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Mr. Dave Seter
Remedial Project Manager
U.S. Environmental Protection Agency Region 9
75 Hawthorne Street, SFD-8-2
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Subject: Pumpback Well System Characterization Work Plan Addendum (Revision 2), Yerington Mine Site, Lyon County, Nevada: Administrative Order for Remedial Investigation and Feasibility Study, EPA Docket No. 9-2007-0005

Dear Mr. Seter:

Atlantic Richfield Company (ARC) has prepared this second revision of the *Pumpback Well System Characterization Work Plan Addendum* (PWS Addendum) to supplement the field and analytical activities described in the *Pumpback Well System Characterization Work Plan* (PWS Work Plan) dated December 30, 2008. The PWS Work Plan was approved by the U.S. Environmental Protection Agency - Region 9 (EPA) on February 13, 2009. A concurrent and related *Shallow Zone Characterization Work Plan* dated December 30, 2008, was also approved by EPA on February 13, 2009. ARC submitted a draft Work Plan Addendum to EPA on September 23, 2009. EPA provided comments to the draft Work Plan Addendum on October 24, 2009 and, as requested by EPA, ARC responded to EPA comments on November 23, 2009 with the acknowledgement that this revised Work Plan Addendum would be submitted to EPA prior to the December 10, 2009 groundwater technical meeting. EPA provided additional direction for the aquifer testing program and restart of the PWS in a letter dated February 9, 2010.

Aquifer testing and associated activities described in this Addendum will be performed as an interim phase of groundwater investigations required under the Administrative Order for Remedial Investigation and Feasibility Study, EPA Docket No. 9-2007-0005 dated January 12, 2007. Activities associated with this Addendum will be performed in 2010. These activities will complement other groundwater investigations to be performed in 2010 including borehole drilling and zonal sampling, the installation of new monitor wells, and the sampling and analysis of groundwater from the wells described in the Draft 2010 Groundwater Monitor Well Work Plan dated January 15, 2010. The location of the Site and the PWS are shown on Figures 1 and 2, respectively.

The aquifer testing program has been designed to achieve the following objectives: 1) improve our understanding of the effectiveness of the pumpback wells in limiting the migration of mine-related groundwater to off-Site, down-gradient receptors; and 2) optimization of future PWS operations. Two phases of aquifer testing are planned during 2010, pending a final decision regarding the continuation of agricultural activities at the Peri Farms, located adjacent to the Site: irrigation season (April - May); non-irrigation season (October - December). If irrigation activities do not occur in 2010, only one phase of testing will occur (April - May), and the second phase will be deferred until agricultural operations resume, or will be eliminated pending discussions with EPA.

All applicable methods and procedures will be performed in accordance with the Site Quality Assurance Project Plan (QAPP - Revision 5; ESI and Brown and Caldwell, 2009) and the Site Health and Safety Plan (HASP - Revision 2; Brown and Caldwell, 2009). The following field activities, including pre-testing activities, are planned for the program:

1. Pumpback well rehabilitation;
2. Installation of 32 piezometers around the 11 pumpback wells, as shown in Figures 3 through 7 (P-1 is an existing piezometer installed proximal to pumback well PW-10S);
3. Development and surveying of the new piezometers;
4. Installation of pressure transducers and data loggers in the wells and associated piezometers; and
5. Performance of four-day pumping aquifer tests followed by four-day aquifer recovery tests for each of the pumpback wells with the measurements of head conditions in the pumpback wells and associated piezometers.

Pumpback Well Rehabilitation

A well rehabilitation program will be conducted prior to aquifer testing to clean the well screens in order to obtain the maximum groundwater extraction rates from each well during the testing program. Well rehabilitation will be performed by an experienced Nevada-licensed well contractor under the supervision of Brown and Caldwell field technicians, similar to well rehabilitation efforts conducted in 2004 and 2008. The well rehabilitation activities will include:

- Down-hole video surveys;
- Brushing the well casing and screens with a nylon brush;
- Air-jetting the well to further loosen and remove incrustation;
- Injecting dry acid and a liquid surfactant;
- Allow a minimum of 24 hours working time for the injected acid and surfactant while agitating with a tight-fitting rubber swab and/or air;
- Additional brushing following the acid treatment and horizontal jetting; and
- Removal of loose material from the well using an air-vac suction procedure.

Down-hole video surveys of each well will follow the well rehabilitation effort to document the condition of the wells and the depths of the tops and bottoms of the well screens. The post-rehabilitation video surveys will be conducted after allowing sufficient time for the water in the wellbore to clear. Chemicals to be used in the well rehabilitation effort, which include a dry acid compound and a liquid surfactant, are manufactured and distributed specifically for the rehabilitation of municipal, domestic and agricultural water supply wells. These chemicals will be used according to manufacturer's recommendations, and will not adversely affect aquifer materials or groundwater quality (product technical information and MSDS sheets are provided in Attachment A). The dry acid compound is certified to NSF/ANSI Standard 60, Drinking Water Treatment Chemicals - Health Effects, and the liquid surfactant is not expected to have any significant environmental persistence or bioaccumulation.

These chemicals have been used in previous well rehabilitation efforts at the Site with no observable adverse affects to groundwater chemical conditions (Attachment B). The total volume of water to be discharged from well rehabilitation activities is conservatively estimated at 2,500 gallons, based on an average saturated thickness of 20 feet and the removal of 10 times the casing volume for each well. Following the completion of the rehabilitation and well video efforts, the pumps that were removed from the PWS wells will be re-installed. Each well will then be pumped for a brief period (i.e., up to 30 minutes) to verify that the pumps and controls are functioning properly.

Groundwater and chemical additives discharged from the pumpback wells during rehabilitation activities will be containerized in portable polyethylene tanks. The pH of the discharged water in the tank will then be measured and, if necessary, the pH will be adjusted with sodium bicarbonate to bring the pH to between 6.5 and 8.5 standard units. Once the discharged water is within this pH range, suitable for potable water, it will be discharged to the middle cell of the PWS evaporation pond.

Piezometer Installations

The number of piezometers included in an aquifer test is dependent on the amount and accuracy of information needed, and the objectives of the aquifer test. In general, three piezometers are recommended (Kruseman and de Ridder, 2000) to allow for time-drawdown and distance-drawdown analyses and an assessment of a larger volume of the aquifer. Data from this type of monitoring array will also allow for an assessment of well efficiency.

Three piezometers will be installed near each of the pumpback wells (PW-10 already has an associated piezometer, P-1. installed approximately seven feet from the well). Approximate piezometer locations, including the location of P-1, are shown on Figures 3 through 7. These sites, selected on the basis of the analysis described below, have been checked for access during and after the aquifer testing program and cleared to avoid sub-surface utilities, resulting in the re-positioning of six locations associated with PW-2, -3 and -4 from previous versions of the PWS Addendum. The 32 new piezometer locations have been surveyed by a Nevada-registered surveyor (X-Y-Z coordinates are presented in Attachment C). Based on these results, and the pumpback well videos, piezometer screen elevations will be constructed to match the pumpback well screen elevations presented in Table 1.

Piezometers have been located at distances that will provide data that can be integrated over a relatively large area of the aquifer and establish the extent of measureable drawdown during aquifer testing. Locations relative to each of the pumpback wells were established using the Theis (1935) solution to estimate the extent and magnitude of drawdown induced by each pumpback well. The observed average pumping rate for each of the wells during the final 10 days of pumping (March 16 to March 25, 2009) prior to the PWS shutdown, presented in Table 2, were input into the Theis (1935) solution.

Aquifer transmissivity values for the Theis solutions were obtained from the pumpback well shutdown aquifer recovery test data acquired in March 2009, as presented in Attachment D. An additional hydraulic parameter required for the Theis (1935) solution, aquifer storativity, has not yet been determined for the pumpback wells. Storativity values of 0.01 and 0.1 (dimensionless) were selected to evaluate predicted drawdown based on the typical range of 0.01 to 0.3 for unconfined alluvial aquifers (Driscoll, 1995). Distances between pumpback wells and associated piezometers were determined using estimates of the extent and magnitude of drawdown derived from the Theis (1935) solution. Table 3 presents the estimated drawdown after 12 hours of pumping at 50, 25, and 10 feet for each well with storativity values of 0.01 and 0.1. Piezometer locations for the analysis are shown in Figures 3 through 7 (the more conservative storativity value of 0.1 was used to locate the piezometers). The conservative assumption that the shallow zone aquifer is unconfined has been used in locating the piezometers given that drawdown in an aquifer with a relatively higher value of storativity will propagate at a slower rate than drawdown in an aquifer with a lower value of storativity.

Table 1. Pumpback Well and Piezometer Screened Intervals					
Well	Ground Surface Elevation (feet-amsl)	Planned Piezometer Screen Interval		Pumpback Well Screen Interval	
		feet bgs	Elevation (feet-amsl)	feet bgs	Elevation (feet-amsl)
PW-1S	4360.6	28-48	4332.6 – 4312.6	27.5-48	4333.1 – 4312.6
PW-2S	4367.1	32-52	4335.1 – 4315.1	31.5-52	4335.6 – 4315.1
PW-3S	4371.5	38-58	4333.5 – 4313.5	37.25-57.75	4334.25 – 4313.75
PW-4S	4366.0	35-55	4331.0 – 4311.0	34.5-55	4331.5 – 4311.0
PW-5S	4368.4	35-55	4334.4 – 4314.4	34-54.5	4334.4 – 4313.9
PW-6S	4368.0	28-48	4340.0 – 4320.0	28-45	4340.0 – 4323.0
PW-7S	4365.8	27-47	4338.8 – 4318.8	26.5-46	4339.3 – 4319.8
PW-8S	4366.2	30-50	4336.7 – 4316.7	29.5-49.5	4336.7 - 4316.7
PW-9S	4366.4	29-49	4337.4 – 4317.4	29-49	4337.4 – 4317.4
PW-10S	4365.6	27-47	4338.6 – 4318.6	27-47	4338.6 – 4318.6
PW-11S	4368.7	29-49	4339.7 – 4319.7	29-49	4339.7 – 4319.7

Table 2. Pumpback Well Average Pumping Rates	
Well ID	Average Pumping Rate (gpm)
PW-1S	13.4
PW-2S	8.0
PW-3S	4.5
PW-4S	2.5
PW-5S	4.4
PW-6S	2.5
PW-7S	1.7
PW-8S	0.22
PW-9S	1.4
PW-10S	0.7
PW-11S	0.7

Hollow stem auger drilling methods will be used to install the piezometers. The piezometers will be constructed with a six-inch diameter steel surface casing, and two-inch diameter schedule 40 polyvinyl chloride (PVC) tubing as the blank (i.e., unscreened) portion of the well. As described above, piezometers associated with individual pumpback wells will be constructed to accurately match the screen interval for each well based on pre-construction surveys.

Table 3. Predicted Drawdown and Piezometer Installation Distances							
	Hydraulic	Predicted Drawdown at 12 Hours (feet)			Installation Distance from Pumping Well		
	Conductivity	Distance from Pumping Well			Piezometer P1	Piezometer P2	Piezometer P3
Well ID	(feet/day)	50 Feet (S=0.01/0.1)	25 Feet (S=0.01/0.1)	10 Feet (S=0.01/0.1)	(feet)	(feet)	(feet)
PW-1	78	0.55/0.24	0.72/0.43	0.96/0.66	10	25	50
PW-2	43	0.56/0.18	0.78/0.41	1.07/0.70	10	25	40
PW-3	35	0.34/0.09	0.48/0.25	0.66/0.43	7	15	30
PW-4	30	0.26/0.07	0.37/0.19	0.51/0.34	7	15	25
PW-5	57	0.32/0.13	0.43/0.24	0.58/0.39	7	15	25
PW-6	83	0.13/0.05	0.18/0.11	0.24/0.17	5	10	20
PW-7	11	0.32/0	0.58/0.13	0.90/0.49	5	10	20
PW-8	1.3	0/0	0.19/0	0.52/0.09	5	10	20
PW-9	60	0.18/0	0.29/0.11	0.42/0.25	5	10	20
PW-10	14	0.13/0	0.24/0.05	0.37/0.20	7	10	20
PW-11	36	0.09/0	0.14/0.06	0.21/0.13	5	10	20

A 20-foot, 0.020-inch slotted screen constructed of schedule 40 PVC will be installed in each of the piezometers. A two-inch flush-threaded PVC end cap will be placed at the bottom of the screened interval. A filter pack consisting of #3 silica sand will be placed against the screen and will extend approximately two feet above the top of the screen interval. Approximately two feet of bentonite chips will be placed on top of the filter pack. Following full hydration of the bentonite chips, a cement grout seal will be placed in the annular space from the top of the bentonite chips to ground surface. Filter pack and bentonite seal depths will be tagged with a measuring tape to ensure correct placement.

After the cement surface seal has cured, each piezometer will be developed to remove fine-grained material from the well and to improve the hydraulic connection to the screened portion of the alluvial aquifer. Development procedures will include surging the well and periodically bailing fine-grained material until the turbidity of the discharge water is less than or equal to 10 NTUs, or has stabilized (i.e., varies less than +/- 10 percent over three successive casing volumes). All piezometers will be surveyed by a registered Nevada surveyor to establish the groundwater elevation measurement points.

Pumpback wells and piezometers will be equipped with In-Situ, Inc. Level TROLL® 700 vented pressure transducers (transducers), rated at 15 PSI with an accuracy of ±0.1 percent of the sensor's full scale (i.e., the 15 PSI-rated transducer has a range of 0 to 15 PSI, accurate to 0.1 PSI or about 0.03 feet). Transducers will be installed via vented data cables that allow for changes in barometric pressure, and will be suspended from the well monument by manufacturer-supplied Kellems Grip® cable retention devices, about two feet above the bottom of well/piezometer. Standard operating procedures (SOPs) for pressure transducer use are provided in the QAPP (Revision 5; ESI and Brown and Caldwell, 2009).

Aquifer Testing Program

Aquifer tests will be conducted at all of the pumpback wells according to the following general procedures: 1) non-adjacent pairs of pumpback wells will be simultaneously tested by pumping the wells at normal operational rates, generally similar to those listed in Table 2, on a continuous basis for a period of four days (96 hours), and then shutting the pumps off; 2) water levels responses will be monitored in the pumpback wells and associated piezometers during the pumping period and during an equivalent recovery period; and 3) upon completion of testing each pair of wells following the sequence presented in Table 4, testing of the next pair will begin. Groundwater elevation measurements in the pumpback wells and piezometers will be used to estimate aquifer hydraulic parameters, as described below.

Table 4. Pumpback Well Test Schedule

Well Pair	Planned Test Sequence
PW-10S/PW-3S	1
PW-2S/PW-4S	2
PW-5S/PW-7S	3
PW-6S/PW-8S	4
PW-9\PW-11S	5
PW-1S	6

<u>Discharge Rate Measurements</u>
During each aquifer test for the pumpback well pairs listed above, discharge (flow) rates will be measured and adjusted as necessary so that the flow rate throughout the test varies by less than approximately 10 percent. Flows will be measured using the existing Sensus SR II flow meters at each pumpback well, with back-up flow measurements using ultrasonic transit time (UTT) flow meters. Pumping conditions will be monitored by Omega pressure transducers. The UTT flow meters and Omega pressure transducers will be equipped with data loggers. Technical specifications for the UTT flow meters and Omega pressure transducers are provided in Attachment E.

The revised approach to obtain back-up flow measurements during the aquifer test program, and associated instrument calibration, are described in more detail below. The use of UTT flow meters replaces manual measurements that use a five-gallon bucket and stop watch at the PWS evaporation pond, as described in previous versions of the PWS Addendum. Site-specific conditions that potentially limit the ability to obtain accurate manual flow measurements using a five-gallon bucket and stop watch include: 1) inaccuracies during early time pumping because of the lag time for the pumped groundwater to reach the evaporation pond, particularly from the northern bank of wells; 2) surging of pumped water through the conveyance pipelines, particularly for wells with low yields (i.e., the northern bank of wells); 3) localized depressions in the PWS conveyance pipeline that may contain previously pumped groundwater from preceding aquifer test pairs; and 4) difficulties in distinguishing well-specific discharges during the simultaneous aquifer tests.

The PWS currently utilizes Sensus SR II 5/8-inch and 1-inch diameter flow meters, which are piston-driven positive-displacement totalizing flow meters with magnetically driven registers. The units register flow 'mechanically' by piston displacement, which is transmitted through the sealed meter to the recording register by turning a magnetic rod in the separately sealed meter and register. The 5/8-inch diameter meter is accurate for flow rates down to about 0.25 gallons per minute (gpm), which makes this device suitable for most of the PWS wells. The 1-inch diameter gauge is accurate for flows above 1 gpm. Potential inaccuracies in flow measurements may result from high concentrations of total dissolved solids (TDS) in the pumped groundwater and associated mineral scale build-up that can interfere with the mechanical drive units. Typically, this condition results in the simultaneous fouling of the pump and meter. However, the pump may continue to run with the gauge running in an impaired state.

The UTT flow meter to be used for back-up flow measurements will be the Shenitech STUF-300-FxB model with data logger. This flow meter uses two ultrasonic sensors that strap to the outside of a pipe and provides readings of the fluid velocity inside the pipe. Flow rates are calculated by the difference in ultrasonic wave transmission between the transmitter and receiver units to measure velocity within the cross-sectional internal pipe diameter. The sensor units will be strapped to the discharge pipe (i.e., riser pipe) of the pump inside the well, which will be modified (if necessary) to provide the required pipeline length free of valves, elbows or tees that could affect flow velocity measurements. The UTT meter is bi-directional and will be sensitive to the low flow range of approximately 0.15 gpm for the existing 1-inch and 1-1/4 inch diameter well discharge lines. This sensitivity will be needed for measuring flows in low-yield pumpback wells (e.g., PW-8, PW-10 and PW-11), as summarized in Table 2. The sensors will also ensure that the discharge pipe is completely full of water, as required when using this type of flow meter. An Omega OM-CP-PR2000 pressure transducer/data logger will be installed at existing pressure gauge taps to record operating conditions for each well pump. These pressure readings can be used to validate the flow rates measured by the Sensus and UTT flow meters.

Flow meter calibration for each pumpback well will be conducted in the field lab at the Site, where the Sensus SR II flow meters that were removed from the wells after the PWS shutdown were stored, cleaned and refurbished. Each Sensus SR II flow meter will be calibrated in the field lab using a Badger Meter Model PSMT field test kit. A steady water source will be used to check the accuracy of the Sensus and UTT flow meters against the factory-calibrated unit. The UTT flow meter will be strapped on to an appropriate length of discharge pipe added to the discharge side of the factory-calibrated meter, and the UTT flow meter will be adjusted to match the calibrated Sensus SR II meter. The accuracy of the Sensus SR II meters from the individual pumpback wells, and the UTT flow meters will be confirmed with bucket and stop watch readings. The flow rates used to calibrate the flow meters in the lab will be approximately equivalent to the flow rates planned for the pumpback wells during the aquifer tests. Flow meter calibration for each pumpback will be performed prior to each paired aquifer test, per the sequence presented in Table 4.

Water Level Monitoring

Transducers installed in the pumpback wells and associated piezometers will be programmed to record water levels at daily intervals when they are installed. Water level data will be downloaded to an In-Situ, Inc., Rugged Reader. The transducers will be programmed to record:

- hourly readings 24 hours prior to the start of pumping tests;
- one-minute readings for the first hour following startup/shutdown;
- five-minute readings from one hour to 24 hours after startup/shutdown;
- hourly readings until the conclusion of startup/recovery phase;
- daily readings from the end of the second recovery phase testing until the end of the year.

Manual water level measurements will be conducted to backup the transducer measurements. For the pumping portion of the tests, manual water levels will be collected from the pumpback wells being tested and the associated piezometers immediately prior to startup and then at the times provided in Table 5. The schedule presented in Table 5 will be used for manual measurements of water levels in the recovery period, but no measurements will be collected on days two and three (Saturday and Sunday). All manual measurements will be performed using an electronic water level probe following SOPs provided in the QAPP - Revision 5, and all measurements will be recorded on aquifer test field forms.

Table 5. Piezometer Manual Water Level Measurement Schedule

Time Since Startup/Shutdown (minutes)	Approximate Measurement Time Intervals (minutes)
0 to 10	2.0
10 to 30	5.0
30 to 60	10
60 to 120	20
120 to 240	30
240 to 480	60
480 to 5,760	3 times daily

In addition to the wells and associated piezometers, two of three existing intermediate zone monitor wells (Figure 8) not currently equipped with pressure transducers will be so equipped (LEP-MW-9I is currently equipped with a pressure transducer/data logger). Well LEP-MW-4I is located near PW-10S, W5AB-3I is located near PW-8S, and LEP-MW-9I is located near PW-5S.

Health and Safety

Field activities will be conducted in accordance with the revised HASP for the Site (Brown and Caldwell, 2009). The HASP is located at the Site field office, and includes the following requirements:

- Safety and health risk or hazard analysis;
- Employee training requirements;
- Personal protective equipment (PPE);
- Medical surveillance;
- Site control measures;
- Decontamination procedures; and
- Emergency response.

A project-specific Health and Safety Plan (Project HASP) will be prepared prior to implementation of the field work described above, and will include specific safety procedures and requirements that are applicable for the tasks required to complete the project. The Project HASP is considered a dynamic document and may be modified and updated throughout implementation of the work and will be made available to all workers and visitors during implementation of field activities. The Project HASP will include the following detailed safety information:

- Identification of roles and responsibilities for the project, including safety roles;
- Project specific standard operating procedures (SOP), if applicable;
- Identification of control of work permits and required safety procedures to implement the work;
- Planning procedures if simultaneous operations (SIMOPS) will be occurring that may conflict or interfere with each other;
- Project and job specific risk assessments and mitigation; and
- Task Safety and Environmental Assessment (TSEA).

Aquifer Test Analyses

Water level response data collected from each of the pumpback wells will be analyzed to estimate the shallow aquifer hydraulic properties in the areas of the individual wells, including transmissivity, hydraulic conductivity and storativity. Selection of the appropriate tool or model to analyze the aquifer test data will be the first step in the analytical process (Kruseman and de Ridder, 2000). ARC plans to use spreadsheet analytical tools and/or AQTESOLV software, based on analytical solutions developed by Theis (1935), Cooper-Jacob (1946), Neuman (1974), or Hantush (1960) as appropriate for the aquifer response and test type (i.e., pumping or recovery).

Plots of the water level drawdown and residual drawdown (i.e., recovery test) versus time will be created prior to aquifer test analyses to determine the type of aquifer system the drawdown data from the pumping test best represent (i.e., confined, semi-confined or unconfined). The characteristics of these log-log and semi-log plots of drawdown versus time will be compared with theoretical models of aquifer systems to classify the aquifer characteristics. The residual drawdown data are more reliable because recovery occurs at a constant rate, whereas a constant discharge during pumping is often difficult to achieve in the field (Kruseman and de Ridder, 2000). Presentation of aquifer test analyses will include time-drawdown and distance-drawdown curves, discussions regarding the choice of theoretical models chosen, and the estimated values of transmissivity, hydraulic conductivity, and storativity.

Capture Zone Analysis

A capture zone refers to the three-dimensional region that contributes the groundwater extracted by one or more wells (Figure 9) and, in this context, is equivalent to the zone of hydraulic containment (EPA, 2008). The PWS capture zone analysis will be performed using two-dimensional analytic element flow models and particle tracking. Other methods of capture zone analysis commonly applied to groundwater remediation systems include: 1) contouring water level surfaces and analysis of flow lines to the wells; 2) a comparison of water level elevations in piezometer pairs that indicate flow toward containment wells; and 3) capture zone calculations (EPA, 2008). Prior to the start of analytic element flow modeling, ARC will discuss aquifer test results with EPA hydrogeologists to confirm appropriate modeling activities.

<u>Analytic Element Flow Modeling</u>
Two-dimensional analytic element groundwater flow models (flow models) will be used to delineate the hydraulic capture zones of the pumpback wells (i.e., the effectiveness of limiting the off-Site migration of mine-related groundwater). Hydraulic data derived from the planned aquifer tests will be used in the construction of the flow models. Model construction will incorporate: 1) the defined lower boundary of the shallow zone; 2) gradients and flow direction (reference heads will be established at locations sufficiently distant from the wells to eliminate artificial effects on simulations); and 3) the assumption that hydraulic capture zone for each well will extend throughout the vertical extent of the shallow zone.

Pumping rates for the simulated pumpback wells, anticipated to be similar to those shown in Table 2, will be discussed with EPA prior to the start of steady state flow model simulations for the shallow zone of the alluvial aquifer. The saturated thickness, flow direction and gradient of the shallow zone will be simulated for each pumpback well for a representative hydraulic gradient scenario selected in concert with EPA from 2010 groundwater elevations measured during the non-irrigation season. If agricultural operations do occur in 2010, a second series (11 additional) of flow models will be performed to represent the hydraulic gradients observed during the irrigation season. The flow models will be adjusted for localized flow directions and gradients. Results of the aquifer test analyses described above will be used to determine a range of aquifer hydraulic parameters for input to the models, and the range will be used in the simulations to assess the effects that uncertainties in hydraulic parameters have on simulation results.

Particle Tracking

Particle tracking will be used in conjunction with the steady-state groundwater flow simulations to estimate the extent of hydraulic capture of the individual wells, considering only advective movement (i.e., no retardation or dispersivity). For each of the flow simulations, particles will be started from a circular pattern surrounding each of the pumpback wells, and will be run in a reverse tracking mode for a period of two years (i.e., using steady-state conditions, the simulated particles will be tracked from their starting locations backwards in space and time).

Data Summary Report

Results of the aquifer testing proposed in this Addendum will be presented in a data summary report (DSR) that will document findings from the PWS Characterization Work Plan. Aquifer test field forms will be appended to the DSR, which will summarize field testing aquifer analytical results. Water level data from the pressure transducers and the aquifer tests solutions will be attached in electronic format. A description of each model and particle tracking simulation will be included. Model outputs will include graphics that compare the modeled capture zones of the pumpback wells with observed groundwater elevation contours. Particle tracking plots will illustrate the region within the shallow zone that supplies groundwater to the pumping well (i.e., within the capture zone) for the two-year simulation period. The DSR will also provide recommendations regarding future operation of the pumpback wells.

Schedule of Planned Activities

A schedule for the field and analytical activities described above, and the submittal of the data summary report, is provided in Figure 10. The schedule reflects only one aquifer test period for the pumpback wells, to be completed by May 31, 2010 (if agricultural operations resume in 2010, ARC will work with EPA to schedule the second phase of testing, aquifer analysis, flow modeling, and revised DSR). The schedule also includes activities and target dates for: 1) design and re-lining of the north cell, and repairs to the south cell of the PWS evaporation pond, 2) restart of the PWS on or before August 1, 2010; and 3) pending receipt of EPA comments, completion of the revised Operations and Maintenance (O&M) Plan for the PWS by June 30, 2010.

PWS Evaporation Pond North Cell Improvements

The current generalized schedule for the planned upgrade to the north cell of the PWS evaporation pond is largely based on weather conditions at the Site (Table 6), which requires safe access to the existing north cell clay liner. If weather conditions permit, ARC will begin its field activities earlier than the planned May 1, 2010 start date (Figure 10). Re-lining of the north cell includes the following three major phases with a number of concurrent or sequential tasks:

Phase 1 - Field Sampling and Laboratory Analyses (May 1 - July 1)

- Geotechnical characterization to develop compaction criteria for the clay sub-grade and borrow materials from the sulfide tailings area
- Geochemical field sampling and laboratory analyses, including TCLP results, for accumulated pond sediments/salt precipitates
- Detailed topographic survey data of the north cell

Phase 2 - Cell Lining Design/Salt Removal Work Plan (July 1 - August 15)

- Cell lining work plan sheets (no specifications)
- Salt management plan (schedule presumes on-site disposal in landfill cell)
- Clay borrow plan (if required)
- EPA review and approval

Phase 3 - Liner Construction (August 15 - October 31)

- Mobilization and safety training
- Road access improvements and temporary salt disposal area
- Remove salt and place on temporary disposal area
- Scarify and re-compact exposed sub-grade
- Excavate and convey clay borrow materials from sulfide tailings area (if required)
- Install 5.7-acre 60-mil hdpe liner
- Punch list and demobilization

The final disposition of the removed and properly stockpiled north pond cell salts/precipitates will be determined on the basis of chemical analyses and leaching test. The management of these wastes will likely occur prior to, or during the construction of the cell liner. Based on available information, it is anticipated that the salts can be placed in an on-Site landfill cell.

Optimal HDPE liner installation conditions occur during the warm, dry, less windy months (i.e., late summer and early fall – August, September and October), as shown in Table 6. Warm temperatures help make HDPE materials pliable and easier to place. Typical QA/QC protocol specifies ambient temperatures between 50 to 90 degrees Fahrenheit for achieving consistent and reliable field welding work, with optimal temperatures in the high 70s to low 80s. Low wind velocity is also a key construction element as low wind facilitates safe liner placement and reduces the effect of wind blown dust on welding.

Table 6 presents average precipitation (inches) and temperature (degrees Fahrenheit) for Yerington and average monthly wind speed from Fallon in mile per hour (the Fallon Naval Air Station is the closest weather station to Yerington that provides wind data). The highlighted cells indicate preferable months for liner construction.

Table 6. Average Site Monthly Climate Conditions

	Jan	Feb	March	April	May	June	July	August	Sept	Oct	Nov	Dec
Ppt.	0.58	0.52	0.43	0.40	0.64	0.47	0.26	0.25	0.24	0.34	0.42	0.52
Temp.	46.15	52.56	59.69	67.09	75.18	83.73	92.20	90.89	82.99	70.85	56.83	47.25
Wind	5.8	7.0	7.9	8.6	8.4	8.1	7.4	6.8	6.6	5.7	5.6	5.8

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If you have any questions or comments regarding this PWS Work Plan Addendum, please contact me at 714-228-6774 or via e-mail at Jack.Oman@bp.com.

Sincerely,

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