WORK PLAN
March 7, 2013

Prepared for:
Rio Algom Mining LLC

Phase 2 of Supplemental Site Assessment to Address Out-of-Compliance Status at Trend Wells RL-1 and EF-8

Lisbon Facility

Prepared by:

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1.0 INTRODUCTION

Montgomery & Associates (M&A) has prepared this work plan on behalf of Rio Algom Mining LLC (RAML) for continued supplemental site assessment (SSA) to address out-of-compliance (OOC) status at Trend Wells RL-1 and EF-8 at the Lisbon Facility located near La Sal, Utah (Site). Investigation activities are being conducted in accordance with Sections 53 and 55 of Radioactive Materials License No. UT 1900481 (License), issued by the Utah Division of Radiation Control (DRC) in February 2012 (DRC, 2012). The primary constituent of concern (COC) identified at the Site is uranium in groundwater. Other COCs include molybdenum, selenium, and arsenic. Total dissolved solids, chloride, sulfate, and bicarbonate are also monitored at the Site.

This work plan describes the proposed field work and evaluation to be completed during Phase 2 of the two-phased investigation approach to the SSA. The two-phase field program was proposed in the work plan titled "Revised Final Work Plan, Supplemental Site Assessment to Address Out-of-Compliance Status at Trend Wells RL-1 and EF-8", submitted by RAML to DRC on August 2, 2012 (M&A, 2012). The August 2012 work plan presented in detail the Site background information; the chronology of regulatory submittals and correspondence; the results of Phase 1 groundwater modeling; assessment of data gaps; the purpose, rationale, and approach for the phased field investigation; and a proposed schedule of Phase 1 and Phase 2 activities. The phased approach to the SSA was developed after the Bureau of Land Management (BLM) determined that an Environmental Assessment (EA) was required under the National Environmental Policy Act (NEPA) to grant a Right-of-Way (ROW) for drilling locations on public land.

The Phase 1 field program was conducted in fall 2012 and included drilling on sites located on RAML property that were not subject to an EA under NEPA. RAML installed eight new wells, and conducted hydraulic testing and groundwater monitoring in existing and new wells during Phase 1. Concurrent with Phase 1, RAML initiated work on the EA/ROW process for proposed Phase 2 well locations on public land. This Phase 2 work plan is being submitted along with a report summarizing Phase 1 of the field program. Data obtained during Phase 1 were used to augment planning of the Phase 2 field program.

RAML anticipates completing the Phase 2 field program by the end of the 2013 drilling season. The EA is currently being prepared by BLM and an approved ROW to the Phase 2 drilling locations is expected to be secured by spring 2013. The EA is subject to public comment. Extensive public comment could delay final approval of the EA and ROW, which could delay initiation of the Phase 2 field program. This work plan describes the Phase 2 field program and includes a schedule of Phase 2 activities. The work plan includes the following sections and appendices:

Section 2.0 – Data Gaps
Section 3.0 – Scope and Schedule of Phase 2 of Supplemental Site Assessment
Section 4.0 – References Cited
Appendix A – Well Construction Methods
Appendix B – Hydraulic Testing Methods
Appendix C – Groundwater Monitoring Methods

2.0 DATA GAPS

The August 2012 Revised Final Work Plan summarizes Site conditions and key data gaps identified in the conceptual Site model (CSM). These data gaps need to be addressed to refine the CSM, conduct additional analysis and modeling, and revise Alternate Concentration Limits (ACLs) for the Site COCs. Investigation to address data gaps began in the Phase 1 field program and will continue in the Phase 2 program. The Phase 2 field program will include installation of shallow and deep wells on public land, hydraulic testing, and groundwater monitoring using methods consistent with those used during Phase 1. Data gaps are summarized below.

Groundwater Elevation Data

Additional exploratory boreholes will be drilled and wells will be installed during the Phase 2 field program to further characterize water table conditions in the Burro Canyon Aquifer (BCA). Additional groundwater elevation data from new shallow and deep wells in the BCA are needed to improve delineation of horizontal and vertical hydraulic gradients, groundwater flow directions and velocities, and to delineate the extent of dry Burro Canyon Formation along the crest of the Lisbon Valley Anticline (LVA).

The Phase 2 field program will also include installation of wells in the Brushy Basin Member of the Morrison Formation (BBM). Groundwater elevation data from wells screened in the BBM are needed to estimate horizontal hydraulic gradients and groundwater flow directions in the BBM and vertical hydraulic gradients between the BCA and BBM.

Hydraulic Conductivity Data

Additional field-based hydraulic testing and laboratory analysis will be conducted during the Phase 2 field program to develop additional estimates of horizontal hydraulic conductivity (K_h) and vertical hydraulic conductivity (K_v) for the BCA and for the upper portion of the BBM. Additional K_h data are needed to improve estimates of groundwater velocities and rates of COC transport. Additional K_v data are needed to characterize vertical flow in the BCA and between the BCA and BBM. Additional K_h and K_v data will also improve understanding of the importance of fracture flow.

Water Quality Data

Additional groundwater sampling and analysis will be conducted in the Phase 2 field program to improve delineation of water quality in groundwater west and southwest of the tailings impoundments.

Additional Characterization at Existing Well Locations

In the August 2012 Revised Final Work Plan, eight existing wells were identified where the screened interval is submerged below the water table. Wells MW-5, H-63, MW-13, EF-3A, EF-8, EF-6, LW-1 and ML-1 were designated as deep-screen BCA wells. During Phase 1, shallow companion wells were installed near deep-screened wells LW-1 and MW-13. The shallow companion wells were screened over the portion of saturated BCA above the portion screened by the deep-screen well. During the Phase 2 field program, shallow companion wells will be installed near deep-screen wells EF-3A, EF-8, EF-6, and ML-1, located west and southwest of the tailings. The companion wells will be fully screened in the shallow portion of the BCA above the screened interval of the deep wells. Water quality data from the shallow companion wells will improve characterization of groundwater quality in the entire BCA at these locations.

Based on a review of historic site data, discrepancies were noted regarding the construction of existing well ML-1. The well log for well ML-1 indicates that it was constructed with two well screen intervals separated by about 70 feet. Video logging conducted during the Phase 1 field program indicated that ML-1 was constructed with a single screened interval from 136 to 155 feet below ground surface (bgs). Based on the video log, this well is considered a deep-screen BCA well, with the well screen submerged below the water table. Thus, a shallow companion BCA water table well will be installed adjacent to ML-1 during Phase 2.

An exploratory borehole will be installed adjacent to existing well RL-6 during Phase 2 to determine if the well is installed in perched or regional groundwater. RL-6 is approximately 18 feet deep and is located near an ephemeral wash. The rationale for the shallow well depth is unknown. It is unclear whether water level data from this well are meaningful given the small saturated thickness (about 2 feet) in the well. It is also unclear if groundwater from this well is from the same hydrostratigraphic zone(s) screened by the other wells. Well installation and construction at this location will be determined by the conditions encountered during drilling.

3.0 SCOPE AND SCHEDULE OF PHASE 2 OF SUPPLEMENTAL SITE ASSESSMENT

This section presents the proposed approach to the Phase 2 field program, outlines the activities that comprise the work to be conducted, and presents the proposed schedule.

3.1 PHASE 2 FIELD PROGRAM

The Phase 2 field program will include installation of new wells, collection of core samples at selected borehole locations for physical properties analysis, conduct of hydraulic testing at new wells, and collection of groundwater samples for water quality analysis. RAML will provide written notice at least 14 days prior to commencing the Phase 2 field program to allow DRC representatives the opportunity to observe drilling, well installation, testing, and/or sampling activities. RAML may elect to conduct additional field activities (e.g., pumping tests, geophysical surveys, or other) during Phase 2. RAML will consult with DRC before conducting additional activities.

3.1.1 Phase 2 Well Construction

During the Phase 2 field program, RAML plans to install 14 monitor wells on BLM land, west and southwest of the RAML property. Drilling is contingent upon receiving approval to access the drill sites from BLM. **Figure 1** shows the locations of the planned Phase 2 well sites. The well locations were selected based on an evaluation of Site data, the results of the Phase 1 modeling, and recommendations from DRC.

All new wells will be designed and constructed in compliance with UAC R317-6-6.3(I)(6), the Utah Division of Water Rights Standards (R655-4 UAC), and the Resource Conservation and Recovery Act guidance document entitled *Ground Water Monitoring*

Technical Enforcement Guidance Document (U.S. Environmental Protection Agency, 1986). All wells will be constructed under the direction of a licensed Professional Geologist in the State of Utah and by a State of Utah licensed well driller. RAML will provide DRC with a well construction schedule at least 14 days prior to startup. To the extent required during the field program, RAML will communicate with DRC on drilling status and unexpected conditions.

Table 1 summarizes the location, proposed construction details, planned hydraulic testing, and rationale for installation of the Phase 2 wells. As required by DRC, all Phase 2 wells in which saturated BCA is encountered will fully screen the saturated zone of the BCA or will screen the saturated portion of the BCA not screened by an existing companion well. In the latter case, the newly screened well will be located as close to the existing companion well as is practicable. RAML may elect to install additional wells on the BLM-approved well sites as deemed necessary to characterize hydrogeologic conditions and address data gaps.

Drilling methods, construction specifications, and well development procedures for the Phase 2 wells are provided in **Appendix A**. The drilling procedures were developed based on conditions encountered during the Phase 1 drilling program and were modified slightly from procedures presented in the August 2012 Revised Final Work Plan. The previous drilling procedures were modified as follows:

- Prior to drilling, temporary instead of permanent steel surface casing will be advanced to and seated in competent rock.
- If no evidence of the water table is encountered in the BCA during drilling, the borehole will be monitored for a period of at least 12 hours before drilling resumes in the BBM.
- At BBM well locations, boreholes will initially be advanced no more than 60 feet below the BCA/BBM contact. If the water table is not encountered within 60 feet below the contact, the borehole will be monitored for a period of at least 12 hours

before any drilling resumes. Following the observation period, a decision will be made (in collaboration with DRC) whether to build a well, abandon the borehole, or continue drilling.

Drilling procedures may be modified in the field in accordance with the conditions encountered. Key aspects of the drilling procedures that require pre-field planning include locating the water table and coring, drilling, and constructing the wells in a manner that avoids water quality cross-contamination between the BCA and BBM.

As required by DRC, RAML will submit geologic logs and well completion diagrams for the new wells within 60 calendar days of completion. The geologic logs will be prepared under the direction of a State of Utah licensed Professional Geologist.

3.1.2 Phase 2 Contingency Drilling Locations

In addition to the planned locations, RAML has designated six additional locations as contingency drill sites (**Figure 1**). Access to these sites has been requested from the BLM and they are included in the EA. Drilling on the contingency sites will depend on hydrogeologic conditions encountered at the planned locations (**Table 1**). Installation, development, surveying and/or sampling of new wells will be coordinated so that useful data can be obtained during the program for contingency site planning. As the drilling program progresses, RAML will work collaboratively with DRC to determine the need for additional boreholes or wells on the contingency drill sites.

3.1.3 Hydraulic Testing

Field-based hydraulic testing and laboratory analysis of cores will be conducted during Phase 2 to estimate formation K_h. Slug testing will be conducted in all Phase 2 wells. Representative core samples from at least one location will be selected and submitted for laboratory analysis of K_h and K_v. **Table 1** summarizes the planned hydraulic testing program for the new wells. **Appendix B** includes a detailed description of slug testing procedures.

During the Phase 2 drilling program, slug testing will also be conducted at Phase 1 wells MW-104 and MW-106, which were not tested during the Phase 1 field program. These wells were evacuated completely during well development and the water level had not recovered sufficiently to conduct slug testing at the time of the November 2012 testing event. Water level recovery monitoring conducted after development indicated that recovery rates are very slow and slug testing at these wells will require an extended monitoring period for each test.

3.1.4 Groundwater Monitoring

Groundwater monitoring will be conducted during the Phase 2 field program. To confirm the Phase 1 groundwater monitoring results and to further compare sampling methods, RAML plans to conduct a second comparative sampling event in March 2013 using the same methods and procedures used during the Phase 1 groundwater monitoring event. Samples will be collected from all existing and Phase 1 wells using no-purge, low-flow, and purge methods. **Appendix C** includes information on the methods and procedures for the comparative sampling event.

Groundwater monitoring will also be conducted following completion of the Phase 2 wells. The monitoring event will include measuring water levels in all new and existing wells and collection of groundwater samples from Phase 2 wells using the three sampling methods described above. RAML may elect to collect additional samples from selected existing and Phase 1 wells during this event. At the request of DRC, groundwater samples will be collected from Phase 2 new wells no sooner than one week after well development. Groundwater samples collected at the time of well development may be analyzed to obtain water quality data for planning purposes.

At a minimum, groundwater samples will be analyzed for dissolved uranium, molybdenum, selenium, arsenic, total dissolved solids, chloride, sulfate, bicarbonate, and pH. Other analyses may be conducted if warranted by conditions encountered during drilling and sampling. Sampling will be performed by qualified and trained personnel. Samples will be analyzed at Energy Laboratories, Inc. and ACZ Laboratories, Inc.

Results of the Phase 1 and Phase 2 comparative sampling will be evaluated and used to select the appropriate sampling method for long-term monitoring at the Site.

3.1.5 Field Program Schedule

Figure 2 presents an estimated schedule for the Phase 2 field program and subsequent reporting. The schedule is based, in part, on projections from the driller on the duration of well installation and development. RAML is planning a day-shift only drilling program utilizing two drilling rigs and two geologists. Monitor well construction and development will be followed by hydraulic testing and groundwater sampling. Including pre-drilling planning, the Phase 2 field program is expected to take about 3 months to complete. The Phase 2 field program is tentatively scheduled to start in July 2013. The actual start date and schedule will depend on access approval by BLM, work plan approval by DRC, availability of subcontractors, and conditions encountered in the field.

3.2 PHASE 2 DATA EVALUATION AND REPORTING

Following the completion of the Phase 2 field program, data from both phases of work will be evaluated and the CSM will be refined. The refined CSM will serve as the basis for reestablishing ACLs for the Site. It is anticipated that Phase 2 will entail modeling to develop the ACLs. After the approval of revised ACLs, an appropriate long-term groundwater monitoring program will be developed.

Data obtained during the Phase 1 and Phase 2 field programs will be presented along with the Phase 2 modeling results in the final report. The final report will include geologic logs and well schematics for all Phase 1 and Phase 2 wells; interpretation, tabulation, and mapping of new water level and water quality data obtained in 2012 and 2013; hydrogeologic cross-sections; analysis of Phase 1 and Phase 2 slug testing; results of Phase 2 groundwater modeling; and recommended revised ACLs or other appropriate compliance conditions. The data evaluation, modeling, ACL development, and final report are projected to take about 11 months to complete after the Phase 2 field is completed (**Figure 2**).

4.0 REFERENCES CITED

Montgomery & Associates, 2012, **Revised Final Work Plan, Supplemental Site Assessment to Address Out-of-Compliance Status at Trend Wells RL-1 and EF-8, Lisbon Facility**: August 2, 2012.

U. S. Environmental Protection Agency, 1986, **RCRA Ground Water Monitoring Technical Enforcement Guidance Document:** USEPA/530/SW-86/055, September 1986.

Utah Division of Radiation Control, 2012, **Radioactive Materials License No. UT 1900481**, February 2012.

TABLE 1. PROPOSED PHASE 2 DRILLING LOCATIONS, SUPPLEMENTAL SITE ASSESSMENT
RIO ALGOM MINING LLC, LISBON FACILITY

WELL ID	APPROXIMATE COORDINATES NAD 1927 UTAH STATE PLANE SOUTH		ESTIMATED DEPTH (feet bgs)[a]	CONDUCTOR CASING LENGTH (feet bgs)	ESTIMATED SCREEN LENGTH (feet)	ESTIMATED SCREENED INTERVAL (feet bgs)	SCREENED UNIT	PLANNED CORE SAMPLING	PLANNED HYDRAULIC TESTING		RATIONALE	PLANNED WELL CONSTRUCTION
	EASTING	NORTHING							SLUG TEST	LAB[b]		
Phase 2 Planned Drilling Locations[c]												
MW-107S	2,628,824	593,237	77	---	35	42 - 77	BCA		X		Characterize shallow BCA groundwater conditions and uranium concentration along the LF	**Screen upper portion of saturated BCA;** screen from water table to top of MW-107D screen (upper half of saturated thickness)
MW-107D	2,628,824	593,237	112	---	35	77 - 112	BCA	X	X		Characterize deep BCA groundwater conditions and uranium concentration along the LF; obtain core samples to characterize fault geology	**Screen lower portion of saturated BCA**; advance boring to Kbc/Jmb contact; determine water table depth and screen the lower half of the saturated thickness
MW-108	2,629,837	593,880	64	---	40	24 - 64	BCA		X		Characterize BCA groundwater conditions and uranium concentration along the crest of the LVA	**Screen saturated BCA from water table to Kbc/Jmb contact**
MW-109	2,632,593	593,613	146	---	20	126 - 146	BCA/BBM	X	X	X	Characterize groundwater conditions and uranium concentration along the crest of the LVA; obtain core samples to assess fracture transport in the BCA; if water table is in BBM, obtain core samples from BBM for horizontal and vertical hydraulic conductivity analysis	**Screen well in water table**; if water table encountered in Kbc, fully screen well in the BCA; if no BCA, drill up to 60 feet (max) into Jmb; screen bottom 30 feet of borehole; estimated boring depth and screened interval assumes saturated BCA
MW-110	2,632,838	592,567	102	---	20	82 - 102	BCA/BBM		X		Characterize groundwater conditions and uranium concentration along the crest of the LVA	**Screen well in water table**; if water table encountered in Kbc, fully screen well in the BCA; if no BCA, drill up to 60 feet (max) into Jmb; screen bottom 30 feet of borehole; estimated boring depth and screened interval assumes saturated BCA
MW-111	2,634,454	591,975	123	---	35	88 - 123	BBM		X		Characterize groundwater conditions and uranium concentration along the crest of the LVA	**Screen well in water table (BBM)**; based on historic and Phase 1 data, the water table is in the BBM, approximately 25 feet below the Kbc/Jmb contact; advance borehole beyond BBM water table and screen top 30 feet of saturation
MW-112	2,631,473	591,433	137	---	101	36 - 137	BCA		X		Characterize groundwater conditions and uranium concentration in the BCA above the ML-1 screen	**Screen saturated zone from water table to top of ML-1 screen**
MW-113	2,633,004	590,671	102	---	41	61 - 102	BCA		X		Characterize groundwater conditions and uranium concentration in the BCA above the EF-6 screen	**Screen saturated zone from water table to top of EF-6 screen**
MW-114	2,632,022	590,520	202	---	145	57 - 202	BCA		X		Characterize BCA groundwater conditions and uranium concentration between EF-8 and LF	**Screen saturated BCA from water table to Kbc/Jmb contact**
MW-115	2,633,238	589,540	213	---	143	70 - 213	BCA		X		Characterize groundwater conditions and uranium concentration in the BCA above the EF-8 screen	**Screen saturated zone from water table to top of EF-8 screen**

TABLE 1. PROPOSED PHASE 2 DRILLING LOCATIONS, SUPPLEMENTAL SITE ASSESSMENT
RIO ALGOM MINING LLC, LISBON FACILITY

WELL ID	APPROXIMATE COORDINATES NAD 1927 UTAH STATE PLANE SOUTH		ESTIMATED DEPTH (feet bgs)[a]	CONDUCTOR CASING LENGTH (feet bgs)	ESTIMATED SCREEN LENGTH (feet)	ESTIMATED SCREENED INTERVAL (feet bgs)	SCREENED UNIT	PLANNED CORE SAMPLING	PLANNED HYDRAULIC TESTING		RATIONALE	PLANNED WELL CONSTRUCTION
	EASTING	NORTHING							SLUG TEST	LAB[b]		
MW-116	2,632,599	589,198	276	---	195	81 - 276	BCA	X	X		Characterize BCA groundwater conditions and uranium concentration along the LF; obtain core samples to characterize fault geology	**Screen saturated BCA from water table to Kbc/Jmb contact**
MW-117S	2,633,971	589,259	151	---	74	77 - 151	BCA		X		Characterize groundwater conditions and uranium concentration in the BCA above the EF-3A screen	**Screen saturated zone from water table to top of EF-3A screen**
MW-117DB	2,633,971	589,259	254	219	30	224 - 254	BBM	X	X	X	Characterize groundwater conditions and uranium concentration in BBM; obtain core samples for horizontal and vertical hydraulic conductivity analysis	**Screen in BBM beneath saturated BCA**; core and ream borehole 5 to 10 feet below the Kbc/Jmb contact, advancing boring into competent unfractured Jmb; cement in steel conductor casing anchored in unfractured Jmb; core and ream another 45 feet into Jmb; screen bottom 30 feet of borehole
MW-118	2,627,910	594,590	64	30	30	34 - 64	BCA	X	X		Determine if shallow well RL-6 is screened in perched water or saturated BCA; characterize groundwater conditions and uranium concentration; obtain core samples to characterize geology	**Screen BCA saturated zone from regional water table to Kbc/Jmb contact**; core borehole to either fine-grained perching layer **OR** Kbc/Jmb contact and proceed as follows: If perching layer encountered, install and cement in steel conductor casing to seal off perched water; screen well from water table below the perching layer to Kbc/Jmb contact If no perching layer encountered above BCA/BBM contact, replace RL-6 with a fully penetrating BCA well, screened from water table to Kbc/Jmb contact
Contingency Drilling Locations												
1	2,631,696	594,622	TBD	---	TBD	TBD	TBD				Characterize groundwater conditions along the crest of the LVA	Drilling dependent on hydrogeologic and hydrochemical findings obtained at new wells MW-108 and MW-109
2	2,628,463	592,572	TBD	---	TBD	TBD	TBD				Characterize groundwater conditions on the west side of the LF	Drilling dependent on hydrogeologic findings obtained at Phase 2 wells in the vicinity of the LF
3	2,632,464	588,210	TBD	---	TBD	TBD	TBD				Characterize groundwater conditions on the west side of the LF	Drilling dependent on hydrogeologic findings obtained at Phase 2 wells in the vicinity of the LF
4	2,634,043	586,291	TBD	---	TBD	TBD	TBD				Characterize groundwater conditions on the west side of the LF	Drilling dependent on hydrogeologic findings obtained at Phase 2 wells in the vicinity of the LF

TABLE 1. PROPOSED PHASE 2 DRILLING LOCATIONS, SUPPLEMENTAL SITE ASSESSMENT
RIO ALGOM MINING LLC, LISBON FACILITY

WELL ID	APPROXIMATE COORDINATES NAD 1927 UTAH STATE PLANE SOUTH		ESTIMATED DEPTH (feet bgs)[a]	CONDUCTOR CASING LENGTH (feet bgs)	ESTIMATED SCREEN LENGTH (feet)	ESTIMATED SCREENED INTERVAL (feet bgs)	SCREENED UNIT	PLANNED CORE SAMPLING	PLANNED HYDRAULIC TESTING		RATIONALE	PLANNED WELL CONSTRUCTION
	EASTING	NORTHING							SLUG TEST	LAB[b]		
5	2,637,577	586,644	TBD	---	TBD	TBD	TBD				Characterize groundwater conditions along the LF	Drilling dependent on hydrogeologic findings obtained at Phase 2 wells in the vicinity of the LF
6	2,641,285	585,218	TBD	---	TBD	TBD	TBD				Characterize groundwater conditions along the crest of the LVA	Drilling dependent on hydrogeologic findings obtained at Phase 2 wells

Notes:

[a] feet bgs = feet below ground surface

[b] Core samples from BBM will be tested in laboratory for horizontal and vertical conductivity.

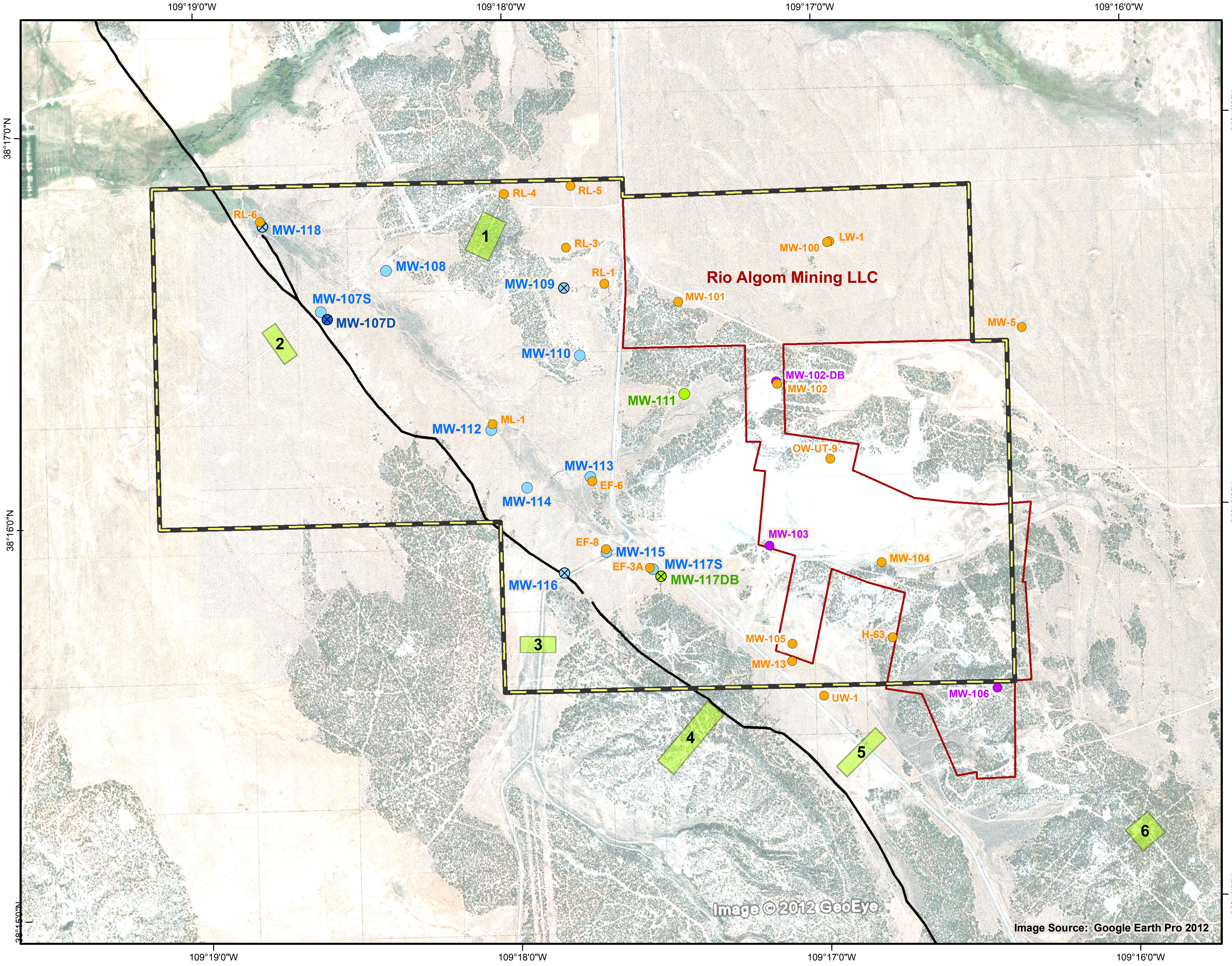
[c] Water level, water quality, and lithology data will be collected at all new wells. All wells will be constructed according to Utah Division of Water Rights Standards.

Kbc = Burro Canyon Formation
Jmb = Brushy Basin Member of the Morrison Formation

BCA = Burro Canyon Aquifer
BBM = Brushy Basin Member Hydrostratigraphic Unit
TBD = to be determined

LF = Lisbon Fault
LVA = Lisbon Valley Anticline

--- = Not available



EXPLANATION

MW-109 — Phase 2 Water Table Well and Identifier

MW-107D — Phase 2 Deep Burro Canyon Aquifer Well and Identifier

MW-111 — Phase 2 Brushy Basin Member Well and Identifier

⊗ — Phase 2 Cored Borehole

1 — Phase 2 Contingency Drilling Location

MW-100 — Existing Burro Canyon Aquifer Well and Identifier

MW-103 — Existing Brushy Basin Member Well and Identifier

Fault

Long Term Surveillance and Maintenance Boundary

Rio Algom Mining LLC Property Boundary

N

0 1,000 2,000 3,000 4,000

Feet

RIO ALGOM MINING LLC
LISBON FACILITY

PROPOSED PHASE 2 WELL SITES

MONTGOMERY & ASSOCIATES
Water Resource Consultants

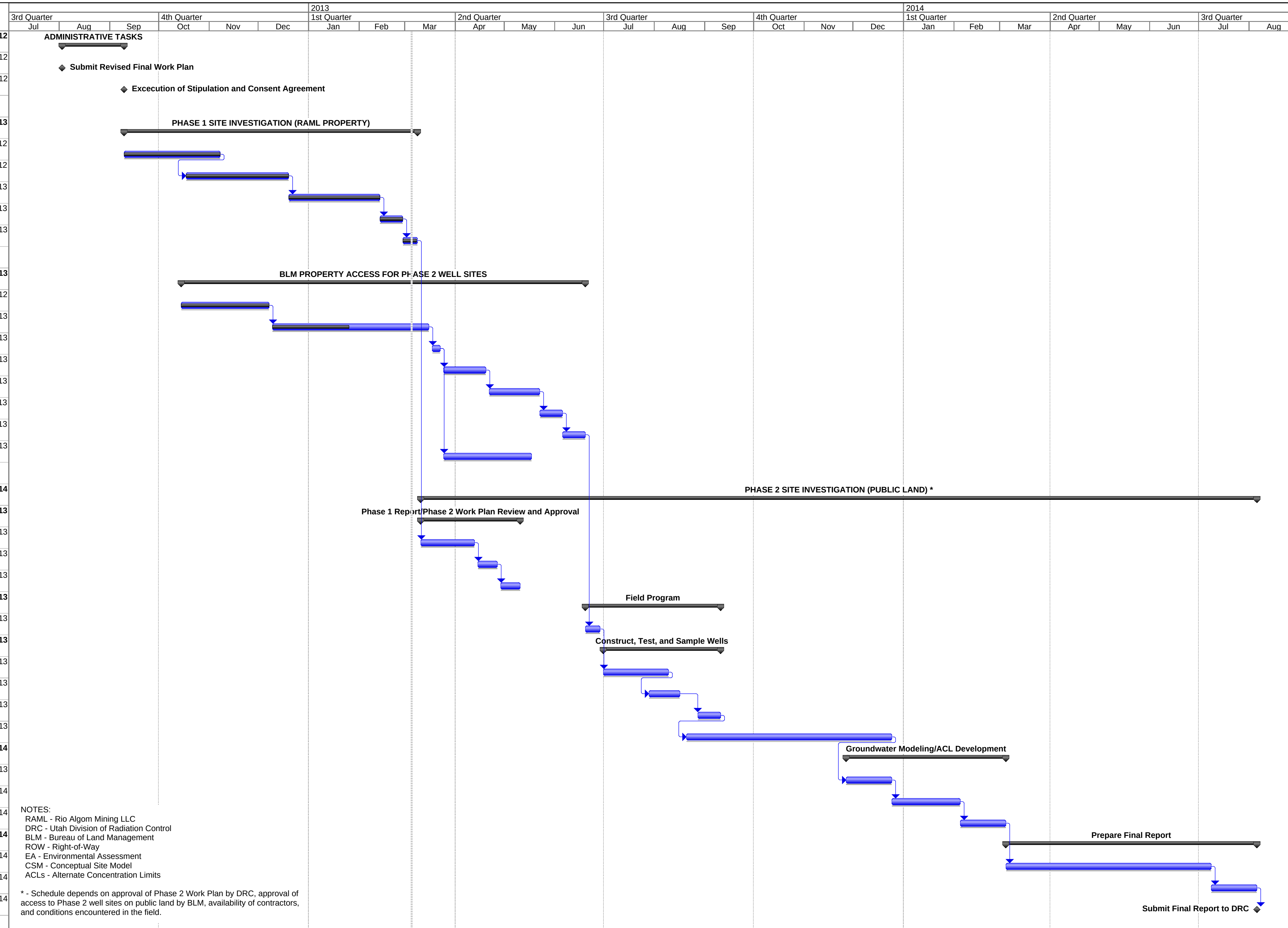
2013

FIGURE 1

GIS\1350.15\Phase2_PropInvestigationWellLoc\14Feb2013 NAD27_SP_Utah_So.

FIGURE 2. PHASE 2 SCHEDULE
SUPPLEMENTAL SITE ASSESSMENT TO ADDRESS OUT-OF-COMPLIANCE STATUS AT TREND WELLS RL-1 AND EF-8
RIO ALGOM MINING LLC
LISBON FACILITY

ID	Task Name	Duration	Start	Finish
1	**ADMINISTRATIVE TASKS**	**26 days**	**Thu 8/2/12**	**Mon 9/10/12**
2	Submit Revised Final Work Plan	0 days	Thu 8/2/12	Thu 8/2/12
3	Excecution of Stipulation and Consent Agreement	0 days	Mon 9/10/12	Mon 9/10/12
4				
5	**PHASE 1 SITE INVESTIGATION (RAML PROPERTY)**	**130 days**	**Mon 9/10/12**	**Fri 3/8/13**
6	Conduct Field Program	43 days	Mon 9/10/12	Wed 11/7/12
7	Evaluate Data	45 days	Thu 10/18/12	Wed 12/19/12
8	Prepare Draft Phase 1 Report and Phase 2 Work Plan for RAML Review	40 days	Thu 12/20/12	Wed 2/13/13
9	RAML Review of Draft Phase 1 Report/Phase 2 Work Plan	10 days	Thu 2/14/13	Wed 2/27/13
10	Revise/Submit Phase 1 Report and Phase 2 Work Plan to DRC	7 days	Thu 2/28/13	Fri 3/8/13
11				
12	**BLM PROPERTY ACCESS FOR PHASE 2 WELL SITES**	**178 days**	**Mon 10/15/12**	**Wed 6/19/13**
13	Prepare Plan of Development/ROW Application (RAML)	40 days	Mon 10/15/12	Fri 12/7/12
14	Prepare EA (BLM)	70 days	Mon 12/10/12	Fri 3/15/13
15	Review Draft EA (RAML)	5 days	Mon 3/18/13	Fri 3/22/13
16	Prepare Final EA/Approve ROWs (BLM)	20 days	Mon 3/25/13	Fri 4/19/13
17	30-Day Public Comment Period (BLM)	23 days	Mon 4/22/13	Wed 5/22/13
18	Respond to Public Comment (if any) (BLM/RAML)	10 days	Thu 5/23/13	Wed 6/5/13
19	Issue Approved ROW Agreement (BLM)	10 days	Thu 6/6/13	Wed 6/19/13
20	Conduct Biological Surveys (RAML)	40 days	Mon 3/25/13	Fri 5/17/13
21				
22	**PHASE 2 SITE INVESTIGATION (PUBLIC LAND) ***	**367 days**	**Mon 3/11/13**	**Tue 8/5/14**
23	**Phase 1 Report/Phase 2 Work Plan Review and Approval**	**45 days**	**Mon 3/11/13**	**Fri 5/10/13**
24	DRC Review of Phase 1 Report and Phase 2 Work Plan	25 days	Mon 3/11/13	Fri 4/12/13
25	Revise Phase 1 Report and Phase 2 Work Plan	10 days	Mon 4/15/13	Fri 4/26/13
26	DRC Approval of Phase 1 Report and Phase 2 Work Plan	10 days	Mon 4/29/13	Fri 5/10/13
27	**Field Program**	**59 days**	**Thu 6/20/13**	**Tue 9/10/13**
28	Prepare for Field Work	7 days	Thu 6/20/13	Fri 6/28/13
29	**Construct, Test, and Sample Wells**	**52 days**	**Mon 7/1/13**	**Tue 9/10/13**
30	Construct and Develop Wells	30 days	Mon 7/1/13	Fri 8/9/13
31	Conduct Slug Testing	15 days	Mon 7/29/13	Fri 8/16/13
32	Sample Wells	10 days	Wed 8/28/13	Tue 9/10/13
33	Evaluate Data/Refine CSM	90 days	Wed 8/21/13	Tue 12/24/13
34	**Groundwater Modeling/ACL Development**	**70 days**	**Wed 11/27/13**	**Tue 3/4/14**
35	Revise Groundwater Model	20 days	Wed 11/27/13	Tue 12/24/13
36	Conduct Model Simulations	30 days	Wed 12/25/13	Tue 2/4/14
37	Develop New ACLs	20 days	Wed 2/5/14	Tue 3/4/14
38	**Prepare Final Report**	**110 days**	**Wed 3/5/14**	**Tue 8/5/14**
39	Prepare Draft Report	90 days	Wed 3/5/14	Tue 7/8/14
40	RAML Review/Prepare Final Report	20 days	Wed 7/9/14	Tue 8/5/14
41	Submit Final Report to DRC	0 days	Tue 8/5/14	Tue 8/5/14



NOTES:
RAML - Rio Algom Mining LLC
DRC - Utah Division of Radiation Control
BLM - Bureau of Land Management
ROW - Right-of-Way
EA - Environmental Assessment
CSM - Conceptual Site Model
ACLs - Alternate Concentration Limits

* - Schedule depends on approval of Phase 2 Work Plan by DRC, approval of access to Phase 2 well sites on public land by BLM, availability of contractors, and conditions encountered in the field.

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APPENDIX A

WELL CONSTRUCTION METHODS
RIO ALGOM MINING LLC, LISBON FACILITY

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APPENDIX A

WELL CONSTRUCTION METHODS
RIO ALGOM MINING LLC, LISBON FACILITY

SCOPE AND APPLICABILTIY

The following sections describe methods for the drilling, installation, and development of wells at the Rio Algom Mining LLC Lisbon facility (RAML) in La Sal, Utah. The methods are intended to be general in nature. As the work progresses, appropriate revisions may be necessary and may be implemented as required to meet project objectives.

DRILLING PREPARATION

Drilling will use conventional or reverse-circulation air drilling methods. Drilling will be conducted by an approved well constructor, licensed in the State of Utah. Wells will be designed and constructed in accordance with Utah Administrative Codes (UAC) R317-6-6.3(I)(6), UAC R655-4-15, and U.S. Environmental Protection Agency (U.S. EPA, 1986) RCRA Ground Water Monitoring Technical Enforcement Guidance Document. Prior to commencing the drilling program, proposed well locations will be field-verified. Each well site will be inspected for drilling impediments (e.g., utilities, limited access, etc.).

FIELD DOCUMENTATION

Drilling and well construction will be overseen by a qualified professional geologist. The geologist will document daily site conditions, drilling activities, and well construction. The field geologist will also provide lithologic descriptions of materials encountered during drilling. Copies of the driller's logs/daily reports will be maintained by the field geologist.

DRILLING AND WELL CONSTRUCTION

Drilling procedures were developed based on available information and may be modified in the field in accordance with the conditions encountered.

Fully Penetrating Burro Canyon Aquifer Wells

At boring locations where the water table is encountered in the Burro Canyon Formation (Kbc), wells will be completed as fully penetrating Burro Canyon Aquifer (BCA) water table wells, screened across the entire saturated thickness of the aquifer, unless they are companion wells to existing BCA wells. At fully penetrating water table well locations, temporary steel surface casing will be advanced to and seated in competent rock. The boreholes will be advanced to the contact of the Kbc and the Brushy Basin Member of the Morrison Formation

(Jmb). The well will be constructed with a screen extending from the contact to at least 5 feet above the water table.

When drilling has reached the suspected water table depth (based on water levels in existing vicinity wells), boreholes will be monitored for water production at 10-foot increments. At each increment, the borehole will be evacuated of drill water by airlifting; airlifting will continue for a prescribed period of time to determine whether the borehole is producing water. Once a determination has been made that the water table is encountered, the field team may elect to take a groundwater sample from the upper portion of the aquifer if deemed appropriate.

Companion BCA Water Table Wells

Wells drilled adjacent to existing monitoring wells are considered companion water table wells. These wells will be drilled so that they screen the entire saturated thickness of the aquifer in conjunction with the existing adjacent well. All of the wells installed prior to 2012 on RAML property and adjacent Bureau of Land Management land are screened immediately above the Kbc/Jmb contact.

When drilling Phase 2 companion wells, temporary steel surface casing will be advanced to and seated in competent rock. When drilling has reached the suspected water table depth (based on water levels in existing vicinity wells), boreholes will be monitored for water production at 10-foot increments. At each increment, the borehole will be evacuated of drill water by airlifting; airlifting will continue for a prescribed period of time to determine whether the borehole is producing water. Once a determination has been made that the water table is encountered, the field team may elect to take a groundwater sample from the upper portion of the aquifer if deemed appropriate. The borehole will then be advanced to the top of the well screen of the adjacent existing well. The new well will be constructed with the bottom of the screened interval at the top of the adjacent existing well screen and the top of the screened interval at least five feet above the water table.

Brushy Basin Member Wells

Wells completed in the Jmb will be designated Brushy Basin Member (BBM) wells. BBM wells will either be constructed as BBM water table wells or double-cased BBM wells screened beneath saturated BCA.

At boring locations where the water table is first encountered in the Jmb, wells will be completed as BBM water table wells. Temporary steel surface casing will be advanced to and seated in competent rock and the boring will be advanced to the Kbc/Jmb contact. After the contact is reached, the borehole will be monitored for a period of at least 12 hours to confirm that the water table is not present in the Kbc. If no water accumulates, the borehole will be advanced into the Jmb to a maximum depth of 60 feet below the contact. As the borehole is advanced in the Jmb, the borehole will be monitored for water production by airlifting at 10-foot increments. Once the water table has been identified, the well will be constructed with a 30-foot screened interval extending at least 5 feet above the water table. If the water table in the BBM is within 5 feet of the Kbc/Jmb contact, the screen will not extend above the contact. If the water table is not encountered within 60 feet below the contact, the borehole will be monitored for a period of at least 12 hours. Following the observation period, a decision will be made whether to build a well, abandon the borehole, or continue drilling. During drilling, appropriate measures will be taken to ensure that there is no cross contamination between the BCA and BBM.

During the Phase 2 field program, at least one well will be completed as a BBM well screened beneath saturated BCA. At this location, a 5-inch diameter core barrel will be advanced to collect continuous core samples to a depth approximately 5 to 10 feet below the Kbc/Jmb contact. The borehole will be advanced into competent, unfractured Jmb. After the cored borehole is reamed to the appropriate diameter, a permanent steel 8-5/8-inch diameter conductor casing string will be installed and cemented in place to seal off the BCA and prevent cross contamination to the BBM. Once the integrity of the seal has been verified, continuous core will be collected 45 feet into the Jmb. After the cored borehole is reamed, the well will be built with 30 feet of screened interval in the BBM.

Exploratory Drilling Near Existing Monitor Well RL-6

One boring will be advanced near existing monitor well RL-6 to determine if it is screened in a perched water zone or the regional groundwater. The borehole will be advanced to the total depth of well RL-6 (approximately 18 feet). The borehole will be evacuated of drill water by airlifting and airlifting will continue for a prescribed period of time to determine whether the borehole is producing water. If the water table is encountered, drilling will continue to the Kbc/Jmb contact or other fine grained unit. If the Jmb is encountered, a monitor well will be built with a 30-foot screened interval just above the contact. If a fine grained "perching unit" in the Kbc is encountered, a steel conductor casing will be installed into this unit and cemented in place to seal off the perched water. Once the integrity of the seal has been verified, drilling will continue to the Kbc/Jmb contact. A well will be built, screened from just below the steel casing to the contact.

Contingency Drilling Locations

RAML has designated six additional locations as contingency drill sites. Drilling on the contingency sites will depend on hydrogeologic conditions encountered at the planned locations. Depending on conditions encountered at the planned locations, additional drilling may be needed to further characterize water table conditions at the southeastern and northwestern extents of the Lisbon Valley Anticline and west of the Lisbon Fault.

At contingency drilling locations east of the Lisbon Fault, boreholes would be advanced until the water table is encountered. RAML may elect to construct BCA or BBM wells at these locations consistent with the methods described above. At locations west of the Lisbon

Fault, BCA and BBM are not expected to be encountered. Boreholes would be advanced to depths approximately 30 feet below the elevation where the water table is encountered in nearby new wells or borings. If the water table is not encountered, the borehole would be monitored for a period of at least 12 hours to confirm the borehole is dry. Following the observation period, a decision will be made whether to abandon the borehole or continue drilling.

Core Sampling

Coring will be conducted at selected borings to retrieve undisturbed samples for physical properties and/or hydrochemical analyses. Borings will be cored using a PQ (5-inch diameter) core barrel. Once coring is completed, the cored borehole will be reamed to the appropriate diameter and drilling will continue as describe above. Core samples not submitted for analysis will be placed in core boxes, labeled, and stored on site in a secured storage unit.

At boring locations selected for physical properties analysis of cores, undisturbed core will be retrieved from the approximate depth of the water table to the bottom of the borehole. The number of samples from each well location will be determined by the lithology encountered during drilling and field observations of physical properties. Core samples will be submitted to Daniel B. Stevens & Associates, Inc. of Albuquerque, New Mexico under standard chain of custody protocols and analyzed for horizontal and vertical saturated hydraulic conductivity by flexible wall falling head-rising tail method.

RAML may elect to collect additional core samples during the Phase 2 field program for hydrochemical analyses of the vadose zone to assess residual uranium concentrations. Selected core samples would be submitted to ACZ Laboratories of Steamboat Springs, Colorado under standard chain of custody protocols and analyzed for uranium and selected metals by US EPA Methods 6010B, 6020, and 7470A.

Well Materials

Most new wells will be constructed with 4-inch diameter flush-threaded schedule 40 PVC casing and well screen with 0.010 machine slots. The screened interval will be determined by saturated thickness of the aquifer in all water table wells. The screened interval of BBM wells will be 30 feet. If the field team believes that a shorter screened interval will lead to higher quality data, they may elect to install nested 2-inch diameter flush-threaded schedule 40 PVC casings and well screen with 0.010 machine slots. Wells constructed in this manner would be installed such that the nested wells in aggregate would screen the entire saturated thickness of the aquifer. For all wells, a filter pack consisting of 10/20 washed silica sand (or similar appropriate material) will be placed in the annulus. This filter pack will extend 2 to 5 feet above the screened interval, provided that this does not expose the BCA/BBM contact to cross contamination. A 2 to 3-foot layer of fine transitional sand will be placed above the filter pack and the annulus will be sealed to ground surface using high solids bentonite grout (or similar appropriate material).

Wells will be completed with a locking above-grade steel monument and a concrete pad. The PVC well casing will extend at least 1 foot above grade. Three steel protective posts will be installed if wells are in areas accessible to vehicular traffic.

DECONTAMINATION

All down-hole drilling equipment including rods, hammers, bits, core barrels, and temporary casing will be steam cleaned between borings.

WELL DEVELOPMENT

New wells will be developed as needed after installation. Wells will be surged using a surge block and purged until development water is free of sediment and field parameters including pH, specific conductance, and temperature have stabilized.

INVESTIGATION DERIVED WASTE

All drill cuttings, drilling fluids, decontamination water, and development water will be containerized during drilling activities and properly disposed using methods approved by RAML and Utah Division of Radiation Control (DRC).

REPORTING

As-built reports for new wells will be submitted to the DRC within 60 calendar days of completion in accordance with DRC requirements. As-built reports will be prepared under the direction of a Professional Geologist licensed by the State of Utah. Reports will include the following:

- Geologic logs detailing lithology and physical properties of all subsurface materials encountered during drilling.

- Well completion diagrams detailing the following:
    - Total depth and diameter of the borehole
    - Depth, type, diameter, and physical properties of well casing and screen
    - Well screen slot size
    - Depth intervals, type, and properties of annular filter pack and seal
    - Design and construction of protective surface casing
    - Horizontal coordinates and measuring point elevation measured to the nearest 0.01 feet by an engineer or land surveyor licensed by the State of Utah
    - Water level elevation measured to the nearest 0.01 feet

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REFERENCES

U.S. Environmental Protection Agency (U.S. EPA), 1986, **RCRA Ground Water Monitoring Technical Enforcement Guidance Document**: USEPA/530/SW-86/055, September 1986.

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APPENDIX B

HYDRAULIC TESTING METHODS
RIO ALGOM MINING LLC, LISBON FACILITY

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APPENDIX B

HYDRAULIC TESTING METHODS
AT RIO ALGOM MINING LLC LISBON FACILITY WELLS

SCOPE AND APPLICABILTIY

The following sections describe standard operating procedures (SOPs) for conducting slug tests at monitoring wells at the Rio Algom Mining LLC Lisbon facility (RAML) in La Sal, Utah. The SOPs are intended to be general in nature. As the work progresses, appropriate revisions may be necessary and may be implemented as needed to meet project objectives.

SLUG TESTING METHOD

A slug test involves the near instantaneous injection or withdrawal of a volume or slug of water or solid cylinder. The test is conducted by displacing a known volume of water from a well and measuring the response of the hydraulic head in the well through time. A solid cylinder will be used for all slug tests conducted at the RAML facility. Tests will comprise the introduction of a solid slug into the groundwater, with subsequent monitoring allowing for hydraulic head to return to static conditions, followed by rapid removal of the slug and measurement of rising head.

Slug testing will be conducted at all new Phase 2 wells at the RAML facility. Slug testing will be conducted in accordance with established American Society for Testing and Materials (ASTM) and U.S. EPA procedures (ASTM, 2002; U.S. EPA, 1994) The following SOPs will be followed when conducting falling-head (slug lowered into a well) and a rising-head (slug removed from the well) slug tests.

Materials and Equipment

The following equipment is needed to perform slug tests. All equipment which comes in contact with the well should be decontaminated prior to commencing field activities.

- Field logbook
- Field test data sheets
- Integrated pressure transducer/datalogger, data cables, and field computer
- Solid cylinder slug and competent tether
- Stopwatch

Test Preparation

1. Review the well construction records for the well specifically focusing on total depth of the well, well diameter, and screen position and length. Tests will be conducted by a qualified groundwater professional.

2. Connect integrated pressure transducer/datalogger to field computer.

3. Synchronize the computer and transducer clocks. Check the battery in the transducer to ensure full power supply.

4. Select a logging rate of one reading per second. Set the transducer to start logging data. Record in the field logbook the transducer ID number being used.

Test Procedures

1. Open the well and manually measure the depth to water to the nearest 0.01 foot. Record this information on the field test data sheet and in the field logbook.

2. Lower the transducer into the well and place it at least 2 feet deeper than the length of the solid cylinder slug. The submerged depth of the transducer should not exceed the maximum submerged design depth for the transducer used.

3. Fasten the transducer data cable at the top of the well so that the transducer cannot move. Re-connect to the field computer for real-time monitoring.

4. Allow the transducer to equilibrate for at least 15 minutes.

5. Measure the water level again to verify that water level has returned to equilibrium after the deployment of the transducer. If it has not, repeat this step in 5-minute intervals until equilibrium is reached. Record this information on the field test data sheet and in the field logbook.

6. Lower the slug into the well and place the slug just above the water level.

7. Lower the slug quickly into the water. Record the time that the slug was placed into the water on the field test data sheet and in the field logbook.

8. Monitor the hydraulic head until it has recovered to within 90 percent of the static head. This portion of the test is now complete.

9. Allow time for the hydraulic head to recover to a static condition. Quickly pull the slug out of the water. Record the time that the slug was pulled from the water on the field test data sheet and in the field logbook.

10. Monitor the hydraulic head until it has recovered to within 90 percent of the static head.

11. Conduct a minimum of two slug tests at each well to ensure the data are repeatable. Where practical as time permits, conduct three slug tests at each well. The data collected from the transducer should be reviewed in the field to determine if additional slug tests are required.

12. Stop transducer from logging data. Download the data files from the transducer and record the file names on the field test data sheet and in the field logbook.

13. Decontaminate the transducer and data cable, water level meter, and slug for next use.

Investigation Derived Waste

No potentially contaminated groundwater will be removed from wells during slug testing. All equipment used during slug testing will be decontaminated after each use to prevent cross contamination. Decontamination water will be containerized, sampled for water quality, and properly disposed using methods approved by RAML and Utah Division of Radiation Control (DRC).

Data Analysis

Data collected during the slug testing will be evaluated using one or more appropriate analytical methods consistent with the conceptual model to estimate the hydraulic conductivity of the formation (Butler, 1998; Bouwer and Rice, 1976). Analytical solutions and software used to calculate the formation hydraulic conductivity will depend on the hydraulic responses observed during slug testing.

REFERENCES

American Society for Testing and Materials (ASTM), 2002, **Standard Test Method (Field Procedure) for Instantaneous Change in Head (Slug) Tests for Determining Hydraulic Properties of Aquifers**: D 4044-96, 2002.

Bouwer, H. and R.C. Rice, 1976, **A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells**: Water Resources Research, vol. 12, no. 3, pp. 423-428.

Butler, J.J., Jr., 1998, **The Design, Performance, and Analysis of Slug Tests**: Lewis Publishers, Boca Raton, Florida.

U.S. Environmental Protection Agency (U.S. EPA), 1994, **Slug Tests**: Standard Operating Procedure No. 2046, October 1994.

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APPENDIX C

GROUNDWATER MONITORING METHODS
RIO ALGOM MINING LLC, LISBON FACILITY

APPENDIX C

GROUNDWATER MONITORING METHODS
RIO ALGOM MINING LLC, LISBON FACILITY

SCOPE AND APPLICABILTIY

The following sections describe standard operating procedures (SOPs) for measurement of water levels in wells and for collection of water quality samples from wells at the Rio Algom Mining LLC Lisbon facility (RAML) in Lisbon, Utah. The SOPs described below are intended to be general in nature. As the work progresses, appropriate revisions may be necessary and may be implemented as needed to meet project objectives.

Under the current groundwater sampling program for the RAML facility, groundwater samples are obtained from existing wells using low-flow purging and sampling methods. As part of the additional characterization work to be conducted in 2013, a field evaluation of various groundwater sampling methods will be performed to determine the most appropriate method for representative sample collection. Comparative samples will be collected from all new and existing wells using the purgeless HydraSleeve method, the low flow minimal purge method, and volume-based standard purge method. SOPs for each sample collection method are described in the following sections.

GENERAL CONSIDERATIONS

Potential hazards associated with the planned tasks shall be thoroughly evaluated prior to conducting field activities. The site-specific Health and Safety Plan (HASP) for the RAML facility provides a description of potential hazards and associated safety and control measures.

Field personnel must wear powder-free nitrile gloves while performing the procedures described in this SOP. Specifically, powder-free nitrile gloves must be worn while measuring water levels, preparing sample bottles, preparing and decontaminating sampling equipment, collecting samples, and packing samples. At a minimum, nitrile gloves must be changed prior to the collection of each sample, or as necessary to prevent the possibility of cross-contamination with the sample, the sample bottles, or the sampling equipment.

Field sampling equipment shall be decontaminated prior to each use. Although water level measurement and sampling should typically be conducted from least to most impacted location, field logistics may necessitate other sample collection priorities. When sampling does not proceed from least to most impacted location, extra precautions must be taken to ensure that appropriate levels of decontamination are achieved.

WATER LEVEL MEASUREMENT

Water levels will be measured in wells prior to purging or sampling. Construction details and any previous measurements for each well will be reviewed by the field staff before obtaining measurements.

Materials and Equipment

The following equipment is needed to measure water levels and well depth. All equipment which comes in contact with the well should be decontaminated prior to commencing field activities.

- Records of well construction details and previous measurements
- Electronic water level indicator with accuracy of 0.01 feet
- Field log or data sheet
- Weighted tape graduated to the nearest 0.01 feet

Measuring Point

Well depth and water level measurements will be referenced from a measuring point, established and marked at the top of the inner casing of each monitoring well. Generally, this point will be on the north side of the top of the casing. The measuring point will be permanently marked using an indelible marker or a notch cut into the casing. A licensed surveyor will survey the measuring point elevation of each monitoring well and reference this measurement to the local datum for location and elevation.

Well Depth Measurements

The total depth of each new well will be measured with a weighted measuring tape immediately after construction and will be verified periodically thereafter. The weighted tape will be lowered into the well until the tape becomes slack indicating the bottom of the well. Care will be taken to lower the tape slowly to avoid damage to the bottom of the well by the weight. The tape will be raised until it becomes taut. With the tape in this fixed position, the total depth of the well will be measured to the nearest 0.01 feet below the measuring point.

Water Level Measurements

Manual water level measurements will be obtained from wells with an electronic water level indicator prior to purging or sampling. If the well is equipped with a pressure transducer and datalogger, the recorded data will be downloaded and viewed in the field on a portable computer. Water level will then be measured manually to verify that the automated device is functioning properly. The SOP for measuring water levels with an electronic water level indicator is as follows:

1. Open the protective outer cover of the monitoring well and remove any debris that has accumulated around the riser near the well plug. If water is present above the top of the riser and well plug, remove the water prior to opening the well plug. Do not open the well until the water above the well head has been removed.
2. Allow well to equilibrate for at least 5 minutes before measuring the water level.
3. Using an electronic water level indicator accurate to 0.01 feet, determine the distance between the established measuring point and the surface of the standing water present in the well. Repeat as necessary until two successive readings agree to within 0.01 feet. Record date and time of each water level measurement and the serial number of the water level indicator used.
4. Decontaminate the water level indicator in preparation for next use.

The accuracy of electronic water level indicators will be verified at least annually as part of routine maintenance. The entire length of the graduated tape/cable will be compared to a steel surveyor's tape of the same or greater length to determine accuracy at 100-foot increments. Water level indicators will be checked more frequently if there is reason to suspect the tape/cable was stretched during field operations.

GROUNDWATER SAMPLE COLLECTION PROCEDURES

As described above, a field evaluation of groundwater sampling methods will be performed in 2013 to determine the most appropriate method for representative sample collection. Once the appropriate sample method is selected for the ongoing RAML facility monitoring program, sampling procedures for this method will be duplicated to the maximum extent practical during subsequent sampling events.

Groundwater samples will be collected from new wells no sooner than seven days after the well has been developed. For the field evaluation of sample methods, the sequence of the concurrent sampling will comprise sample collection by the purgeless HydraSleeve method, followed by the low flow minimal purge method, followed by the volume-based standard purge method. SOPs for the three sampling methods are described below.

Materials and Equipment

The following equipment is needed to collect groundwater samples from wells. All equipment which comes in contact with the well should be decontaminated prior to commencing field activities.

General Materials and Equipment:

- Monitoring instruction sheet for each site
- Field logbook
- Field sampling data sheets (FSDS)
- Site maps
- Health & Safety Plan
- Indelible black-ink pens and markers
- Sample labels
- Chain-of-custody forms
- Custody seals
- Shipping labels
- Water level meter
- pH/conductivity/temperature/oxidation reduction potential (ORP) meter, turbidity meter, and dissolved oxygen meter
- Insulated cooler(s)
- Laboratory-supplied sample containers
- Ice
- Decontamination equipment: Liquinox or similar, and jugs for potable water

Equipment for HydraSleeve Sampling:

- HydraSleeve
- Static deployment line calibrated with footmarks
- Weight with attachment clip
- Recovery reel

Equipment for Low-Flow and Standard Purge Sampling:

- Variable rate electric submersible pump and controller
- Portable generator
- Flow-through cell
- Disposable discharge tubing

Purgeless Sample Method

Purgeless sample collection will be conducted using the HydraSleeve method, which comprises deployment of a clean, flat, empty bailer into the well screen. Groundwater samples will be collected using the HydraSleeve method in accordance with the manufacturer's recommended procedures (GeoInsight, 2006). A HydraSleeve consists of a disposable polyethylene tube-shaped bag, sealed at the bottom and flared open at the top with a check-valve. This method requires that a minimum of 6 feet of well screen be submerged below the water level for proper deployment. The benefits of purgeless sampling include little or no purge water generated for disposal and little or no decontamination since the equipment is either dedicated or disposable.

HydraSleeve Deployment

1. Measure and record the depth to water to nearest 0.01 feet as described above. Compare water level with well construction details to confirm that the HydraSleeve sampling device can be deployed. Record this information on the FSDS and in the field logbook.
2. Install the HydraSleeve sampling device approximately 2 feet below the midpoint of the screened interval of the well and at least 4 feet below water level. Deployment of the sampler causes a disturbance to the well water chemistry by allowing mixing with the "stagnant" water contained in the well pipe above the screened portion of the well and by disturbance of any sediment attached to the well pipe. The device will be deployed at least 24 hours prior to sample collection.
3. Fasten the weight to the bottom of the device and attach to the deployment line with a snap hook. Determine the expected footmark on the graduated line at the top of casing when the top of the device is in the planned position. Deploy the sampling device slowly into the well.
4. For wells with a planned deployment depth near the bottom of the open screen a top weight will be used. The top weight (available from the HydraSleeve manufacturer) is a weighted stainless-steel pipe sized to fit around the outside of the top of the device. It is held in place by a clip that also holds the mouth of the device open. Upon deployment, the top weight compresses the device in the bottom of the well effectively lowering the deployment depth to approximately 6 to 12 inches above the bottom of the well.

HydraSleeve Retrieval and Sampling

1. After at least 24 hours, retrieve the HydraSleeve with one smooth motion of approximately 4 feet. If the top of the well casing is too high to raise the device in one motion, the sampler can partially raise the device then adjust his grip on the tether to complete the stroke. The device must be removed at a rate of 1 to 2 feet per second or faster to allow water to pass the check valve.
2. Perforate the top of the device with the provided discharge tube and direct the water to the appropriate laboratory-supplied sample containers. Apply labels to bottles and immediately return to ice chest.
3. Record sampling information on the FSDS and in the field logbook.
4. Decontaminate deployment line and associated equipment for next use.

Low Flow (Minimal Purge) Sample Method

Groundwater samples will be collected using the low-flow sampling method in accordance with procedures described in U.S. EPA *Low-Flow (Minimal Drawdown) Ground-Water Monitoring Procedures* (Puls and Barcelona, 1996). U.S. EPA recommends the use of adjustable-rate bladder and electric submersible pumps during low-flow purging and sampling activities. The following SOPs assume that a non-dedicated electric variable rate submersible pump will be used to purge and sample wells by the low-flow method. The following procedures will be used for low-flow sampling:

Low Flow Well Purging

1. Prepare sampling equipment including calibration of field meters prior to use.
2. Measure and record the depth to water to the nearest 0.01 feet as described above. Using the specific details of well construction and current water-level measurement, determine the pump set depth, typically the mid-point of the saturated well screen or other target sample collection depth adjacent to specific high-yield zones. If disposable tubing is to be used, cut appropriate length of disposable tubing from roll and attach to pump.
3. Remove the decontaminated pump from the pump holder and rinse the pump off with water. Slowly lower the pump into the well to the target depth. Record the depth of the pump intake after lowering the pump into location.
4. Connect the cable for the control box to the pump reel. Start the generator. Make sure the generator is kept downwind from the sampling system.
5. Connect the discharge tubing from the pump to the base of the flow-through cell. Place the probes for the calibrated field meters into the flow-through box. Attach small section of discharge tubing to the top of the flow-through cell and place end of hose into bucket to catch purge water.
6. Place water level probe in well and record static water level on the FSDS.
7. If the well has been previously sampled using low-flow purging and sampling methods, begin purging at the rate known to induce minimal drawdown. Frequently check the drawdown rate to verify that minimum drawdown is being maintained. If sampling the well for the first time, begin purging the well at the minimum pumping rate of 100 milliliters per minute (mL/min) and slowly increase the pumping rate to no more than 500 mL/min. Monitor and record drawdown in well (if any). Record data on FSDS. If drawdown exceeds 0.3 feet from static, adjust flow rate until drawdown stabilizes (if possible).
8. For wells screened below the static water level, if the drawdown does not stabilize at a pumping rate of 100 mL/min, continue pumping until the drawdown reaches a depth of two feet above the top of the well screen. Stop pumping and collect a groundwater sample once the well has recovered sufficiently to collect the appropriate sample

volume. Document the details of purging, including the purge start time, rate, and drawdown on the FSDS and in the field logbook.

For wells screened across the static water level, if the drawdown does not stabilize at 100 mL/min, continue pumping. However, do not draw down the water level more than 25 percent of the distance between the static water level and pump intake depth. If the recharge rate of the well is lower than the minimum pumping rate, then collect samples at this point even though indicator field parameters have not stabilized. Begin sampling as soon as the water level has recovered sufficiently to collect the required sample volumes. Allow the pump to remain undisturbed in the well during this recovery period to minimize the turbidity. Document the details of purging on the FSDS and in the field logbook.

9. Start recording field parameters on the FSDS sheet every 3 minutes. Purging should continue at a constant rate until the parameters stabilize. Stabilization is considered achieved when three sequential measurements are within the ranges listed below:

   - pH ± 0.1 standard units
   - Specific Conductance ± 3%
   - Temperature ± 3%
   - ORP ± 10 millivolts
   - Turbidity ± 10% (for values greater than 5 NTUs)
   - Dissolved Oxygen ± 10%

Low Flow Well Sampling

1. After specified parameters have stabilized, reduce flow rate on control box to approximately 100 mL/min.
2. Disconnect discharge tubing base of flow-through cell, being careful to contain water within the cell. Cut off approximately 0.5 feet from end of discharge tubing. Place a bucket beneath sampling tube to catch water.
3. Fill necessary sample bottles. Label sample bottles with a unique sample number, time and date of sampling, the initials of the sampler, and the requested analysis on the label. Additionally, provide information pertinent to the preservation materials or chemicals used in the sample. Record comments pertinent to the color and obvious odor. Record sampling information on FSDS sheet and in field logbook.
4. Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container. Immediately seal each sample and place the sample on ice in a cooler to maintain sample temperature preservation requirements. Fill bottles in the following order:

   - Metals, and Radionuclides
   - Filtered Metals and Radionuclides
   - Other water-quality parameters.

5. Remove the pump from the well taking care that the tubing does not contact the ground while being retrieved. Decontaminate pump and tubing for next use.
6. Containerize and properly dispose of purge water and decon water generated during sampling.

Volume Based (Standard Purge) Sample Method

Groundwater samples will be collected using the volume-based purge sampling method in accordance with procedures described in US EPA *Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers* (Yeskis and Zavala, 2002). The following SOPs assume that a non-dedicated electric variable rate submersible pump will be used to purge and sample wells by the volume-based method. The following procedures will be used for standard purge sampling:

Well Purging

1. Prepare sampling equipment including calibration of field meters prior to use.
2. Measure and record the depth to water to the nearest 0.01 feet as described above. Calculate a casing volume for the well based on the specific details of well construction, the current depth to water measurement, and casing diameter. For wells with multiple casing diameters, calculate the volume for each segment and use the sum of the values.
3. Remove the decontaminated pump from the pump holder and rinse the pump off with water. Slowly lower the pump into the well to the target depth. Set the pump immediately above the top of the well screen or 3 to 5 feet below the top of the water table. Lower the pump if the water level drops during purging. Record the depth of the pump intake after lowering the pump into location.
4. Connect the cable for the control box to the pump reel. Start the generator. Make sure the generator is kept downwind from the sampling system.
5. Purge the well until at least three casing volumes are removed. Maintain a purge rate so that recharge water is not entering the well in an agitated manner and the water level in the well does drop below the pump intake. Containerize all purge water.
6. Record field parameters periodically and after each casing volume is purged. Stabilization is considered achieved when three sequential measurements are within the ranges listed below:

• pH	± 0.1 standard units
• Specific Conductance	± 3%
• Temperature	± 3%
• ORP	± 10 millivolts

- Turbidity ± 10% (for values greater than 5 NTUs)
- Dissolved Oxygen ± 10%

If the indicator parameters have not stabilized after the removal of six casing volumes, field instruments will be recalibrated. If no problems are found, sampling can be conducted; however, the project manager will be notified and all information will be recorded in the field notebook and/or field purge record.

7. If the yield of the well is low such that it can be pumped dry, then the recharged groundwater in the well will be considered representative regardless of the number of casing volumes of groundwater removed. If a well is purged dry, the well may be sampled after 80 percent recovery.

Sampling after Standard Purge

1. Collect samples within 2 hours of purging, if possible. It is acceptable to collect samples within 24 hours of purging.
2. Fill necessary sample bottles. Label sample bottles with a unique sample number, time and date of sampling, the initials of the sampler, and the requested analysis on the label. Additionally, provide information pertinent to the preservation materials or chemicals used in the sample. Record comments pertinent to the color and obvious odor. Record sampling information on FSDS sheet and in field logbook.
3. Fill all sample containers with minimal turbulence by allowing the groundwater to flow from the tubing gently down the inside of the container. Immediately seal each sample and place the sample on ice in a cooler to maintain sample temperature preservation requirements. Fill bottles in the following order:

    - Metals and Radionuclides
    - Filtered Metals and Radionuclides
    - Other water-quality parameters.

4. Remove the pump from the well taking care that the tubing does not contact the ground while being retrieved. Decontaminate pump and tubing for next use.
5. Containerize and properly dispose of purge water and decon water generated during sampling.

Sample Analyses

Groundwater samples will be submitted for hydrochemical analysis to analytical laboratories certified by the State of Utah. At a minimum, samples will be analyzed for uranium, molybdenum, selenium, arsenic, total dissolved solids, chloride, sulfate, and bicarbonate. Other analyses may be conducted if warranted by conditions encountered during drilling and sampling. The list of hydrochemical parameters and approved analysis methods are given in **Table 1**.

TABLE 1. GROUNDWATER SAMPLING PARAMETER LIST

Parameter[a]	Analytical Method	Lab Reporting Limit[b]	Preserve Method	Holding Time	Container & Size[c]
Total Dissolved Solids	SM 2540C	10	Cool	7 days	Plastic-250 mL
Bicarbonate, as $CaCO_3$ Chloride Sulfate	SM 2320B EPA 300.0 EPA 300.0	5 1 4	Cool	28 days	Plastic-250 mL
Arsenic (As) Molybdenum (Mo) Selenium (Se) Uranium (U)	EPA 200.8[d] EPA 200.8 EPA 200.8 EPA 200.8	0.001 0.1 0.001 0.04	HNO_3	6 months	Plastic-250 mL

[a] Concentration for all parameters in milligrams per liter (mg/L)
[b] Laboratory reporting limits in mg/L and based on Utah regulations and laboratory standard practice.
[c] Containers are abbreviated as: P = plastic. Container size given in milliliters (mL).
[d] All metals will be sampled and reported as dissolved

Sample Filtration

Samples collected for dissolved parameters will be field-filtered using a disposable, in-line, 0.45 micron filter. When the HydraSleeve sampling method is used water will be transferred from a clean unpreserved sample container, through the filter, and into the appropriate preserved sample container using a hand pump or syringe. When sampling using low-flow or standard purge methods, the water samples will be pumped through the filter attached directly to the discharge tubing of the groundwater pumping system. A new filter and tubing will be used for each sample.

Quality Control Sampling

Quality Assurance/Quality Control (QA/QC) samples will consist of split samples, duplicate samples, and equipment rinsate blanks. For QA/QC purposes all QA/QC samples will be blind labeled. QA/QC samples will be clearly identified on the field sampling forms.

- Duplicate groundwater samples will be collected at a frequency of 10 percent of the total number of groundwater samples collected.
- A split sample will be collected at one well location using all three sample methods. At this location a second set of sample containers will be filled, and the two sets will be submitted to different laboratories.
- At least two equipment rinsate blanks will be collected to assess the effectiveness of equipment decontamination procedures. Equipment blanks will be prepared by

pouring or pumping ASTM Type II reagent-grade water over or through sampling devices after decontamination procedures have been conducted.

Decontamination Procedures

Before use at each location, the submersible pump, temperature, pH, specific conductivity, ORP, dissolved oxygen meters, and depth to water indicators will be washed using a solution of water and Liqui-Nox™, rinsed with potable water, and rinsed a second time with distilled/deionized water.

Investigation Derived Waste

Investigation derived waste (IDW) generated during groundwater sampling will include monitoring well purge water and equipment decontamination water. Purge and decontamination water will be placed on the RAML property in secured, approved container and labeled as "Non-Hazardous Waste". The label will also include the accumulation date, facility contact, and a contact phone number. Water generated during groundwater sampling will be properly disposed following receipt of laboratory analytical results and disposal characterization. The site owner will remain as the generator of all wastes to be disposed, and will sign all transport and disposal manifests as such.

SAMPLE MANAGEMENT

Sample Containers/Sample Handling

The sample containers will be prepared and provided by the analytical laboratory. Samples will be preserved consistent with conditions presented in **Table 1**. The type and size of container used for each parameter and the type of preservative added, if any, will be recorded on the field sampling data form. Sample containers will be placed in an iced cooler immediately after sample collection. The sample containers will be kept closed, maintained under custody, and refrigerated until analysis. Maximum holding times from the time of sample collection until sample analysis are provided in **Table 1**.

Sample Designation and Labeling

All groundwater samples collected from monitoring wells, including any duplicate samples, will be recorded on field sampling data sheets. Each sample will be given a unique blind 4-digit sample identifier. Groundwater samples collected from the same well using different sample methods will be considered distinct samples and will be given unique sample identifiers. Sample containers will be labeled with the sample identifier, project name, data and time of sampling, and sampler's initials.

Sample Custody

At the end of each sampling day and before samples are transferred off site, chain-of-custody entries will be made on the Chain-of-Custody/Laboratory Analysis Request form to document sample custody. Information on the container labels will be compared to the information on the chain-of-custody form and on the field sampling data forms, and the field logbook.

Once a sample is collected, it will remain in the custody of the sampler or other authorized personnel, until it is shipped to the laboratory. Upon transfer of sample possession to subsequent custodians, the persons transferring custody will sign the chain-of-custody form. During interstate transport, the chain-of-custody form will be placed in a resealable plastic bag and accompany each sample cooler to the laboratory. Signed and dated chain-of-custody seals will be placed on coolers prior to shipping. When the samples are received at the laboratory, the custody seal on the shipping container will be broken and the condition of the samples recorded by the laboratory custodian. Chain-of-custody records will be included in the analytical report prepared by each laboratory. Copies of the chain-of-custody records will be retained in the project file.

Upon receipt of the samples, the laboratory will complete the chain-of-custody record. The condition of each sample container will be noted. The laboratory will also maintain a sample-tracking record that will follow each sample through the laboratory process. The sample-tracking record must show the dates of sample extraction or preparation, and sample analysis for each sample. These records will be used to determine compliance with specified holding times.

REFERENCES

GeoInsight, 2006, **HYDRASleeve Simple by Design (US Patents No. 6,481,300; 6,837,120; others pending), Field Manual:** 2006.

Puls, R. W. and M. J. Barcelona. 1996, **Low-Flow (Minimal Drawdown) Ground-Water Monitoring Procedures**: EPA/540/S-95/504, April 1996.

Yeskis, D. and B. Zavala. 2002, **Ground-Water Sampling Guidelines for Superfund and RCRA Project Managers:** EPA 542-S-02-001, May 2002.