the project manager), usually to two feet above the screened interval, with the remaining annular space above the silica sand pack being sealed with bentonite. The monitoring wells will be completed at the surface by cementing a stick-up protective monitoring well cover around the well head. The monitoring well cover will be locked at the completion of each well. These wells will be constructed in general accordance with Wyoming State Standards and in general accordance with ASTM D 5092-04 *Standard Practice for Design and Installation of Ground Water Monitoring Wells.*

The designated measuring point and elevation datum at each monitoring well is defined as the ground surface immediately adjacent to the surficial concrete seal to the north and the top of the PVC well casing on the north side. A licensed professional surveyor will be contracted to survey in the horizontal and vertical positions of the monitoring wells as well as other pertinent site features. Should any modifications to the well casing be made, the licensed surveyor will be contacted to perform a new survey of the elevation.

3.3 Monitoring Well Development

Monitoring wells will be developed once the installations are completed. Based upon the amount of water in each well and the presence of suspended and settled solids, each well will undergo a process intended to remove water added during the drilling process, a significant amount of settled and suspended solids, and infiltrating formation fines. The amount of water removed will be based upon the amount of suspended solids present (the ability of the submersible pump to pump the fluid, where used), and the recharge capacity of the well. The well will be considered developed when water quality parameters reported by field instrumentation (dissolved oxygen, oxygen reduction potential, conductivity, pH, and temperature) stabilize during the development process and when the amount of water used during drilling has been removed from the well. (See Section 2.4).

In many cases, the wells may be pumped or bailed dry during development. In these cases, the recharge will be estimated and additional fluid may be removed once sufficient fluids flow into the well casing.

3.4 Monitoring Well Sampling

Prior to well purging and sample collection, the static water level present in the well will be measured from the north side of the top of the PVC casing. The measuring of static water levels will be performed in general accordance with ASTM D 4750-87 (Reapproved 2001) *Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)*. The wells will then be purged and sampled with a low-flow bladder pump. At this point in time, Terracon is evaluating specific bladder pump systems. However, low-flow sampling consists of the removal of 0.1 liters/minute up to 1 liter/minute depending on the production of the well.

The elevation of the inlet of the bladder pumps will be determined based upon a number of factors, including, but not limited to, height of the water column, length of the screened interval, the production of the monitoring well, the results of past analytical sampling and recent field screening (See Section 2.6), and the geologic unit in which it is screened. Typically, inlet elevations will be located in the center of the screened interval, unless the production of the monitoring well, as determined through development, is low, at which point the inlet would be lowered to allow for potential drawdown.

To ensure that representative groundwater samples are collected, water quality parameters (dissolved oxygen, oxygen reduction potential, conductivity, pH, and temperature) will be monitored and allowed to stabilize during the purging process prior to sample collection. Sampling procedures will be in general accordance with ASTM D 4448-01 *Standard Guide for Sampling Ground-Water Monitoring Wells* and EPA's *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*.[11]

Portable field parameter measuring instruments will be calibrated using the following methods:

pH:	pH 4.0 and 7.0 buffer solutions
Conductivity:	1,413 uS conductivity solution

Dissolved Oxygen:	Sodium sulfite solution and oxygen saturated distilled water
Oxidation Reduction Potential:	1,413 uS conductivity solution

After purging, the groundwater samples will be collected in appropriate containers and preserved, labeled, and packaged on ice to maintain a temperature near 4° C. The samples will be hand-delivered, or shipped, under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

The analyses performed include the following suite of testing:

- Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015/8260;
- Volatile Organic Compounds by EPA Method 8260 (Long List) with Tentatively Identified Compounds (TICs);
- Semi Volatile Organic Compounds by EPA Method 8270 with TICs and
- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015.
- Dissolved Methane by EPA Method by 8015 (GC-FID) (RSK 175); and
- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015.

Based upon our conversations with WDEQ, changes to the analytical suite as shown above, will be considered by WDEQ following the completion of a minimum of four quarters of data. At that time, Terracon and Windsor may request a modification to the suite as proposed herein.

Purge water will be disposed of in the reserve pit located on the Crosby 25-3 Natural Gas Well Drilling pad. Other Investigation Derived Waste (IDW) will be disposed of off-site, or as directed by the project manager and in accordance with applicable regulations. Once the reserve pit is closed, Terracon will provide drums for storage of the purged groundwater. The contents of the drums will be removed by a contractor licensed to transport and accept petroleum-impacted water.

3.5 Domestic Water Well Sampling

Domestic water well sampling will follow similar procedures to those described above, with the exception of the measurement of parameters. The collection of domestic water wells typically involves a system which is in operation frequently enough to have sufficiently developed. However, a purging of the system will be performed to ensure that "formation water" is flowing prior to collecting the sample. Purging will consist of allowing the well's submersible pump to operate for upwards of ten minutes, subsequent to any cisterns or storage tanks being emptied. Alternatively, if possible, the samples will be obtained from point in the domestic water system that precedes the cistern or storage tank. See *Figure 3 – Private Water Wells/Surface Water Samples Location Map* for locations of the majority of the private water wells and the surface water sample locations.

After purging, the groundwater samples will be collected in appropriate containers and preserved, labeled, and packaged on ice to maintain a temperature near 4° C. The samples will be hand-delivered or shipped under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

The analyses performed include the following suite of testing:

- Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015/8260;
- Volatile Organic Compounds by EPA Method 8260 (Long List) with Tentatively Identified Compounds (TICs);
- Semi Volatile Organic Compounds by EPA Method 8270 with TICs
- Dissolved Methane by EPA Method by 8015 (GC-FID) (RSK 175); and
- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015.

Additionally, Level IV data packages will be prepared for the samples collected and submitted from the private drinking water wells. The data packages will be provided to each individual well owner as previously requested.

Based upon our conversations with WDEQ, changes to the analytical suite as shown above, will be considered by WDEQ following the completion of a minimum of four quarters of data. At that time, Terracon and Windsor may request a modification to the suite as proposed herein.

3.6 Drilling Water Sampling

Drilling water was obtained from two different contractors hauling water to the site from the Clark's Fork of the Yellowstone River near the Highway 120 Bridge as part of the site investigation activities documented in the *Report of Investigation (ROI) - Amended*. A single sample was obtained from each of the water trucks operated by the two different contractors hauling water to the site. Both of the samples were reported with detectable concentrations of petroleum hydrocarbons. The first drilling water sample obtained on 28 August 2006 was impacted with petroleum hydrocarbons exceeding State of Wyoming[7] and Federal Drinking water standards[8,9]. The second sample had detectable concentrations of petroleum hydrocarbons but did not exceed state or federal drinking water standards.

During this current phase of investigation, in progress, we have contracted a different contractor (Right On! Services of Powell, Wyoming) and received a letter from the owner dated 26 August 2006, which indicates that the "Kenworth Truck ….has never had anything other than fresh (from stream, creek, or reservoir) water hauled in it."

However, in order to document the quality of the water being brought to the site and used during the advancement of the borings, Terracon will collect a random sample of the drilling water imported to the site.

The drilling water sample will be collected in appropriate containers and preserved, labeled, and packaged on ice to maintain a temperature near 4° C. The samples will be hand-delivered or shipped under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

The analyses performed include the following suite of testing:

- Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015/8260;
- Volatile Organic Compounds by EPA Method 8260 (Long List) with Tentatively Identified Compounds (TICs);
- Semi Volatile Organic Compounds by EPA Method 8270 with TICs
- Dissolved Methane by EPA Method by 8015 (GC-FID) (RSK 175); and
- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015.

3.7 Spring Sampling

Basins were excavated using hand tools in the spring channels as part of previous site activities documented in Terracon's *Monitoring Report – April 2007* and shown on *Figure 2 - Proposed Additional Monitoring Wells*. The basins were excavated such that sampling glassware can be effectively maneuvered below the water surface of the spring. The water in the basins will be allowed to clarify prior to sample collection activities as proposed herein.

The first sampling event of the springs located on the site (March 2007) indicated that petroleum hydrocarbons were present at concentrations exceeding regulatory standards.[7,8] In response, Terracon installed sorbent socks into the spring channels in an effort to adsorb hydrocarbons from the water prior to it entering Line Creek. These socks will be changed on a monthly basis and disposed of in accordance with applicable local and state regulations. The springs have also been fenced to prevent livestock from consuming the water in the five impacted springs.

Containers will be inverted and lowered to a point below the water surface, but not in a location where bottom sediments could enter the sample container. Surficial water will not be allowed to enter the container during the sample collection process, where possible. The containers will then be removed from the surface water and packaged as described subsequently. Spring samples will not be submitted for methane analysis due to biogenic methane interference likely to be present.

Biogenic interference, in this case, refers the likely presence of naturally occurring methane from the natural degradation of organic materials present in the topsoil and shallow surficial soils. Spring water emanating from, or flowing through, and sitting atop these soils may contain methane generated from these biological processes. Determining the source of the methane, if detected in the spring water samples, either biogenic or thermogenic (geologically formed and present as a result of the blowout), requires collecting a sample of the methane gas (if possible) and analyzing the carbon isotopic ratios. The requirements and complexity of the sampling and analysis were determined to be of little value to the site characterization when the springs have already been determined to be impacted with petroleum-related hydrocarbons for which regulatory standards exist. The use of methane as a tracer material to determine probable impact in the nearby monitoring wells from natural gas released during the blowout is far more valid due to the lack of biogenic material in the screened intervals. Additionally, testing monitoring wells for methane, which are often sealed to the atmosphere is appropriate for health and safety reasons, where explosion or ignition may be a concern.

The spring samples will be collected in appropriate containers and preserved, labeled, and packaged on ice to maintain a temperature near 4° C. The samples will be hand-delivered or shipped under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

The analyses performed include the following suite of testing:

- Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015/8260;
- Volatile Organic Compounds by EPA Method 8260 (Long List) with Tentatively Identified Compounds (TICs);
- Semi Volatile Organic Compounds by EPA Method 8270 with TICs; and

- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015.

Based upon our conversations with WDEQ, changes to the analytical suite as shown above, will be considered by WDEQ following the completion of a minimum of four quarters of data. At that time, Terracon and Windsor may request a modification to the suite as proposed herein.

3.8 Surface Water (Line Creek) Sampling

The samples will be collected with the laboratory provided containers and "dipped" into Line Creek in a location estimating the mean flow rate and depth for that segment of the stream which the sample is intended to characterize. See *Figure 3 – Private Water Wells/Surface Water Samples Location Map* for the surface water sample locations.

The in-stream sampling will consist of the containers being inverted and lowered to a point below the water surface, but not in a location where bottom sediments could enter the sample container. Surficial water will not be allowed to enter the container during the sample collection process. The containers will then be removed from the surface water and packaged as described subsequently. Surface water samples will not submitted for methane analysis due to biogenic methane interference likely to be present. (See Section 3.7 above for a discussion on biogenic methane).

The surface water samples will be collected in appropriate containers and preserved, labeled, and packaged on ice to maintain a temperature near 4° C. The samples will be hand-delivered or shipped under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

The analyses performed include the following suite of testing:

- Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015/8260;
- Volatile Organic Compounds by EPA Method 8260 (Long List) with Tentatively Identified Compounds (TICs);
- Semi Volatile Organic Compounds by EPA Method 8270 with TICs; and
- Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015.

Based upon our conversations with WDEQ, changes to the analytical suite as shown above, will be considered by WDEQ following the completion of a minimum of four quarters of data. At that time, Terracon and Windsor may request a modification to the suite as proposed herein.

Two well points have been proposed to be installed along the banks of Line Creek in an effort to evaluate shallow groundwater migrating into the surface water body. The purpose of the wells is to collect a sample of shallow groundwater before it enters the surface water and becomes diluted by the upgradient surface water.

4.0 PROPOSED SAMPLING SCHEDULE

The following table presents our proposed schedule for on-going groundwater, surface water, and private drinking water well sampling:

TABLE I: PROPOSED SAMPLING SCHEDULE

Sample ID	08/07	11/07	02/08	05/08	08/08	11/08	02/09	05/09	08/09
CURRENT MONITORING WELLS			X	X	X	X	X	X	X
PROPOSED ADDITIONAL WELLS			X	X	X	X	X	X	X
SPRING SAMPLES			X	X	X	X	X	X	X
LINE CREEK SAMPLES			X	X	X	X	X	X	X
PRIVATE DRINKING WATER WELLS									
McNabb Well	X	X	X	X	X	X	X	X	X
King Well	X	X	X	X	X	X	X	X	X
Hutton Well	X	X	X	X	X	X	X	X	X
Bennett Pad Well	X	X	X	X	X	X	X	X	X
Sonderman Well #1	X	X	X	X	X	X	X	X	X
Sonderman Well #2	X	X	X	X	X	X	X	X	X
Linebaugh Well	X	X	X	X	X	X	X	X	X
Thomas Well	X	X	X	X	X	X	X	X	X
Dickson Well	X	X	X	X	X	X	X	X	X
Hammer Well	X	X	X	X	X	X	X	X	X
Hager Well	X	X		X		X		X	
Woolard Well	X	X		X		X		X	
Waldron Well	X	X		X		X		X	
Brown Well	X	X		X		X		X	
McCoy Well #1	X	X		X		X		X	
McCoy Well #2	X	X		X		X		X	

The concentrations of detected constituents (see Sections 3.4 through 3.8 for respective suites of analysis) will be compared to the *Federal Drinking Water Standard – Maximum Contaminant Level* (MCL) or the *Wyoming Drinking Water Equivalent Level*. In the absence of these constituents in the MCL or DWEL regulations, the concentrations will be compared to *EPA Region IX Preliminary Remediation Goals* (PRGs). A handful of detected constituents do not have any of the above standards for comparison. These constituents include: p-isopropyltoluene, methane, 1-methylnaphthalene, and 2-methylnaphthalene. It is our opinion that the project value of these low concentration constituents, excluding methane, is minimal due to the significant amount of data and associated regulatory standards present for the other constituents.

It should be noted that the schedule proposed herein may be changed based upon the collection and analysis of additional data at the site and if impacts are noted in the wells.

Should petroleum impacts be noted in any of the wells that is attributed, sampling frequency will be increased.

5.0 QUALITY ASSURANCE/QUALITY CONTROL METHODS

The Quality Assurance/Quality Control (QA/QC) objective for the remedial investigation and subsequent groundwater monitoring at the Crosby 25-3 Natural Gas Well site, Line Creek, and down gradient private drinking water wells is to ensure that samples sent to the laboratory and reported analytical results represent actual field conditions. In order to accomplish this goal, sampling guidelines and procedures have been established in accordance with standard industry practices accepted by the EPA and WDEQ.

These measures include:

- Adherence to the sampling frequency schedule as discussed herein;
- Adherence to decontamination procedures between sampling;
- Utilization of unique sample labeling;
- Adherence to chain-of-custody procedures;
- Utilization of laboratory-provided sample containers and sampling kits; and
- Adherence to sample holding times and matrix preservation protocols.

5.1 Sampling Frequency

Sampling of potentially-impacted soil for characterization purposes will be performed in each boring where field screening or other indications suggests the presence of petroleum hydrocarbons. When the exploration exhibits no indications of petroleum hydrocarbons, soil samples will be obtained at or near the groundwater interface or the bedrock interface.

- Selection of soil samples to be submitted for analytical testing will be made by Terracon personnel, based upon the aforementioned field indications.

- Groundwater samples will be collected from the well upon completion of construction and successful development. We estimate that regular sampling will take place after completion of the monitoring wells.

- Drilling water will be analyzed periodically to determine whether petroleum hydrocarbons are present.

5.2 Decontamination Procedures

The sampling tools, equipment, and instruments will be cleaned between samples to minimize the potential for cross contamination. Following sampling activities the sampling equipment will be washed in a laboratory-grade, biodegradable phosphate-free, detergent solution and rinsed with potable water. A final rinse with distilled water will remove detergent residue from the sampling equipment. Clean, unused nitrile gloves will be used to handle each sample. Polyethylene tubing and/or disposable polyethylene bailers used during development and sampling of the groundwater monitoring wells will be disposed of after sampling is completed.

5.3 Sample Labeling

Samples will be identified from the boring or well from which they are collected. For soil/bedrock samples, the sample identification will include the boring or well number and the depth from which it was collected. For example, the soil sample collected from a boring identified as B-1 at a depth of 20 feet would be labeled B-1 @ 20'. Groundwater samples will be identified with the well number or sampling location. Private drinking water, surface water, and spring samples will be identified by the proper designation of the sample location. For example, the sample collected from sampling site number 5 on Line Creek will be identified as *Line Creek SS-5*. The labeling will be completed on laboratory provided labels, affixed to each sampling container utilized. The containers will be cleaned and dried to ensure that sample labels are securely attached to the containers. Labeling will be performed using an indelible felt-tip marker.

5.4 Containers, Preservation, and Holding Times

The following table presents the containers, analytical laboratory methods, and preservation information utilized for each media to be sampled:

Matrix	*Analyte*	*Container*	*Preservation*	*Holding Time*
Soil	Total Petroleum Hydrocarbons (GRO and DRO) by EPA Method 8015/8260;	Two 9-oz glass jars	Cool to 4° C	14 days
Soil	Volatile Organic Compounds by EPA Method 8260			
Water	Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO) by EPA Method 8015/8260;	Four 40 mL VOA vials	HCl and Cool to 4° C*	14 days
Water	Volatile Organic Compounds by EPA Method 8260			
Water	Dissolved Methane by EPA Method by 8015 (GC-FID) (RSK 175)	One 40 mL VOA vial	H_2SO_4 and Cool to 4° C	14 days
Water	Total Petroleum Hydrocarbons – Diesel Range Organics (DRO) by EPA Method 8015;	One 1L Amber glass bottle	H_2SO_4 and Cool to 4° C	7 days
Water	Semi-Volatile Organic Compounds by EPA Method 8270.	One 1L Amber glass bottles	Cool to 4° C	7 days

* Two vials will not be preserved as Acrolein requires a non-acidified environment to remain stable.

5.5 Field Quality Control

When groundwater samples are to be collected, a trip blank is supplied by the laboratory, and is later analyzed for VOCs. The trip blank is placed in the sample collection cooler at the beginning of the field sampling event and it accompanies the samples at all times until delivery to the laboratory.

Every sampling event, a blind duplicate water sample will be collected from the groundwater monitoring wells, the springs, and Line Creek. The blind duplicate sample will be collected subsequent to collecting a sample. The sample identification will be limited to “Duplicate” or similar. The location from which the blind duplicate sample was collected will be withheld from the laboratory but noted on field documentation. The purpose of the blind duplicate sample is to ensure repeatability in the laboratory methodology.

Blind duplicates for soil samples will be collected for each batch (chain-of-custody) submitted to the analytical laboratory, where field screening has suggested the presence of volatile constituents.

5.6 Laboratory Quality Control

The analytical laboratory shall be accredited by the State of Wyoming to perform the specified analytical methods. This project is utilizing Energy Laboratories, Inc. in Billings, MT to analyze the samples collected. Laboratory quality control will consist of analysis of a method blank, a matrix spike/matrix spike duplicate report, and a blank spike. Additionally, for each private drinking water well sample collected, a Level IV Analytical Package will be made available to the homeowners and public.

5.7 Site Observation and Well Maintenance

The physical condition of the well monuments will be observed during each sampling event. Each well will be kept clean and free of debris that could potentially enter the well. The area around each well will be kept clear of overgrowth, and will remain visible to the extent possible. Locks and expansion plugs will be observed and replaced if faulty. The concrete surface seal of each well will be observed and replaced or repaired if significantly cracked.

6.0 ADDITIONAL ANALYTICAL TESTING EVALUATION

Appendix B contains a table with compounds used during the advancement of the boring and their respective chemical components as listed in the MSDSs provided by Bariod-Halliburton. The components used during the "killing" of the well consist solely of bentonite mud.[12] According to Dan Johnson at Windsor Energy Group, the mud was produced by Schlumberger and identified with the active component as *Bentonite Extender D20*. Due to the volume of MSDS sheets (approximately 200), the sheets are not included in this work plan, but are available upon request to any interested parties. A copy of all MSDS sheets are made available to the public and are contained at the Hinckley Library in Powell, Wyoming. The MSDS sheets are also available for viewing on Windsor's website: *http://windsorlinecreek.info*.

The table in Appendix B contains numerous chemical components, many of which are non-toxic, insoluble, or otherwise not a threat to the environmental integrity of the groundwater underlying the subject site. Terracon has evaluated the products used on site to determine their use volumes, potential toxicities, persistence in the environment, regulatory status, and potential analytical methodologies for detection and reporting and placed the information in the table in Appendix B.

The following products were determined to:

- Represent a potential threat to groundwater;
- Not have analytical testing procedures; and

- Not have regulatory standards for their presence in groundwater.

6.1 ALDACIDE G

The drilling mud used on site contained *Aldacide G.* The biocide is used to control sulfate reducing bacteria and reduce the spoilage of the drilling mud when starches are added. The active ingredient in the material is glutaraldehyde (CAS 111-30-8) at 10 to 30%. Based upon our review of records of products used at the site and based upon conversations with the drilling contractor, a total of 350-gallons of *Aldacide G* was added to approximately 9,000 barrels of water (378,000 gallons) used for drilling fluid. The concentration of glutaraldehyde present in the drilling mud is likely ranged from approximately 93 ppm up to 270 ppm

When exposed to potential groundwater, leachability, dilution, and degradation greatly reduce the availability of the substance to groundwater. Few studies have been completed regarding the fate and transport of glutaraldehyde, however, according to a handful of sources, such as the Australian Department of the Environment and Water Resources, "Glutaraldehyde that makes its way into the ground or water is degraded within days." [14] Additionally, the United Nations Environment Programme Chemicals Branch with the Organisation for Economic Co-Operation and Development (OECD) cite studies a handful of studies regarding the fate and transport of glutaraldehyde.[15] They conclude that "glutaraldehyde is hydrophilic, biodegradable in soil and water and has no bioaccumulative properties."

Terracon contacted EPA Region VIII regarding an acceptable laboratory analysis procedure for glutaraldehyde. The qualifications for the testing procedure to be considered acceptable include detection limits in the part per billion (ppb) range and the ability for other well-equipped laboratories to relatively easily implement the procedure in order to perform the testing. A custom-designed procedure, those specifically designed by a laboratory for Terracon is undesirable due to the inability for other laboratories to reproduce the data. According to EPA officials, a potential testing procedure would be EPA Method 556.1 (Standard Method 6252B). However, the analytes do not include glutaraldehyde, and therefore a reported value would not be reliable or repeatable. Additionally, any concentrations of glutaraldehyde detected by laboratory testing would have to be compared to a regulatory standard, which has not been established.

At this time we are not proposing to test for glutaraldehyde.

6.2 N-VIS L

N-VIS L contains a chemical called dipropylene glycol monomethyl ether. This chemical was used in very little quantity at the subject site, approximately three to six gallons. The material was added to likely thousands of gallons of drilling fluid, thus diluting the available concentrations for groundwater impact.

According to Energy Laboratories, no methods to quantify dipropylene glycol monomethyl ether in groundwater exist, no regulatory standards for it exist, and it is listed as being of low toxicity.

At this time we are not proposing to test for dipropylene glycol monomethyl ether.

6.3 ENVIRO TORQ

ENVIRO-TORQ contains a chemical called diethanolamine. This compound was used in very little quantity at the subject site, approximately one to five gallons.

According to Energy Laboratories, there are no methods to quantify this compound in groundwater, nor any regulatory standards to which to compare concentrations. According to an MSDS for diethanolamine by Mallinckrodt-Baker, Inc., when released into the soil, diethanolamine should be expected leach into groundwater and have a half-life between 10 and 30 days.[16]

At this time we are not proposing to test for diethanolamine.

6.4 POLYAC PLUS

POLYAC PLUS contains a chemical called sodium polyacrylate. This compound was used in large quantity at the subject site, up to 7,900 pounds.

According to Energy Laboratories, there are no methods to quantify this compound in groundwater, nor any regulatory standards to which to compare concentrations. The material is known as a super absorber, and is used in every day products such as disposable diapers. Should the material come into contact with water, it would absorb the water and become relatively immobile. According to an MSDS prepared by Emerging Technologies, Inc., "Polyacrylate absorbents are relatively inert in aerobic and anaerobic conditions. They are immobile in landfills and soil systems (> 90% retention), with the mobile fraction showing biodegradability." [17]

At this time we are not proposing to test for sodium polyacrylate.

6.5 THERMA THIN

THERMA THIN contains a chemical called an anionic acrylic polymer. This compound was used in little quantity at the subject site, approximately forty-two to seventy gallons. The material was added to likely thousands of gallons of drilling fluid, thus diluting the available concentrations for groundwater impact.

According to Energy Laboratories, there are no methods to quantify this compound in groundwater, nor any regulatory standards to which to compare concentrations. .

At this time we are not proposing to test for any anionic acrylic polymers.

7.0 REFERENCES

[1] Dahlberg, Jeff; Windsor Energy Group, L.L.C.; Interviews; August to November 2006

[2] Johnson, Rick; H.C.S., Inc. then Johnson's Oil and Water, Inc.; Interviews; November 2006 through present

[3] Berge Jr., Allan T.; Wyoming Oil and Gas Commission; Letter; August 17, 2006

[4] Terracon Consultants, Inc.; *Site Safety and Health Plan for Petroleum Hydrocarbon Contamination*; August 24, 2006

[5] Wyoming Oil and Gas Commission Website; *Wellbore Schematic Windsor Energy 25-3;*

[6] P.E. Grosch Construction, Inc.; Survey of Monitoring Wells and Springs; September 18, 2006

[7] Wyoming Department of Environmental Quality; *Guidance Document 2 – Remediation Constants and Calculations §3 "State Drinking Water Equivalent Levels"; May 11, 2006*

[8] Environmental Protection Agency – Office of Water; *National Primary Drinking Water Standards* (EPA Publication 816-F-03-016); June 2003

[9] Environmental Protection Agency – Region IX; *Region 9 Preliminary Remediation Goals (PRGs); October 2004*

[10] Wyoming Oil & Gas Commission – *MEMO – Line Creek Anticline, (Bennett Creek) Field Development*; August 18, 2006

[11] United States Environmental Protection Agency – Office of Research and Development – Office of Solid Waste and Emergency Response – *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures* (EPA Publication No. EPA/540/S-95/504); April 1996

[12] Great White Well Control – *Well Control Operations – Windsor Energy Group, LLC – Crosby 25-3 – Park County, Wyoming* dated September 25, 2006

[13] Cooper, H.H. and Jacob, C.E., *A Generalized Graphical Method for Evaluating Formation Constants and Summarizing Well Field History*. American Geophysical Union Transactions, Vol. 27, pp. 526-524; 1946

[14] Australian Department of the Environment and Water Resources website: http://www.npi.gov.au/database/substance-info/profiles/46.html

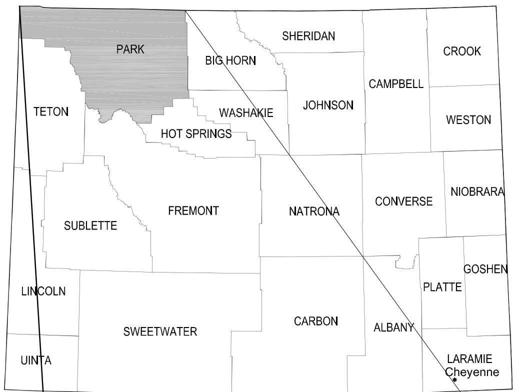
[15] United Nations Environment Programme Chemicals Branch with the Organisation for Economic Co-Operation and Development (OECD) website: http://www.chem.unep.ch/irptc/sids/oecdsids//111308.pdf

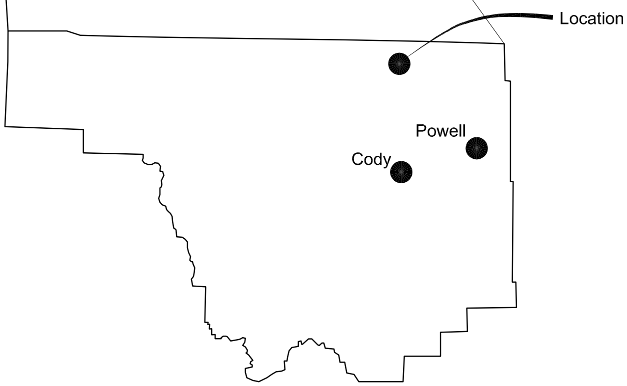
[16] Mallinckrodt-Baker, Inc. *MSDS – Diethanolamine*

[17] Emerging Technologies, Inc. – *MSDS - LiquiBlock™ 44-OC*

Windsor Energy Group, LLC
Crosby #25-3 Natural Gas Well Release
Road 1AB, Park Co., Wyoming

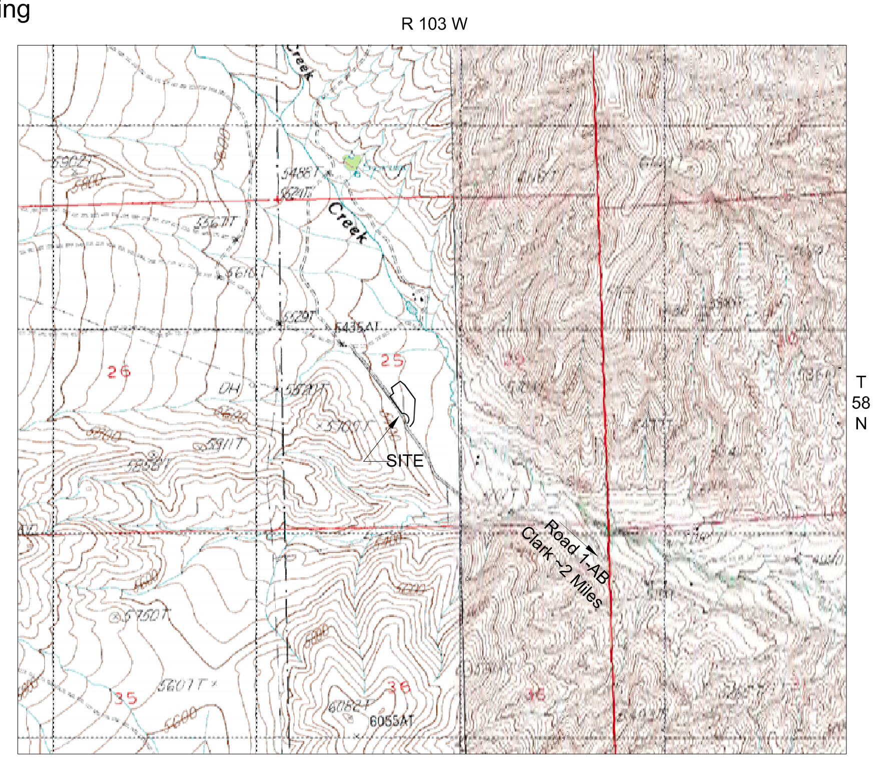
STATE OF WYOMING





PARK COUNTY

Scale in Feet
Not a Legal Survey
All Locations Approximate



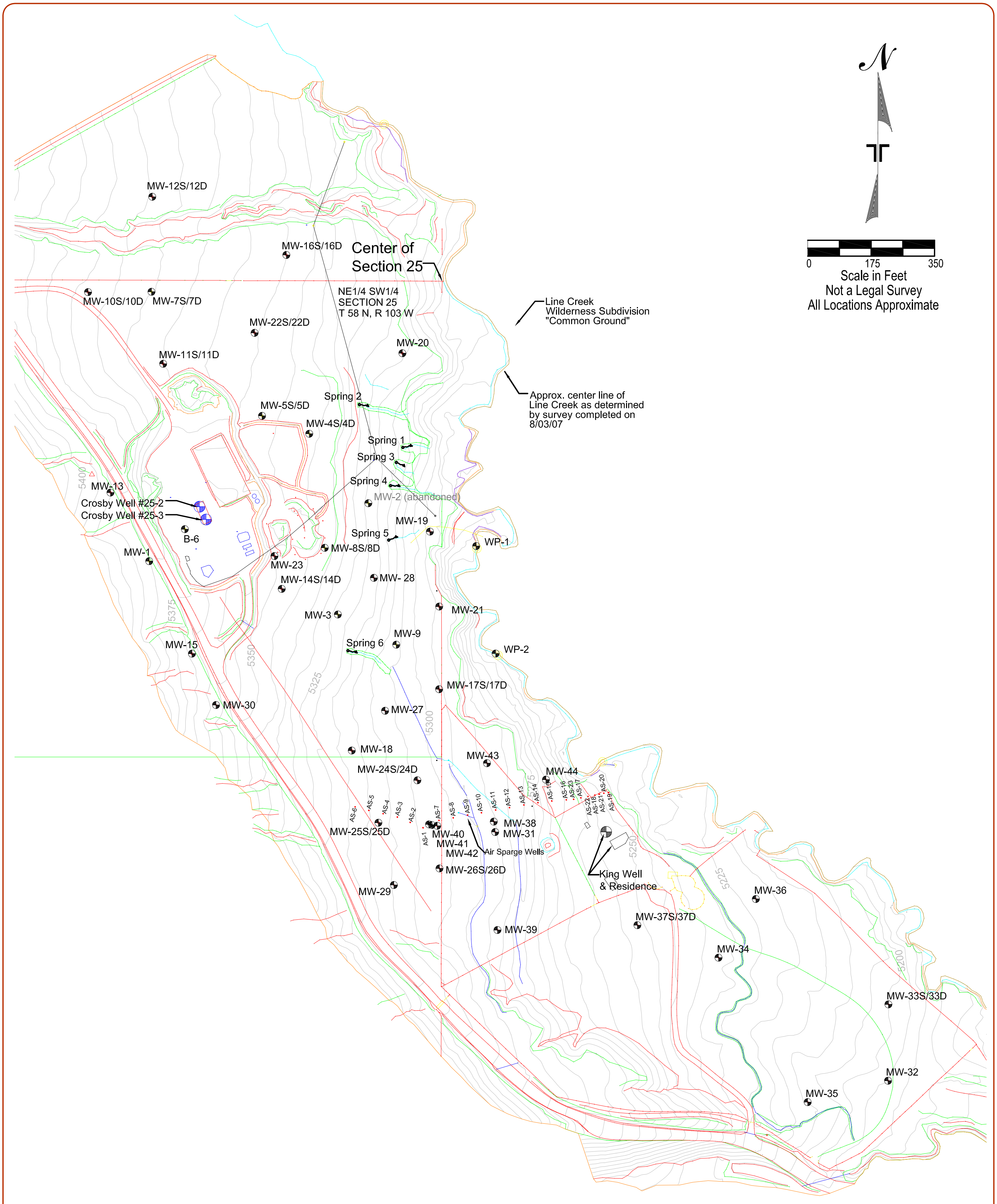
Sections 25, Township 58 N, Range 103W,
Mapping Excerpted From USGS
7½-minute Quad North Bennett Creek, Wyoming

MAP INDEX SHEET

Sheet	Description
1.	Site Location Map
2.	Site & Exploration Plan
3.	Private Water Wells / Surface Water Samples Location Map
4.	Groundwater Contour Map - September 2006
5.	Groundwater Contour Map - January 2007
6.	Groundwater Contour Map - May 2007

Site Location Map
Crosby #25-3 Natural Gas Well Release
Road 1AB, Park Co., Wyoming

Project Mngr: M.Bullock	Terracon 2110 Overland Avenue, Suite 124 Billings, MT 59102 406-656-3072	Project No.	26067064
Designed By:		Scale:	As Shown
Checked By:		Date:	Sept. 2007
Approved By:		Drawn By:	WK
File Name: Gen Location.dwg		Figure No.	1



Site and Exploration Plan

Crosby #25-3 Natural Gas Well Release
Road 1AB, Park Co., Wyoming

2110 Overland Avenue, Suite 124
Billings, Montana 59102
ph: 406-656-3072
fax: 406-656-3578

Terracon

Job #	Date	Drawn	Scale
26067064	Feb. 2007	M. Bullock	As Shown

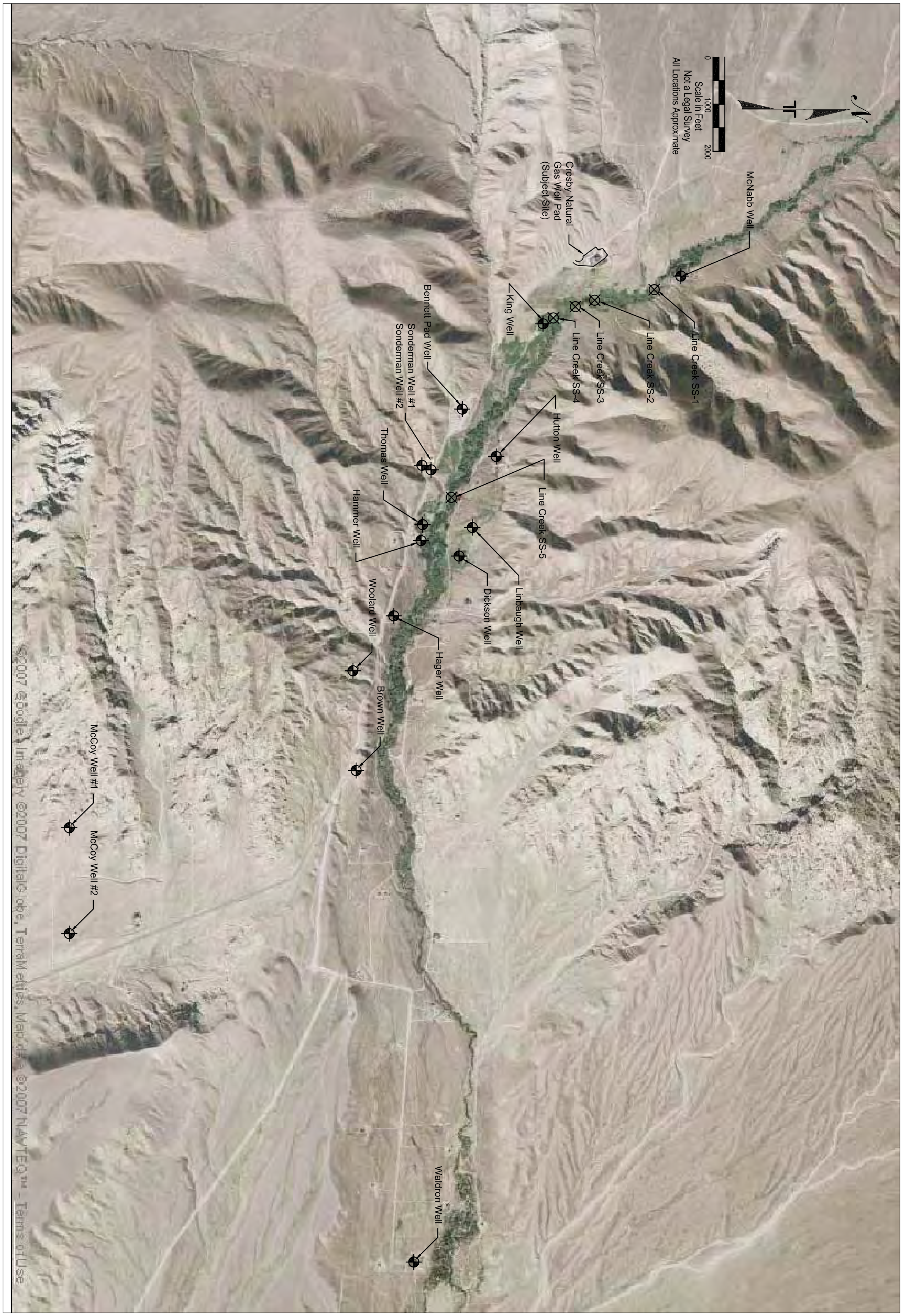


Figure 3 - Private Water Wells / Surface Water Samples
Location Map

Crosby #25-3 Natural Gas Well Release
Road 1AB, Park Co., Wyoming

Job #	Date	Drawn	Scale
26067064	Sept. 2007	W. Knudsen	As Shown

Terracon

2110 Overland Avenue, Suite 124
Billings, Montana 59102
ph: 406-656-3072
fax: 406-656-3578

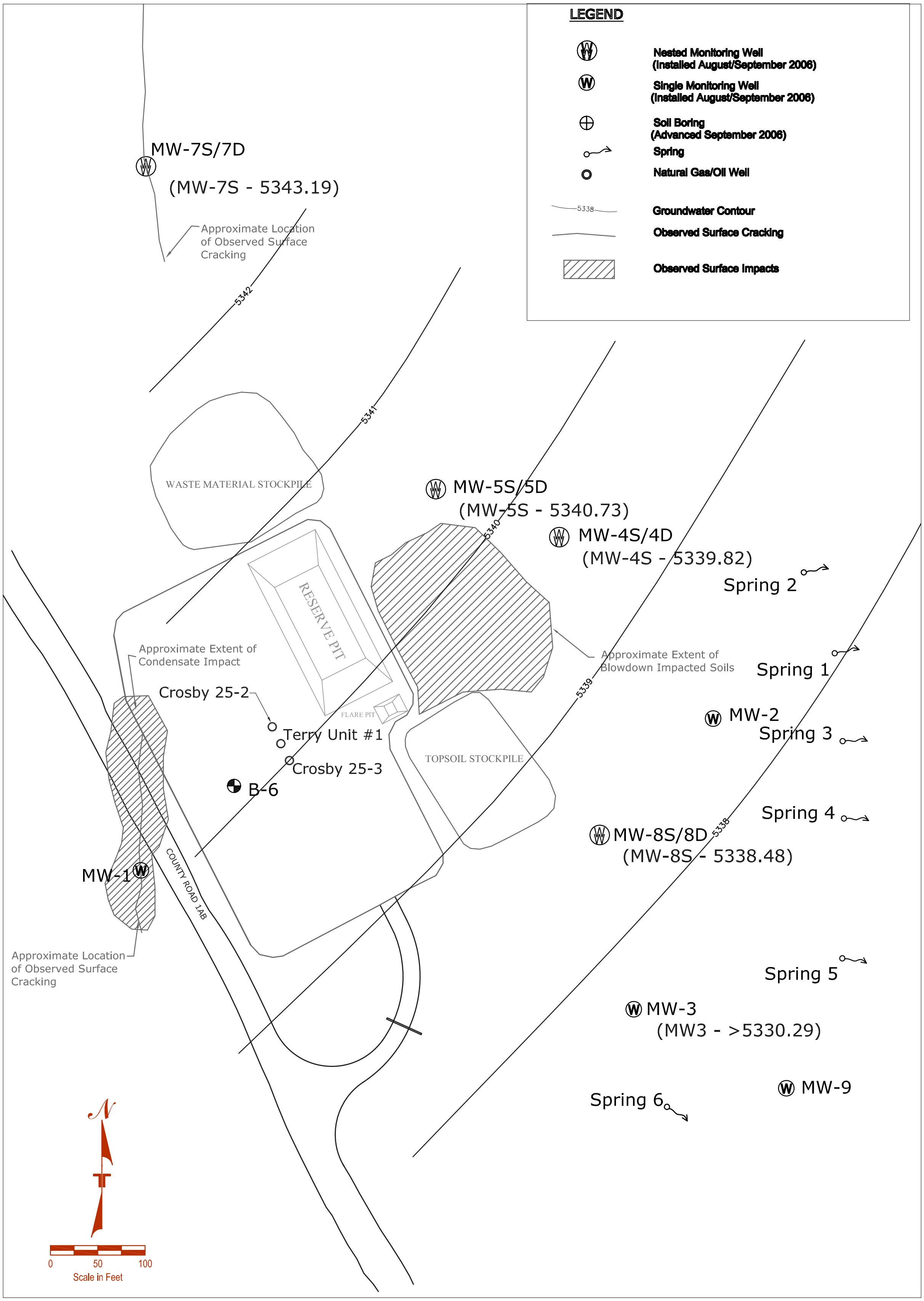


Figure based upon site survey performed by P.E. Grosch Construction Inc. of Worland, WY.

Figure 4 - Groundwater Contour Map - September 2006

Crosby #25-3 Natural Gas Well Release
Road 1AB, Park Co., Wyoming

2110 Overland Avenue, Suite 124
Billings, Montana 59102
ph: 406-656-3072
fax: 406-656-3578

Job #	Date	Drawn	Scale
26067064	Sept. 2007	W. Knudsen	As Shown

Terracon

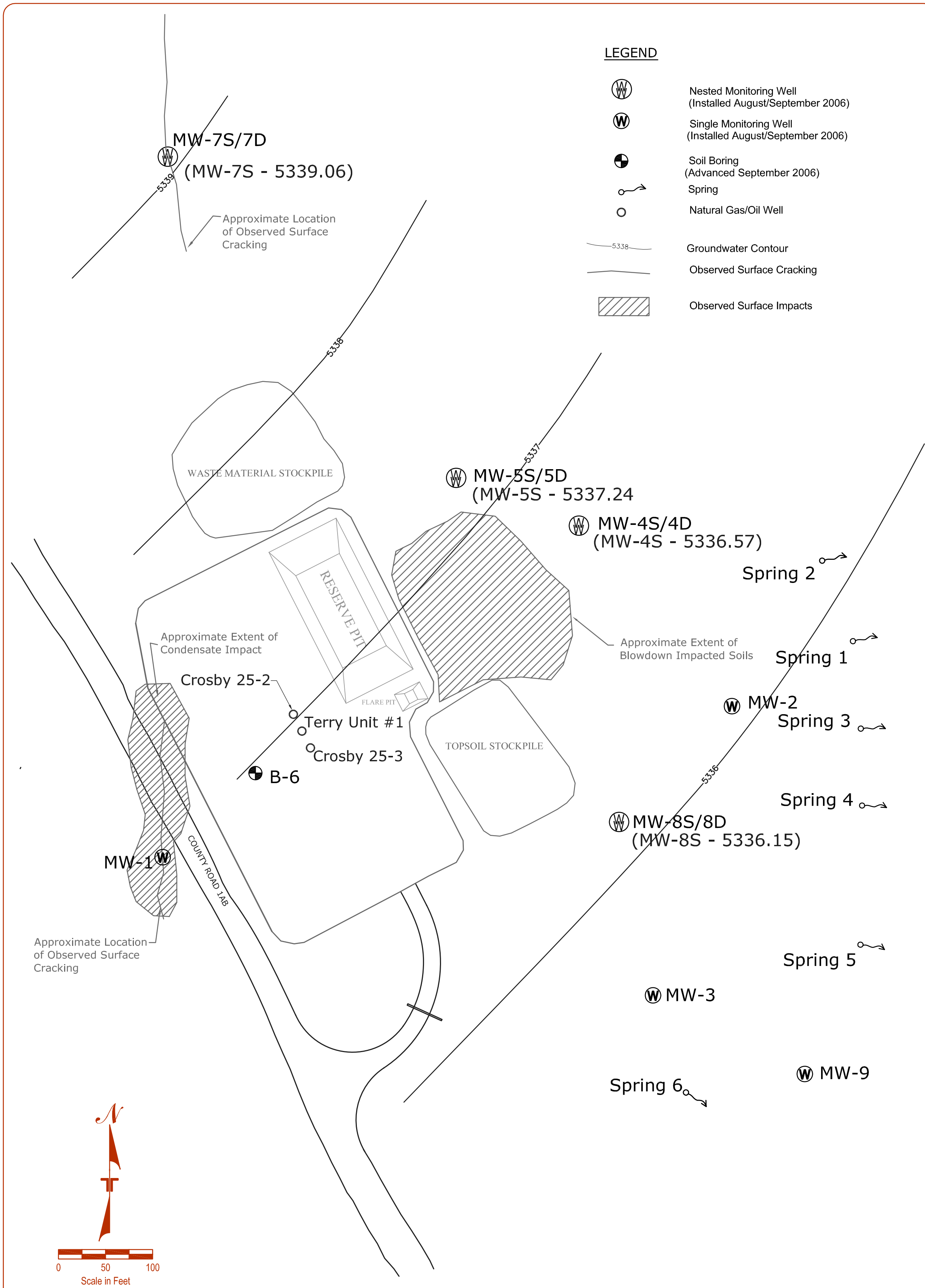


Figure based upon site survey performed by P.E. Grosch Construction Inc. of Worland, WY.

Figure 5 - Groundwater Contour Map - January 2007

Crosby #25-3 Natural Gas Well Release
Road 1AB, Park Co., Wyoming

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fax: 406-656-3578

Job #	Date	Drawn	Scale
26067064	Sept. 2007	W. Knudsen	As Shown

Terracon

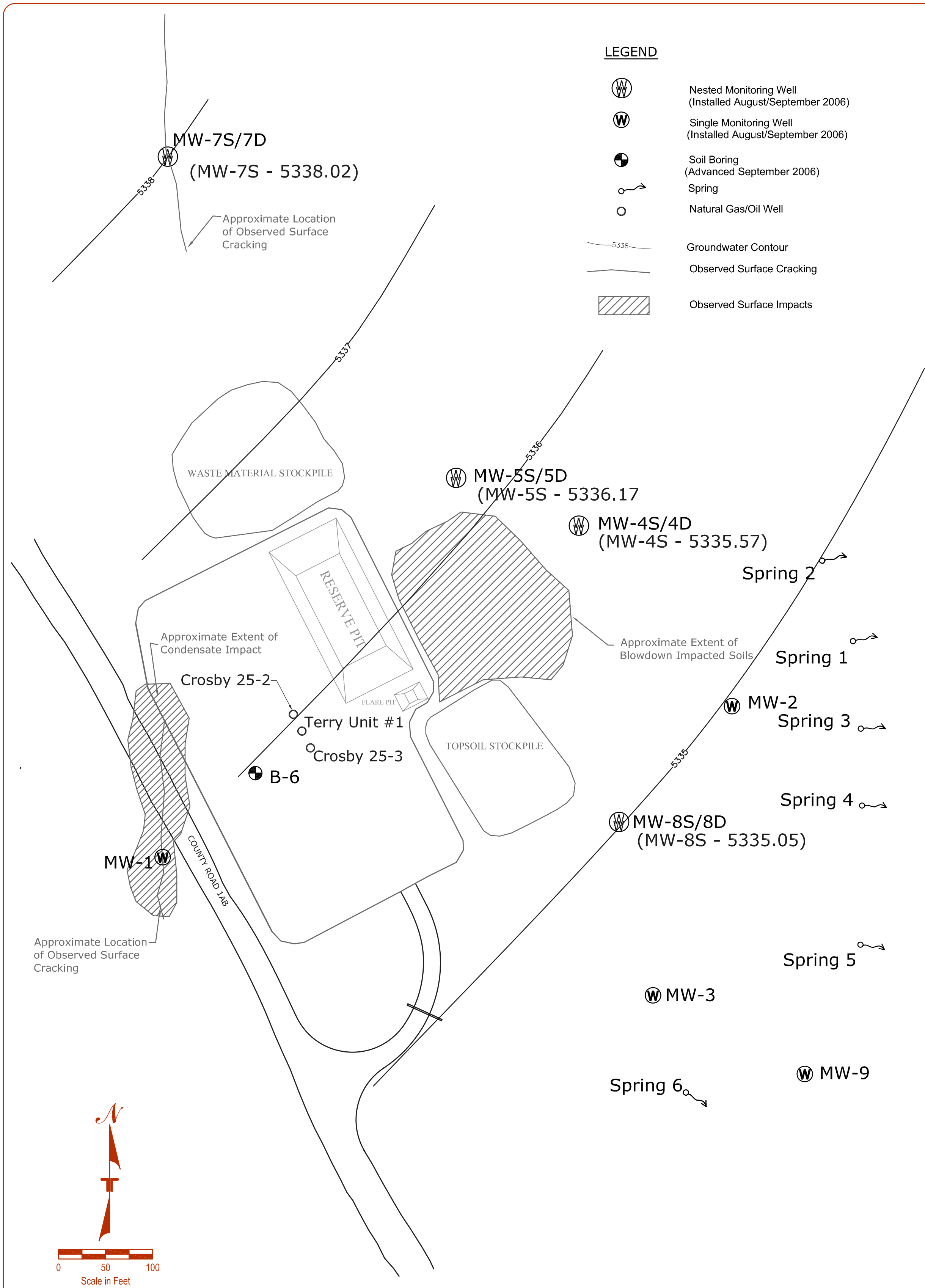

Figure based upon site survey performed by P.E. Grosch Construction Inc. of Worland, WY.

Figure 6 - Groundwater Contour Map - May 2007

Crosby #25-3 Natural Gas Well Release
Road 1AB, Park Co., Wyoming

2110 Overland Avenue, Suite 124
Billings, Montana 59102
ph: 406-656-3072
fax: 406-656-3578

Job #	26067064	Date	Sept. 2007	Drawn	W. Knudsen	Scale	As Shown

Terracon

APPENDIX A

Sampling and Analysis Plan (SAP)

SAMPLING AND ANALYIS PLAN (SAP)

Crosby 25-3 Natural Gas Well Release
Road 1AB
Clark, Park County, Wyoming

Submitted To:

Windsor Energy Group, L.L.C.
Oklahoma City, Oklahoma

2 February 2007

Terracon Job No.:
26067064

Prepared by:

Terracon
Consulting Engineers & Scientists

2110 Overland Avenue, Suite 124
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406-656-3072 Fax: 406-656-3578

2 February 2007

Windsor Energy Group, L.L.C.
14313 North May Avenue
Oklahoma City, Oklahoma 73134
ph: (405) 242-4421

Attention: Mr. Jeff Dahlberg

Subject: Sampling and Analysis Plan
Subsurface Investigation
Crosby 25-3 Natural Gas Well Release
Road 1AB
Clark, Park County, Wyoming
Terracon Project No. 26067064

Dear Mr. Dahlberg:

Terracon Consultants, Inc. (Terracon) is pleased to present this Sampling and Analysis Plan (SAP) for the Crosby 25-3 Natural Gas Well project. In a letter dated 26 December 2006, the Wyoming Department of Environmental Quality required Windsor Energy to include a Sampling and Analysis Plan (SAP) with the *Report of Investigation* (ROI) dated 17 November 2006. It should also be noted that the procedures presented herein will be utilized for all future work by Terracon on the subject site.

We appreciate this opportunity to be of service to you. If you have any questions or regarding the findings in this report, please do not hesitate to contact the undersigned at your earliest convenience.

Respectfully submitted,
Terracon Consultants, Inc.

Michael J. Bullock
Project Engineer

Dan C. Nebel, P.G.
Office Manager

cc: Mr. Mark Thiese, Wyoming Department of Environmental Quality

SAMPLING AND ANALYSIS PLAN
Subsurface Investigation
Crosby 25-3 Natural Gas Well Blowout
Clark, Park County, Wyoming
Terracon Project No. 26067064

TABLE OF CONTENTS

1.0 PROJECT MOBILIZATION 1

2.0 FIELD SCREENING 1

3.0 SOIL/BEDROCK SAMPLING 2

4.0 MONITORING WELL CONSTRUCTION 2

5.0 MONITORING WELL DEVELOPMENT 3

6.0 MONITORING WELL SAMPLING 4

7.0 DOMESTIC WATER WELL SAMPLING 5

8.0 QUALITY ASSURANCE/QUALITY CONTROL METHODS 5

- **8.1 Sampling Frequency 6**
- **8.2 Decontamination Procedures 6**
- **8.3 Sample Labeling 7**
- **8.4 Containers, Preservation, and Holding Times 7**
- **8.5 Field Quality Control 8**
- **8.6 Laboratory Quality Control 8**
- **8.7 Site Observation and Well Maintenance 8**

1.0 PROJECT MOBILIZATION

All field personnel will review with the project manager (Michael Bullock) the requirements and objectives of their participation in the field. The field personnel will read and review this Sampling and Analysis Plan (SAP), the site Safety and Health Plan (dated 24 August 2006), and any previous published information regarding the site prior to arriving on site. These meetings allow the field personnel to review and discuss issues such as project objectives, health and safety concerns, drilling, development, and/or sampling procedures, decontamination procedures, communication policies, documentation requirements, chain-of-custody policies, and equipment usage and maintenance.

2.0 FIELD SCREENING

Field screening is conducted to assist in the identification of petroleum impacted soils and bedrock. Field screening is accomplished with a Photoionization Detector (PID), and/or a Flame Ionization Detector (FID) and visual / olfactory indications of petroleum hydrocarbons.

When possible, each soil/bedrock sample collected is field screened for the presence of Volatile Organic Compounds (VOCs) to estimate if petroleum could be present. This involves plunging the probe of a PID or FID through a sealable plastic bag containing approximately 6-ounces of soil or bedrock extracted from the subsurface by the drilling subcontractor.

The value presented by the PID or FID indicates the total vapor concentration of volatilized organic compounds in the air surrounding the soil/bedrock samples. These compounds include numerous constituents of petroleum hydrocarbons. However, the PID or FID is not capable of determining the species of these compounds or their absolute concentrations in the soil samples. Consequently, it should be considered merely a screening tool that aided in detecting the presence of volatile soil contaminants. Calibration of the PID or the FID with 100 parts per million (ppm) isobutylene will occur in the morning prior to any field screening taking place.

Due to the apparent presence of methane in the subsurface soils and the heat often generated as part of the drilling process, it is anticipated that field screening might yield false high readings. In most cases, olfactory indications would be the preferred method to screen the soil/bedrock to select appropriate samples for analytical laboratory testing.

Soil and bedrock samples undergoing field screening will be disposed of with any drill cuttings generated.

3.0 SOIL/BEDROCK SAMPLING

Soil/bedrock sampling will consist of filling two, 9-ounce soil jars with soil/bedrock collected from the soil/bedrock extracted during borehole advancement. (See Sections 8.3 and 8.4 of this SAP for procedures related to sample identification and analyses) Selection of soil/bedrock samples to be collected and submitted for analytical laboratory testing will be based upon field screening and subsurface conditions encountered such as inferred or estimated confining layers.

When water is used during drilling, unconsolidated fine gravels, sands, silts, and clays are often flushed out of the soil/bedrock leaving only the coarser aggregate or competent bedrock layers. Soil/bedrock samples will not be collected from these intervals as they would not accurately represent the subsurface soil and/or bedrock conditions.

After the samples are collected, they will be labeled, and packaged on ice to maintain a temperature near 4° C. Preservation, packaging, and transporting procedures will be in general accordance with ASTM D4220-95 (Reapproved 1995) *Standard Practices for Preserving and Transporting Soil Samples.* The samples will be hand-delivered or shipped under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

4.0 MONITORING WELL CONSTRUCTION

All monitoring wells will be constructed with either 4-inch diameter Schedule 40 polyvinyl chloride (PVC) casing or 2-inch diameter PVC casing. Diagrams of the well construction methods will be included with the boring logs presented in the report documenting installation. Some borings will be completed as “nested” monitoring wells.

Nested monitoring wells consist of two 2-inch diameter monitoring wells installed within the same borehole, but completed in apparent different groundwater bearing zones. These wells have different screened intervals in order to collect samples from different groundwater bearing zones and are sealed with bentonite clay to minimize communication between the zones.

A 0.01 inch (or alternate size as determined by the project manager) slotted PVC screen will be incorporated in each well. The elevation of the top of the screened interval will be selected such that any fluctuations in groundwater elevation would result in the top of the water level remaining within the screened interval. However, oftentimes the water levels encountered during drilling and those encountered after the construction of the well are higher than anticipated. The difference is often a result of artesian groundwater zones or confined groundwater zones which may result in a groundwater elevation above the screened interval.

The annular space between the borehole wall and the slotted PVC will be backfilled with 10-20 silica sand (or other size as determined by the project manager), usually to two feet above the screened interval, with the remaining annular space above the silica sand pack being sealed with bentonite. The monitoring wells will be completed at the surface by cementing a stick-up protective monitoring well cover around the well head. The monitoring well cover will be locked at the completion of each well. These wells will be constructed in general accordance with Wyoming State Standards and in general accordance with ASTM D 5092-04 *Standard Practice for Design and Installation of Ground Water Monitoring Wells.*

The designated measuring point and elevation datum at each monitoring well is defined as the ground surface immediately adjacent to the surficial concrete seal to the north and the top of the PVC well casing on the north side. A licensed professional surveyor will be contracted to survey in the horizontal and vertical positions of the monitoring wells as well as other pertinent site features. Should any modifications to the well casing be made, the licensed surveyor will be contacted to perform a new survey of the elevation.

5.0 MONITORING WELL DEVELOPMENT

Monitoring wells will be developed once the installations are completed. Based upon the amount of water in each well and the presence of suspended and settled solids, each well will undergo a process intended to remove water added during the drilling process, a significant amount of settled and suspended solids, and infiltrating formation fines. The amount of water removed will be based upon the amount of suspended solids present (the ability of the submersible pump to pump the fluid), and the recharge capacity of the well.

In many cases, the wells may be pumped dry during development. In these cases, the recharge will be estimated and additional fluid may be removed once sufficient fluids flow into the well casing.

6.0 MONITORING WELL SAMPLING

The designated measuring point and elevation datum at each monitoring well is defined as the ground surface immediately adjacent to the surficial concrete seal to the north and the top of the PVC well casing on the north side. These locations are the basis for all future references to elevation in relation to the monitoring well. Should any modifications to the well casing be made, the licensed surveyor will be contacted to perform a new survey of the elevation.

Prior to well purging and sample collection, the static water level present in the well will be measured from the north side of the top of the PVC casing. The measuring of static water levels will be performed in general accordance with ASTM D 4750-87 (Reapproved 2001) *Standard Test Method for Determining Subsurface Liquid Levels in a Borehole or Monitoring Well (Observation Well)*. The wells will then be purged and sampled with a submersible pump or disposable bailer. At least three casing volumes will be purged from each well before a sample was collected, when possible. To ensure that representative groundwater samples are collected, water quality parameters (dissolved oxygen, oxygen reduction potential, conductivity, pH, and temperature) will be monitored and allowed to stabilize during the purging process prior to sample collection. Sampling procedures will be in general accordance with ASTM D 4448-01 *Standard Guide for Sampling Ground-Water Monitoring Wells.* (See Sections 8.3 and 8.4 of this SAP for procedures related to sample labeling, container selection, and analyses)

Portable field parameter measuring instruments will be calibrated using the following methods:

pH:	pH 4.0 and 7.0 buffer solutions
Conductivity:	1,413 uS conductivity solution
Dissolved Oxygen:	Sodium sulfite solution and oxygen saturated distilled water
Oxidation Reduction Potential:	1,413 uS conductivity solution

After purging, the groundwater samples will be collected in appropriate containers and preserved, labeled, and packaged on ice to maintain a temperature near 4° C. The samples will be hand-delivered, or shipped, under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

Purge water will be disposed of in the reserve pit located on the Crosby 25-3 Natural Gas Well Drilling pad. Other Investigation Derived Waste (IDW) will be disposed of off-site, or as directed by the project manager and in accordance with applicable regulations. Once the reserve pit is closed, Terracon will provide drums for storage of the purged groundwater. These drums will be emptied when they are full, by a contractor licensed to accept petroleum-impacted groundwater.

7.0 DOMESTIC WATER WELL SAMPLING

Domestic water well sampling will follow similar procedures to those described in Section 6.0, above, with the exception of the measurement of parameters. The collection of domestic water wells typically involves a system which is in operation frequently enough to have sufficiently developed. However, a purging of the system will be performed to ensure that “formation water” is flowing prior to collecting the sample. Purging will consist of allowing the well’s submersible pump to operate for a minimum of ten minutes, subsequent to any cisterns or storage tanks being emptied. Alternatively, if possible, the samples will be obtained from point in the domestic water system that is precedes the cistern or storage tank. The analyses performed, the sample containers used, and the preservation methods will all remain the same as described in the other sections of this SAP.

After purging, the groundwater samples will be collected in appropriate containers and preserved, labeled, and packaged on ice to maintain a temperature near 4° C. The samples will be hand-delivered or shipped under chain-of-custody procedures to Energy Laboratories in Billings, Montana for analysis. Chain-of custody procedures will be in general accordance with ASTM D4980-99 (Reapproved 2004) *Standard Guide for Sample Chain-of-Custody Procedures*.

8.0 QUALITY ASSURANCE/QUALITY CONTROL METHODS

The Quality Assurance/Quality Control (QA/QC) objective for the monitoring program at the Crosby 25-3 Natural Gas Well site and down gradient domestic water wells is to ensure that samples sent to the laboratory and reported analytical results represent actual field conditions. In order to accomplish this goal, sampling guidelines and procedures have been established in accordance with standard industry practices accepted by the EPA and WDEQ.

These measures include:

- Adherence to the sampling frequency schedule as discussed herein;
- Adherence to decontamination procedures between sampling;
- Utilization of unique sample labeling;
- Adherence to chain-of-custody procedures;
- Utilization of laboratory-provided sample containers and sampling kits; and
- Adherence to sample holding times and matrix preservation protocols.

8.1 Sampling Frequency

Sampling of potentially-impacted soil for characterization purposes will be performed in each boring where field screening or other indications suggests the presence of petroleum hydrocarbons. When the exploration exhibits no indications of petroleum hydrocarbons, soil samples will be obtained at or near the groundwater interface or the bedrock interface.

- Selection of soil samples to be submitted for analytical testing will be made by Terracon personnel, based upon the aforementioned field indications.

- Groundwater samples will be collected from the well upon completion of construction and successful development. We estimate that regular sampling will take place after completion of the monitoring wells.

- Drilling water (i.e. water to be used during drilling) will be analyzed periodically to determine whether petroleum hydrocarbons are present in the drilling water utilized to complete the drilling.

8.2 Decontamination Procedures

The sampling tools, equipment, and instruments will be cleaned between samples to minimize the potential for cross contamination. Decontamination will be accomplished via tap and distilled water rinses and washes with a phosphate-free detergent solution. Following sampling activities the sampling equipment will be washed in a laboratory-grade, biodegradable phosphate-free, detergent solution and rinsed with potable water. A final rinse with distilled water will remove detergent residue from the sampling equipment. A clean, unused, pair of nitrile gloves will be used to handle each sample. Polyethylene tubing and/or disposable polyethylene bailers used during development and sampling of the groundwater monitoring wells will be disposed of after sampling is completed.

8.3 Sample Labeling

Samples will be identified from the boring or well from which they are collected. For soil/bedrock samples, the sample identification will include the boring or well number and the depth from which it was collected. For example, the soil sample collected from a boring identified as B-1 at a depth of 20 feet would be labeled B-1 @ 20'. Groundwater samples will be identified with the well number or sampling location. Drilling water samples will be identified by the designation of Drilling Water and the date on which it was collected. The labeling will be completed on laboratory provided labels, affixed to each sampling container utilized. The containers will be cleaned and dried to ensure that sample labels are securely attached to the containers. Labeling will be performed using an indelible felt-tip marker.

8.4 Containers, Preservation, and Holding Times

The following table presents the containers, analytical laboratory methods, and preservation information utilized for each media to be sampled:

<table>
<tr><th>Matrix</th><th>Analyte</th><th>Container</th><th>Preservation</th><th>Holding Time</th></tr>
<tr><td>Soil</td><td>Total Petroleum Hydrocarbons (GRO and DRO)
by EPA Method 8015/8260;</td><td rowspan="3">Two 9-oz glass jars</td><td rowspan="3">Cool to 4° C</td><td rowspan="3">14 days</td></tr>
<tr><td>Soil</td><td>Volatile Organic Compounds
by EPA Method 8260</td></tr>
<tr><td>Soil</td><td>Semi-Volatile Organic Compounds
by EPA Method 8270.</td></tr>
<tr><td>Water</td><td>Total Petroleum Hydrocarbons – Gasoline Range Organics (GRO)
by EPA Method 8015/8260;</td><td rowspan="2">Two 40 mL VOA vials</td><td rowspan="2">HCl and
Cool to 4° C</td><td rowspan="2">14 days</td></tr>
<tr><td>Water</td><td>Volatile Organic Compounds
by EPA Method 8260</td></tr>
<tr><td>Water</td><td>Dissolved Methane by EPA Method by 8015 (GC-FID) (RSK 175)</td><td>Two 40 mL VOA vials</td><td>H_2SO_4 and
Cool to 4° C</td><td>14 days</td></tr>
<tr><td>Water</td><td>Total Petroleum Hydrocarbons – Diesel Range Organics (DRO)
by EPA Method 8015;</td><td>One 1L Amber glass bottle</td><td>H_2SO_4 and
Cool to 4° C</td><td>7 days</td></tr>
<tr><td>Water</td><td>Semi-Volatile Organic Compounds
by EPA Method 8270.</td><td>One 1L Amber glass bottles</td><td>Cool to 4° C</td><td>7 days</td></tr>
</table>

8.5 Field Quality Control

When groundwater samples are to be collected, a trip blank is supplied by the laboratory, and is later analyzed for VOCs. The trip blank is placed in the sample collection cooler at the beginning of the field sampling event and it accompanies the samples at all times until delivery to the laboratory.

Occasionally, a field duplicate groundwater sample will be collected. The field duplicate sample will be collected subsequent to collecting a groundwater sample from a monitoring well. The sample identification will be limited to "Duplicate" or similar. The location from which the duplicate sample was collected will be withheld from the laboratory but noted on field documentation. The purpose of the field duplicate sample is to ensure precision in the laboratory methodology.

8.6 Laboratory Quality Control

The analytical laboratory shall be accredited by the State of Wyoming to perform the specified analytical methods. This project is utilizing Energy Laboratories, Inc. in Billings, MT to analyze the samples collected. Laboratory quality control will consist of analysis of a method blank, a matrix spike/matrix spike duplicate report, and a blank spike.

8.7 Site Observation and Well Maintenance

The physical condition of the well monuments will be observed during each sampling event. Each well will be kept clean and free of debris that could potentially enter the well. The area around each well will be kept clear of overgrowth, and will remain visible to the extent possible. Locks and expansion plugs will be observed and replaced if faulty. The concrete surface seal of each well will be observed and replaced or repaired if significantly cracked.

APPENDIX B

Worksheet - Drilling Products Used at Site

Worksheet - Drilling Products Used at Site

PRODUCT	Contents	CAS Number	Chemical Formula	Min%	Max%
ALDACIDE G *	Glutaraldehyde	111-30-8	$C_5H_8O_2$	10	30
ALUMINUM STEARATE	Aluminum Stearate	637-12-7	$C_{54}H_{105}AlO_6$	60	100
AQUAGEL	Crystalline silica, cristobalite	14464-46-1	O_2Si	0	1
	Crystalline silica, tridymite	15468-32-3	O_2Si	0	1
	Crystalline silica, quartz	14808-60-7	O_2Si	1	6
	Bentonite	1302-78-9	(Al,Fe1.67Mg.33)Si10(OH)2Na(+)Ca(++)/2.33	92	100
BARACARB 150	Crystalline silica, quartz	14808-60-7	O_2Si	0	1
	Limestone	1317-65-3	$CCaO_3$	60	100
BARACARB 25	Crystalline silica, quartz	14808-60-7	O_2Si	0	1
	Limestone	1317-65-3	$CCaO_3$	60	100
BARA DEFOAM 1	Kerosene	8008-20-6	C_{12} to C_{15} Complex hydrocarbon	30	60
BARAZAN D PLUS	Xanthan gum	11138-66-2	$(C_{35}H_{49}O_{29})_n$	60	100
BAROFIBRE MEDIUM	Nut hulls	0	--	60	100
BAROID	Crystalline silica, quartz	14808-60-7	O_2Si	1	5
	Barium sulfate	7727-43-7	BaO_4S	60	100
BARO-SEAL MEDIUM	Contains no hazardous substances	Mixture	$(C_6H_{10}O_5)_n$	60	100
BARO-TROL PLUS	Crystalline silica, quartz	14808-60-7	O_2Si	0	1
BENTONITE EXTENDER D20	Bentonite	1302-78-9	(Al,Fe1.67Mg.33)Si10(OH)2Na(+)Ca(++)/2.33	60	100
BICARBONATE OF SODA	Sodium bicarbonate	144-55-8	$CHNaO_3$	100	100
CARBONOX	Crystalline silica, quartz	14808-60-7	O_2Si	2	6
	Coal	--	--	60	100
CAUSTIC SODA	Sodium hydroxide	1310-73-2	HNaO	60	100
DRIL-N-SLIDE	Fatty acid ester	-		60	100
ENVIRO-TORQ*	Diethanolamine	111-42-2	$C_8H_{15}NO_6$	1	5
	Isopropanol	67-63-0	C_3H_8O	10	30
	Hydrotreated light petroleum distillate	64742-47-8		10	30
EZ MUD (EZ MUD L)	Hydrotreated light petroleum distillate	64742-47-8		10	30
FUMARIC ACID 1	Fumaric Acid	110-17-8	$C_4H_4O_4$	60	100
LIME	Calcium hydroxide	1305-62-0	CaH_2O_2	60	100
MICA COARSE	Crystalline silica, quartz	14808-60-7	O_2Si	1	5
	Mica	12001-26-2	$K_2O \cdot Al_2O_3 \cdot SiO_2$	60	100
MICATEX FINE	Crystalline silica, quartz	14808-60-7	O_2Si	1	5
	Mica	12001-26-2	$K_2O \cdot Al_2O_3 \cdot SiO_2$	60	100
NEW BAR	Barium sulfate	7727-43-7	BaO_4S	100	100
N-VIS	Xanthan gum	11138-66-2	$(C_{35}H_{49}O_{29})_n$	60	100
N-VIS PLUS	Contains no hazardous substances - xanthan gum	Mixture	$(C_{35}H_{49}O_{29})_n$	60	100
N-VIS L*	Dipropylene glycol monomethyl ether	34590-94-8	$C_7H_{16}O_3$	30	60
PAC R	Cellulose derivative - polyanionic cellulose		$(C_6H_{10}O_5)_n$	60	100
POLYAC PLUS*	Contains no hazardous substances - Sodium polyacrylate	Mixture		60	100
SAPP	Sodium acid pyrophosphate	7758-16-9	$H_2Na_2O_7P_2$	60	100
SAWDUST	Wood byproduct		$(C_6H_{10}O_5)_n$	100	100
THERMA-THIN*	Contains no hazardous substances - anionic acrylic polymer	Mixture		60	100
WALL-NUT MEDIUM	Walnut hulls	Mixture	--	60	100
VOLCLAY PREMIUM GEL	Crystalline quartz	14808-60-7	O_2Si	1	2
	Bentonite	1302-78-9	(Al,Fe1.67Mg.33)Si10(OH)2Na(+)Ca(++)/2.33	100	100
XC-207	Xanthan gum	11138-66-2	$(C_{35}H_{49}O_{29})_n$	60	100

Shaded entries denote a compound which has been identified as a potential groundwater contaminant.

The information presented in this table was gathered from MSDSs (available on Windsor's public information website), Energy Laboratories, Inc., and other online sources.

* See Section 6.0 for further discussion

Worksheet - Drilling Products Used at Site

PRODUCT	Contents	Use
ALDACIDE G *	Glutaraldehyde	Kills microbes in drilling mud which degrade the drilling mud
ALUMINUM STEARATE	Aluminum Stearate	Drilling mud defoaminng agent
AQUAGEL	Crystalline silica, cristobalite	Gelling agent used in mud
	Crystalline silica, tridymite	
	Crystalline silica, quartz	
	Bentonite	
BARACARB 150	Crystalline silica, quartz	Used for loss circulation control
	Limestone	
BARACARB 25	Crystalline silica, quartz	Used for loss circulation control
	Limestone	
BARA DEFOAM 1	Kerosene	Removes bubbles and foam from mud
BARAZAN D PLUS	Xanthan gum	Increases viscosity of drilling mud
BAROFIBRE MEDIUM	Nut hulls	Used for loss circulation control
BAROID	Crystalline silica, quartz	Weighting agent used in drilling mud
	Barium sulfate	
BARO-SEAL MEDIUM	Contains no hazardous substances	Contains, cedar shavings, cotton – used for loss circulation control
BARO-TROL PLUS	Crystalline silica, quartz	Shale stabilizer
BENTONITE EXTENDER D20	Bentonite	Gelling agent used in mud
BICARBONATE OF SODA	Sodium bicarbonate	Treats cement contamination of drilling mud
CARBONOX	Crystalline silica, quartz	Dispersant used to lower API Fluid Loss
	Coal	
CAUSTIC SODA	Sodium hydroxide	Stabilizes mud by increasing alkalinity
DRIL-N-SLIDE	Fatty acid ester	Lubricant
ENVIRO-TORQ*	Diethanolamine	Lubricant
	Isopropanol	
	Hydrotreated light petroleum distillate	
EZ MUD (EZ MUD L)	Hydrotreated light petroleum distillate	Increases viscosity of drilling mud
FUMARIC ACID 1	Fumaric Acid	Used to adjust pH of the drilling fluid
LIME	Calcium hydroxide	Stabilizes mud by increasing alkalinity
MICA COARSE	Crystalline silica, quartz	Lubricant
	Mica	
MICATEX FINE	Crystalline silica, quartz	Lubricant
	Mica	
NEW BAR	Barium sulfate	Weighting agent used in drilling mud
N-VIS	Xanthan gum	Increases viscosity of drilling mud
N-VIS PLUS	Contains no hazardous substances - xanthan gum	Increases viscosity of drilling mud
N-VIS L*	Dipropylene glycol monomethyl ether	Increases viscosity of drilling mud
PAC R	Cellulose derivative - polyanionic cellulose	Lowers amount of free water in drilling mud
POLYAC PLUS*	Contains no hazardous substances - Sodium polyacrylate	Lowers amount of free water in drilling mud
SAPP	Sodium acid pyrophosphate	Bit balling preventative. Breaks up mud on drill head.
SAWDUST	Wood byproduct	Used for loss circulation control, and surface absorbent
THERMA-THIN*	Contains no hazardous substances - anionic acrylic polymer	Decreases the viscosity of the drilling mud
WALL-NUT MEDIUM	Walnut hulls	Lubricant
VOLCLAY PREMIUM GEL	Crystalline quartz	Gelling agent used in mud
	Bentonite	
XC-207	Xanthan gum	Increases viscosity of drilling mud

Shaded entries denote a compound which has been identified as a potential groundwater contaminant.

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*   See Section 6.0 for further discussion

Worksheet - Drilling Products Used at Site

PRODUCT	Contents	Min%	Max%	Containers	Amount per Container		Total Used on Site = Containers times Amount per Container	Minimum Active Ingredient Used = Total Used times Min%	Maximum Active Ingredient Used = Total Used times Max%	
ALDACIDE G *	Glutaraldehyde	10	30	70	5	GAL	350	35	105	GAL
ALUMINUM STEARATE	Aluminum Stearate	60	100	2	25	LB	50	30	50	LB
AQUAGEL	Crystalline silica, cristobalite	0	1	133100	1	LB	133100	0	1331	LB
	Crystalline silica, tridymite	0	1	133100	1	LB	133100	0	1331	LB
	Crystalline silica, quartz	1	6	133100	1	LB	133100	1331	7986	LB
	Bentonite	92	100	133100	1	LB	133100	122452	133100	LB
BARACARB 150	Crystalline silica, quartz	0	1	283	50	LB	14150	0	141.5	LB
	Limestone	60	100	283	50	LB	14150	8490	14150	LB
BARACARB 25	Crystalline silica, quartz	0	1	281	50	LB	14050	0	140.5	LB
	Limestone	60	100	281	50		14050	8430	14050	LB
BARA DEFOAM 1	Kerosene	30	60	48	5	GAL	240	72	144	GAL
BARAZAN D PLUS	Xanthan gum	60	100	90	25	LB	2250	1350	2250	LB
BAROFIBRE MEDIUM	Nut hulls	60	100	9	25	LB	225	135	225	LB
BAROID	Crystalline silica, quartz	1	5	337030	1	LB	337030	3370.3	16851.5	LB
	Barium sulfate	60	100	337030	1	LB	337030	202218	337030	LB
BARO-SEAL MEDIUM	Contains no hazardous substances	60	100	157	40	LB	6280	3768	6280	LB
BARO-TROL PLUS	Crystalline silica, quartz	0	1	111	50	LB	5550	0	55.5	LB
BENTONITE EXTENDER D20	Bentonite	60	100	4316	1	BBLS	4316	2589.6	4316	BBLS
BICARBONATE OF SODA	Sodium bicarbonate	100	100	143	50	LB	7150	7150	7150	LB
CARBONOX	Crystalline silica, quartz	2	6	81	50	LB	4050	81	243	LB
	Coal	60	100	81	50	LB	4050	2430	4050	LB
CAUSTIC SODA	Sodium hydroxide	60	100	115	25	KG	2875	1725	2875	KG
DRIL-N-SLIDE	Fatty acid ester	60	100	16	55	GAL	880	528	880	GAL
ENVIRO-TORQ*	Diethanolamine	1	5	20	5	GAL	100	1	5	GAL
	Isopropanol	10	30	20	5	GAL	100	10	30	GAL
	Hydrotreated light petroleum distillate	10	30	20	5	GAL	100	10	30	GAL
EZ MUD (EZ MUD L)	Hydrotreated light petroleum distillate	10	30	156	5	GAL	780	78	234	GAL
FUMARIC ACID 1	Fumaric Acid	60	100	25	50	LB	1250	750	1250	LB
LIME	Calcium hydroxide	60	100	89	110	LB	9790	5874	9790	LB
MICA COARSE	Crystalline silica, quartz	1	5	144	50	LB	7200	72	360	LB
	Mica	60	100	144	50	LB	7200	4320	7200	LB
MICATEX FINE	Crystalline silica, quartz	1	5	401	50	LB	20050	200.5	1002.5	LB
	Mica	60	100	401	50	LB	20050	12030	20050	LB
NEW BAR	Barium sulfate	100	100	70	100	LB	7000	7000	7000	LB
N-VIS	Xanthan gum	60	100	15	25	LB	375	225	375	LB
N-VIS PLUS	Contains no hazardous substances - xanthan gum	60	100	50	50	LB	2500	1500	2500	LB
N-VIS L*	Dipropylene glycol monomethyl ether	30	60	2	5	GAL	10	3	6	GAL
PAC R	Cellulose derivative - polyanionic cellulose	60	100	183	50	LB	9150	5490	9150	LB
POLYAC PLUS*	Contains no hazardous substances - Sodium polyacrylate	60	100	158	50	LB	7900	4740	7900	LB
SAPP	Sodium acid pyrophosphate	60	100	20	50	LB	1000	600	1000	LB
SAWDUST	Wood byproduct	100	100	107	40	LB	4280	4280	4280	LB
THERMA-THIN*	Contains no hazardous substances - anionic acrylic polymer	60	100	14	5	GAL	70	42	70	GAL
WALL-NUT MEDIUM	Walnut hulls	60	100	463	50	LB	23150	13890	23150	LB
VOLCLAY PREMIUM GEL	Crystalline quartz	1	2	162	50	LB	8100	81	162	LB
	Bentonite	100	100	162	50	LB	8100	8100	8100	LB
XC-207	Xanthan gum	60	100	9	6	LB	54	32.4	54	LB

Shaded entries denote a compound which has been identified as a potential groundwater contaminant.

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* See Section 6.0 for further discussion

Worksheet - Drilling Products Used at Site

PRODUCT	Contents	Potential Groundwater Contaminant?	Reason for Not being a Groundwater Contaminant	Can it be detected with the current suite of analyses?	Are there methods for testing for it in groundwater?	Are there regulatory standards for this compound in groundwater?
ALDACIDE G *	Glutaraldehyde	YES	NO	NO	NO	NO
ALUMINUM STEARATE	Aluminum Stearate	NO	Insoluble			
AQUAGEL	Crystalline silica, cristobalite	NO	Insoluble			
	Crystalline silica, tridymite	NO	Insoluble			
	Crystalline silica, quartz	NO	Insoluble			
	Bentonite	NO	Insoluble			
BARACARB 150	Crystalline silica, quartz	NO	Insoluble			
	Limestone	NO	Insoluble			
BARACARB 25	Crystalline silica, quartz	NO	Insoluble			
	Limestone	NO	Insoluble			
BARA DEFOAM 1	Kerosene	YES	NO	YES	GRO/DRO	
BARAZAN D PLUS	Xanthan gum	NO	Safe food additive			
BAROFIBRE MEDIUM	Nut hulls	NO	Food by-product			
BAROID	Crystalline silica, quartz	NO	Insoluble			
	Barium sulfate	NO	Insoluble			
BARO-SEAL MEDIUM	Contains no hazardous substances	NO	Insoluble			
BARO-TROL PLUS	Crystalline silica, quartz	NO	Insoluble			
BENTONITE EXTENDER D20	Bentonite	NO	Insoluble			
BICARBONATE OF SODA	Sodium bicarbonate	NO	Safe food additive			
CARBONOX	Crystalline silica, quartz	NO	Insoluble			
	Coal	NO	Insoluble			
CAUSTIC SODA	Sodium hydroxide	NO	Merely adjusts pH			
DRIL-N-SLIDE	Fatty acid ester	YES	NO	YES	8270 TIC	
ENVIRO-TORQ*	Diethanolamine	YES	NO	NO	NO	NO
	Isopropanol	YES	NO	YES	8260 TIC	
	Hydrotreated light petroleum distillate	YES	NO	YES	GRO/DRO	
EZ MUD (EZ MUD L)	Hydrotreated light petroleum distillate	YES	NO	YES	GRO/DRO	
FUMARIC ACID 1	Fumaric Acid	NO	Safe food additive			
LIME	Calcium hydroxide	NO	Merely adjusts pH			
MICA COARSE	Crystalline silica, quartz	NO	Insoluble			
	Mica	NO	Insoluble			
MICATEX FINE	Crystalline silica, quartz	NO	Insoluble			
	Mica	NO	Insoluble			
NEW BAR	Barium sulfate	NO	Insoluble			
N-VIS	Xanthan gum	NO	Safe food additive			
N-VIS PLUS	Contains no hazardous substances - xanthan gum	NO	Safe food additive			
N-VIS L*	Dipropylene glycol monomethyl ether	YES	NO	NO	NO	NO
PAC R	Cellulose derivative - polyanionic cellulose	NO	Approved for water well drilling			
POLYAC PLUS*	Contains no hazardous substances - Sodium polyacrylate	YES	NO	NO	NO	NO
SAPP	Sodium acid pyrophosphate	NO	Safe food additive			
SAWDUST	Wood byproduct	NO	Insoluble			
THERMA-THIN*	Contains no hazardous substances - anionic acrylic polymer	YES	NO	NO	NO	NO
WALL-NUT MEDIUM	Walnut hulls	NO	Food by-product			
VOLCLAY PREMIUM GEL	Crystalline quartz	NO	Insoluble			
	Bentonite	NO	Insoluble			
XC-207	Xanthan gum	NO	Safe food additive			

Shaded entries denote a compound which has been identified as a potential groundwater contaminant.

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* See Section 6.0 for further discussion