



## Memorandum

To: Merry Gamper, BLM  
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Date: February 3, 2011

Project: 136550010  
cc: Belinda Salinas, Ultra  
Cally McKee, Ultra  
Craig Brown, QEP  
Casey Hensley, QEP  
Jim Sewell, Shell

**Subject: Progress Report, Interim Groundwater/Aquifer Pollution Prevention, Mitigation and Monitoring Plan, Pinedale Anticline Oil and Gas Exploration and Development Project, Sublette County, Wyoming**

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This memorandum and attachments provide a summary of Fall 2010 field data collection activities, the status of key project tasks and a proposed 2011 schedule for the Interim Groundwater/Aquifer Pollution Prevention, Mitigation and Monitoring Plan (Interim Plan). AMEC Geomatrix, Inc. is implementing the Interim Plan on behalf of Ultra Resources, QEP Resources and Shell. The following three attachments summarize the status of the Interim Plan as of February 2, 2011:

- Summary of Fall 2011 Field Activities – this two-page table presents work task, dates, descriptions of work performed and key comments. Field activities were associated with the two primary field investigations involved with the Interim Plan: Hydrogeologic Data Gaps Investigation; and, the Low Level Petroleum Hydrocarbon Source Investigation.
- Status of Project Tasks – project tasks remaining (uncompleted) for the Interim Plan as of October 1, 2010 are identified in the second attachment. For each active task, the approximate percent complete is provided along with comments regarding the status of the task. Noted at the bottom of the table are several Interim Plan work activities that were completed prior to October 2010.
- 2011 Proposed Schedule – the third attachment provides a proposed schedule for four primary project deliverables for the period of February through June 2011.

AMEC Geomatrix presented information provided in each of the three attachments during a project meeting hosted by the Bureau of Land Management (BLM) on February 2, 2011. Participants included representatives of various Wyoming BLM offices, Wyoming Department of Environmental Quality (State and Lander Regional Office), Region VIII of the Environmental Protection Agency, Ultra, QEP and Shell.

### Attachments

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**AMEC Geomatrix**

SUMMARY OF FALL 2010 FIELD ACTIVITIES, AMEC GEOMATRIX  
HYDROGEOLOGIC DATA GAPS AND LLPHC STUDIES -- INTERIM PLAN  
PINEDALE ANTICLINE PROJECT AREA, SUBLETTE COUNTY, WYOMING

Task	Dates	Description of Work Performed	Summary/Comments	Project	
Study well Development	August 11 - October 31	<ul style="list-style-type: none"> <li>- Most study wells developed with 4-ft stainless bailer; several wells developed with airlift methods and/or submersible pump. Note: Of the 30 study wells, 8 were not bailed: 3 were dry, 3 of the artesian wells couldn't be pumped, and one (T-4-RW-a) was not developed due to LEL concerns.</li> <li>- Began installation of air-tight modified J-plugs on industrial WSWs and study wells (T-3, T-4, WB 8-6, WB 7-5, MS 14-16) for preliminary measurements of LEL and gas flow in well casings in order to target wells for stray gas sampling in October and December.</li> </ul>	<ul style="list-style-type: none"> <li>- 13 wells surge and bail methods</li> <li>- 5 study wells developed with sub. Pump</li> <li>- 3 wells developed with by airlift</li> <li>- 2 wells developed w/ pump and by airlift</li> </ul>	LLPHC	Hydro Data Gaps
Survey - Study Wells, Piezometers, SW	September 21 - 27	Survey conducted by WLC for horizontal and vertical locations of for all study wells and piezometers installed in 2009 and 2010; also shot SW elevations	52 locations surveyed (includes 30 study wells, 13 piezometers, and 9 New Fork River locations)	Hydro data Gaps	
Depth to water measurements (2010)	September 21 - 27	Measure DTW in credible/suitable WSW, study wells, piezometers using a sonic water level meter and elec. tape; record pressures in 4 artesian wells.	<ul style="list-style-type: none"> <li>- DTW measured in 84 wells</li> <li>- Stage in 9 surface water locations</li> </ul>	Hydro data Gaps	
Oversee WSW well pump removal; Sample pipe dope for source characterization	September 23 & November 8 - 11	<ul style="list-style-type: none"> <li>- Sept 23 -- began industrial pump removal for Ultra WSWs Warbonnet 7-15 and 16-5, Boulder 12A-33 and Riverside 15-12, 1-4, and 11-14); collect pipe dope samples analyzed for VOC, SVOC, DRO, and GRO.</li> <li>- Nov 8-11 -- continued pump removal for QEP industrial WSWs (Mesa 14-16 and Mesa 15-16); collect pipe dope samples for same analyses.</li> <li>- Nov 18 -- continued pump removals for Shell industrial WSWs (Mesa 12-28, Boulder 1-32, and Warbonnet 7-5); collect pipe dope samples for same analyses</li> </ul>	<ul style="list-style-type: none"> <li>- Sep 23 -- 6 Ultra pumps pulled by Premier Pumps; 9 samples collected of pipe dope, grease and black corroded material from pump and drop-pipe</li> <li>- Nov 8 -- 2 pumps removed from QEP wells, stored offsite</li> <li>- Nov 18 -- 3 pumps removed from Shell wells, stored offsite</li> </ul>	LLPHC	
Site T-4 -- Groundwater sampling/stray gas analysis	October 4 - 6	<ul style="list-style-type: none"> <li>- Sampled groundwater via HydraSleeve from wells T-4-RW-a, T-4-RW-b, T-4-SW, and Antelope 11-10D WSW for Hydro Data Gaps/LLPHC parameters.</li> <li>- Performed stray gas analysis at T-4-RW-a, T-4-RW-b and Antelope 11-10D WSW. Gas composition analyses performed by mobile laboratory; isotope analysis by Isotech Labs.</li> </ul>	<ul style="list-style-type: none"> <li>- 4 wells sampled for WQ parameters</li> <li>- 3 well casings sampled for gas (T-4-RW-a, T-4-RW-b &amp; An 11-10D)</li> </ul>	LLPHC	Hydro Data Gaps
Artesian wells -- WQ sampling	November 4 - 5	Sampled wells T-8-SW, X-5-SW, X-4-SW and X-4-RW for Hydro Data Gaps analytical parameters	- 4 wells sampled for WQ parameters	Hydro data Gaps	
Study Wells - continue GW sampling; install pressure transducers	November 8 - 11	<ul style="list-style-type: none"> <li>- Collected groundwater samples via HydraSleeve for Hydro Data Gaps analytical parameters</li> <li>- Deployed pressure transducers in study wells to log every 6 hours to generate GW hydrographs</li> </ul>	<ul style="list-style-type: none"> <li>- 14 wells sampled for WQ parameters</li> <li>- 23 wells: installed transducers and two barometer loggers</li> <li>- (Note: 2 transducers installed in wells X-1-A and X-1-SW in July 2010)</li> </ul>	Hydro data Gaps	

Task	Dates	Description of Work Performed	Summary/Comments	Project
Winterize 4 artesian study wells	November 12 December	<ul style="list-style-type: none"> <li>- Installed mechanical stainless well packers in wells T-8-SW, X-5-SW, and X-4-SW.</li> <li>- Pressure and flow too high in well X-4-RW for packer installation. A heated shed was installed by Shell Construction over the well at the Jensen 11 pad in December 2010.</li> </ul>	<ul style="list-style-type: none"> <li>- Note: piping manifold at wells X-4-SW and -RW froze and split by Oct 26; manifolds repaired and wells heated w/ blowers until permanent remedy.</li> <li>- X-4-RW was heated with blower until completion of shed in December</li> </ul>	Hydro data Gaps
Industrial WSW - Groundwater sampling	November 12 - 21	<ul style="list-style-type: none"> <li>- Collected groundwater samples via HydraSleeves for LLPHC analytical parameters; sample for additional LNAPL where necessary in WSWs.</li> <li>- Continued LEL testing of industrial WSWs in November 2010. MS 12-28 was identified as a possible candidate for gas sampling after slightly elevated LEL readings were recorded during groundwater sampling.</li> </ul>	<ul style="list-style-type: none"> <li>- 23 WSWs sampled for LLPHC parameters</li> <li>- 6 study wells sampled for both LLPHC and Data Hydro Gaps parameters</li> <li>- Samples sent to Energy (volatile, semi-volatile, inorganics &amp; metals) and Isotech (dissolved gas composition &amp; isotopes) for analysis.</li> </ul>	LLPHC
Stray Gas Evaluation sampling	December 6 - 22	<ul style="list-style-type: none"> <li>- Collected gas samples from casings of industrial WSWs with elevated LEL readings (WB 7-4, WB 7-5, AN 1-16, BO 12A-33, RS 11-14, Highway #7) and a study well (T-3-SW) in December 2010. MS 12-28 did not have enough gas accumulate in well casing when plugged in December for analysis.</li> <li>- Collected gas samples from production wells (WB 7-4, WB 7-5, WB 7-15D, AN 1-9, BO 12A-33 [meter run], &amp; RS 11-14) at or nearby locations of well casing gas sampling and analysis.</li> </ul>	<ul style="list-style-type: none"> <li>- 18 wells initially tested for elevated LEL readings and gas flow; (dissolved gas data later indicate groundwater from 15 wells had detections of methane)</li> <li>- 7 well casings sampled for gas and analyzed for extended gas composition via mobile laboratory and isotopes by Isotech.</li> <li>- 6 production wells were sampled and analyzed for extended gas composition via mobile laboratory and</li> </ul>	LLPHC
Study Wells - Aquifer testing	December 6 - 10	Aquifer testing conducted at wells T-1-SW, T-1-RW, X-2-A and X-2-SW	<ul style="list-style-type: none"> <li>- Yield tests performed on each well to establish appropriate pumping rate.</li> <li>- Constant discharge tests at 7 - 40 gpm for 8 hours; well T-1-RW pumped for 20 hours (~7 gpm).</li> </ul>	Hydro data Gaps
Source Characterization sampling	December 9 - 10	Samples of condensate, drill mud, produced water, completion fluids and flowback collected from Ultra, Shell and QEP facilities (e.g., liquid gathering pipelines, central gathering facility, liquid separators on well pads, active drilling systems on well pads).	<ul style="list-style-type: none"> <li>- 3 samples of oil-based drilling mud collected</li> <li>- 6 samples of produced water collected</li> <li>- 1 sample of condensate collected</li> <li>- 1 sample of flowback fluid collected</li> </ul>	LLPHC

**INTERIM GROUNDWATER/AQUIFER POLLUTION PREVENTION, MITIGATION AND MONITORING PLAN**

Pinedale Anticline Project Area, Sublette County, Wyoming

October 1, 2010 Project Tasks -- Status as of February 1, 2011

DESCRIPTION	~PERCENT COMPLETE	COMMENTS
<b>0136550010.020 PROJECT ADMINISTRATION, MEETINGS, DOCUMENT QC</b> Task 2: Database Conversion Task 3: Project Meetings in Pinedale or Cheyenne, Wyoming (Sep and Nov 2010, Mar 2011) Task 4: Project Administration/Management and Progress Reporting	95 40 40	Awaiting 2010 data from SCCD and remaing Fall 2010 lab data
<b>0136550010.050 MONITORING PROGRAM AUGMENTATION</b> Task 3: Document 2009-2010 Water Withdrawals Task 4: Prepare Technical Memoranda	10 0	Awaiting data from BLM in February 2011 for 2009 and 2010
<b>0136550010.060 HYDROGEOLOGIC DATA GAPS STUDY</b> Task 1: Survey and Collect 2010 Water Elevation Data; Prepare GW Flow Maps Task 4: Remaining Well Installations, Determine Hydraulic Properties for Each HSU Task 5: Establish Data Collection System Task 7: Investigate Hydraulic Connection Between HSUs Task 8: Prepare Technical Report and Revised Conceptual Model Report	90 90 90 10 5	Wasatch potentiometric and alluvial flow maps pending tech review Aquifer test analysis pending technical review Transducers installed and recording data, artesian wells seasonal WQ, flow, geology, hydrostratigraphy, etc. analysis in progress In preparation
<b>0136550010.070 LOW-LEVEL PETROLEUM HYDROCARBON COMPOUND STUDY</b> Task 2: Finalize Sampling and Analysis Plan Task 3: Assess Drilling, Pump Installing and Sampling Practices Task 4: Implement LLPHC SAP Phase I Groundwater Sampling Source Characterization Sampling and Stray Gas Evaluation Task 5: Data Evaluation and Reporting	100 70 95 95 90 5	In preparation Confirmation re-sampling of 2 wells conducted 1/2/11 Awaiting final QC packages from labs and data validation pending In preparation
<b>0136550010.080 MITIGATION MEASURES FOR POTENTIAL CONTAMINANT SOURCES</b> Task 2: Prepare Technical Memorandum on Existing and Recommended Mitigation Measures	70	Revised Draft Tech Memo in preparation
<b>0136550010.090 PREPARE DRAFT FINAL PLAN</b> Task 1: Prepare Abbreviated Conceptual Model and PAPA Background Task 2: Prepare Sampling And Analysis Plan Task 3: Prepare QAPP Task 4: Prepare Draft Final GW/Aquifer Pollution Prevention, Mitigation and Monitoring Plan	0 0 0 0	

Note: Work Tasks Completed 2009 through September 2010 include:

All Project Planning Documents  
 Initial Vulnerability Assessment and Credible / Suitable Well Inventory-Determination  
 Initial April 2009 Survey and DTW Measurements in Credible Wells

Permitting and Study Well and Piezometer Installations  
 Synoptic Flow Study of New Fork River and Spring Characterization  
 LLPHC Sampling and Analysis Plan

**2011 PROPOSED SCHEDULE - INTERIM PLAN**  
**Pindale Anticline Project Area, Sublette County, Wyoming**

Prepared: 01 February 2011

ITEM	FEBRUARY				MARCH				APRIL				MAY					JUNE			
	7	14	21	28	7	14	21	28	4	11	18	25	2	9	16	23	30	6	13	20	27
Revised Draft Technical Memorandum, Evaluation of Operators Standard Operating Practices and Procedures	█	█																			
BDE and USQ Review and Comment			█	█	█	█															
MEETING - BDE, USQ and AMEC - Discuss LLPHC Findings with Respect to Current SOPs/Mitigations												█									
Final Technical Memorandum, Evaluation of Operators Standard Operating Practices and Procedures													█	█							
Draft Technical Report, Hydrogeologic Data Gaps Investigation and Revised Hydrogeologic Conceptual Model	█	█	█	█	█																
BDE and USQ Review and Comment						█	█	█	█												
Final Technical Report, Hydrogeologic Data Gaps Investigation and Revised Hydrogeologic Conceptual Model										█	█										
Draft Technical Report, Low Level Petroleum Hydrocarbon Souce Study	█	█	█	█	█	█	█														
BDE and USQ Review and Comment								█	█	█	█										
Final Technical Report, Low Level Petroleum Hydrocarbon Souce Study												█	█								
Draft, Draft Final Groundwater/Aquifer Pollution Prevention, Mitigation and Monitoring Plan						█	█	█	█	█	█	█	█	█							
MEETING - BDE, USQ and AMEC - Discuss Existing Mitigation and Establish Objectives of Monitoring Plan								█													
BDE and USQ Review and Comment														█	█	█	█				
Revised Draft Final Groundwater/Aquifer Pollution Prevention, Mitigation and Monitoring Plan																		█	█		