

October 6, 2015

Mr. Tom McLaughlin
Nuclear Regulatory Commission
11555 Rockville Pike
Rockville, MD 20852

**RE: Ambrosia Lake Facility
License SUA-1473, Docket No. 40-8908
2013 Well Replacement Report**

Dear Mr. McLaughlin,

This well replacement report documents the drilling of 14 replacement wells and the abandonment of 15 monitoring wells. This work took place between October 2012 and February 2013.

Sincerely,

INTERA Incorporated



Angela Persico
Environmental Scientist

Enclosure

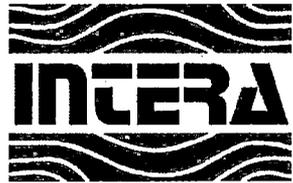
MONITORING WELL REPLACEMENT REPORT

**Rio Algom Mining, LLC
McKinley County, New Mexico**

Prepared for:

Rio Algom Mining, LLC
P.O. Box 218
Grants, New Mexico 87020

Prepared by:



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May 2013



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ABBREVIATIONS AND ACRONYMS

ARCH	air, rotary, casing, hammer
bgs	below ground surface
ft	feet
HSA	hollow-stem auger
INTERA	INTERA Incorporated
Jet West	Jet West Geophysical Services, LLC
NMED	New Mexico Environment Department
NMOSE	New Mexico Office of the State Engineer
PVC	polyvinyl chloride
RAML	Rio Algom Mining, LLC
Site	Property owned by RAML located in the Ambrosia Lake Mining District, 19 miles northwest of Grants, McKinley County, New Mexico
YJD	Yellow Jacket Drilling



1.0 INTRODUCTION

This report describes the field activities that were used to install 14 replacement monitoring wells and plug and abandon 15 existing monitoring wells (one well was not replaced) on property that belongs to Rio Algom Mining, LLC (RAML) in McKinley County, New Mexico (Site). A Site location map is included as Figure 1. Figure 2 shows the locations of the replacement monitoring wells and of the monitoring well that was plugged and abandoned, but not replaced.

The wells that were replaced, plugged, and abandoned were MW 05-03, MW 05-08, MW 05-73, MW 30-04, MW 30-68, MW 30-48 Kd, MW 31-01 Tra, MW 31-02 Trb, MW 31-05, MW 31-70, MW 32-01, MW 32-02, MW 32-45 Kd, MW 32-50. The well that was plugged and abandoned, but not replaced, was MW 30-03. Field work was conducted between October 29, 2012 and February 1, 2013.

This rest of this report is divided into the following sections: Section 2 describes the site and provides historical perspective on the need for this well replacement program; Section 3 describes the site geology and hydrogeology; Section 4 presents each aspect of the project including well drilling and completion, well development, and well abandonment; and Section 5 includes a list of references. The figures are provided in a separate section and consist of a site location map and a site map showing the location of all of the replacement monitoring wells. Table 1 presents all of the relevant well data such as location in latitude and longitude, total depth, screen interval, top of casing elevation, groundwater elevation, etc. The appendices are as follows: Appendix A – Lithologic Logs for Alluvial Wells (Field and Final), Appendix B – Lithologic Logs and Geophysical Logs for Bedrock Wells (Field and Final), Appendix C – Well Completion Diagrams, Appendix D – Well Development Forms, Appendix E – Well Permits, Appendix F – Well Plugging Plan of Operations and Plugging Records, Appendix G – Field Notes, and Appendix H – Geophysical Logs (.pdf format) and Photo Log.

2.0 SITE DESCRIPTION

2.1 Location and History

The RAML well replacement project Site is located in the Ambrosia Lake Mining District, 19 miles northwest of Grants, McKinley County, New Mexico. At the request of the New Mexico Environment Department (NMED), RAML performed a review of Discharge Permit DP-169 monitoring wells. The review included inspection of original well-completion records for total depth of each well and a comparison of those depths to the current measured depth of each well. Wells that were significantly shallower than indicated by well-completion records were selected



for replacement. The review also included a physical inspection of each well and wells that had visible integrity issues, such as broken casings or screens, were also selected for replacement.

The 15 monitoring wells to be abandoned were constructed in the 1960s and 1970s and have been used to monitor groundwater elevation and groundwater chemistry as part of the Site groundwater monitoring program. The wells range in depth from approximately 35 feet (ft) to more than 350 ft below ground surface (bgs) and are sampled periodically by the RAML field sampling team.

2.2 Current Site Conditions

The RAML Site is a former uranium mill that has been shut down and is undergoing site restoration. Access to the RAML Site is controlled 24 hours a day, seven days a week by a guard and gated entry, and only authorized and safety-trained personnel are allowed on the Site. The current Site conditions consist of relatively flat, sandy ground with sparse vegetation. Access to the well locations is via dirt roads. All well locations were accessible throughout the well replacement program, as the weather was relatively dry.

3.0 GEOLOGY AND HYDROGEOLOGY

The geologic sequence in the project area is as follows, from ground surface to depth: alluvium, Tres Hermanos "b" sandstone, Mancos Shale, Tres Hermanos "a" sandstone, Mancos Shale, Dakota sandstone. The Tres Hermanos "c" (the uppermost Tres Hermanos sandstone) has generally been eroded away on the Site. The alluvial deposits consist of unconsolidated (uncemented) silty, clayey, sand with an occasional gravel lense. The Tres Hermanos and Dakota Formation sandstones consist of poorly-cemented to well-cemented, fine- to coarse-grained, quartz-rich sandstone.

The nine alluvial wells are water table wells in that they contain the first water encountered in the subsurface. The two Tres Hermanos "b" wells, MW 31-02 Trb-R and MW 32-50 Trb-R, are also water table wells in that the alluvial deposits have eroded down into the Tres Hermanos "b" such that the alluvial aquifer and the water in the Tres Hermanos "b" are hydraulically connected. The Tres Hermanos "a" well (MW 31-01 Tra-R) and the two Dakota Formation wells are considered confined aquifers because these zones are separated from upper geologic zones by layers of Mancos Shale.



4.0 INVESTIGATION ACTIVITIES

Prior to performing drilling activities at the Site, INTERA obtained permits from the New Mexico Office of the State Engineer (NMOSE) to drill groundwater monitoring wells and to plug and abandon the groundwater monitoring wells that were being replaced. INTERA personnel also prepared equipment, schedules, and subcontractor technical services agreements; identified Site utilities with RAML Site personnel; and attended RAML Site health and safety training.

In accordance with the work plan, drilling, sampling, and development equipment were decontaminated prior to drilling and between soil boring and well drilling activities (INTERA, 2012). Drill cuttings generated during drilling activities were thin-spread on the ground adjacent to the well boring.

The health and safety of the workers on-site during well replacement activities was a top priority for RAML and INTERA. INTERA personnel and their subcontractors wore radiation detection badges and conducted alpha particle and gamma ray monitoring of drill cuttings as the wells were drilled. In compliance with RAML policy, INTERA and subcontractor personnel conducted personal and vehicle radiation scans at the end of each work day and recorded the results on the forms provided by RAML. Radiation levels above background or RAML action levels were not observed.

4.1 Replacement Monitoring Wells

From October 30 through December 18, 2012, INTERA oversaw the drilling, installation, and development of 14 replacement groundwater monitoring wells. The name of each replacement monitoring well is the same as the name of the well it is replacing with the addition of the letter "R" at the end of the name to denote that the new well is a "replacement." Nine of the replacement monitoring wells (MW 05-03-R, MW 05-08-R, MW 05-73-R, MW 30-04-R, MW 30-68-R, MW 31-05-R, MW 31-70-R, MW 32-01-R, and MW 32-02-R) were installed in alluvial deposits. The alluvial wells were drilled using hollow-stem auger (HSA) drilling methods. The remaining five replacement monitoring wells were installed using air-rotary drilling methods in various Tres Hermanos sandstone units of the Mancos Shale (MW 31-01 Tra-R, MW 31-02 Trb-R, and MW 32-50 Trb-R) or within the Dakota Sandstone (MW 30-48 Kd-R and MW 32-45 Kd-R). Two of these bedrock wells (MW 31-02 Trb-R and MW 32-50 Trb-R) are considered to be water table wells because they are in hydrogeologic communication with the alluvial aquifer sediments. The other three bedrock wells (MW 31-01 Tra-R, MW 32-45 Kd-R, and MW 30-48 Kd-R) are considered confined aquifers wells.



Well drilling, installation, development, and abandonment activities were conducted in accordance with the *Monitoring Well Replacement Work Plan, Rio Algom Mining, LLC*, dated October 10, 2012 (INTERA, 2012). This work plan was revised and updated from a previous version dated October 18, 2011. The well drilling, installation, and development activities were performed by Yellow Jacket Drilling (YJD) of Phoenix, Arizona. Geophysical logging was performed by Jet West Geophysical Services, LLC (Jet West), of Farmington, New Mexico. Field supervision of drilling, geologic logging, geophysical logging, well installation, well development, and well abandonment were provided by INTERA geologists. The locations of the groundwater replacement wells are provided on Figure 2. The lithologic logs (Field and Final) are presented in Appendices A and B. The well completion diagrams of each of the 14 wells, including construction details, are provided in Appendix C.

4.1.1 HSA Drilling

From October 30 through November 15, 2012, INTERA oversaw HSA drilling activities of nine alluvial replacement monitoring wells. Soil borings were drilled using a CME-85 drilling rig equipped with 10-inch augers and a center bit. To determine the total depth of the alluvium, each soil boring was overdrilled a few feet into the underlying bedrock unit.

While advancing each soil boring, soil samples were collected from the auger flights for lithologic logging. Soil samples were collected approximately every 10 ft, starting from ground surface to the total depth of each boring. Total depths for the soil borings ranged from approximately 34 ft bgs at MW 05-73-R to approximately 82 ft bgs at MW 31-70-R. Based on visual observations of soil samples collected from the alluvial boreholes, the subsurface geology consists of poorly graded fine sands with silt or clay, silts with fine sand, or clay with fine sand. A few gravel zones were observed in the alluvium but were not prevalent across the Site. Results of field screening for radiation were below background levels measured at the borehole surface location. Information regarding depths and background readings for these boreholes can be found on the lithologic logs in Appendix A.

4.1.2 Air-Rotary Drilling

From November 15 through December 18, 2012, INTERA oversaw air-rotary drilling activities of five bedrock replacement monitoring wells. Soil/rock borings were drilled with a Gefco Speedstar 50K drilling rig using ARCH (air rotary casing hammer) drilling and air-rotary hammer drilling methods. An 8½-inch tri-cone drilling bit was used during ARCH drilling to advance 9¾-inch surface casing from the ground surface to a few feet beyond the bedrock/alluvium contact. Once the surface casing was secured in place, the borehole was drilled open hole using an 8½-inch carbide hammer button drilling bit. A weighted collar was positioned



directly above the carbide hammer button drilling bit to keep weight on the bit and the borehole plumb.

While advancing each boring, soil or rock samples were collected from the cuttings discharge line for lithologic logging. Soil or rock samples were collected approximately every 10 ft, starting from the ground surface to the total depth of each boring. Water was added to the boring when necessary to assist in removing cuttings from the borehole. Field screenings of drill cuttings for alpha and gamma radiation were below background readings measured at the ground surface. Information regarding depths, fluids, and background readings for these boreholes can be found on the lithologic logs in Appendix B.

Subsequent to the drilling of each bedrock borehole, Jet West conducted geophysical logging of the borehole. Each geophysical logging suite included a gamma ray log used to determine lithology and mineralization and a neutron density tool used to determine porosity and saturation. The geophysical logging results were used in conjunction with the field lithologic logs to design the monitoring wells. The geophysical log curves have been incorporated into the lithologic logs for the bedrock wells and are located in Appendix B.

The bedrock boreholes were drilled to total depths of 377 ft bgs (MW 30-48 Kd-R), 245 ft bgs (MW 31-01 Tra-R), 160 ft bgs (MW 31-02 Trb-R), 291 ft bgs (MW 32-45 Kd-R), and 110 ft bgs (MW 32-50 Trb-R). All of the boreholes were overdrilled approximately 20 ft deeper than the anticipated total depths (usually into the underlying bedrock unit), allowing for a full geophysical log of the unit to be recorded. Based on the field lithologic logs and on the geophysical logs where noted, the depths to the tops of major stratigraphic units encountered in each monitoring well are as follows:

Well I.D.	<u>Formation</u>		
	Tres Hermanos "a" (ft bgs)	Tres Hermanos "b" (ft bgs)	Dakota (ft bgs)
MW 32-50 Trb R		80	
MW 31-02 Trb R		93*	
MW 31-01 Tra R	187*	94*	
MW 30-48 Kd R	205*	111*	280
MW 32-45 Kd R	105*	65*	180

*Based on geophysical log as interpreted by the INTERA geologist.



As noted above, the depths to the top of the Tres Hermanos “a” and “b” sandstone units of the Mancos Shale are based on the geophysical log depths instead of the depths indicated by an examination of drill cuttings. The depths to the top of these units were selected as the depths corresponding to a change in gamma-ray values because these values are recorded continuously, in contrast with the depths determined from drill cuttings, which were sampled every 10 ft.

4.1.3 Well Installation

Prior to setting the well, the overdrilled section of each boring was backfilled (i.e., sealed) using coated ¼-inch bentonite seal. Each well was constructed using 4-inch, flush-joint threaded, polyvinyl chloride (PVC) schedule 80 casing and well screen.

Each well was installed with a 20-ft section of 0.010-inch slotted screen with an end cap. Blank casing was placed from the top of the screen to approximately 3 ft above ground surface. Each well was then constructed using a 10/20 Colorado silica sand filter pack that was placed in the annulus between the well screen and the boring wall. Above the 10/20 filter pack sand, a 20/40 Colorado silica sand transitional filter pack was installed, followed by ¼-inch or ⅜-inch diameter (coated pellets if in water, uncoated chips if dry) bentonite seal a minimum of 5 ft thick. The seal was hydrated as needed and allowed to cure prior to installing the annular cement grout. The cement/bentonite grout was installed in multiple lifts as needed, with a minimum of 24 hours of curing time between each lift. The cement grout extended from the top of the bentonite seal to approximately 3 ft bgs. The sand, bentonite seal, and cement/bentonite grout materials were installed through 5¼-inch inner diameter augers on the HSA drilling rig for the alluvial wells, and through a 2-inch inner diameter tremie pipe on the air-rotary drilling rig for the bedrock wells. The volume of water used to “wash in” the filter pack materials and coated bentonite pellets during backfilling activities was calculated for removal during development. Surface completion for all wells consisted of an above-ground, sloped, 2-ft diameter by 6-inch thick concrete pad with a yellow protective metal standpipe with a locking cover surrounded by four yellow bollards. Details regarding well construction and completion are summarized on Table 1. Well completion diagrams are provided in Appendix C.

4.1.4 Well Development

From January 8 through February 1, 2013, INTERA oversaw development of all replacement monitoring wells. Development consisted of surging, bailing, and pumping. Water quality parameters for pH, conductivity, temperature, and visual turbidity were recorded during development.

Prior to development, the static water level was measured in each well. Each well was initially developed by surging the well screen from bottom to top using a surge block attached to a



section of drop pipe. The drop pipe was lowered to the bottom of the well on a wire line and was marked at the surface to identify when the surge block was at the well bottom. The surge block was then raised up and down throughout the well screen to sort and capture loose sediment around the screen. A 10-ft long by 2½-inch diameter bailer was then used to remove water and sediment from the well. Once the volume of coarse sediment recovery had diminished to a minimal volume, a 1.5 horsepower submersible pump was used when possible. Low recharge rates at certain wells made it impractical to develop by pumping; therefore, those wells were developed by bailing. Wells were developed until three to five casing volumes of water had been removed. The additional water added during well construction backfilling activities was removed, as practical, and water quality parameters (pH, specific conductance, and temperature) were measured until they had stabilized over three consecutive readings. Development water was land applied on-site per the approved work plan (INTERA 2012). Water quality parameters and approximate volumes of water removed (in gallons) during well development were recorded on the well development sheets and in the field logbook. The well development forms are provided in Appendix D.

4.2 Plugging and Abandoning

From January 24 through February 1, 2013, INTERA oversaw plugging and abandonment activities of 15 existing groundwater monitoring wells (MW 05-03, MW 05-08, MW 05-73, MW 30-03, MW 30-04, MW 30-68, MW 30-48 Kd, MW 31-01 Tra, MW 31-02 Trb, MW 31-05, MW 31-70, MW 32-01, MW 32-02, MW 32-45 Kd, MW 32-50 Trb). The wells were plugged and abandoned due to a lack of water in the well and/or structural damage of the well screen or casing, which obstructed sampling equipment from entering the well.

A mixture of bentonite (5% by weight) and cement was placed into each well to be abandoned through a 2-inch diameter tremie pipe from the total well depth to ground surface. Wells ranged from 4- to 8-inches in diameter. The well vaults were removed, and the plugged wells were rechecked for grout subsidence after all the wells had been initially backfilled. A concrete/bentonite mixture was placed in the subsided areas. Three 20-ft joints of tremie pipe, from approximately 250 ft to 190 ft bgs, were inadvertently cemented into well MW 31-01 Tra. All other joints of tremie pipe were successfully removed from the well, and the well was fully abandoned.

The monitoring wells were plugged and abandoned according to NMED and NMOSE requirements as described in the New Mexico Environment Department Ground Water Quality Bureau Monitoring Well Construction and Abandonment Guidelines (2011). Prior to plugging and abandonment activities, a "Well Plugging Plan of Operations" form was completed for each well and submitted to the NMOSE. In addition, upon completion of plugging and abandonment



activities, "Well Plugging Record" forms were prepared and submitted to the NMOSE by the drilling contractor. Copies of these forms are provided in Appendix F.

4.3 Field Notes

Copies of all field notes are provided in Appendix G.

4.4 Geophysical Logs and Project Photographs

A compact disc containing electronic files of the geophysical logs (in .pdf format) and the project photographs and a paper copy of the photographs are provided in Appendix H. The geophysical logs are identified by well name, and the photographs show each of the newly completed monitoring wells.

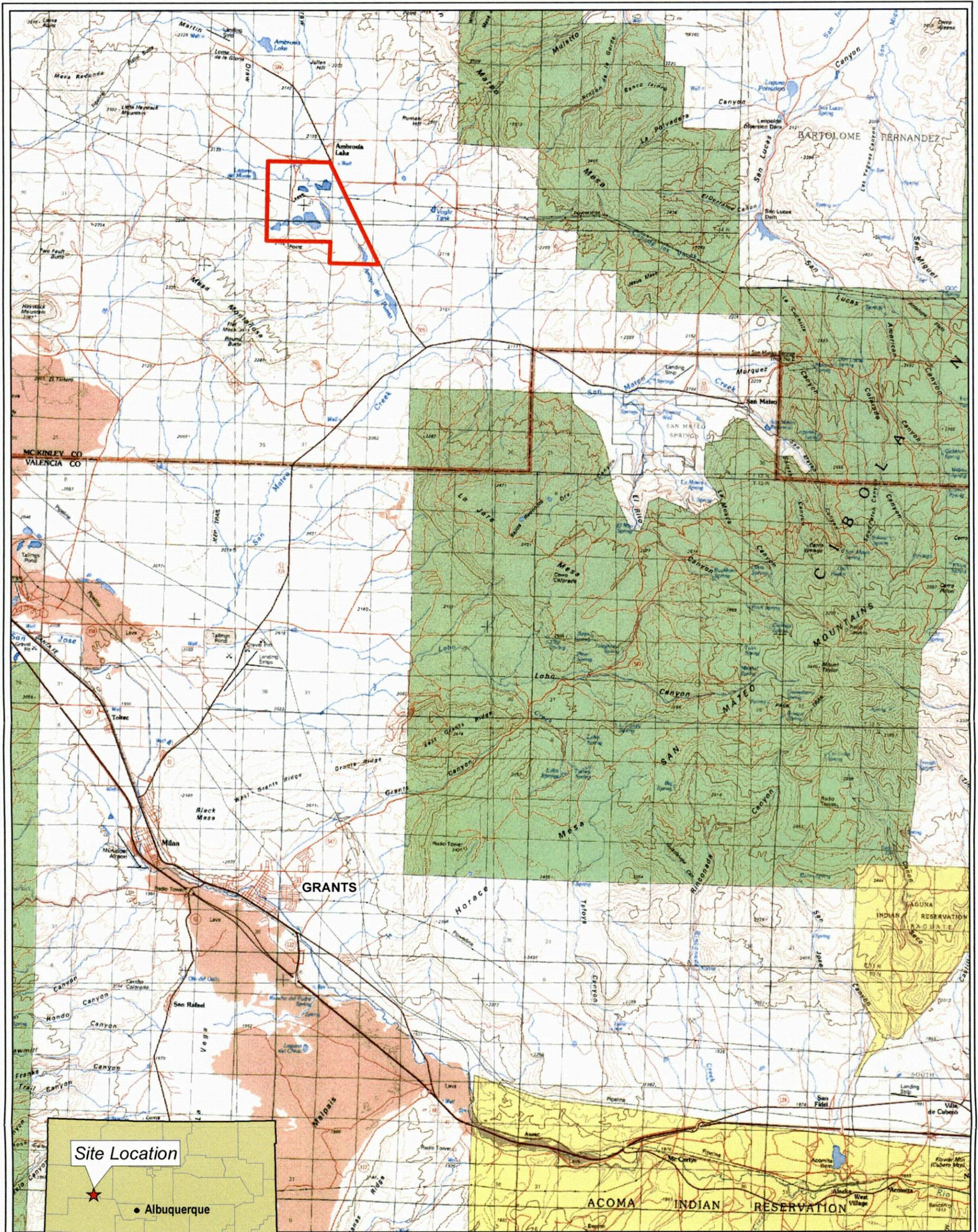


5.0 REFERENCES

INTERA Incorporated, 2012. *Monitoring Well Replacement Work Plan, Rio Algom Mining, LLC*. October 10.

New Mexico Environment Department Ground Water Quality Bureau (NMED GWQB), 2011. *New Mexico Environment Department Ground Water Quality Bureau Monitoring Well Construction and Abandonment Guidelines*. March.

FIGURES



USGS 100k Topographic Map:
Grants Quadrangle, 1978;
Contour Interval 50 Meters



0 6,000 12,000 24,000
Feet

Legend

Site Location

Figure 1
Site Location Map
Rio Algom Well Replacement Report



0 500 1,000 2,000
 Feet

Legend

 Monitoring Well

Note: "R" in well name denotes replacement well.

Figure 2
 Site Plan, Well Replacement
 Rio Algom Well Replacement Report



Sources: Aerial – RGIS website, dated 2009;
 Point locations – Rio Algom, Bowman, 3/20/2013

TABLE

TABLE 1
Replacement Monitoring Well -- Survey, Construction, and Groundwater Elevation Data
Monitoring Well Replacement Report
Rio Algom Mine, LLC, McKinley County, NM

	Well ID	Well Installation Date	Latitude	Longitude	Ground Surface Elevation ¹ (ft amsl)	TOC Elevation (ft amsl)	Total Well Depth (ft btoc)	Well Screen Interval (ft btoc)	Date Depth to Water Gauged	Depth to Water (ft btoc)	Groundwater Elevation (ft btoc)
Alluvial Wells	MW 05-03-R	11/5/2012	35.391466577	-107.813902686	2101.59	2104.59	56.4	36 - 56	1/18/2013	24.32	2080.27
	MW 05-08-R	11/2/2012	35.385027384	-107.807534195	2098.58	2101.58	76.5	56.1 - 76.1	1/18/2013	33.10	2068.48
	MW 05-73-R	11/4/2012	35.387182735	-107.813250427	2097.62	2100.62	35.8	15.4 - 35.4	1/18/2013	19.20	2081.42
	MW 30-04-R	11/1/2012	35.406664945	-107.822599554	2115.66	2118.66	72.25	51.85 - 71.85	1/18/2013	55.47	2063.19
	MW 30-68-R	11/13/2012	35.418706980	-107.837913124	2122.31	2125.31	66.0	45.6 - 65.6	1/18/2013	Dry	N/A
	MW 31-05-R	11/12/2012	35.405009425	-107.823385310	2114.05	2117.05	66.4	46 - 66	1/18/2013	48.75	2068.30
	MW 31-70-R	11/6/2012	35.402968532	-107.824197149	2112.20	2115.20	81.4	61 - 81	1/18/2013	40.30	2074.90
	MW 32-01-R	11/12/2012	35.398821221	-107.821931373	2108.54	2111.54	61.4	41 - 61	1/18/2013	19.70	2091.84
	MW 32-02-R	10/30/2012	35.405657186	-107.821419552	2114.08	2117.08	70.65	50.25 - 70.25	1/18/2013	49.97	2067.11
Bedrock Wells	MW 30-48 Kd-R	12/5/2012	35.409141534	-107.827090782	2118.05	2121.05	358.4	338 - 358	1/18/2013	322.50	1798.55
	MW 31-01 Tra-R	12/12/2012	35.402450374	-107.831073806	2126.48	2129.48	213.4	193 - 213	1/18/2013	204.75	1924.73
	MW 31-02 Trb-R	12/14/2012	35.402444136	-107.831176870	2126.56	2129.56	128.4	108 - 128	1/18/2013	95.20	2034.36
	MW 32-45 Kd-R	11/28/2012	35.398672181	-107.817502916	2108.47	2111.47	278.0	257.6 - 277.6	1/18/2013	256.55	1854.92
	MW 32-50 Trb-R	12/2/2012	35.403775552	-107.817516889	2113.23	2116.23	88.4	68 - 88	1/18/2013	50.39	2065.84
	MW 30-03	Abandoned, but not replaced	35.408372	-107.823808	-	-	-	-	-	-	-

Notes:

¹ Ground surface elevations are estimates calculated by subtracting 3 feet from the top-of-casing elevation.

amsl = above mean sea level

btoc = below top of casing

ft = feet

TOC = top of casing



APPENDIX A

Lithologic Logs for Alluvial Wells (Field and Final)



LOG OF BORING

MWS-φ3R

(Page 1 of 3)

Project Name:

Rio Algom

Date Started : 11/05/12

Driller : J. Laguna

Date Completed : 11/05/12

Depth to Water : 26.20' bgs

Drilling Method : HSA-10"OD

Logged By : L. Dalton

Sampling Method : Cuttings

Project #:

Drilling Company : Yellow Jacket

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

φ

Poorly Graded Sand (SP), few clay, fine sand, non-plastic, very loose, H. brown, dry, strong HCl. rxn, (99% & 2/1% lithics)

5

10

(as above) - trace clay, ~~no HCl. rxn~~
weak HCl. rxn

15

20

Clayey Sand (SC), ~~red~~ fine sand, low-med plasticity, loose, red-brown, wet, ~~no~~ HCl. rxn. (weak)

25

Notes: Background α + γ readings
α = non-detect
γ = 17 μR/hr



LOG OF BORING

MWS-φ3R

(Page 2 of 3)

Project Name: Rio Algom	Date Started :	Driller :
Project #:	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
25						
30					lean clay w/ sand (CL), fine sand, med plasticity, soft, brown, wet, weak HCl, rxn	
35						
40					clayey sand (SC), fine sand, no- ^{to} low plasticity (too wet), very loose, lt. brown, wet, no HCl. rxn.	
45						
50						

Notes: *Hard drilling @ 52' bgs.*
 + 25 gallons during well installation (20/40 sand)



LOG OF BORING

MWS-φ3R

(Page 3 of 3)

Project Name:

Rio Algon

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

50

Fat clay (CH), high plasticity, hard, gray-brown, moist, ~~moist~~, no HCl. rxn

~~Sandstone (Tres Hermanos), lt. brown, mod. weathered very weak - weak rock, fine sand (99% gtz/1% lithis), no HCl. rxn., alteration to clay - clast supported. ls (red + black)~~

55

TD @ ~53.5' bgs

Notes: Hard drilling beginning @ 52' bgs



LOG OF BORING

MW5-φBR

(Page 1 of 3)

Project Name:

Rio Algom

Date Started : 11/02/12
 Date Completed : 11/03/12
 Drilling Method : HSA (10" OD)
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket

Driller : J. Logonec
 Depth to Water : 30.10' bgs
 Logged By : L. Dalton

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen/Rec.

PID (ppm)

DESCRIPTION

Group Symbol

φ

Sandy Silt (ML), fine sand, nonplastic, very soft, lt. brown, dry, strong HCl rxn, roots

5

Silty Sand (SM), poorly graded, F-M sand (ppol. fine sand), ~~sub~~ submed, nonplastic, very loose, lt. brown, dry, strong HCl rxn.

15

Poorly Graded Sand (SP), few clay, ^(trace sandstone) fine gravel, F-M sand (ppol. fine sand), ~~sub~~ submed, nonplastic, loose, red-brown, dry - moist, weak HCl rxn.
 (99% gtz / 1% lithics)

20

25

Notes: Background α & γ readings

α = PID
 γ = 18 μR/hr



LOG OF BORING

MW 5 - Ø 8 R

(Page 2 of 3)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen/Rec.

PID (ppm)

DESCRIPTION

Group Symbol

25

30

35

40

45

50

(SP) - as above, ~~moist~~ little clay, moist.

(as above) - wet

(as above)

Notes:

+50 gallons added inside Augers. to keep flowing sands out during well install.



LOG OF BORING

MWS-08R

(Page 3 of 3)

Project Name: Rio Algom	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth In Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
50						
55						
60					Clayey Sand (SC), poorly graded, F-M sand (pred. fine sand), 3-subnd., med. plasticity, loose, lt. brown, wet, no HCl. rxn.	
65						
70						
75					Sandstone (Tres Hermanos), lt. gray, med - non weathered, medium weak rock, fine - medium sand (90% fine / 10% medium), (99% gt 1% lithics), 3-subnd., no HCl. rxn., alteration to clay in matrix, cleft supported.	

Notes: - TD @ 75' bgs.
 per 3 Hard drilling @ ~ 71' bgs
 + add 50 gallons of H₂O during 10% backfilling.
 (+100 gallons total)



LOG OF BORING

MWS-73R

(Page 1 of 2)

Project Name:

Rio Algom

Date Started : 11/03/12
Date Completed : 11/04/12
Drilling Method : HSA
Sampling Method : Cuttings
Drilling Company : Yellow Jacket

Driller : J. Logana
Depth to Water : 16.20' bgs
Logged By : L. Dalton

Project #:

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Sandy clay, (CL), fine sand, low-med. plasticity, very soft, lt. brown, dry, strong HCl rxn., roots	
5						
10					Silty Sand (SM), trace clay, poorly graded, fine sand, non-plastic, very loose, lt. brown, clay, strong HCl rxn., roots. (99% g + z / 1% lithics)	
15						
20					clayey sand (SC), poorly graded, fine sand, low plasticity, loose, brown, wet, weak HCl rxn., roots, (99% g + z / 1% lithics)	
25						

Notes:

Background α + γ readings
 α = N/D
 γ = 26.4R/hr



LOG OF BORING

MWS-73R

(Page 2 of 2)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth
In
Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

25

30

35

40

← move

beginning @ 27' bgs = slower drilling

→ beginning @ 32' bgs = hard drilling

Sandstone (Tres Hermanas), lt. brown, fine sand, mod. weathered, very weak - weak rock, (99% gt 2/170 lithics), no HCl rxn., alteration to clay (red & black / white), c last supported

TD @ 34' bgs

Notes:

+ 10 gallons added during well install to push out leam



LOG OF BORING

MW30-~~4~~R

(Page 1 of 3)

Project Name:

Rio Algom

Date Started : 10/31/12

Driller : J. Logana

Date Completed : 11/01/12

Depth to Water : 52.50' bgs

Drilling Method : HSA (10" OD)

Logged By : L. Dalton

Sampling Method : Cuttings

Project #:

Drilling Company : Yellow Jacket

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Silty Sand (SM), fine sand, nonplastic, very loose, lt. brown, dry, strong HCl., roots. (99% gtz/1% lithics)	
5						
10					Sandy silt (ML), few clay, fine sand, low plasticity, loose, red gray, strong HCl., dry	
15						
20					Poorly Graded Sand (SP), few clay, fine sand, nonplastic, loose, lt. brown, dry, strong HCl. (99% gtz/1% lithics)	
25						

Notes: Background (max reading) α + γ readings

α = ND

γ = 16 μ R/hr



LOG OF BORING

MW30-φ4R

(Page 2 of 3)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
25						
30					(as above)	
35					- per driller gravel \otimes beginning @ -35' bgs	
40					Poorly Graded Sand w/ Clay & Gravel (SP-SC), F-M sand (ppd fine), non plastic sub s -subnd., subnd - gravel, non-plastic, loose, red-brown, dry, strong HCl. (99% gtz/1% lithics)	
45						
50						

Notes:



LOG OF BORING

MW30-44R

(Page 3 of 3)

Project Name:

Rio Algom

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
50					Partly graded sand (SP), few clay, fine sand, nonplastic, loose, brown, moist, no HCl rxn.	
55						
60					(as above) - lt. brown + wet	
63					Sandstone (Tres Hermanos), lt. gray, mod. weathered, weak - very weak rock, fine sand, (99% gt 2/12 lithics), no HCl rxn., alteration to clay - clast supported.	
70					TD @ 70' bgs	
75						

Notes: per driller - Hard drilling beginning @ 63' bgs

+ 18 gallons added during 20/40 backfilling



LOG OF BORING

MW30-68R

(Page 1 of 3)

Project Name: Rio Algom	Date Started : 11/13/12	Driller : J. Kagan
	Date Completed : 11/14/12	Depth to Water : Dry @ 63' bgs
	Drilling Method : HSA (10' CDS)	Logged By : L. Dalton
Project #:	Sampling Method : Cuttings	
	Drilling Company : Yellow Jacket	

Depth in Feet	Sample Interval	Sample #	Pen./Fec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Lean clay (CL), trace fine sand, low-med. plasticity, very soft, lt. brown, strong HCl. rxn, clay, roots	
5						
10					Poorly graded sand (SP), few clay, fine sand, no plasticity, very loose, lt. brown, dry, strong HCl. rxn	
15						
20					(as above) - trace clay	
25						

Notes: Background α & γ (max reading)
 α = nondetect
 γ = 21 μ R/hr



LOG OF BORING

MW30-68R

(Page 2 of 3)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Group Symbol

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

25

30

35

40

45

50

Silty Sand (SM), fine sand, non-plastic, loose, lt. brown, dry, strong HCl. rxn.

Poorly Graded Sand (SP), few clay, fine sand, non-plastic, loose, brown, dry, strong HCl. rxn.

Notes: slower drilling beginning @ 52' bgs



LOG OF BORING

MW 30-68R (Page 3 of 3)

Project Name: <i>Rio Algom</i>	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
50					Sandy Clay (LD), fine sand, med. plasticity, soft, red brown, dry-moist, strong HCl. rxn., trace F.C sandstone gravel - rounded.	
55					Sandstone gravels beginning in 57' bgs: lt. gray-gray, fine sand, slightly weathered, mod. weak rock, some weathering (orange), clast supported, strong HCl. rxn, dry	
60					Shale (Tres Hermanos?), dark gray, fresh, very weak rock, strong HCl. rxn, dry	
65					TD @ 64' bgs	

Notes: *Hard drilling beginning @ 61' bgs.*



LOG OF BORING

MW 31-φ5R

(Page 1 of 3)

Project Name:
Rio Algodon

Date Started : 11/12/12
Date Completed : 11/13/12
Drilling Method : HSA (10" OD)
Sampling Method : Cuttings
Drilling Company : Yellow Jacket

Driller : S. Lopez
Depth to Water : 46.90' bgs
Logged By : L. Dalton

Project #:

Depth In Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).	Group Symbol
					DESCRIPTION	
0					Poorly Graded Sand w/ silt (SP-SM), trace clay, fine sand, non-plastic, very loose, lt. brown, dry, strong HCl. rxn., roots.	
5						
10					Clayey Sand (SC), poorly graded, fine sand, no-low plasticity, loose, lt. brown, dry-moist, strong HCl. rxn.	
15						
20					Poorly Graded Sand (SP), trace clay, fine sand, no plasticity, loose, lt. brown, dry-moist, strong HCl. rxn.	
25						

Notes: Background α + γ readings
α = non-disturb
γ = IBMR/hr.



LOG OF BORING

MW31-05R

(Page 2 of 3)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

25

30

(SP) as above -

35

40

(SP) as above -

45

50

(SP) as above - wet

Notes:



LOG OF BORING

mw 21-45R

(Page 3 of 3)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

50

55

60

65

70

Sandstone (Tres Hermanas), gray - lt. gray, med. - weakly weathered, med. - very weak rock, fine sand, (97% silt/1% lithif.), no HCl rxn., alteration to clay in matrix (red-brown, orange, black), clast supported, trace shale

TD @ 66' bgs

Notes: Hand drilling beginning @ 63' bgs



LOG OF BORING

MW 31-70R

(Page 1 of 4)

Project Name:

Rio Algom

Date Started : 11/25/12

Driller : J. Lagana

Date Completed : 11/26/12

Depth to Water : 37.10' bgs

Drilling Method : HSA (10" OD)

Logged By : L. Dalton

Sampling Method : Cuttings

Project #:

Drilling Company : Yellow Jacket

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Silty Sand (SM), poorly graded, fine sand, non-plastic, very loose, lt. brown, dry, strong HCl. rxn. roots (99% gtz/1% lithics)	
5						
10					Poorly Graded Sand (SP), trace clay, fine sand, non-plastic, loose, lt. brown, dry-moist, strong HCl. rxn. (99% gtz/1% lithics)	
15						
20					Sandy lean clay (CL), fine sand, low-med. plasticity, soft, brown, moist, weak HCl. rxn.	
25						

Notes: Background α & γ readings
 α = non-detect
 γ = 26 MR/hr



LOG OF BORING

MW 31-70 R

(Page 2 of 4)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

25

30

35

40

45

50

Clayey Sand (SC), ~~S~~ poorly graded, fine sand, low-med plasticity, loose, brown, wet, weak HCl rxn. (99% gtz (1% lithics))

Sandy clay (CL), fine sand, med. plasticity, soft, (hard) wet, weak HCl rxn.

Notes:



LOG OF BORING

MW 31-70R

(Page 3 of 4)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Project #:

Sampling Method :

Drilling Company :

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

50

clayey sand (SC), poorly graded, fine sand, no-low plasticity (too wet), loose, lt-brown, wet, weak HCl rxn. (99% gtz / 1% lithics)

55

60

Poorly Graded Sand w/ clay (SP-SC), fine sand, no plasticity (sticky), very loose, lt. brown, wet, weak HCl rxn. (99% gtz / 1% lithics)

65

70

No sample collected

75

Notes: ~~10~~ hard drilling beginning @ 70' hrs



LOG OF BORING

MW 31-70R

(Page 4 of 4)

Project Name:

Rio Algom

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth
in
Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

75

80

85

Sandstone (Trea Hermanos), lt. gray, moderate -
weakly weathered, very weak - weak rock, fine
sand (99% gtz / 1% lithics), no HCl rxn. alteration
to clay in matrix + clast supported.

TD @ 82' bgs.

reddish-brown, orange, black weathered

Notes:



LOG OF BORING

MW32-φ1R

(Page 1 of 3)

Project Name: Rio Algom	Date Started : 11/7/12	Driller : E. Lagana
	Date Completed : 11/21/12	Depth to Water : 16-60" bgs
	Drilling Method : HSA (10" dia)	Logged By : L. Dalton
Project #:	Sampling Method : Cottings	
	Drilling Company : Yellow Jacket	

Depth 5 Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Poorly Graded Sand w/ Silt (SP-SM), trace clay, fine sand, non-plastic, very loose, lt. brown, dry, strong HCl. rxn.	
5						
10					Clayey Sand (SC), poorly graded, fine sand, med plasticity, loose, brown, moist, strong HCl. rxn.	
15					→ per driller - sandy clay beginning @ 12' bgs.	
20					Lean Clay (CL), med. plasticity, firm, brown, moist-wet, strong HCl. rxn.	
25						

Notes: Background α + γ (none reading)
 α = non-detect
 γ = 29 µR/hr



LOG OF BORING

MW32-φ1R

(Page 2 of 3)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
25						
30					Poorly Graded Sand w/ clay (SP-SC), fine sand, non-plastic, loose, brown, wet weak HCl. rxn	
35						
40					(as above) - dark brown.	
45						
50						

Notes:



LOG OF BORING

MW32-PIR

(Page 3 of 3)

Project Name: Rio Algom	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
50					(SP-SC) as above, lean clay.	
55					Sandstone (Tres Hermosa), lt. gray, mod. - weakly weathered, very weak-weak rock, fine sand (95% gtz / 5% lithics), no HCl. alteration 7% clay in matrix (red-brown, orange & black), clast supported.	
60					TD @ 60' bgs	

Notes: per driller - "chunky" beginning @ ~55' bgs
↳ hard beginning @ 59'

12 gallons added during 20/40 backfilling.



LOG OF BORING

MW 32-φ2R

(Page 1 of 3)

Project Name:

Rio Algom

Date Started : 10/30/12

Date Completed : 10/31/12

Drilling Method : HSA (10" OD)

Sampling Method : cuttings

Drilling Company : Yellow Jacket

Driller :

Depth to Water :

Logged By :

J. Lagana

46.80' bgs

L. Dalton

Project #:

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Silty Sand (SM), Fine sand, nonplastic, very loose, lt. brown, dry, strong HCl. roots (99% gtz / 1% lithics)	
5						
10					Clayey silt (ML) little clay, fine sand, low-med plasticity, loose, red-gray, dry, strong HCl.	
15						
20					Poorly graded sand (SP), few silt, fine sand, non-plastic, loose, lt. brown, dry, strong HCl. (99% gtz / 1% lithics)	
25						

Notes:

Background $\gamma = 16 \text{ pcf/hr}$ } max
 Background $\alpha = \phi \text{ cpm}$ } reading



LOG OF BORING

MW 32 - ~~AR~~ R

(Page 2 of 3)

Project Name: <i>Rio Algon</i>	Date Started :	Driller :
	Date Completed :	Depth to Water :
Project #:	Drilling Method :	Logged By :
	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
25						
30					Poorly graded sand (SP), ^{few} little clay, fine sand (trace med. sand), - sub s -submed., nonplastic, loose, brown, strong HCl., clay (99% gtz / 1% lithics)	
35						
40					(as above)	
45						
50					(as above) - wet	

Notes:



LOG OF BORING

MW 32-CP2R

(Page 3 of 3)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
50						
55						
60					(SP) - as above	
65					Sandstone: (Tres Hermanos), light gray, med. weathered, very weak rock, fine - med. sand (90% fine / 10% med.), (99% Qtz / 1% lithics), δ submed., no HCl rxn., alteration to clay in in matrix - clast supported.	
70					TD @ 68' bgs	
75						

Notes: Driller indicates gravel @ ~ 61' bgs.
 or
 (harder drilling)

+ 7.5 gallons added during 10/20 backfilling



LOG OF BORING : MW 05-03-R

(Page 1 of 1)

Project Name: BHP Billiton Rio Algom Site	Date Started : 11/05/12	Driller : J. Lagana
	Date Completed : 11/05/12	Depth to Water : 21.2' bgs
Project #: RIOAL.C003.169	Drilling Method : HSA (10" OD)	Logged By : L. Dalton
	Sampling Method : Cuttings	Latitude : 35.391466577
	Drilling Company : Yellow Jacket Drilling	Longitude : -107.813902686

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2101	Poorly Graded SAND, few clay, fine grained sand (99% quartz/1% lithics), nonplastic, very loose, light brown, dry, strong HCl reaction	<p>MW 05-03-R: TOC Elev.: 2104.59</p> <ul style="list-style-type: none"> Lockable Cover Grout 4.5" OD SCH 80 PVC Bentonite Seal 20/40 Sand 10/20 Sand 0.010" Slotted Screen Slough End Cap
10	2091	Trace clay, weak HCl reaction	
20	2081	Clayey SAND, poorly graded, fine grained sand (99% quartz/1% lithics), low to medium plasticity, loose, reddish-brown, wet, weak HCl reaction	
30	2071	Lean CLAY with Sand, fine grained sand, medium plasticity, soft, brown, wet, weak HCl reaction	
40	2061	Clayey SAND, poorly graded, fine grained sand (99% quartz/1% lithics), non-plastic (too wet), very loose, light brown, wet, no HCl reaction	
50	2051	Fat Clay, high plasticity, hard, gray-brown (glossy), moist, no HCl reaction	
60		SANDSTONE (Tres Hermanos B); light brown, moderately weathered, weak to very weak rock, fine grained (99% quartz/1% lithics), no HCl reaction, alteration to clay in matrix (red and black), clast supported	
		Bottom of boring at 54' bgs	

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 17 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.



LOG OF BORING : MW 05-08-R

(Page 1 of 1)

Project Name: BHP Billiton Rio Algom Site	Date Started : 10/31/12 Date Completed : 11/01/12 Drilling Method : HSA (10" OD) Sampling Method : Cuttings Drilling Company : Yellow Jacket Drilling	Driller : J. Lagana Depth to Water : 52.5' bgs Logged By : L. Dalton Latitude : 35.385027384 Easting : -107.807534195
Project #: RIOAL.C003.169		

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2098	Sandy SILT, fine grained sand, non-plastic, loose, light brown, dry, strong HCl reaction, roots	<p>MW 05-08-R: TOC Elev.: 2101.58</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>Bentonite Seal</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted Screen</p> <p>End Cap Slough</p>
10	2088	Silty SAND, poorly graded, fine to medium grained sand (99% quartz/1% lithics), angular to subround, non-plastic, very loose, light brown, dry, strong HCl reaction	
20	2078	Poorly Graded SAND, few clay, trace fine sandstone gravel, fine to medium grained sand (99% quartz/1% lithics), angular to subround, non-plastic, loose, reddish-brown, dry to moist, weak HCl reaction	
30	2068	Little clay, moist	
40	2058	Wet	
50	2048		
60	2038	Clayey SAND, poorly graded, fine to medium grained sand (99% quartz/1% lithics), angular to subround, medium plasticity, loose, light brown, wet, no HCl reaction	
70	2028	SANDSTONE (Tres Hermanos B); light gray, moderately to non-weathered, medium weak rock, fine (90%) to medium (10%) grained (99% quartz/1% lithics), angular to subround, no HCl reaction, alteration to clay in matrix, clast supported	
80		Bottom of boring at 75' bgs	

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 18 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.

03-27-2013 S:\Projects\Borelogs\Rio Algom\MW05-08R.bor



LOG OF BORING : MW 05-73-R

(Page 1 of 1)

Project Name: BHP Billiton Rio Algom Site	Date Started : 11/03/12 Date Completed : 11/04/12 Drilling Method : HSA (10" OD) Sampling Method : Cuttings Drilling Company : Yellow Jacket Drilling	Driller : J. Lagana Depth to Water : 16.2' bgs Logged By : L. Dalton Latitude : 35.387182735 Longitude : -107.813250427
Project #: RIOAL.C003.169		

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2097	Sandy CLAY, fine grained sand, low to medium plasticity, very soft, light brown, dry, strong HCl reaction, roots	<p>MW 05-73-R: TOC Elev.: 2100.62</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted Screen</p> <p>End Cap</p>
5	2092		
10	2087	Silty SAND, trace clay, poorly graded, fine grained sand (99% quartz/1% lithics), nonplastic, very loose, light brown, dry, strong HCl reaction, roots	
15	2082		
20	2077	Clayey SAND, poorly graded, fine grained sand (99% quartz/1% lithics), low plasticity, loose, brown, wet, weak HCl reaction, roots	
25	2072	Per driller slower drilling at 27' bgs	
30	2067		
35	2062	SANDSTONE (Tres Hermanos B); light brown, moderately weathered, weak to very weak rock, fine grained (99% quartz/1% lithics), no HCl reaction, alteration to clay in matrix (red, black, and white), clast supported	
40		Bottom of boring at 34' bgs	

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 26 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.

04-02-2013 S:\Projects\BoreLogs\Rio Algom\MW05-73R.bor



LOG OF BORING : MW 30-04-R

(Page 1 of 1)

Project Name:
BHP Billiton
Rio Algom Site

Date Started : 10/31/12
Date Completed : 11/01/12
Drilling Method : HSA (10" OD)
Sampling Method : Cuttings
Drilling Company : Yellow Jacket Drilling

Driller : J. Lagana
Depth to Water : 52.5' bgs
Logged By : L. Dalton
Latitude : 35.406664945
Longitude : -107.822599554

Project #: RIOAL.C003.169

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2115	Silty SAND, poorly graded, fine grained sand (99% quartz/1% lithics), non-plastic, very loose, light brown, dry, strong HCl reaction, roots	<p>MW 30-04-R: TOC Elev.: 2118.66</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>Bentonite Seal</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted Screen</p> <p>End Cap</p>
10	2105	Sandy SILT, few clay, fine grained sand, low plasticity, loose, reddish-gray, dry, strong HCl reaction	
20	2095	Poorly Graded SAND, few clay, fine grained sand (99% quartz/1% lithics), non-plastic, loose, light brown, dry, strong HCl reaction	
30	2085	Per driller, harder drilling at 35' bgs	
40	2075	Poorly Graded SAND with gravel and clay, fine to medium grained sand (99% quartz/1% lithics), subangular to subround, non-plastic, loose, reddish-brown, dry, strong HCl reaction	
50	2065	Poorly Graded SAND, few clay, fine grained sand (99% quartz/1% lithics), non-plastic, loose, brown, moist, no HCl reaction	
60	2055	Wet	
70	2045	SANDSTONE (Tres Hermanos B); light gray, moderately to non-weathered, weak to very weak rock, fine grained (99% quartz/1% lithics), no HCl reaction, alteration to clay in matrix, clast supported	
80		Bottom of boring at 70' bgs	

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 16 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.

03-27-2013 S:\Projects\BoreLogs\Rio Algom\MW30-04R.bor



LOG OF BORING : MW 30-68-R

(Page 1 of 1)

Project Name: BHP Billiton Rio Algom Site	Date Started : 11/13/12 Date Completed : 11/14/12 Drilling Method : HSA (10" OD) Sampling Method : Cuttings Drilling Company : Yellow Jacket Drilling	Driller : J. Lagana Depth to Water : 63' bgs Logged By : L. Dalton Latitude : 35.418706980 Longitude : -107.837913124
Project #: RIOAL.C003.169		

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2122	Lean CLAY, trace fine grained sand, low to medium plasticity, very soft, light brown, dry, strong HCl reaction, roots	<p>MW 30-68-R: TOC Elev.: 2125.31</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>Bentonite Seal</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted PScreen</p> <p>End Cap Slough</p>
10	2112	Poorly Graded SAND, few clay, fine grained sand (99% quartz/1% lithics), non-plastic, very loose, light brown, dry, strong HCl reaction	
20	2102	trace clay	
30	2092	Silty SAND, poorly graded, fine grained sand (99% quartz/1% lithics), non-plastic, loose, light brown, dry, strong HCl reaction	
40	2082	Poorly Graded SAND, few clay, fine grained sand (99% quartz/1% lithics), non-plastic, loose, brown, dry, strong HCl reaction	
50	2072	Sandy Lean CLAY, trace fine to coarse rounded sandstone gravel, fine grained sand, medium plasticity, soft, brown, dry to moist, strong HCl reaction	
60	2062	SANDSTONE (Tres Hermanos B); light gray to moderate gray, slightly weathered (orange), moderately weak rock, fine grained (99% quartz/1% lithics), strong HCl reaction, alteration to clay in matrix, clast supported, dry	
		SHALE (MANCOS); moderate gray, fresh, very weak rock, strong HCl reaction, dry	
70	2052	Bottom of boring at 64' bgs	
80			

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 21 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.

03-27-2013 S:\Projects\BoreLogs\Rio Algom\MW30-68R.bor



LOG OF BORING : MW 31-05-R

(Page 1 of 1)

Project Name: BHP Billiton Rio Algom Site	Date Started : 11/12/12 Date Completed : 11/13/12 Drilling Method : HSA (10" OD) Sampling Method : Cuttings Drilling Company : Yellow Jacket Drilling	Driller : J. Lagana Depth to Water : 40.4' bgs Logged By : L. Dalton Latitude : 35.405009425 Longitude : -107.823385310
Project #: RIOAL.C003.169		

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2114	Poorly Graded SAND with Silt, trace clay, fine grained sand (99% quartz/1% lithics), non-plastic, very loose, light brown, dry, strong HCl reaction, roots	<p>MW 31-05-R: TOC Elev.: 2117.05</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>Bentonite Seal</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted Screen</p> <p>End Cap</p> <p>Slough</p>
10	2104	Clayey SAND, poorly graded, fine grained sand (99% quartz/1% lithics), no to low plasticity, loose, brown, dry to moist, strong HCl reaction	
20	2094	Poorly Graded SAND, trace clay, fine sand (99% quartz/1% lithics), non-plastic, loose, light brown, dry to moist, strong HCl reaction	
30	2084		
40	2074		
50	2064	wet	
60	2054		
70	2044	SANDSTONE (Tres Hermanos B); light gray to gray, moderately to weakly weathered, weak to medium weak rock, fine grained (99% quartz/1% lithics), no HCl reaction, alteration to clay in matrix (red-brown, orange, and black), clast supported	
	2044	Bottom of boring at 66' bgs	
80			

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 18 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.

03-27-2013 S:\Projects\BoreLogs\Rio Algom\MW31-05R.bor



LOG OF BORING : MW 31-70-R

(Page 1 of 1)

Project Name:
BHP Billiton
Rio Algom Site

Date Started : 11/05/12
Date Completed : 11/05/12
Drilling Method : HSA (10" OD)
Sampling Method : Cuttings
Drilling Company : Yellow Jacket Drilling

Driller : J. Lagana
Depth to Water : 37.1' bgs
Logged By : L. Dalton
Latitude : 35.402968532
Longitude : -107.824197149

Project #: RIOAL.C003.169

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2112	Silty SAND, poorly graded, fine grained sand (99% quartz/1% lithics), non-plastic, very loose, light brown, dry, strong HCl reaction, roots	<p>MW 31-70-R: TOC Elev.: 2115.20</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>Bentonite Seal</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted Screen</p> <p>End Cap</p> <p>Slough</p>
10	2102	Poorly Graded SAND, trace clay, fine grained sand (99% quartz/1% lithics), non-plastic, loose, light brown, dry to moist, strong HCl reaction	
20	2092	Sandy Lean CLAY, fine grained sand, low to medium plasticity, soft, light brown, dry to moist, strong HCl reaction	
30	2082	Clayey SAND, poorly graded, fine grained sand (99% quartz/1% lithics), low to medium plasticity, loose, brown, wet, weak HCl reaction	
40	2072	Sandy Lean CLAY, fine grained sand, medium plasticity, soft, light brown, wet, weak HCl reaction	
50	2062	Poorly Graded SAND with Clay, fine sand (99% quartz/1% lithics), non-plastic (sticky), very loose, light brown, wet, weak HCl reaction	
60	2052		
70	2042	No sample collected	
80	2032	SANDSTONE (Tres Hermanos B); light gray, moderately to weakly weathered, very weak to weak rock, fine grained (99% quartz/1% lithics), no HCl reaction, alteration to clay in matrix, clast supported	
90		Bottom of boring at 82' bgs	

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 26 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.



LOG OF BORING : MW 32-01-R

(Page 1 of 1)

Project Name: BHP Billiton Rio Algom Site	Date Started : 11/07/12 Date Completed : 11/12/12 Drilling Method : HSA (10" OD) Sampling Method : Cuttings Drilling Company : Yellow Jacket Drilling	Driller : J. Lagana Depth to Water : 16.6' bgs Logged By : L. Dalton Latitude : 35.398821221 Longitude : -107.821931373
Project #: RIOAL.C003.169		

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2108	Poorly Graded SAND with Silt, trace clay, fine grained sand (99% quartz/1% lithics), non-plastic, very loose, light brown, dry, strong HCl reaction	<p>MW 32-01-R: TOC Elev.: 2111.54</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>Bentonite Seal</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted Screen</p> <p>Slough</p> <p>End Cap</p>
10	2098	Clayey Sand, poorly graded, fine grained sand (99% quartz/1% lithics), medium plasticity, loose, brown, moist, strong HCl reaction per driller clay beginning around 12' bgs	
20	2088	Lean CLAY, medium plasticity, firm, brown, moist to wet, strong HCl reaction	
30	2078	Poorly Graded SAND with Clay, fine sand (99% quartz/1% lithics), non-plastic, loose, brown, wet, weak HCl reaction	
40	2068	dark brown	
50	2058		
60	2048	SANDSTONE (Tres Hermanos B); light gray, moderately to weakly weathered, very weak to weak rock, fine grained (95% quartz/5% lithics), no HCl reaction, alteration to clay in matrix (red-brown, orange, and black), clast supported	
		Bottom of boring at 60' bgs	
70	2038		
80			

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 29 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.

03-27-2013 S:\Projects\BoreLogs\Rio Algom\MW32-01R.bor



LOG OF BORING : MW 32-02-R

(Page 1 of 1)

Project Name: BHP Billiton Rio Algom Site	Date Started : 10/30/12 Date Completed : 10/31/12 Drilling Method : HSA (10" OD) Sampling Method : Cuttings Drilling Company : Yellow Jacket Drilling	Driller : J. Lagana Depth to Water : 46.8' bgs Logged By : L. Dalton Latitude : 35.405657186 Longitude : -107.821419552
Project #: RIOAL.C003.169		

Depth in Feet	Surface Elevation in Feet amsl	DESCRIPTION	GRAPHIC
0	2114	Silty SAND, poorly graded, fine grained sand (99% quartz/1% lithics), non-plastic, very loose, light brown, dry, strong HCl reaction, roots	<p>MW 32-02-R: TOC Elev.: 2117.08</p> <p>Lockable Cover</p> <p>Grout</p> <p>4.5" OD SCH 80 PVC</p> <p>Bentonite Seal</p> <p>20/40 Sand</p> <p>10/20 Sand</p> <p>0.010" Slotted Screen</p> <p>End Cap</p>
10	2104	SILT, little clay, fine grained sand, low to medium plasticity, loose, reddish-gray, dry, strong HCl reaction	
20	2094	Poorly Graded SAND, few silt, fine grained sand (99% quartz/1% lithics), loose, light brown, dry, strong HCl reaction	
30	2084	few clay, trace medium grained sand, subangular to subround, nonplastic, brown	
40	2074		
50	2064	Wet	
60	2054	SANDSTONE (Tres Hermanos B); light gray, moderately weathered, very weak rock, fine (90%) to medium (10%) grained (99% quartz/1% lithics), angular to subround, no HCl reaction, alteration to clay in matrix, clast supported	
70	2044	Bottom of boring at 68' bgs	
80			

Notes:

1. Grab sample taken at ~10' intervals.
2. Max Background Readings: alpha = non-detect; gamma = 16 uR/hr.
3. Surveyed Top of Casing (TOC) elevation (feet, above mean sea level) measuring point is on the top of the PVC, north side.

03-27-2013 S:\Projects\BoreLogs\Rio Algom\MW32-02R.bor

APPENDIX B
Lithologic Logs and Geophysical Logs for Bedrock Wells
(Field and Final)



LOG OF BORING

MW 30-48 KDR

(Page 1 of)

Project Name: Rio Algon	Date Started : 12/3/12	Driller : K. Jacobs
	Date Completed : 12/5/12	Depth to Water : 119' bgs
	Drilling Method : Air-Rotary	Logged By : L. DeHaven
Project #:	Sampling Method : Cuttings	
	Drilling Company : Yellow Jacket	

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

1420

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Silty Sand (SM), poorly graded, trace gravel (1-2"), f-m sand, subX-submed., non-plastic, very loose, lt. brown, dry, strong HCl, roots.	
5						
10					clayey sand (SC), poorly graded, fine sand (99% gts/1% lithics), low plasticity, very loose, brown, dry, strong HCl, roots.	
15						
20					SC (as above) ~ 50%	
25					lean clay (CL), trace fine sand, low-med. plasticity, very soft, brown, clay-moist, strong HCl, nodules	

Notes:

Background
 $\alpha = ND$
 $\gamma = 17 \text{ kN/m}^3$



LOG OF BORING

MW30-48 KDR

(Page 2 of)

Project Name: Rio Algom	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
25						
30					Poorly Graded Sand (SP), fine sand, very loose, lt. brown, dry-moist, weak HCl. (99% s + z / 1% lithics)	
35						
40					SP (as above) - 80% Lean clay (CL), trace fine sand, low-med plus plastic, very soft, brown, dry-moist, weak HCl, nodules, 94 P.Som	
45					Harder drilling - 44' - 60' bgs ↳ (big chatter)	
50						

1450
Hopper

Notes:



LOG OF BORING

MW 3D-48 KDR

(Page 3 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type; grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth In Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

50

Sandy Clay (SC) ^{lean}, fine sand, low-med. plasticity, (little sand).
loose, brown, dry-moist, strong HCl, trace fine gravel - red - subred.

55

Poorly Graded Sand (SP) little clay, non-plastic, fine sand, loose H. brown, no HCl.
↳ (99% gtz/1% lithics)

1510

60

65

Well Graded Gravel (SW), subred - red
45% siltstone, mod. gray, ~~very~~ extremely weak rock, fine sand, (sandy) (99% gtz/1% lithics), no HCl, wet, fine gravel (± 2")
fresh
5% - sandstone, fine sand (99% gtz/1% lithics) very weak rock, (silty) slightly weathered (orange, red, brown black)
↳ (last supported)

70

75

Notes:

Injecting H₂O beginning @ 60 bgs
- per driller bedrock @ ~70 bgs



LOG OF BORING

MW30-48KDR

(Page 4 of)

Project Name: Rio Algom	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

12/4
PERS

Depth
In
Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

75

~~75~~ 80

Siltstone (as above), trace fine sand, dry /
Strong HCl.

85

90

(as above)

95

8:30

100

(as above)

Notes:



LOG OF BORING

MW30-48KDR (Page 5 of)

Project Name:

Date Started : Driller :
 Date Completed : Depth to Water :
 Drilling Method : Logged By :
 Sampling Method :
 Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
100						
105						
110					Sandy siltstone (as above)	
115						
120					(Trb) Sandstone, the gray, very fine sand (99% $\frac{3}{4}$ + $\frac{1}{16}$ lithic - green mineral), well sorted, no HCl, dry-moist, fresh 100% unconsolidated.	
125						

8:45

Notes:



LOG OF BORING

MW30-48 KDR (Page 6 of)

Project Name:

Date Started : Driller :
 Date Completed : Depth to Water :
 Drilling Method : Logged By :
 Sampling Method :
 Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
125						
130					Sandstone (as above)	
135						
140					Sandstone (as above), lt. gray, strong HCl, weak (silty) (90% unconsolidated) clast supported rock	
145					borehole producing some water - begin injecting H ₂ O	
150						

Hopper 8:57

Notes:



LOG OF BORING

MW30-48KDR

(Page 7 of)

Project Name:

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
150					Sandstone (as above), weak HCl. ↳ (70%) (30%) Sandy siltstone ^(70%) (20%), med - lt. gray (alternating sandy laminae bands), extremely weak rock, fine sand, fresh, no HCl, wet, dry	
155						
160					(as above) SS = 80% 20% Sandy siltstone = 20% 80%	
165						
170					Siltstone, med. gray, extremely weak rock, fresh, no HCl, dry	
175						

155-160
7-35

Notes:



LOG OF BORING

MW30-48 KDR (Page 8 of)

Project Name:

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

175

180

185

190

195

200

Hopper
9:35

Shale, dark gray, ~~ext~~ very weak rock, (weakly silty) no HCl, clay (laminar)

(as above), trace blue-green clay to white

(as above)

9:50

Notes:



LOG OF BORING

MW 30-48 KLR (Page 9 of)

Project Name:

Date Started : Driller :
 Date Completed : Depth to Water :
 Drilling Method : Logged By :
 Sampling Method :

Project #:

Drilling Company :

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
200						
205						
210					<p>silty shale (as above) (150%)</p> <p>(50%) Sandstone, (Tra), lt. gray, fine sand (99% gt 2/100, 1% lithics - green mineral), well sorted, weak rock, no HCl, wet.</p>	
215						
220					<p>silty shale (as above) - 20%</p> <p>Sandstone - 80%</p>	
225						

Hopper 1000

Notes:



LOG OF BORING

MW30-48KDR (Page 10 of)

Project Name:	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth In Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
225					<p>Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).</p> <p>(as above) silty shale = 10% Sandstone = 90%, weak HCl.</p> <p>Sandstone (as above) - 95% (5%) siltstone, mod gray, extremely weak rock, fresh, no HCl., dry</p>	
230						
235						
240						
245						
250						

1022

Notes:



LOG OF BORING

MW 30-48KDR (Page 11 of)

Project Name:
Rio Algom

Date Started	:	Driller	:
Date Completed	:	Depth to Water	:
Drilling Method	:	Logged By	:
Sampling Method	:		
Drilling Company	:		

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
250					(10%) Sandstone (as above)	
255					(70%) Sandy siltstone, lt.-med gray (laminar bands), extremely weak rock, fresh, dry, no HCl.	
260					(as above) SS = 40% S. SITS = 60%	
265						
270					- Sandy siltstone (as above) - 80% 65%	
					- CaCO ₃ (35%) cement, fracture fill (?), strong HCl. med. weak rock,	
275					Sandstone (Dakota), wet, F-C sand, subX-submed.	

Hopper 1042

Notes:



LOG OF BORING

MW30-48KDR (Page 12 of)

Project Name:

Rio Algon

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Project #:

Sampling Method :

Drilling Company :

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

275

Hopper
1100

280

(60%)
Sandstone, lt - mod gray, very weak rock, fine sand. (92% silt/1% lithics), well sorted, no HCl, wet, fresh, clast supported

285

Silty shale/siltstone, mod. gray, weakly laminar, fresh, extremely weak rock, dry, no HCl.

(40%)

Interbedded

290

(as above) SS = 80%
Silty shale/siltstone = 20%
- trace lt. gray - white clay

295

Hopper

300

(as above) SS = 30%
Silty shale/siltstone = 70%

Notes:

(((



LOG OF BORING

MW 30-4B KLR (Page 13 of)

Project Name:

Date Started :
 Date Completed :
 Drilling Method :
 Sampling Method :
 Drilling Company :

Driller :
 Depth to Water :
 Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
300						
305						
310					(as above) SS = 60% silty shale/siltstone = 40%	
315						
320					(as above) SS = 80% silty shale/siltstone = 20%	
325						

Hopper 1122

Notes:



LOG OF BORING

MW30-4B XDR (Page 14 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Project #:

Sampling Method :

Drilling Company :

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

325

330

335

340

345

350

(as above) SS = 85%
silty shale/siltstone = 15%
trace CaCO₃, strong HCl.
(vein?)

(as above) SS = 70%
silty shale/silt. stone = 30%

(as above) SS = 40%
silty shale/silt. stone = 60%

Hopper 1134

Notes:



LOG OF BORING

MW30-48 WDR (Page 15 of 1)

Project Name:
Rio Algom

Date Started	:	Driller	:
Date Completed	:	Depth to Water	:
Drilling Method	:	Logged By	:
Sampling Method	:		
Drilling Company	:		

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
350						
355						
360					(90%) shale (Brushy Basin), lt. emerald green, fresh, very weak rock, weakly laminar, dry, no HCl. silty shale/slt. stone (as above) - 10%	
365						
370					(as above) shale - 90% silty shale/slt. stone - 10%	
375					TD @ 375' bgs	

Hopper 1147

Notes:



LOG OF BORING

mw31-φ1Tra-R

(Page 1 of)

Project Name:

Rio Algom

Date Started : 12/11/12

Date Completed : 12/12/12

Drilling Method : Air Rotary

Sampling Method : Cuttings

Drilling Company : Yellow Jacket

Driller : R. Jacobs

Depth to Water : 200.8

Logged By : L. Dalton

Project #:

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Thin veneer of silty sand above Sandstone (Tres Hermanos C), trace H. gray, H. brown to (silty) slightly orange; fine sand, (99% gtz/1% lithics), well sorted, weak HCl, dry, fresh - slightly weathered, clast supported, very weak rock.	
5					Silty SS (as above), no H. gray	
10					(switch to hammer bit)	
15					(as above), 90% unconsolidated reddish-brown	
20						
25						

Notes: Tri-cone = 8.5" OD
 ↳ surface casing = 9.5" (φ-7' bgs)
 - hammer bottom bit = 8.5" OD

Background
 α = n/d
 γ = 26 μR/LR
 32



LOG OF BORING

MW 31-φ1 Tra-R (Page 2 of)

Project Name:

Rio Algom

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

25

30

35

40

45

50

X=32 ~~44~~/_{hr}

(as above)

X=32

Silty SS (as above) - 95%

trace silty shale, med-gray & reddish-brown, extremely weak rock, fresh-slightly weathered, no HCl. rxn, laminar, clay (80% v. consolidated)

X=32

12/12/12
0820

Notes:



LOG OF BORING

MW31-φ1 Tra-R (Page 3 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Project #:

Sampling Method :

Drilling Company :

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Group Symbol

Depth In Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

50

YE 32 PR NR

Sandy Siltstone/Siltstone, mod. gray to trace reddish-brown, extremely weak rock, fresh (slightly weathered) fine sand, no HCl, dry
90% unconsolidated

55

60

Siltstone, lt. - mod. gray, trace fine sand, extremely weak rock, fresh, ~~no~~ HCl, dry (Strong)
90% unconsolidated

65

70

Siltstone (as above), weakly laminar
(90% unconsolidated)

75

Notes:



LOG OF BORING

MW31-φ1 Tr-R (Page 4 of)

Project Name:
Rio Algom

Date Started	:	Driller	:
Date Completed	:	Depth to Water	:
Drilling Method	:	Logged By	:
Sampling Method	:		
Drilling Company	:		

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
75						
80					siltstone (as above)	
85						
90					(as above)	
95					90% unconsolidated, no HCl, ↑ in sand content (trace - few)	
100						

hopper #550

hopper #552

Notes:



LOG OF BORING

MW31-φ1 Trunk

(Page 5 of)

Project Name: Rio Algom	Date Started :	Driller :
Project #:	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
100					Sandstone (Tres Hermanos B), lt. gray, fine sand (99% silt/1% lithics), well sorted, very weak rock, fresh, cleft supported, strong HCl., clay-moist (95% unconsolidated)	
105						
110					(as above) trace siltstone, fine sand, lt.-mod gray, extremely (sandy) weak rock, fresh, clay, no HCl.	
115						
120					(as above) - Sandstone (100% unconsolidated)	
125						

φ910

Notes:



LOG OF BORING

MW 31-01 TRK

(Page 6 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

125

130

Sandstone (as above), 79% unconsolidated strong HCl.

135

140

→ (Manganese)
Sandy siltstone/siltstone, lt.-mod gray, fine sand, extremely weak rock, fresh, laminar, weak HCl, dry, (90% unconsolidated)

145

150

Upper
log 239

Notes:



LOG OF BORING

MW31-φ1 Tr-R

(Page 7 of)

Project Name:

Rio Algom

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth
in
Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

150

Siltstone (as above)

155

φ935 160

Siltstone/shale (as above)

(80% unconsolidated)

165

170

Shale, lt. gray - white, extremely weak rock,
fresh, laminar + platy, no H₂O, clay - moist,

(20% unconsolidated + larger cuttings)

175

Notes:



LOG OF BORING

MW 31-41 Tran R

(Page 8 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

175

180

Siltstone, lt.-mod gray, very weak rock, laminar, fresh, dry, strong HCl.
(80% unconsolidated)

185

190

Sandstone (Tras Hermanos A), lt. gray, fine sand, (silty) (99% gtz/1% lithics), well sorted, ~~very~~ very weak rock, fresh, clast supported, no HCl., dry-moist

195

(99% unconsolidated)

200

100 ft per 1000

Notes:



LOG OF BORING

mw 31-φ1 TRR

(Page 9 of)

Project Name: Rio Algom	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
---------------	-----------------	----------	-----------	-----------	-------------	--------------

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

200					Sandstone (as above), moist, weak HCl.	
205						
210					(as above), strong HCl., trace interbedded siltstone/shale	
215						
1012 220					(as above) trace Sandstone (as above) sandy siltstone, lt. - mod. gray, extremely to very weak rock, no HCl., dry, laminar fine sand. (90% unconsolidated)	
225						

Notes:



LOG OF BORING

MW 31-01 TRAK

(Page 1 of 1)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth
in
Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

225

230

235

240

245

250

siltstone, lt.-mod gray, extremely - very weak, strong HCl, dry, laminar

siltstone (as above), trace fine sand, no HCl.

TD @ 245' bgs

Notes:



LOG OF BORING

MW31-φ2 TrbR (Page 1 of)

Project Name: Rio Algom	Date Started : 12/13/12 Date Completed : 12/14/12 Drilling Method : Air Rotary Sampling Method : Cuffings Drilling Company : Yellow Jacket	Driller : K. Jacobs Depth to Water : 113' Logged By : L. Sutton
Project #:		

1445

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
0					Thin veneer of silty sand above...	
5					Silty Sandstone (Tres Hermanos c), fine sand , H. brown, orange, fine sand, (99% gtz/1% lithic), well sorted, weak HCl, clay, fresh - slightly weathered, clast supported, very weak rock	
10					(as above), Silty SS, fresh (99% unconsolidated)	
15						
20					(as above)	
25						

Notes: ~~For test (BAST)~~
 ↳ surface casing = 95/8" (φ - 7' bgs)
 Hammer bottom bit (8.5" OD)

Background
 α = 11d
 γ = 32 μR/hr

(105-125' bgs - screen)



LOG OF BORING

MW 31-φ2 TrbR (Page 2 of)

Project Name: Rio Algom	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
25						
30					silty SS (as above), increase in silt content trace med. gray (silty SS/sandy siltstone) (95% unconsolidated)	
35						
40					Sandy siltstone/siltstone, (maroon), lt. - med. gray, extremely weak rock, fresh, fine sand, ^{weak} HCl, clay (strong) (95% unconsolidated)	
45						
50						

Notes:



LOG OF BORING

MW31-φ2 T&R (Page 3 of)

Project Name: Rio Algom	Date Started : Date Completed : Drilling Method : Sampling Method :	Driller : Depth to Water : Logged By :
Project #:	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PI/D (ppm)	DESCRIPTION	Group Symbol
50					Siltstone, lt.-mod gray, trace fine sand, extremely weak rock, fresh, weak HCl., dry (95% unconsolidated)	
55						
60 hopper 1548					(as above), strong HCl., weakly laminar	
65						
70					(as above), laminar, lt.-mod gray + reddish-brown (90% unconsolidated)	
75						

Notes:



LOG OF BORING

mc031-φ2 TrbR (Page 4 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

75

1557 80

siltstone (as above), ~~no sand~~, ↓ in sand contact, lt. - med gray, ~~wrinkly~~ laminar

85

90

(as above), ↑ in sand contact (trace) (60% unconsolidated)

95

100

Notes:



LOG OF BORING

MW 31-φ2 T-b R (Page 5 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

1610

100

Sandstone (Tuz Hermanos B), lt. gray, fine sand, (99% s&t/1% lithics), well sorted, very weak rock, fresh, clast supported, strong HCl, dry-moist, (99% unconsolidated)

105

110

(as above) - (90%)
few siltstone, lt.-med. gray, fine sand, (sandy) extremely weak rock, fresh, dry, no HCl, weakly laminar (10%)

115

topper 1620

120

(as above)

125

Notes:



LOG OF BORING

MW31-φ2 Trb R (Page 6 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Project #:

Sampling Method :

Drilling Company :

Depth in Feet	Sample Interval	Sample #	Pen/Rec.	PID (ppm)	DESCRIPTION	Group Symbol
125					Sandstone - 70% } (as above) Sandy siltstone - 10%	
130						
135						
140					(manca) Sandy siltstone/siltstone, lt.-mod gray very weak - weak rock, fine sand, fresh, laminar, strong HCl, dry	
145					(95% unconsolidated)	
150						

Notes:



LOG OF BORING

MW31-42 TrbR (Page 7 of)

Project Name: Rie Algom	Date Started :	Driller :
	Date Completed :	Depth to Water :
	Drilling Method :	Logged By :
Project #:	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
150					Siltstone, lt.-med. gray, extremely weak - very weak rock, fresh, no HCl., clay, weakly laminar (90% unconsolidated)	
155						
160					(as above)	
165					TD @ 160' bgs	

Notes:



LOG OF BORING

MW 22-45 KDR.

(Page 1 of)

Project Name:

Rio Algon

Date Started : 11/16/12
Date Completed : 11/28/12
Drilling Method : Air-Rotary
Sampling Method : Cuttings
Drilling Company : Yellow Jacket

Driller : K. Jacobs
Depth to Water : 255' bgs
Logged By : L. Dalton

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth
In
Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

9:30

0

not sampled

5

10

Poorly graded sand (SP), trace clay, fine sand, non-plastic, very loose, lt. brown, clay, strong HCl rxn. (99% gtz/1% lithics).

15

9:56

20

Clayey Sand (SC), poorly graded, fine sand (77% gtz/1% lithics), med. plasticity, med. dense, brown, moist, strong HCl rxn.

25

net returns @ 25' bgs

Notes:

Tri-Lane: 8.5"
Carbide hammer bottom bit: 8.5"
Surface casing: 95/8"

Background
α = non-detect
γ = 18 uR/hr



LOG OF BORING

MW32-45 HDR

(Page 2 of)

Project Name:

Rio Algom

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
25						
30					Lean clay w/ sand (CL), fine sand, med. plasticity, firm, H. brown, wet, weak HCl rxn.	
35						
40					(CL) - as above - trace sand, no HCl rxn.	
45						
50						

Hopper 1057

Notes:



LOG OF BORING

MW32-45 KDR

(Page 3 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).	Group Symbol
					DESCRIPTION	
1100 50					(CL) - as above, weak HCl rxn.	
55						
1200 60					<p>Poorly graded sand (SP) ^(trace clay) fine sand, (99% gtz/1% lithics), med. dense, lt. brown, wet, strong HCl rxn., weakly cemented. nonplastic</p>	
65					start shale like clay @ 65' bgs	
70						
75					Sandstone (Tua Hermara), gray - lt. gray (orange where weathered), fine sand (99% gtz/1% lithics), med. weak rocky, wet, Fresh - mod. weathered, strong HCl rxn, clast supported, well sorted	

Notes:



LOG OF BORING

MW32-45 KDR

(Page 4 of)

Project Name:

Rio Algom

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Group Symbol

DESCRIPTION

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
75					shale beginning @ 75' bgs	
1355 80					shale (massive), black, weak rock, no HCl rxn, wet, laminar	
hammer 85					injecting water	
90					-shale (as above), trace gypsum (50%) -clay is white-gray, very soft, no-low plasticity, no HCl rxn, wet L>(50%)	
95						
1437 100					shale (as above)	

Notes: - surface casing ϕ -76' bgs
- begin drilling w/ hammer bit @ 80' bgs.

Injecting water @ 85' bgs



LOG OF BORING

MW32-45KDR

(Page 5 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Group Symbol

DESCRIPTION

1437

100

105

110

115

Hopper
1510

120

125

10% - shale (as above)
90% - ~~siltstone~~
↳ siltstone, trace fine sand, mod. gray, fresh,
(no HCl rxn, wet, extremely weak rock
Silty Sandstone, fine sand (97% silt / 1% lithics)
clast supported, → well sorted

(as above) - silty Sandstone (60%), mod - lt. gray -
alternating laminar bands
(40%) - silty shale, mod. gray, fresh, no HCl, wet,
extremely weak rock,

Notes:



LOG OF BORING

MW 32-45 KDR

(Page 6 of)

Project Name: Rio Algom	Date Started : Date Completed : Drilling Method : Sampling Method :	Driller : Depth to Water : Logged By :
Project #:	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
125					(as above) 80% - silty sandstone 20% - silty shale	
130						
135					(as above) 90% - silty sandstone 10% - silty shale	
140						
145					(as above)	
150						

1555

Notes:	
--------	--



LOG OF BORING

MW32-45 KDR

(Page 7 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, calcite nodules, drilling conditions), geologic name (if known).

Group Symbol

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

150

155

160

165

170

175

(as above) -

silty sandstone (as above)

1635
Hopper
11/17/12
1450

Notes:



LOG OF BORING

MW32-45WDR

(Page 8 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

175

Hopper 1535

180

(possibly from uptake)

Silty Sandstone (as above) S-100

Sandstone; (Tras Hernandez?), lt. gray, fine sand, 95% unconsolidated, 99% g + 21% lithics, wet, strong HCl rxn. well sorted

185

add 95%

190

(as above) silty SS = 5% - 2%

Sandstone = 95% 98-99%

99% unconsolidated

195

Hopper 1615

200

(as above) silty SS = 40% Sandstone = 60%

Notes:

↳ ~55% unconsolidated



LOG OF BORING

MW32-45 KDR

(Page 9 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth In Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

200

205

210

215

220

225

Few returns
(as above) silty ss = <1%
Sandstone = 99%
(100% unconsolidated)

not No Returns (air only)

Sandstone (as above)
↳ few returns

1117
845

Notes:



LOG OF BORING

MW32-45 KDR

(Page 10 of)

Project Name:

Rio Algon

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth
In
Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

225

230

235

240

245

250

(trace gypsum)
Sandstone (as above) 90%
Shale, black, extremely weak rock, no HCl. rxn, wet
↳ (10%)
(silty)

(as above) - Sandstone (30%)
- silty sandstone, lt. gray - mod. gray, fresh, fine sand (99% gtz/lithic), very weak rock, well sorted, wet, no HCl. rxn } 30%
- F-C gtz grains (unconsolidated), submed, clear-milky white, wet, poorly sorted

Notes: Injecting water beginning @ 230' bgs.



LOG OF BORING

MW32-451DR

(Page 1 of)

Project Name:

Rio Algon

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Project #:

Sampling Method :

Drilling Company :

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

250

Sandstone (50%)

Silty Sandstone (50%)

} (as above)

trace shale, black, extremely weak rock, no HCl, wet
↳ F-C grit grains (as above)

255

Hopper
1000

260

Sandstone (10%)

~~Silty Sandstone~~ Silty Sandstone (85%)

~~Sandy Siltstone~~

Shale (5%)

} (as above)

265

270

Sandy Siltstone, lt.-med. gray, weak rock, fine sand, no HCl, wet,

275

Notes:



LOG OF BORING

MW32-45KDR (Page 12 of)

Project Name:	Date Started :	Driller :
	Date Completed :	Depth to Water :
Project #:	Drilling Method :	Logged By :
	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
275					<p>@ - 277 (per driller) lithology change</p> <p>Silty shale, lt. green, extremely weak rock, no HCl, wet, laminar</p> <p>trace sandy siltstone (as above)</p>	
280						
285						
290					<p>Silty shale (as above), lt. green = 60%</p> <p>lt. gray = 20%</p> <p>purple-brown = 20%</p> <p>TD @ 291' bgs</p>	
295						
300						

Notes:



LOG OF BORING

MW32-SOR

(Page 1 of)

Project Name:

Date Started : 11/30/12

Driller : K. Jacobs

Date Completed : 12/2/12

Depth to Water : 48.3' bgs

Drilling Method : Air-Rotary

Logged By : L. Dalton

Sampling Method : Cuttings

Drilling Company : Yellow Jacket

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

1415

0

Silty Sand (SM), poorly graded, fine sand, non-plastic, very loose, lt. brown, dry, ~~strong~~ weak HCl rxn, roots (99% gtz / 1% lithics)

5

10

Poorly Graded Sand (SP), few silt, fine sand, non-plastic, very loose, lt. brown, dry, ~~strong~~ weak HCl, roots (99% gtz / 1% lithics)

15

→ Sandy clay lens (~11-11.5' bgs)

1435

20

(Trace silt)
(as above), F-m sand, sub~~xy~~-submed, no roots
↳ (10%)
↳ (90%)

25

Notes:

Background

α = non-detect

γ = 17 μ R/hr



LOG OF BORING

MW32-SOR

(Page 2 of)

Project Name:

Rio Algom

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Project #:

Sampling Method :

Drilling Company :

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet

Sample Interval

Sample #

Pen./Rec.

PID (ppm)

DESCRIPTION

Group Symbol

25

30

35

40

45

50

(as above), dry-moist, fine sand

rig chatter

clayey sand (SC), poorly graded, fine sand, low plasticity, med. dense, brown, dry-moist, strong HCl.

1500
tapper

Notes:



LOG OF BORING

MW 32-SOR

(Page 3 of)

Project Name:

Rio Algom

Date Started :
Date Completed :
Drilling Method :
Sampling Method :
Drilling Company :

Driller :
Depth to Water :
Logged By :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
50					Poorly graded sand (SP), trace clay, fine sand, non-plastic, loose, lt. brown, moist-wet, weak HCl.	
55						
60					Well graded sand (SW), trace clay, F-C sand, sub-s. - sub-mel., non-plastic, loose, lt. brown, wet, strong HCl. (30%) Silty sandstone, fine sand (97% gtz / 1% lithics), lt. brown - gray, slightly weathered (black + orange), very weak rock, well sorted, clay supported, strong HCl., clay wet Silty sandstone, mod. gray, very weak rock, fine sand, slightly weathered (black + orange) (strong HCl.) wet (20%) Silty - trace shale, mod. gray, very weak, strong HCl., dry wet ↳ slightly weathered (orange)	
65						
70					(Gravel layer)	
75					Hard drilling beginning @ 71' bgs Well graded gravel w/ sand (SW), F-C gravel & sand, gravel (round-subround) / sand (sub-s. - sub-mel.), fossils, wet, med. dense, gravel = (SS, siltstone, shale)	

Notes: borehole making water beginning @ 60' bgs



LOG OF BORING

MW32-SOR (Page 4 of)

Project Name:	Date Started :	Driller :
	Date Completed :	Depth to Water :
Project #:	Drilling Method :	Logged By :
	Sampling Method :	
	Drilling Company :	

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
75						
80					<p>(85%)</p> <p>1/21 Sandstone (Trb), lt. gray, fresh, fine sand (99% silt/1% lithics), weak rock, well sorted, no HCl, wet</p> <p>↳ SS, siltstone + shale (gravel from above?) (15%)</p>	
85						
90					siltstone. (massive), mod. gray, extremely weak rock, weakly laminar, wet, no HCl,	
95						
100					(as above)	

Notes: softer drilling @ ~87' bgs.



LOG OF BORING

MW32-50R

(Page 5 of)

Project Name:

Date Started :

Driller :

Date Completed :

Depth to Water :

Drilling Method :

Logged By :

Sampling Method :

Drilling Company :

Project #:

Group (soil) name (clay, sand, silty sand, etc), percentage of non-predominant soil type, grading (coarse-grained soils only), particle-size (coarse-grained soils only), angularity, shape, maximum particle size (gravel only), plasticity (fine-grained soils only; non, low, medium, high), density (coarse-grained soils only; very loose, loose, medium dense, dense, very dense), consistency (fine-grained soils only; very soft, soft, firm, hard, very hard), color, odor, moisture (dry, moist, wet), reaction with HCl (none, weak, strong), structure, cementation, other (roots, mica, gypsum, caliche nodules, drilling conditions), geologic name (if known).

Depth in Feet	Sample Interval	Sample #	Pen./Rec.	PID (ppm)	DESCRIPTION	Group Symbol
100						
105						
110					siltstone (as above).	
115					T _D @ 110' bgs	
120						
125						

Notes:



LOG OF BORING : MW 30-48 Kd-R

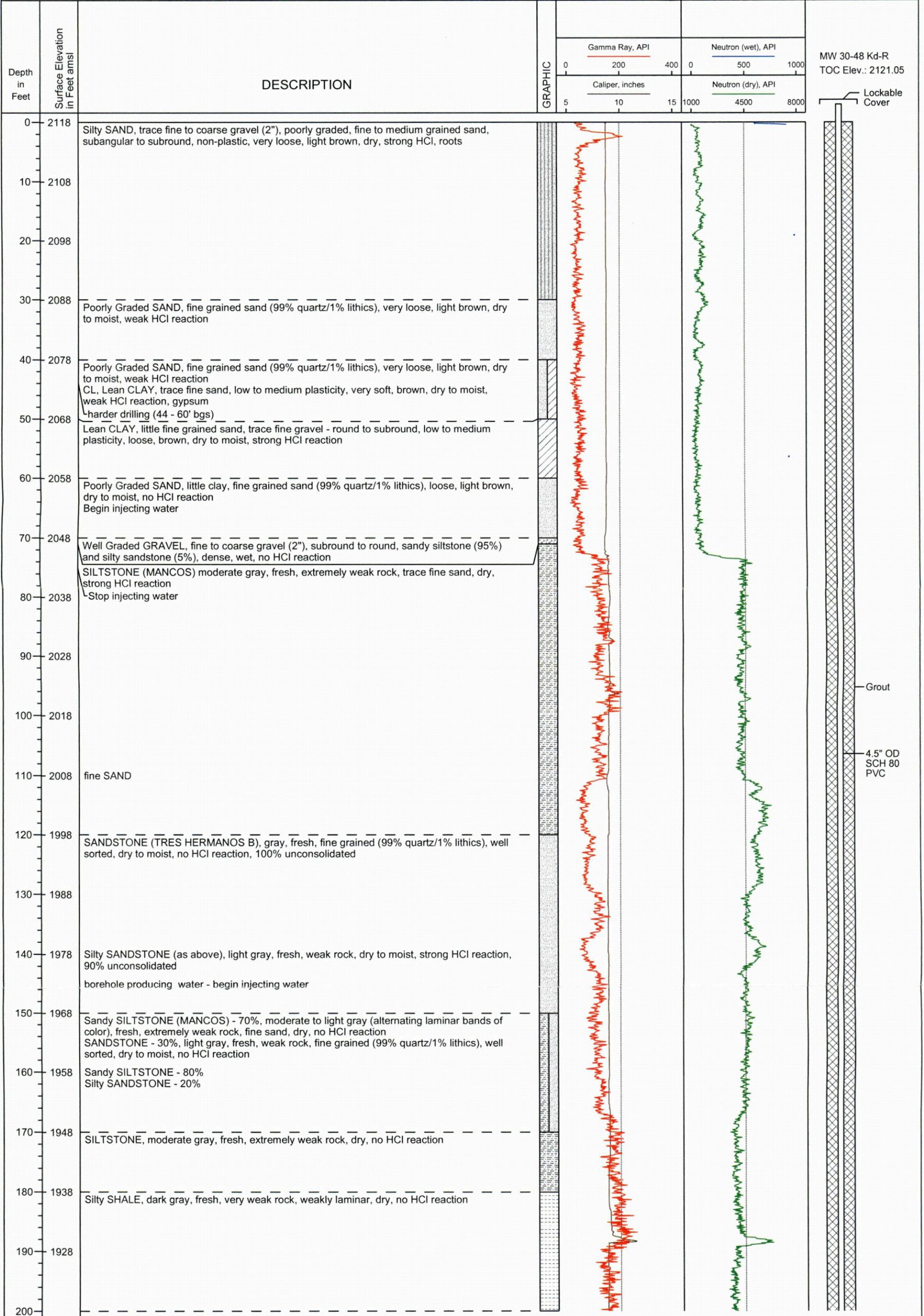
(Page 1 of 2)

Date Started : 12/03/12
 Date Completed : 12/05/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 319' bgs
 Logged By : L. Dalton
 Latitude : 35.409141534
 Longitude : -107.827090782

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 17 µR/hr.
 2. Tri-cone (8.5" OD) 0-73' bgs advancing 10" surface casing (0-73' bgs);
 Carbide Hammer Button Bit (8.5" OD) 73-377' bgs.
 3. Surveyed Top of Casing (TOC) elevation (ft. amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 30-48 Kd-R

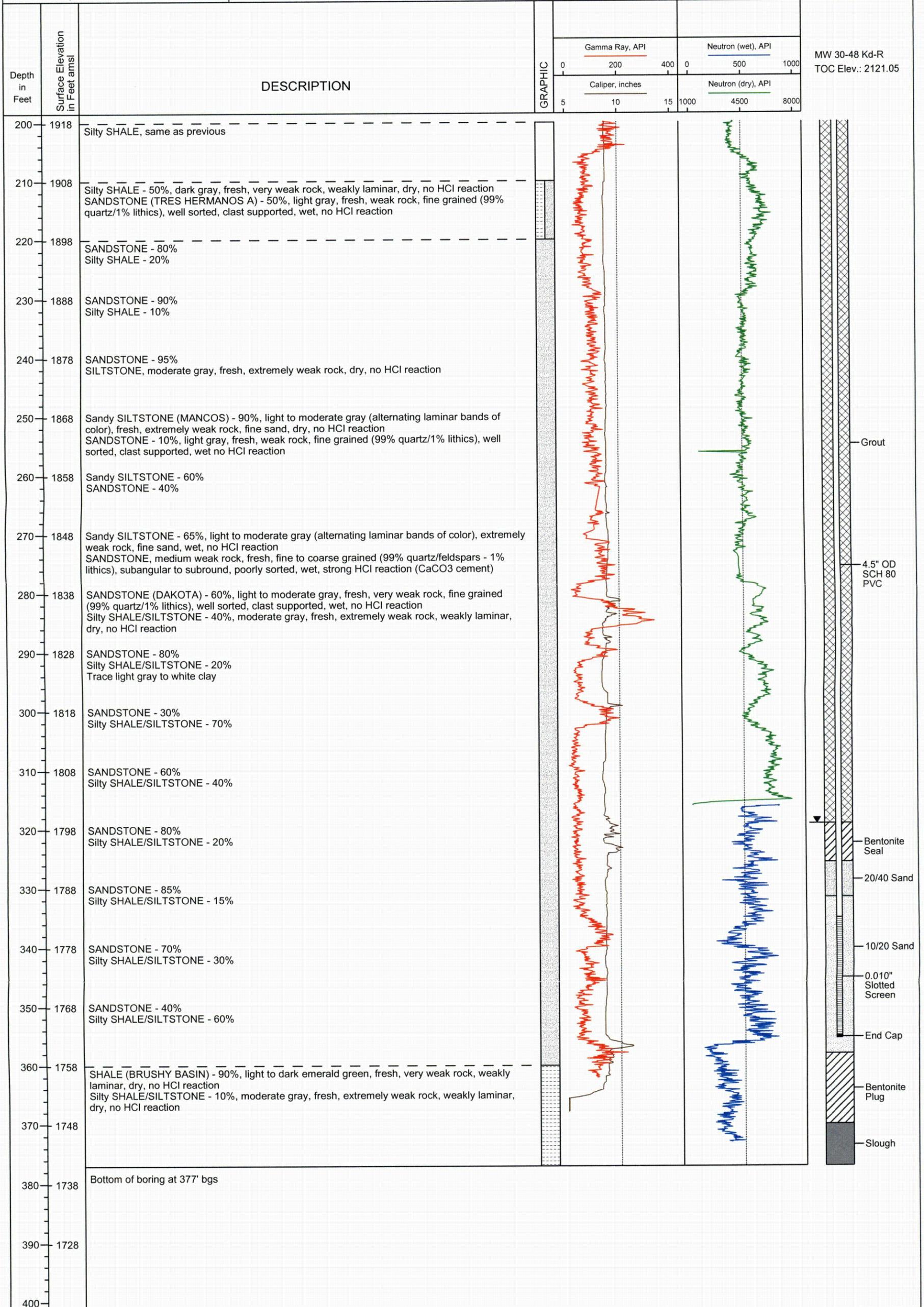
(Page 2 of 2)

Date Started : 12/03/12
 Date Completed : 12/05/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 319' bgs
 Logged By : L. Dalton
 Latitude : 35.409141534
 Longitude : -107.827090782

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 17 µR/hr.
 2. Tri-cone (8.5" OD) 0-73' bgs advancing 10" surface casing (0-73' bgs); Carbide Hammer Button Bit (8.5" OD) 73-377' bgs.
 3. Surveyed Top of Casing (TOC) elevation (ft, amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 31-01 Tra-R

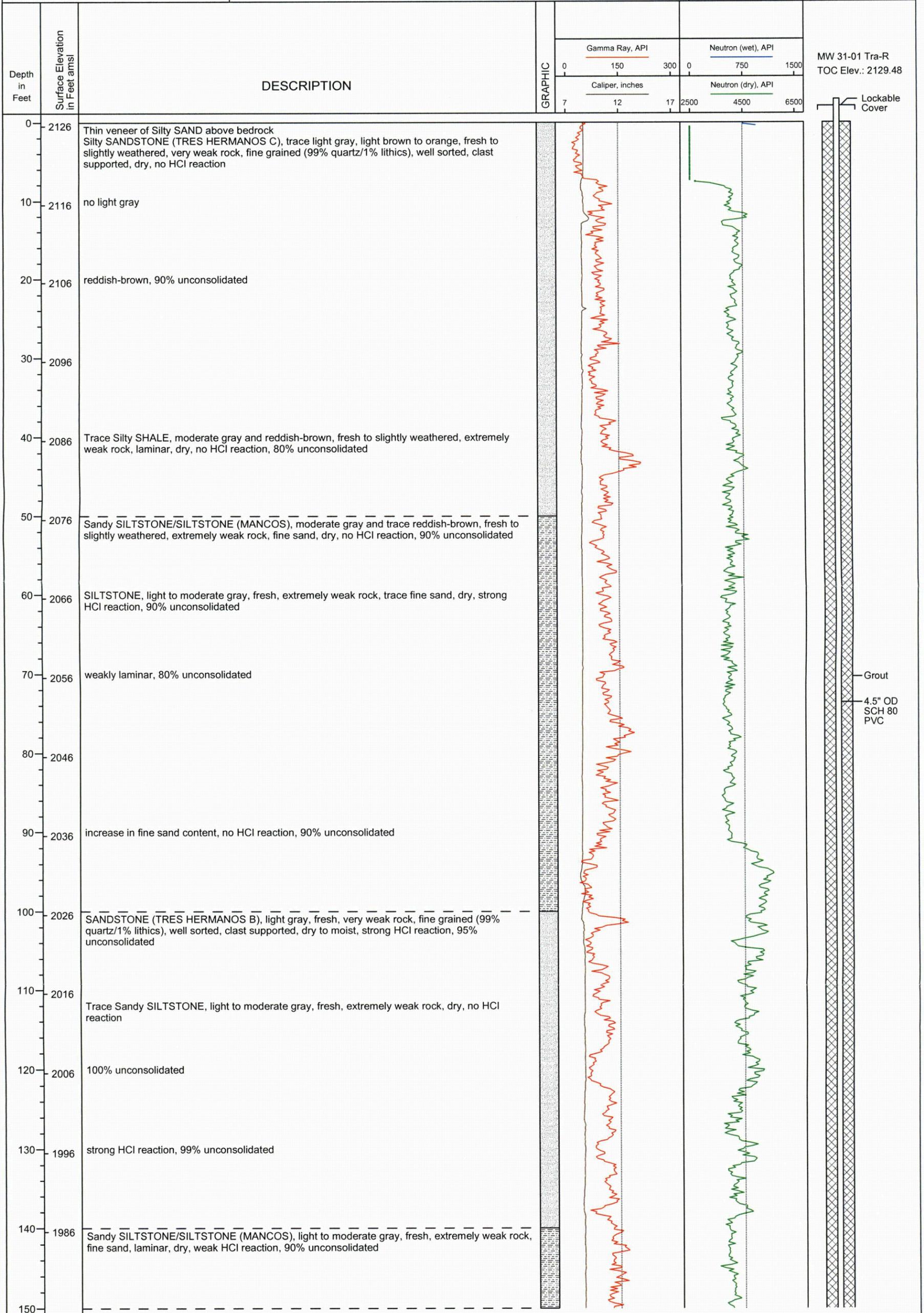
(Page 1 of 2)

Date Started : 12/11/12
 Date Completed : 12/12/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 200.8' bgs
 Logged By : L. Dalton
 Latitude : 35.402450374
 Longitude : -107.831073806

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 32 µR/hr
 2. Tri-cone (8.5" OD) 0-15' bgs advancing 10" surface casing (0-7' bgs);
 Carbide Hammer Button Bit (8.5" OD) 15-245' bgs
 3. Surveyed Top of Casing (TOC) elevation (ft. amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 31-01 Tra-R

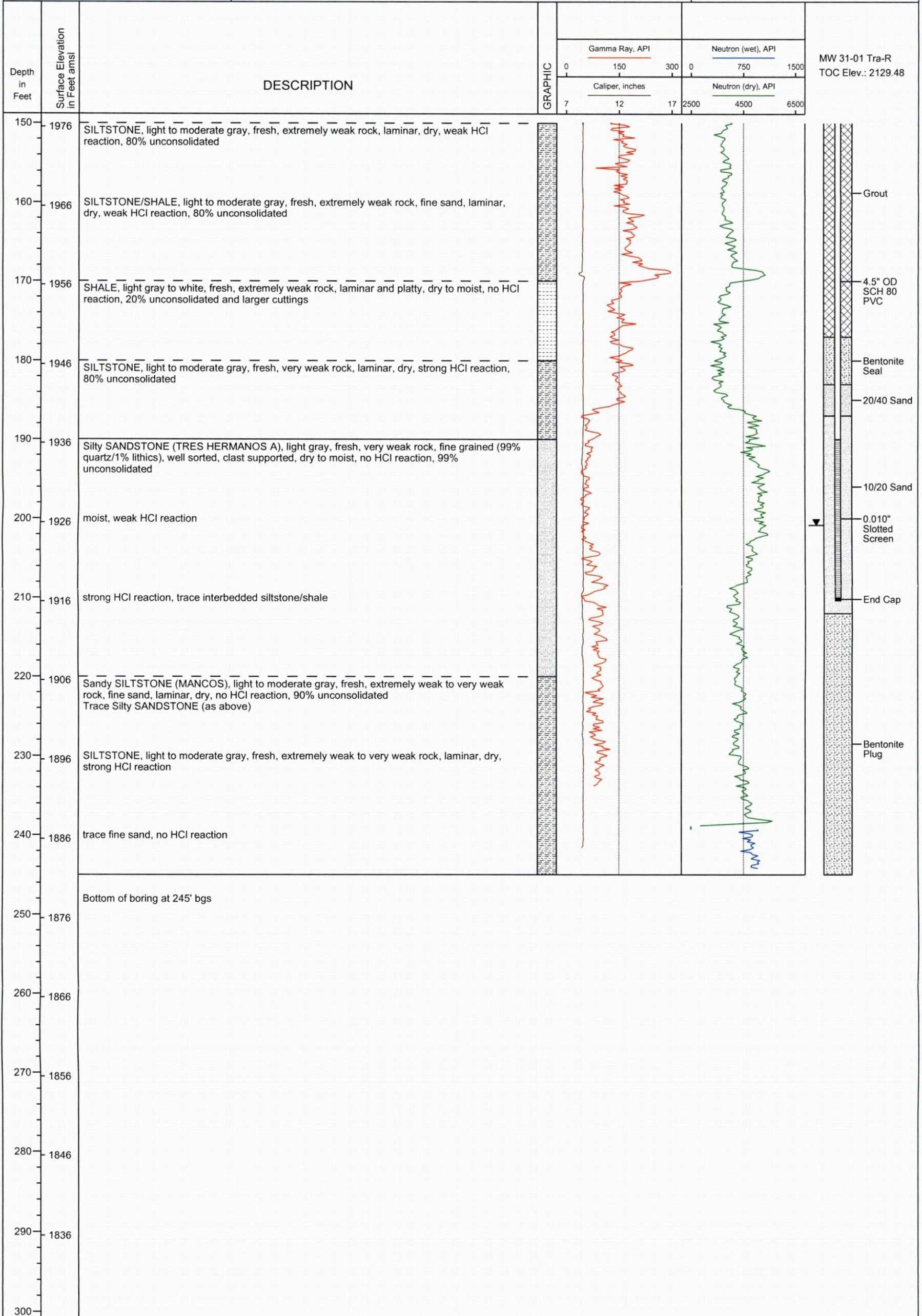
(Page 2 of 2)

Date Started : 12/11/12
 Date Completed : 12/12/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 200.8' bgs
 Logged By : L. Dalton
 Latitude : 35.402450374
 Longitude : -107.831073806

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 32 µR/hr
 2. Tri-cone (8.5" OD) 0-15' bgs advancing 10" surface casing (0-7' bgs);
 Carbide Hammer Button Bit (8.5" OD) 15-245' bgs
 3. Surveyed Top of Casing (TOC) elevation (ft. amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 31-02 Trb-R

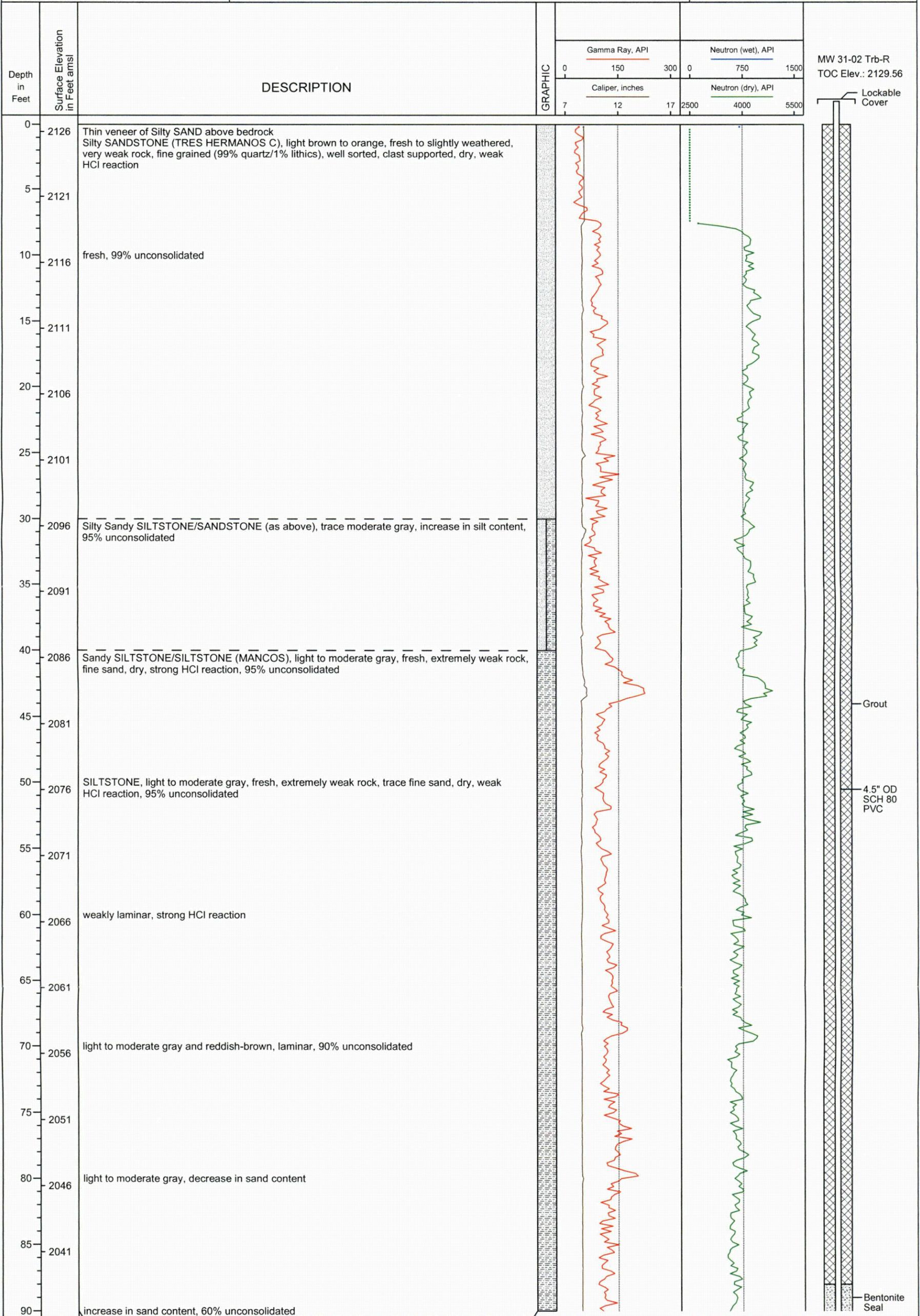
(Page 1 of 2)

Date Started : 12/13/12
 Date Completed : 12/14/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 113' bgs
 Logged By : L. Dalton
 Latitude : 35.402444136
 Longitude : -107.831176870

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 32 µR/hr.
 2. Carbide Hammer Button Bit (8.5" OD) 0-160' bgs advancing 10" surface casing (0-7' bgs).
 3. Surveyed Top of Casing (TOC) elevation (ft, amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 31-02 Trb-R

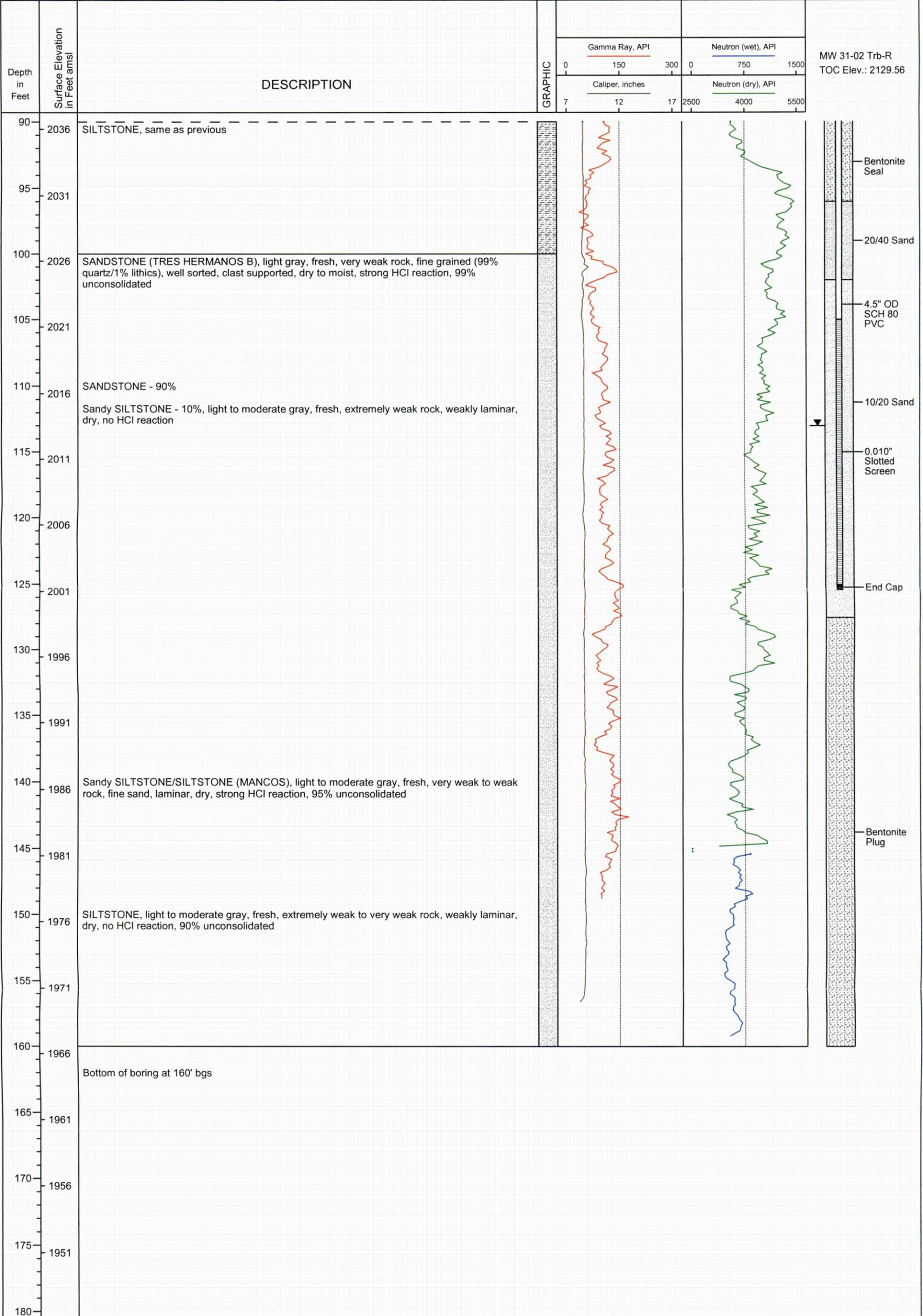
(Page 2 of 2)

Date Started : 12/13/12
 Date Completed : 12/14/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 113' bgs
 Logged By : L. Dalton
 Latitude : 35.402444136
 Longitude : -107.831176870

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 32 µR/hr.
 2. Carbide Hammer Button Bit (8.5" OD) 0-160' bgs advancing 10" surface casing (0-7' bgs).
 3. Surveyed Top of Casing (TOC) elevation (ft, amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 32-45 Kd-R

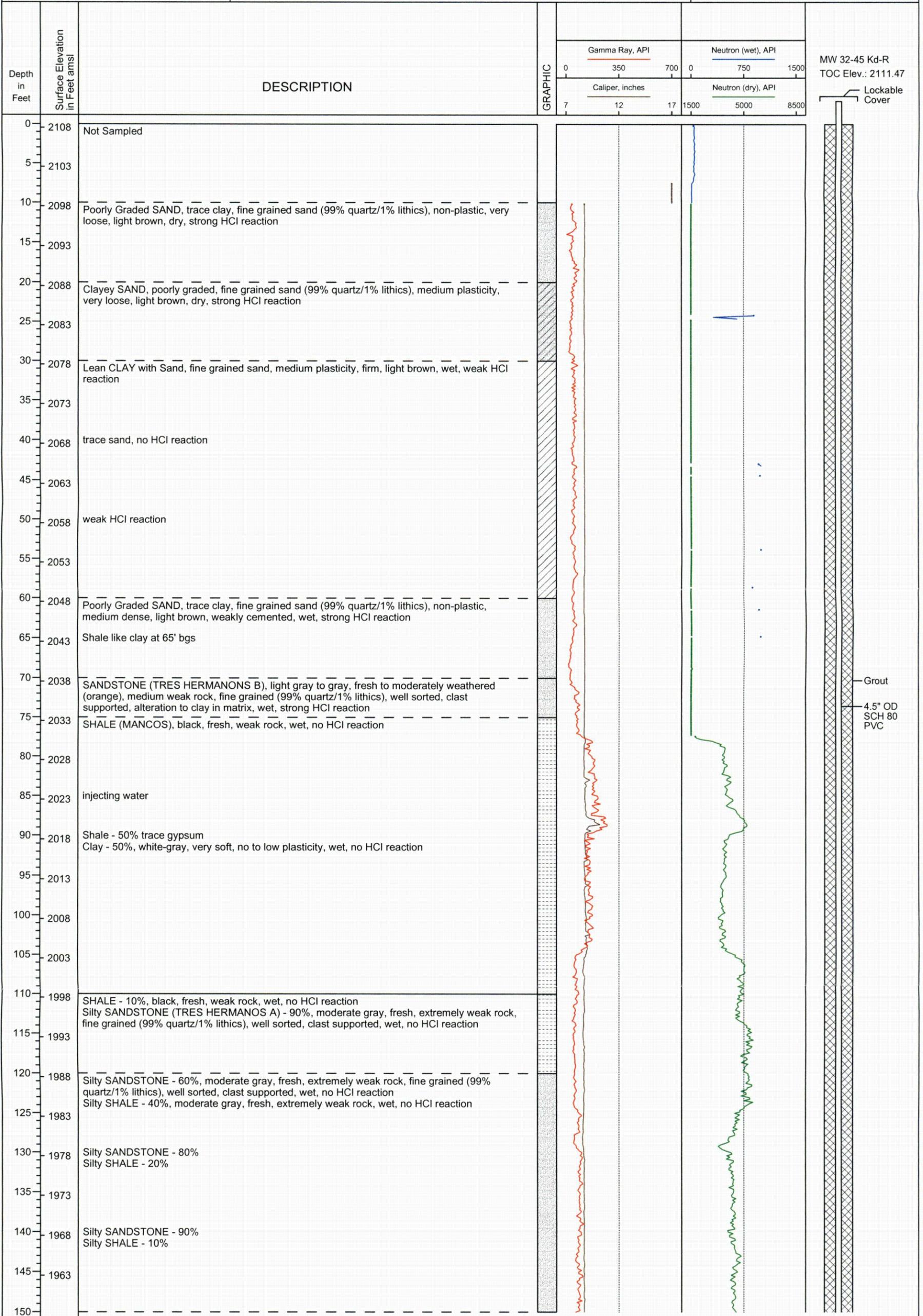
(Page 1 of 2)

Date Started : 11/16/12
 Date Completed : 11/28/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 253.1' bgs
 Logged By : L. Dalton
 Latitude : 35.398672181
 Longitude : -107.817502916

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 18 µR/hr.
 2. Tri-cone (8.5" OD) 0-80' bgs advancing 10" surface casing (0-76' bgs); Carbide Hammer Button Bit (8.5" OD) 80-291' bgs.
 3. Surveyed Top of Casing (TOC) elevation (ft, amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 32-45 Kd-R

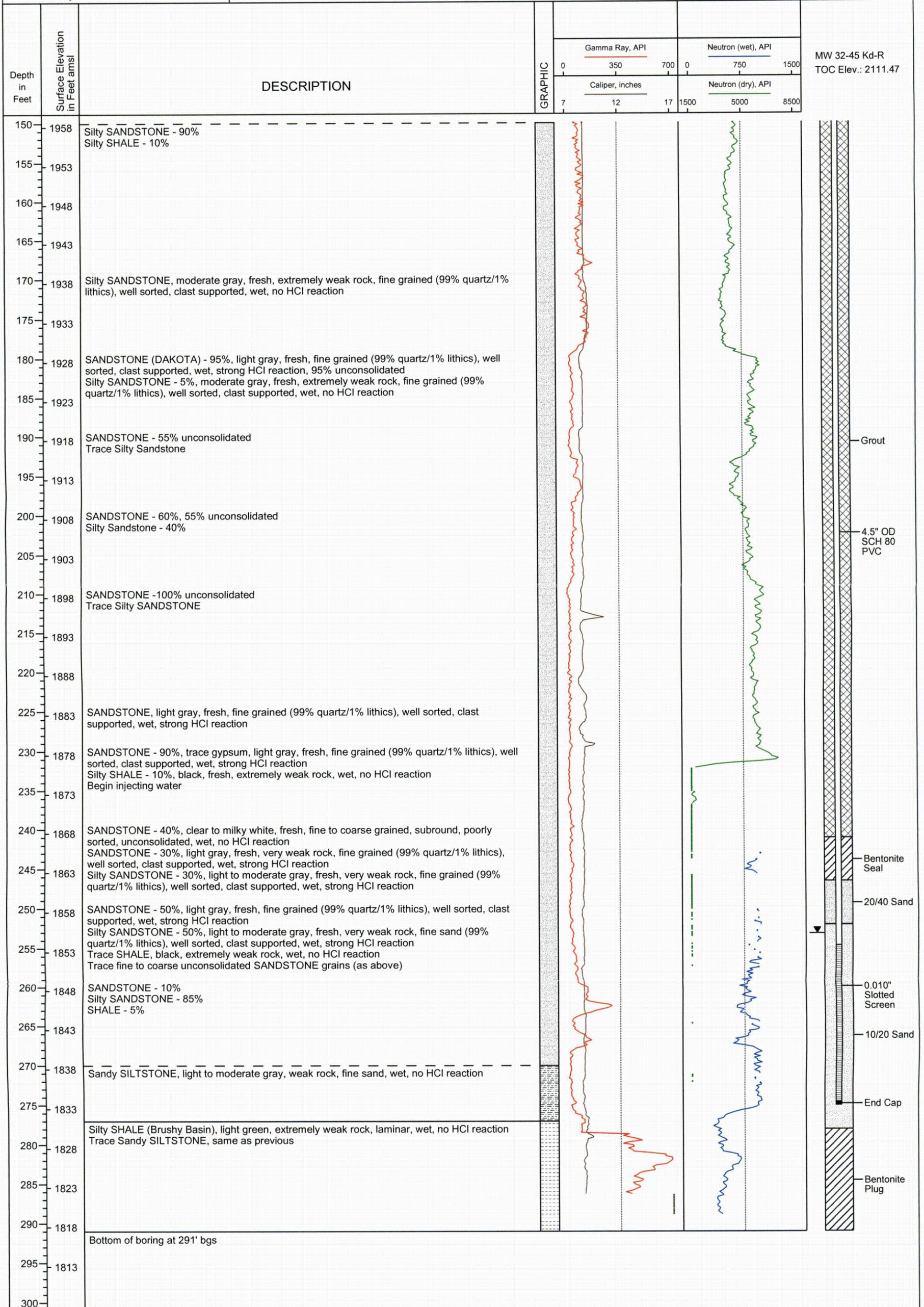
(Page 2 of 2)

Date Started : 11/16/12
 Date Completed : 11/28/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 253.1' bgs
 Logged By : L. Dalton
 Latitude : 35.398672181
 Longitude : -107.817502916

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 18 µR/hr.
 2. Tri-cone (8.5" OD) 0-80' bgs advancing 10" surface casing (0-76' bgs);
 Carbide Hammer Button Bit (8.5" OD) 80-291' bgs.
 3. Surveyed Top of Casing (TOC) elevation (ft, amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 32-50 Trb-R

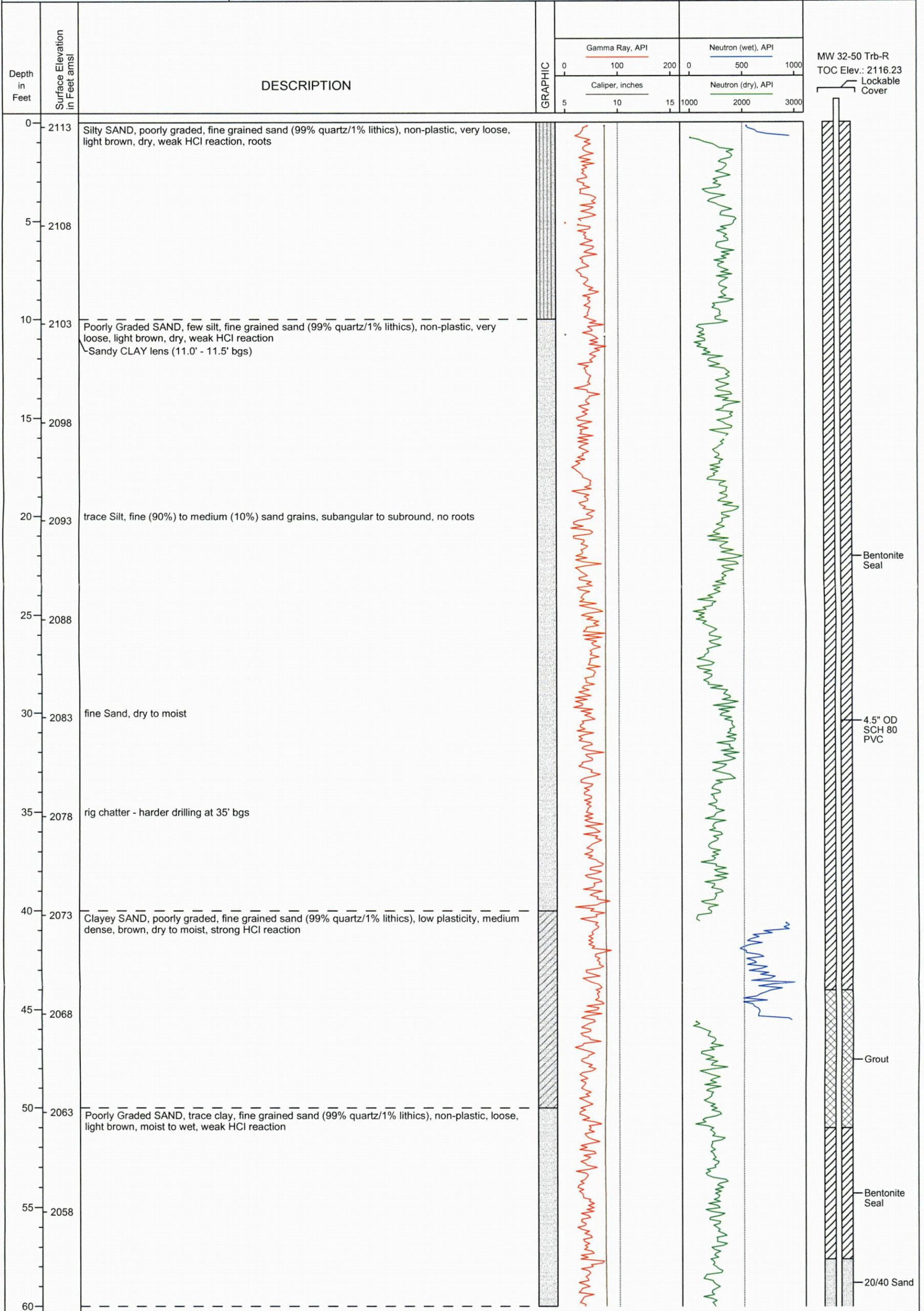
(Page 1 of 2)

Date Started : 11/30/12
 Date Completed : 12/02/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 48.30' bgs
 Logged By : L. Dalton
 Latitude : 35.403775552
 Longitude : -107.817516889

Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 17 µR/hr.
 2. Tri-cone (8.5" OD) 0-110' bgs advancing 10" surface casing (0-57' bgs).
 3. Surveyed Top of Casing (TOC) elevation (ft, amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169





LOG OF BORING : MW 32-50 Trb-R

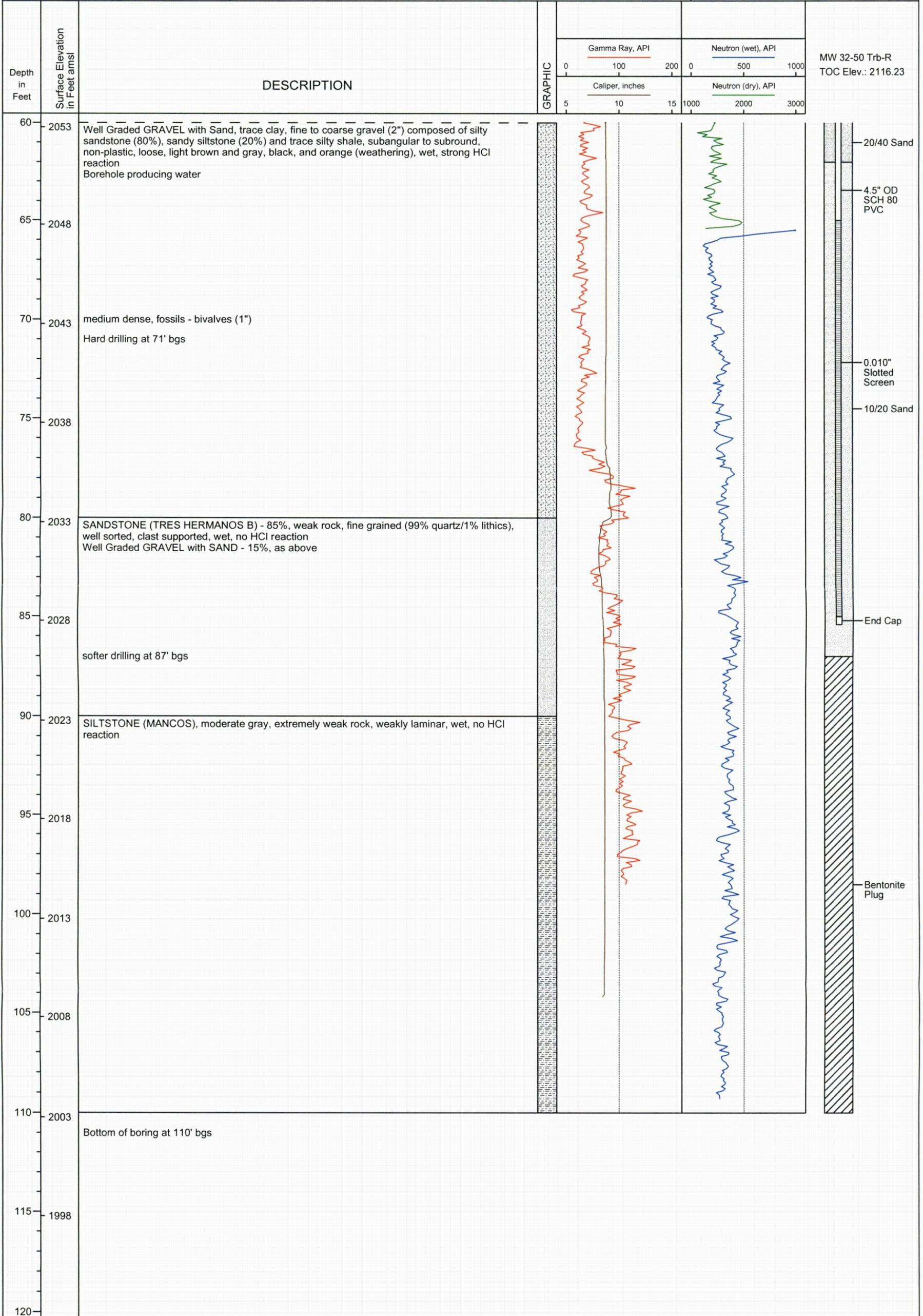
(Page 2 of 2)

Date Started : 11/30/12
 Date Completed : 12/02/12
 Drilling Method : Air Rotary
 Sampling Method : Cuttings
 Drilling Company : Yellow Jacket Drilling
 Driller : K. Jacobs
 Depth to Water : 48.30' bgs
 Logged By : L. Dalton
 Latitude : 35.40377552
 Longitude : -107.817516889

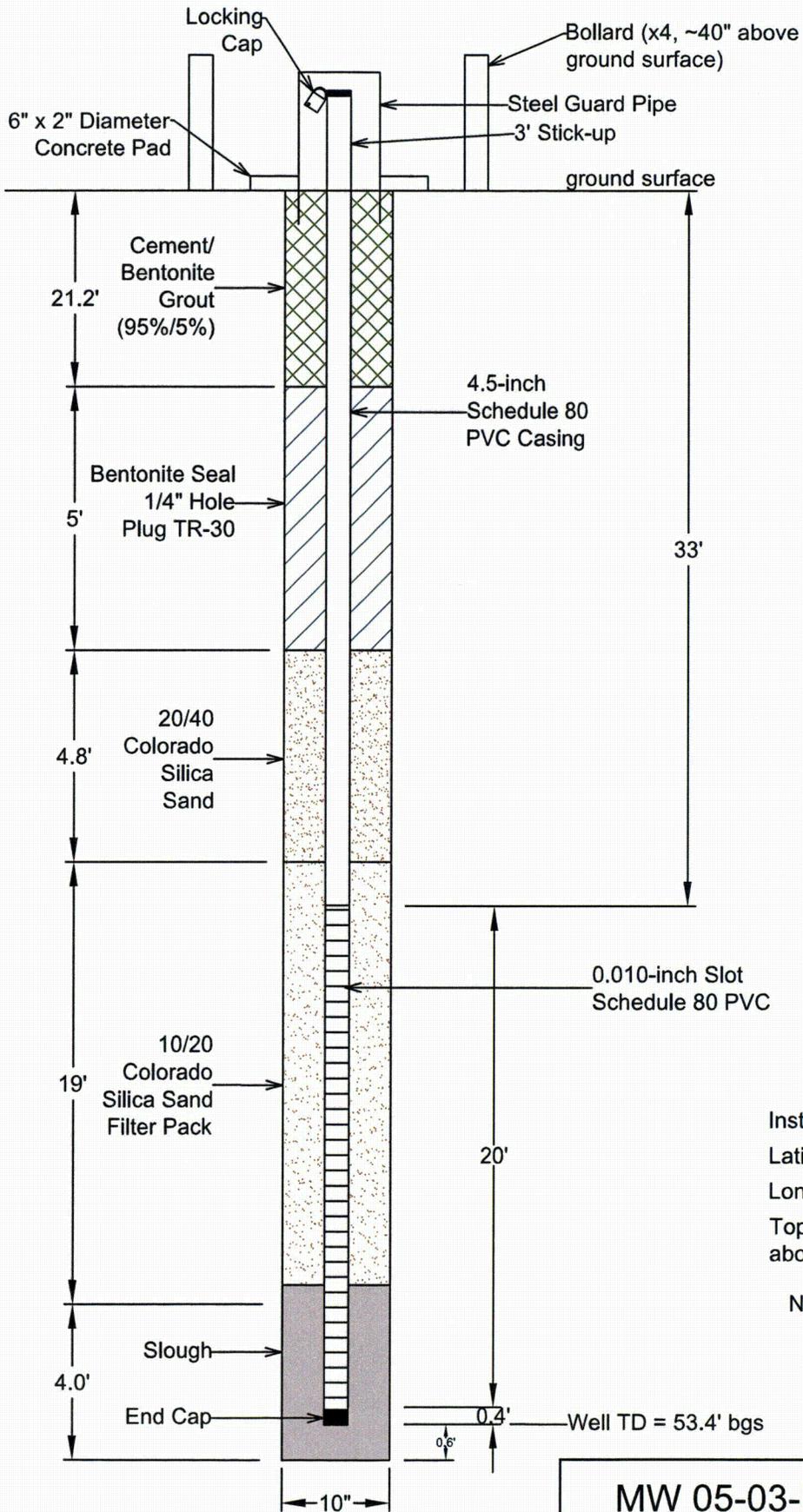
Project Name:
 BHP Billiton
 Rio Algom Site

Notes:
 1. Maximum Background Readings: alpha = non detect; gamma = 17 µR/hr.
 2. Tri-cone (8.5" OD) 0-110' bgs advancing 10" surface casing (0-57' bgs).
 3. Surveyed Top of Casing (TOC) elevation (ft. amsl) measuring point is on the top of the PVC, north side.

Project #: RIOAL.C003.169



APPENDIX C
Well Completion Diagrams



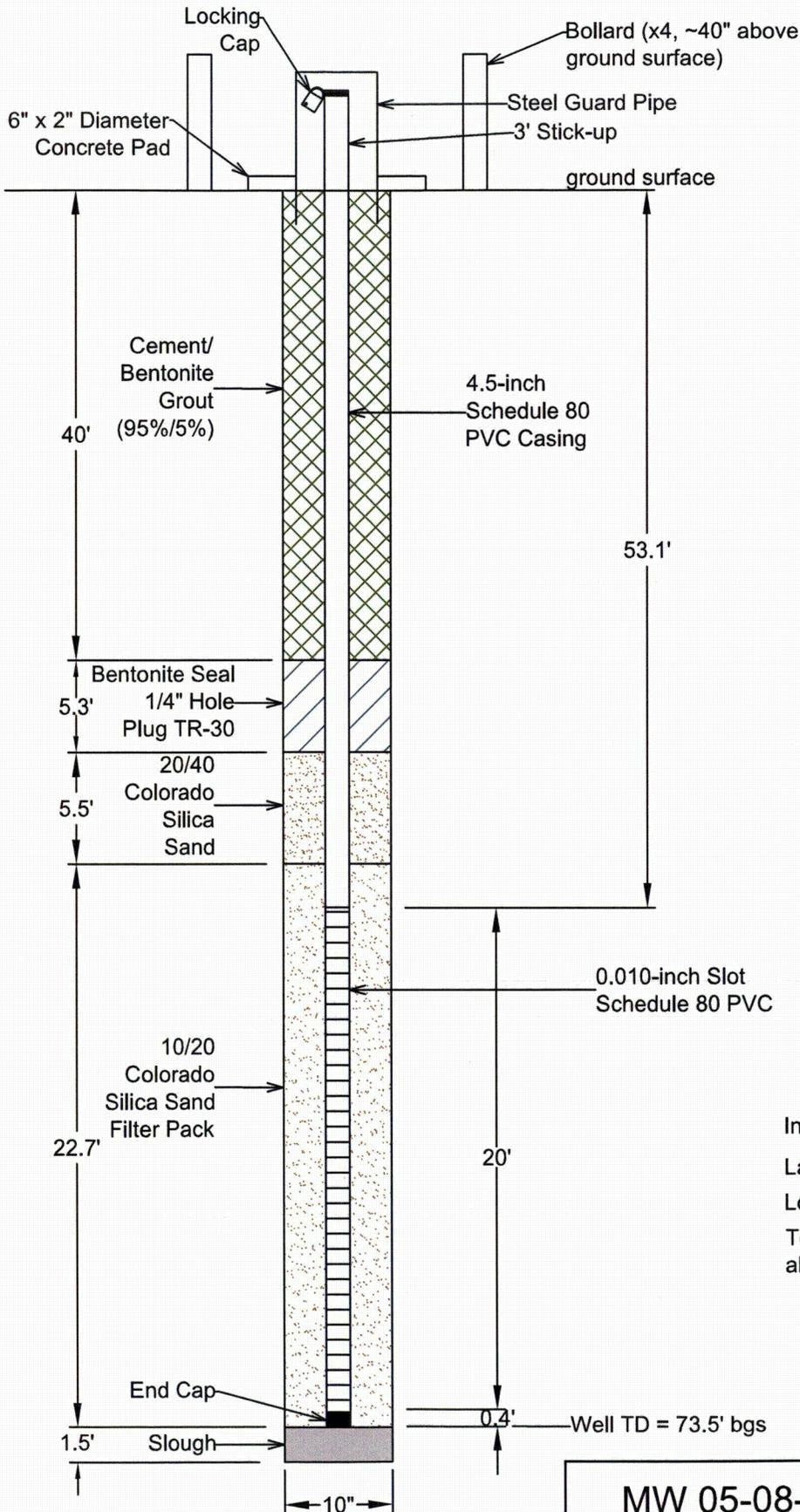
Install Date: 11/05/12
 Latitude: 35.391466577
 Longitude: -107.813902686
 Top of Casing Elevation, ft, above mean sea level: 2104.59

NOT TO SCALE

MW 05-03-R Well Diagram

BHP Billiton
 Rio Algom Site





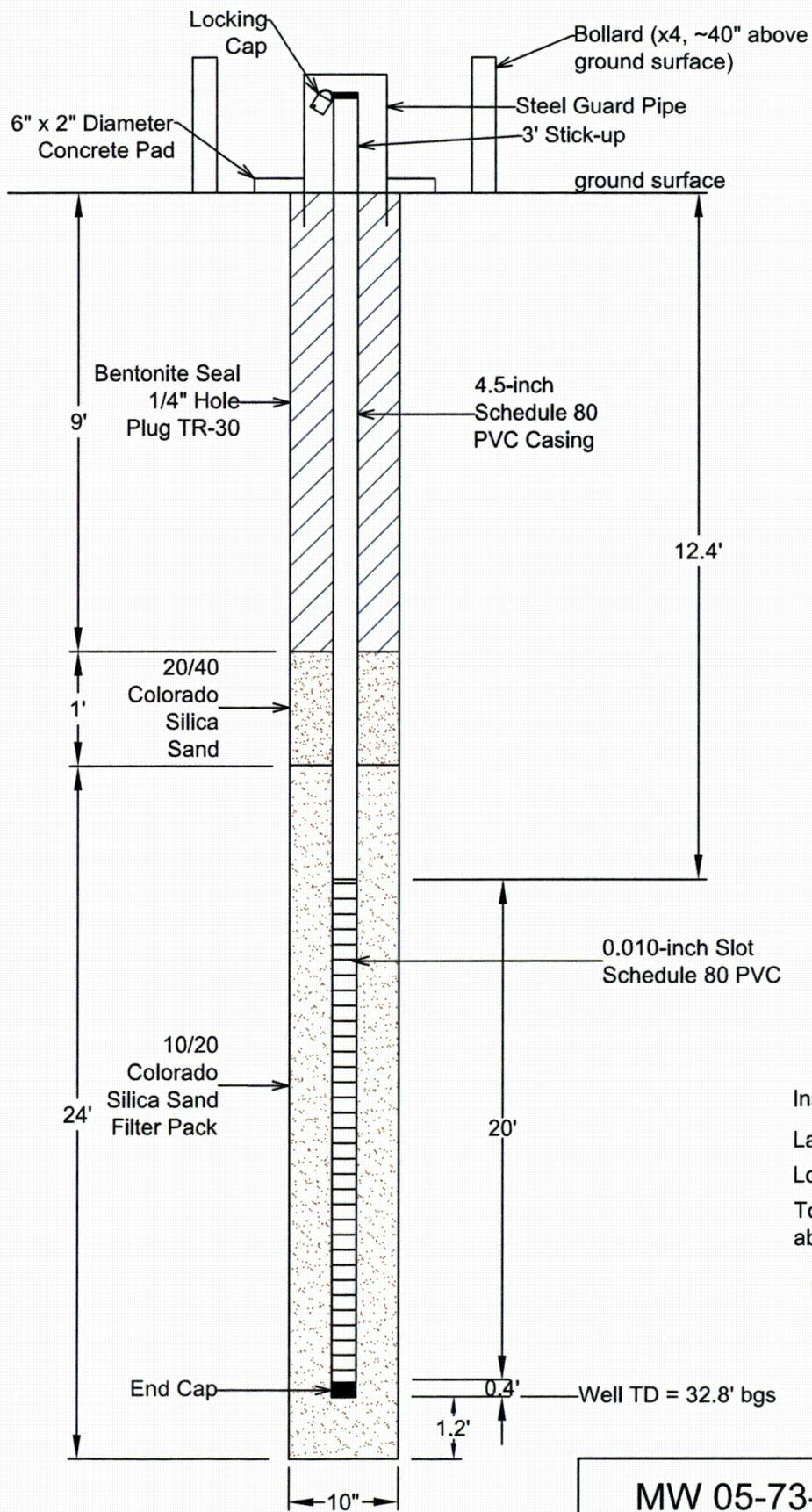
Install Date: 11/02/12
 Latitude: 35.385027384
 Longitude: -107.807534195
 Top of Casing Elevation, ft, above mean sea level: 2101.58

NOT TO SCALE

MW 05-08-R Well Diagram

BHP Billiton
 Rio Algom Site



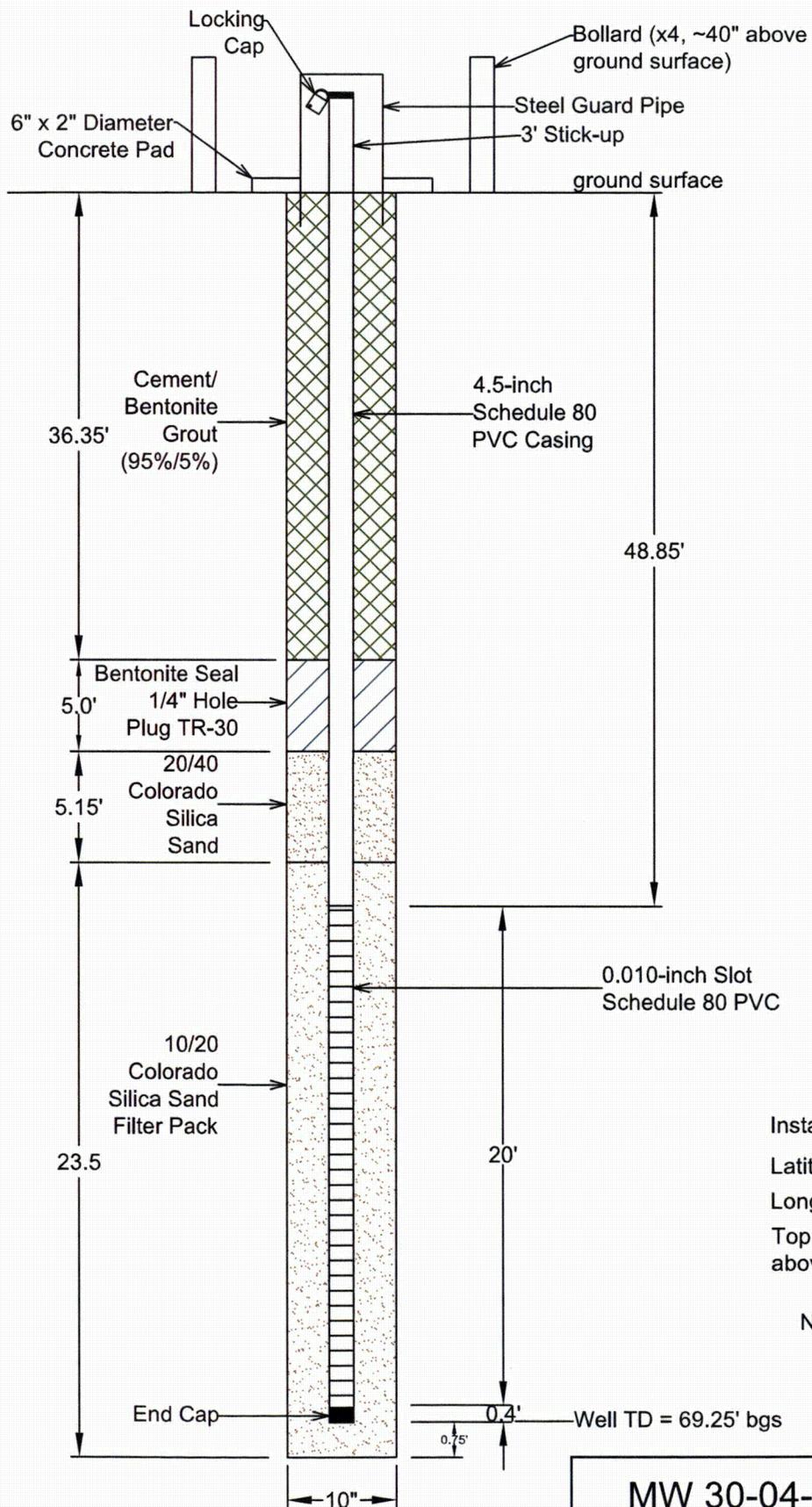


Install Date: 11/04/12
 Latitude: 35.387182735
 Longitude: -107.813250427
 Top of Casing Elevation, ft,
 above mean sea level: 2100.62

NOT TO SCALE

MW 05-73-R Well Diagram
 BHP Billiton
 Rio Algom Site





Install Date: 11/01/12
 Latitude: 35.406664945
 Longitude: -107.822599554
 Top of Casing Elevation, ft,
 above mean sea level: 2118.66

NOT TO SCALE

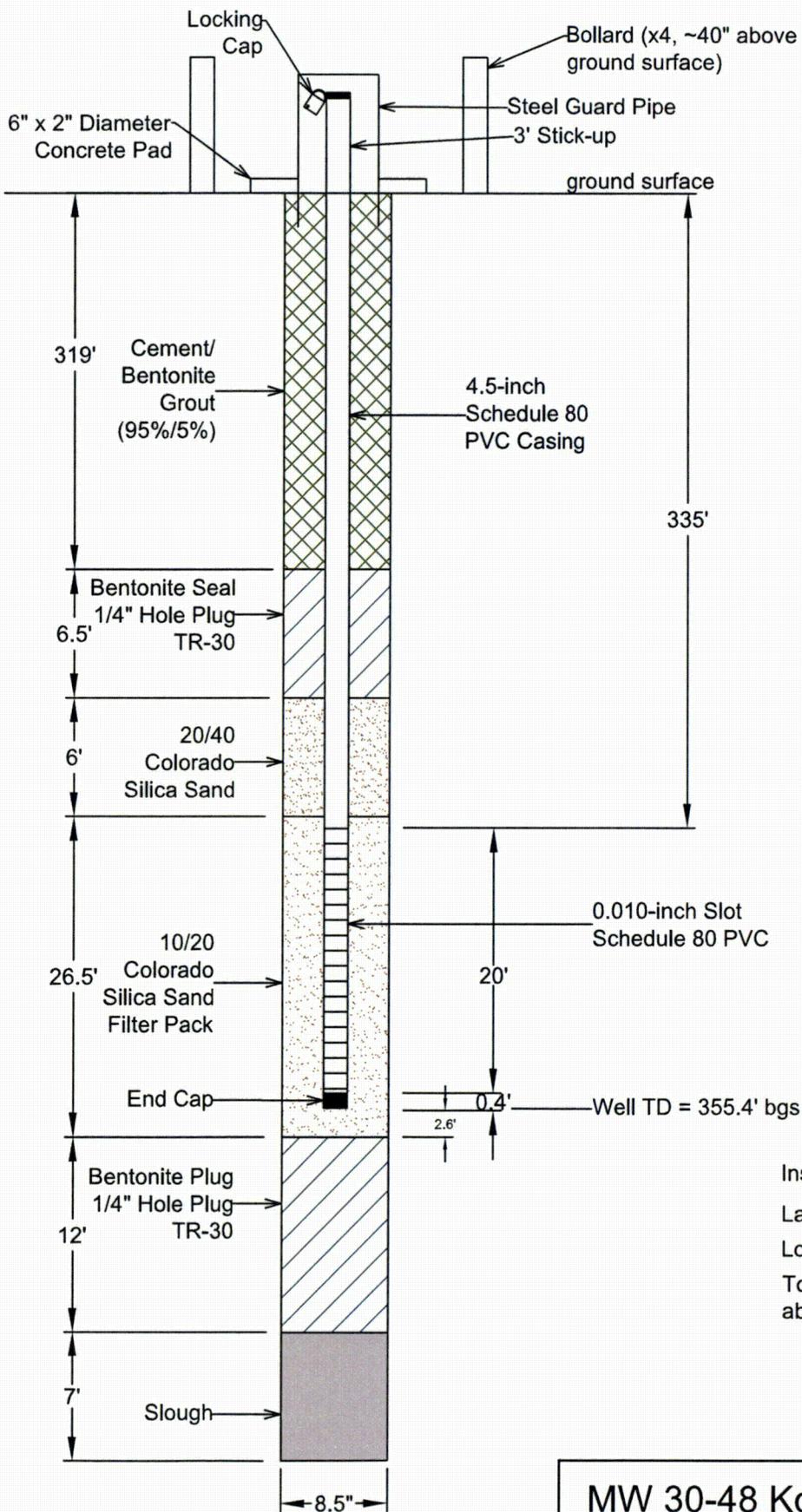
Well TD = 69.25' bgs

Borehole TD = 70' bgs

MW 30-04-R Well Diagram

BHP Billiton
 Rio Algom Site





Install Date: 12/05/12
 Latitude: 35.409141534
 Longitude: -107.827090782
 Top of Casing Elevation, ft,
 above mean sea level: 2121.05

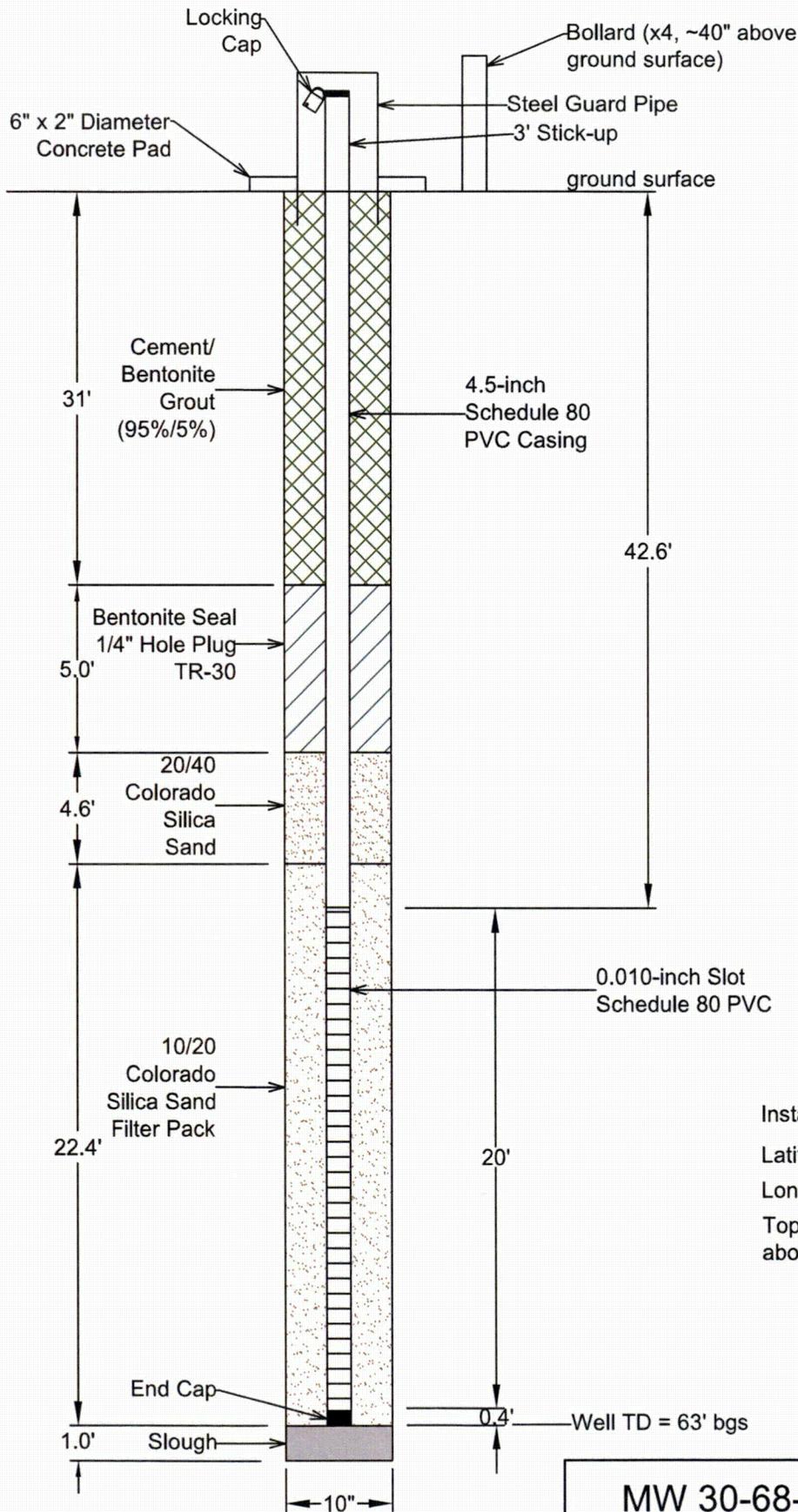
NOT TO SCALE

MW 30-48 Kd-R Well Diagram

BHP Billiton
 Rio Algom Site



Borehole TD = 377' bgs



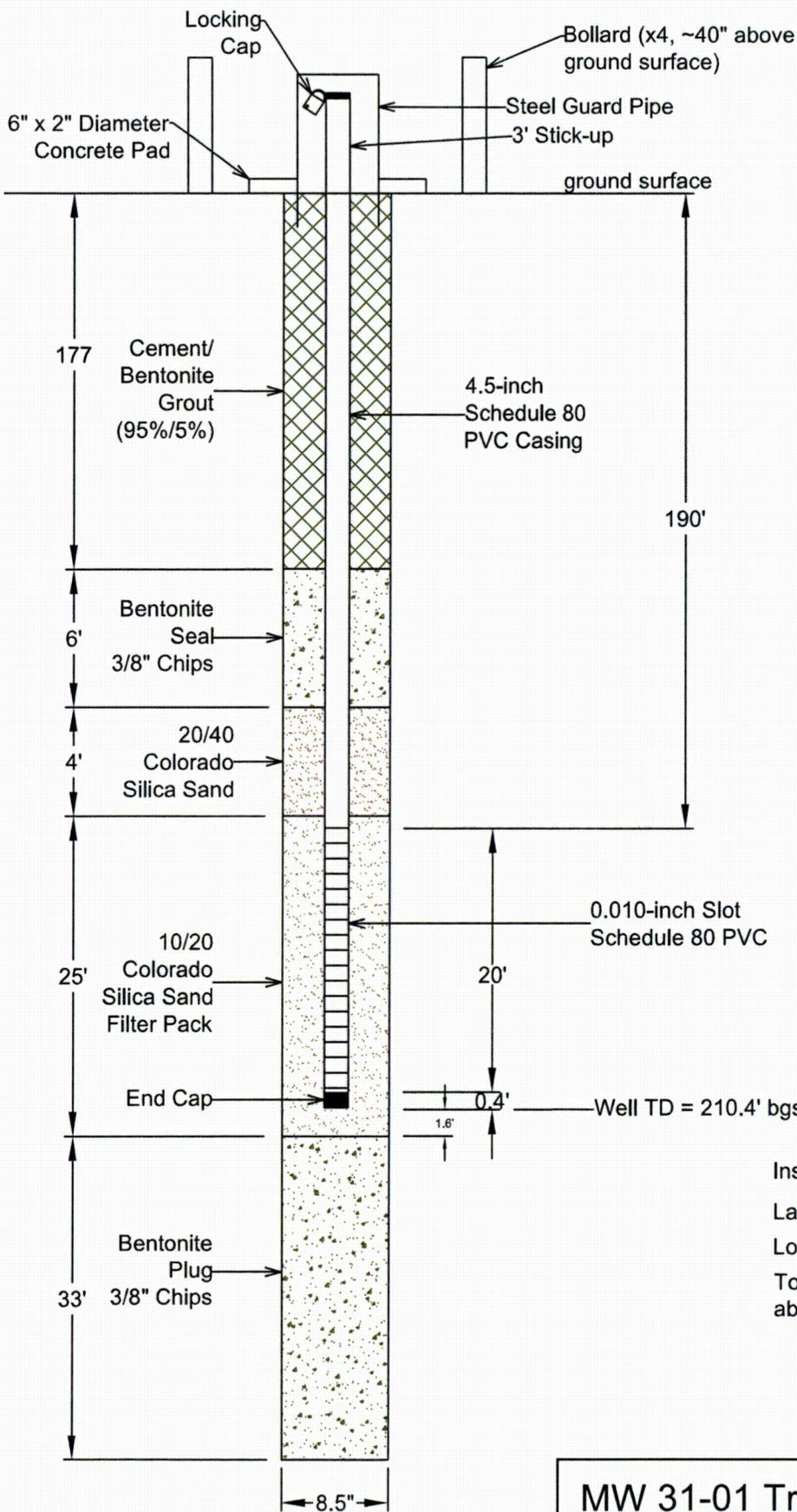
Install Date: 11/13/12
 Latitude: 35.418706980
 Longitude: -107.837913124
 Top of Casing Elevation, ft, above mean sea level: 2125.31

NOT TO SCALE

MW 30-68-R Well Diagram

BHP Billiton
 Rio Algom Site





Install Date: 12/12/12

Latitude: 35.402450374

Longitude: -107.8310738064

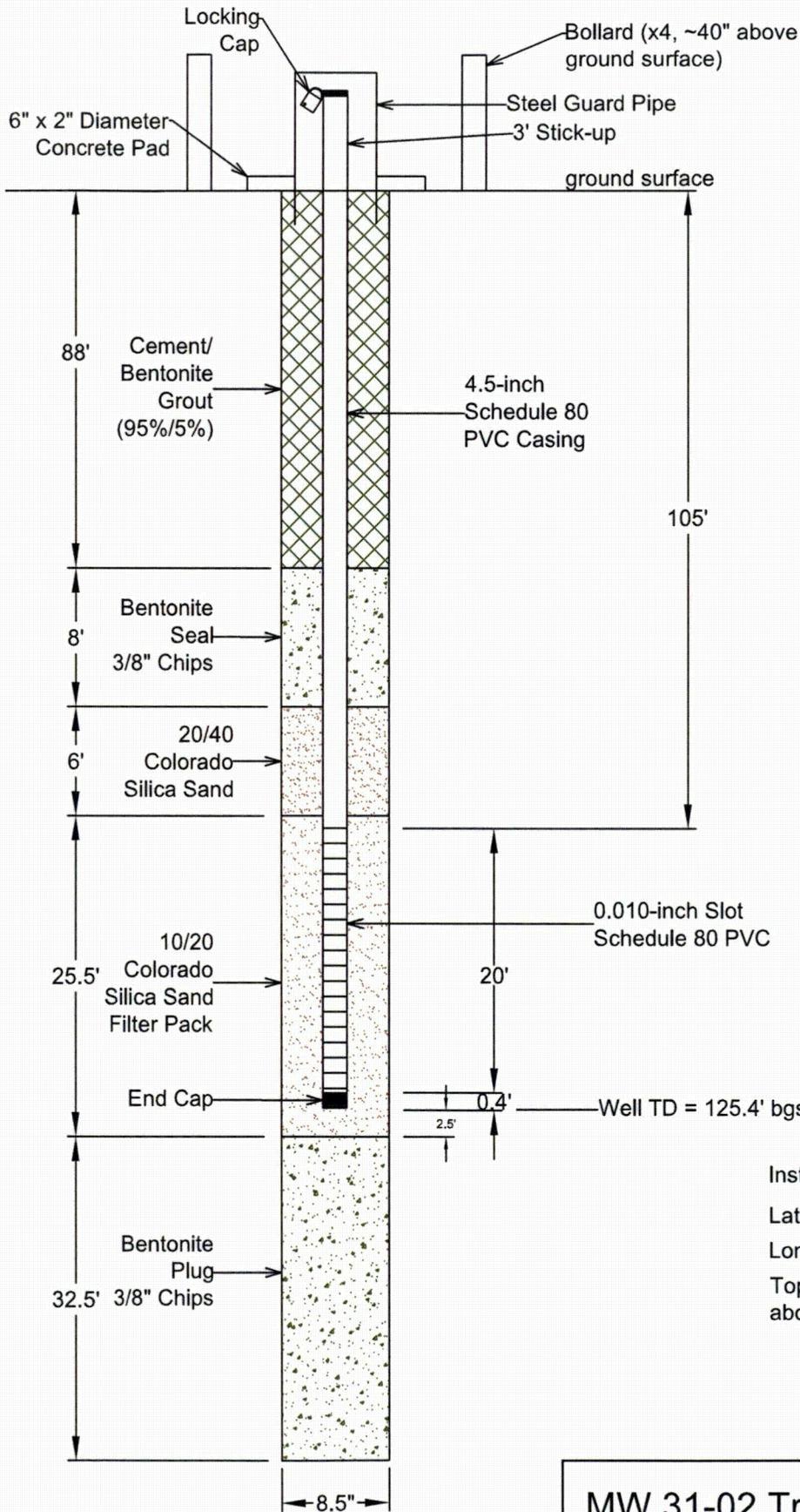
Top of Casing Elevation, ft, above mean sea level: 2129.48

NOT TO SCALE

MW 31-01 Tra-R Well Diagram

BHP Billiton
Rio Algom Site





Install Date: 12/14/12

Latitude: 35.402444136

Longitude: -107.831176870

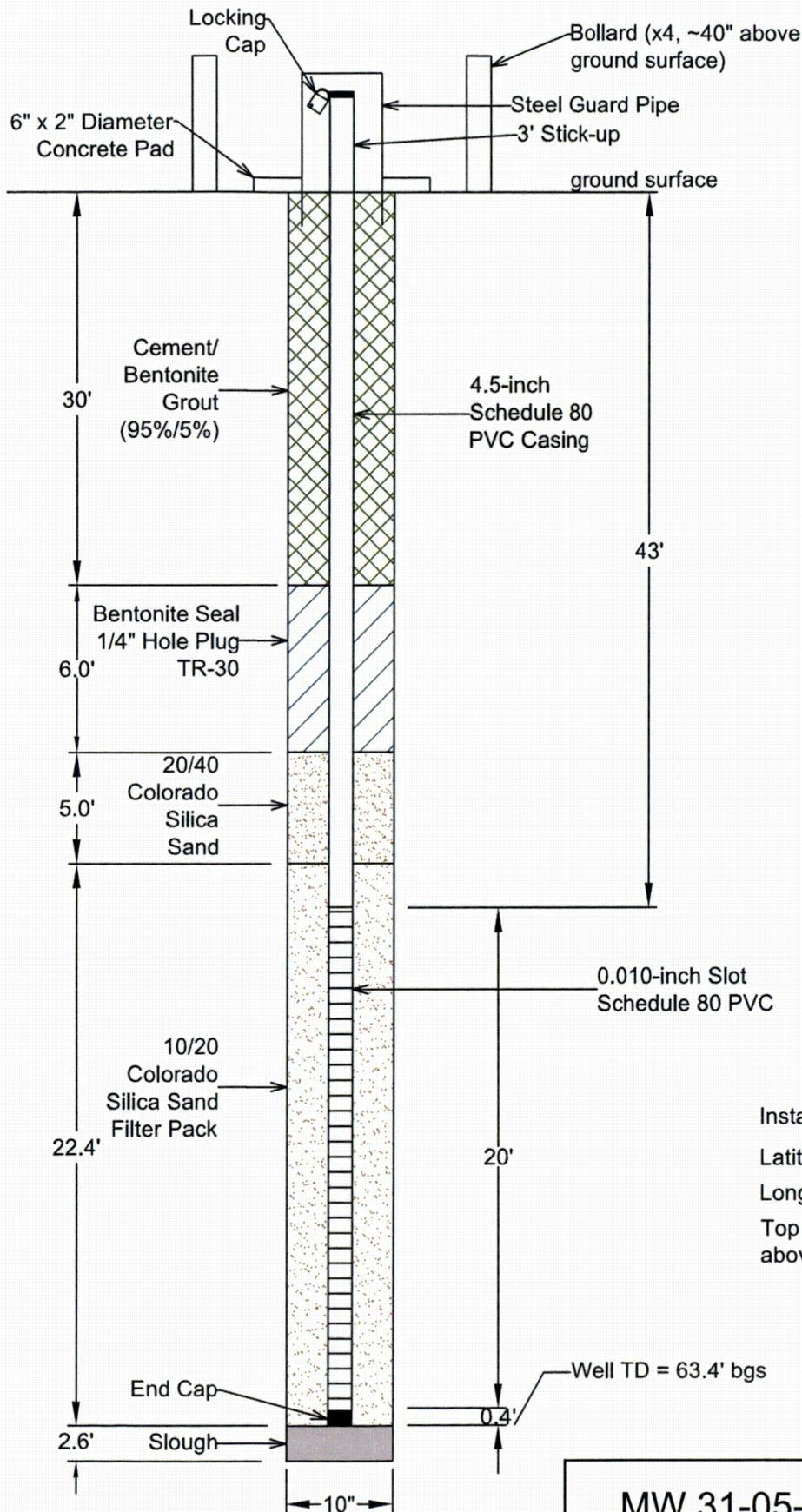
Top of Casing Elevation, ft, above mean sea level: 2129.56

NOT TO SCALE

MW 31-02 Trb-R Well Diagram

BHP Billiton
Rio Algom Site





Install Date: 11/12/12

Latitude: 35.405009425

Longitude: -107.823385310

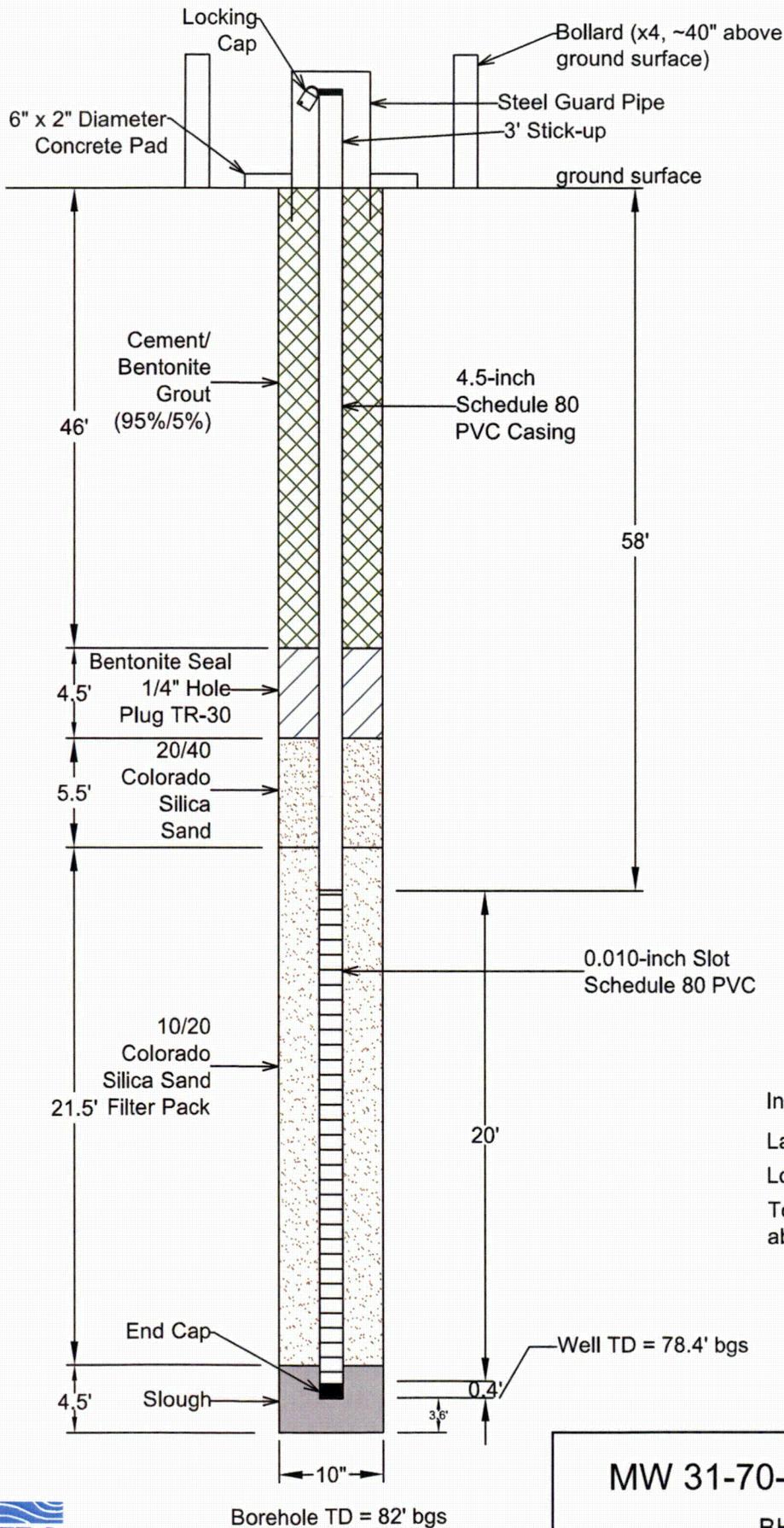
Top of Casing Elevation, ft, above mean sea level: 2117.05

NOT TO SCALE

MW 31-05-R Well Diagram

BHP Billiton
Rio Algom Site





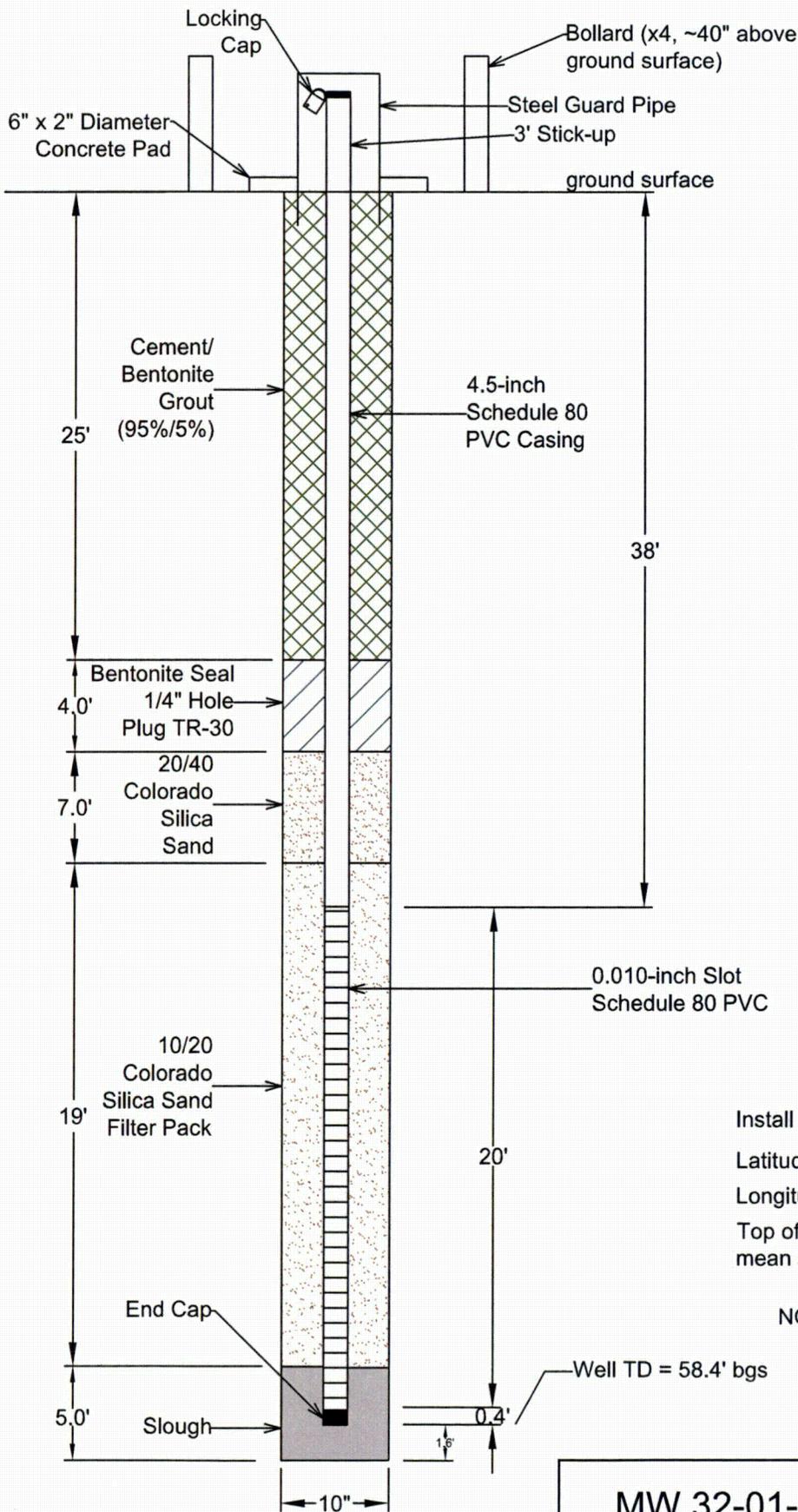
Install Date: 11/06/12
 Latitude: 35.402968532
 Longitude: -107.824197149
 Top of Casing Elevation, ft, above mean sea level: 2115.20

NOT TO SCALE

MW 31-70-R Well Diagram

BHP Billiton
 Rio Algom Site





Install Date: 11/12/12

Latitude: 35.398821221

Longitude: -107.821931373

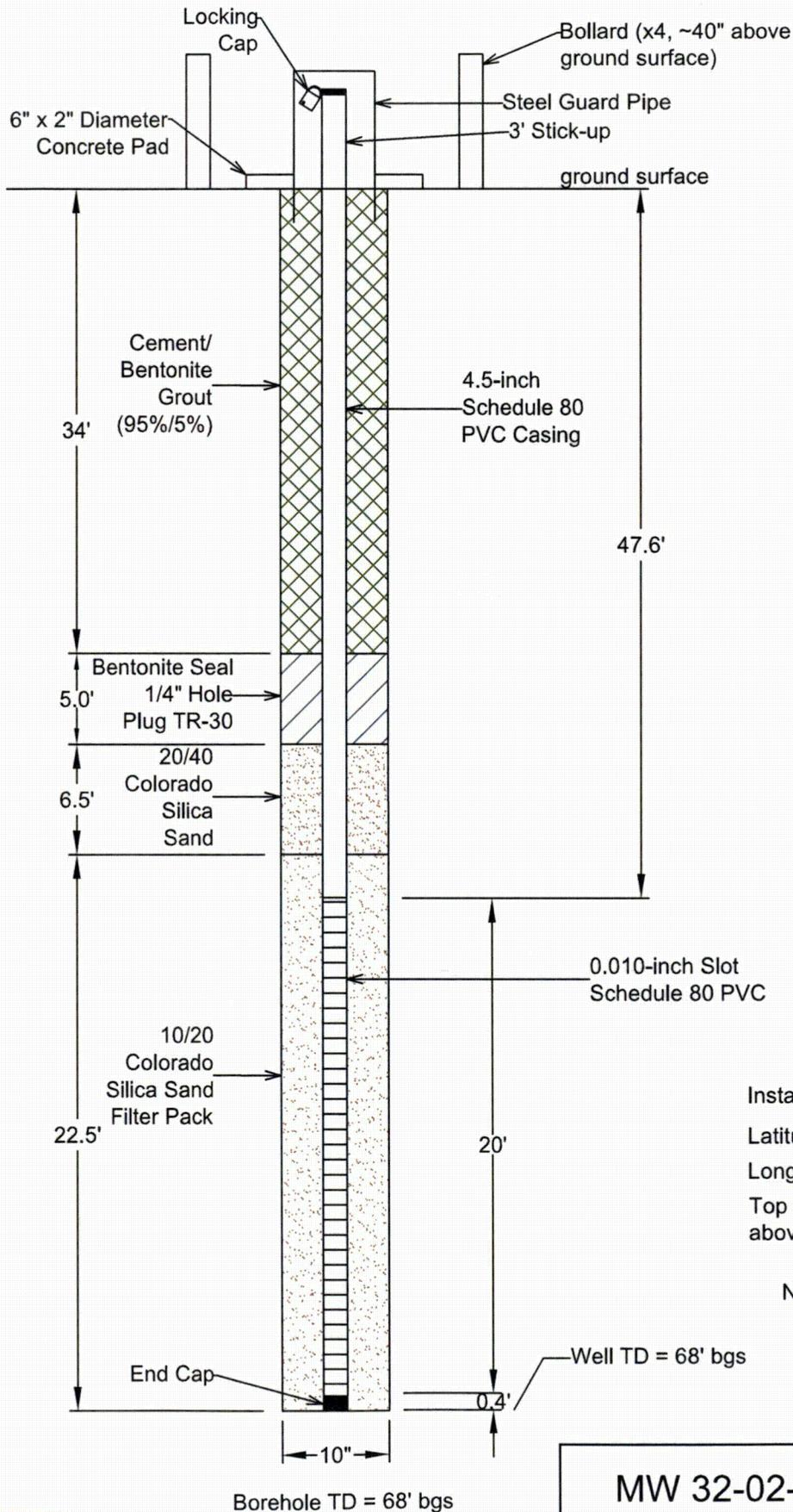
Top of Casing Elevation, ft, above mean sea level: 2111.54

NOT TO SCALE

MW 32-01-R Well Diagram

BHP Billiton
Rio Algom Site





Install Date: 10/30/12

Latitude: 35.405657186

Longitude: -107.821419552

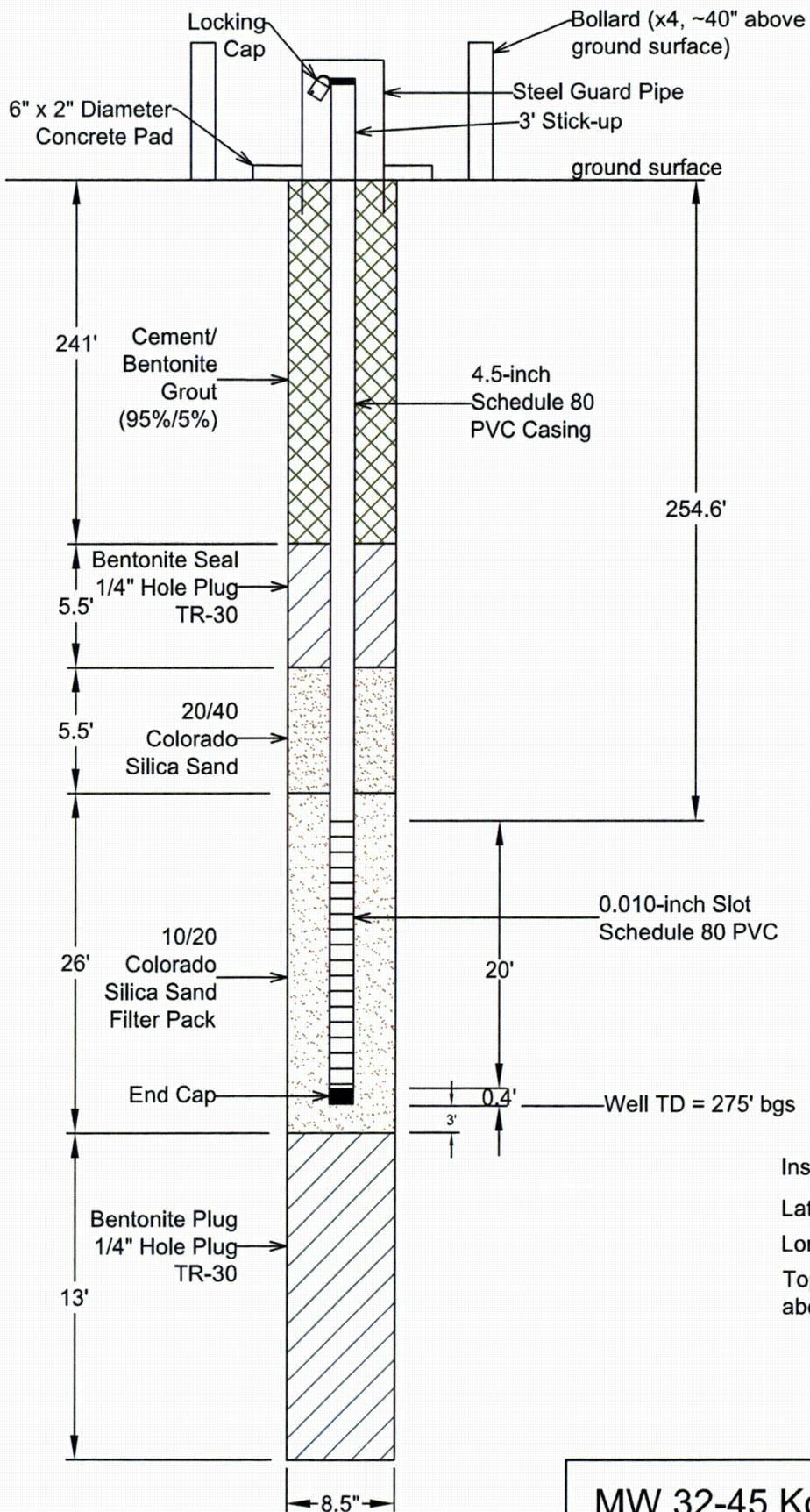
Top of Casing Elevation, ft, above mean sea level: 2117.08

NOT TO SCALE

MW 32-02-R Well Diagram

BHP Billiton
Rio Algom Site





Install Date: 11/28/12

Latitude: 35.398672181

Longitude: -107.817502916

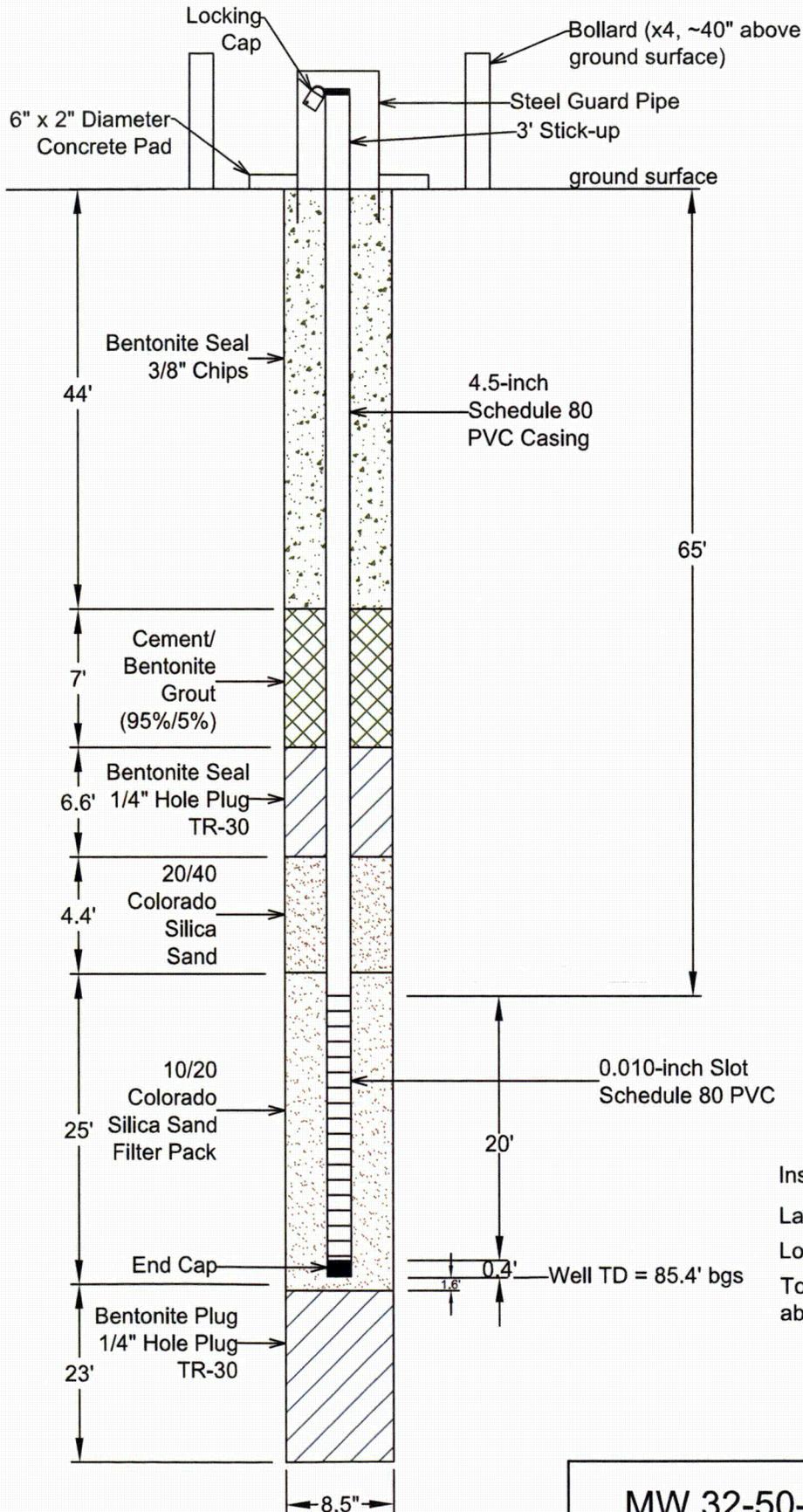
Top of Casing Elevation, ft, above mean sea level: 2111.47

NOT TO SCALE

MW 32-45 Kd-R Well Diagram

BHP Billiton
Rio Algom Site





Install Date: 12/02/12

Latitude: 35.403775552

Longitude: -107.817516889

Top of Casing Elevation, ft, above mean sea level: 2116.23

NOT TO SCALE

MW 32-50-R Well Diagram

BHP Billiton
Rio Algom Site



Borehole TD = 110' bgs

APPENDIX D
Well Development Forms



WELL DEVELOPMENT

PROJECT NAME: Rio Algon Well Replacement WELL ID: mw 5-φ3-R
 PROJECT NO.: Rioal. cφφ 1. 169-φ5-φ1 DATE: φ1/22/13
 FORM COMPLETED BY: J. Hiller

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 56.40
 BOREHOLE DIAMETER (FT): φ.71
 WELL INNER DIAMTERT (FT): φ.33
 SCREEN INTERVAL (FT, BTOC): 36-56

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: φ1/φ8/13
 WATER LEVEL INSTRUMENT USED: Kuck-rental
 WATER LEVEL (FT, BTOC): 29.32
 LINEAR FEET OF WATER (FT): 32.08

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
-----------	-------------	-----------	-----------	-----------	----------	----------	-----------

1 well casing volume = Volume/Linear Foot x Water Column Height

1 c.v. = 21.1 gallons

+ 25 gallons (well install)

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: bail, swab, pump

5 c.v. = WATER VOLUME TO BE REMOVED (GAL): 105.6 WATER VOLUME ACTUALLY REMOVED (GAL): 132

TIME DEVELOPMENT STARTED: 1014 (1/22/13) TIME DEVELOPMENT COMPLETED: φ830 (1/23/13)

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
<u>481 556 mps</u>	<u>1-22-13</u>	<u>JH</u>	<u>2pt ptd, Cond</u>

**WELL DEVELOPMENT**

PROJECT NAME: Rio Algon Well Replacement WELL ID: mw 5-48-R
 PROJECT NO.: Final. C401. 169. 45. 41 DATE: 1/16/13
 FORM COMPLETED BY: C. STORT

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 76.50
 BOREHOLE DIAMETER (FT): φ.71
 WELL INNER DIAMETER (FT): φ.33
 SCREEN INTERVAL (FT, BTOC): 56.10 - 76.10

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 1/16/13
 WATER LEVEL INSTRUMENT USED: K&N - rental
 WATER LEVEL (FT, BTOC): 33.10
 LINEAR FEET OF WATER (FT): 43.40

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
-----------	-------------	-----------	-----------	-----------	----------	----------	-----------

1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 28.6 gallons

+ 100 gallons (well install)

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Bail/Scrub/Bail

5 C.V. = WATER VOLUME TO BE REMOVED (GAL): 143.2 WATER VOLUME ACTUALLY REMOVED (GAL): 151

TIME DEVELOPMENT STARTED: 1351 (1/16/13) TIME DEVELOPMENT COMPLETED: 1948 (1/22/13)

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI 556 MPS	1/16/13	CHS	3 pt pt, Sp Cond.
" " "	1/17/13	CHS	" "
" " "	1/22/13	JH.	2 pt pt "



WATER QUALITY READINGS DURING DEVELOPMENT

DATE	TIME	VOLUME (gal)	TEMP °C °F	SP. COND (µS/CM)	pH	CONDITION	
11/16/13	1401	6	11.65	3179	7.38	silty, muddy, lt brown	
	1430	26	11.98	3698	7.36	sandy, lt brown	
	1441	34	12.11	4108	7.32	sandy, silty, lt brown	
	1548	37					
	1608	39	12.75	4220	7.25	" " "	
	1613	52	12.61	4232	7.30	" " "	
11/17/13		40 CM7	445				
	0850	54	12.61	4164	7.02	silty, lt brown	
	0856	66	12.15	4304	7.21	" "	
	0901	74	12.01	4327	7.25	" "	
	0905	77					
	1139	81	11.85	4406	7.410	" "	
	1144	97	11.74	4404	7.27	silty, clearing, lt brown, gas exsolving	
11/22/13	0953	99	10.15	3811	7.03	silty, lt. brn	
	0955	126	12.26	3849	7.19	" "	
	1435	128	12.80	4185	7.13	sl. silty, clearing	
	1440	140	12.35	4098	7.26	" "	
	1448	157	12.50	3888	7.34	clearing	
			parameters "stable"				

Stabilization = Temp. ±1°C, pH ±0.2 units, Sp. Cond. ±10%

COMMENTS: _____



WELL DEVELOPMENT

PROJECT NAME: Rio Algon Well Replacement WELL ID: MW 5-73-R
 PROJECT NO.: Rioal. C & P. 169. 45. 41 DATE: 01/22/13
 FORM COMPLETED BY: J. Hiller

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 35-80
 BOREHOLE DIAMETER (FT): 6.71
 WELL INNER DIAMETER (FT): 6.33
 SCREEN INTERVAL (FT, BTOC): 15.4-35.4

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 01/22/13
 WATER LEVEL INSTRUMENT USED: Keck - rental
 WATER LEVEL (FT, BTOC): 19.20
 LINEAR FEET OF WATER (FT): 16.6

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
-----------	-------------	-----------	-----------	-----------	----------	----------	-----------

1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 11 gallons

+10 gallons (well install)

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Bailing & swabbing
 S.C.V. = WATER VOLUME TO BE REMOVED (GAL): 55 WATER VOLUME ACTUALLY REMOVED (GAL): 55
 TIME DEVELOPMENT STARTED: 1014 TIME DEVELOPMENT COMPLETED: 1405

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
<u>YSI 556 MPS</u>	<u>1-27-13</u>	<u>JH</u>	<u>2pt Alt, Sp. Cond.</u>



WELL DEVELOPMENT

PROJECT NAME: Rio Algom Well Replacement WELL ID: MW 30-04-R
 PROJECT NO.: Rioal. 2001. 169. 05. 01 DATE: 1/14/13
 FORM COMPLETED BY: C. SHORT

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 72.25
 BOREHOLE DIAMETER (FT): φ-71
 WELL INNER DIAMETER (FT): φ-33
 SCREEN INTERVAL (FT, BTOC): 51.85 - 71.85

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 01/08/13
 WATER LEVEL INSTRUMENT USED: Kuck - rental
 WATER LEVEL (FT, BTOC): 55.47
 LINEAR FEET OF WATER (FT): 16.78

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 11.1 gallons

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Bail / Swab / bail
 5 C.V. = WATER VOLUME TO BE REMOVED (GAL): 55.4 WATER VOLUME ACTUALLY REMOVED (GAL): 290
 TIME DEVELOPMENT STARTED: 1227 TIME DEVELOPMENT COMPLETED: 1055
1/15/13

+ 18 gallons (well install)

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI-556 MPS	1/14/13	CAS	



CHS

Recharged 68 - 57 = 11 min

PLW	Time elapsed
57.1	5:35
58.1	3:23
59.1	2:19
60.1	1:23
61.1	0:39
62.1	0:00

WATER QUALITY READINGS DURING DEVELOPMENT

DATE	TIME	VOLUME (gal)	TEMP °C °F	SP. COND (µS/CM)	pH	CONDITION
1/14/13	1231	2	11.33	5435	7.73	11 brown, murky, silty, fine sand
	1252	0	10.52	5429	7.46	11 sandy, clogging trailer
	1305	20	10.47	5581	7.29	11 sandy, trailer flowing better
	1403	26	11.14	5049	7.40	11 " " " muddy
	1407	34	11.09	5127	7.37	11 " " " muddy
	1414	41	11.21	5498	7.25	11 " " " muddy
	1435	55	11.10	5900	7.10	11 " " clearing a little
	1446	63	11.00	5582	7.14	11 brown, silty, murky
CHS	1445	70	11.15	5455	7.24	11 " " " "
	1445	70	11.24	5689	7.17	11 " " " "
	1449	82	11.31	5816	7.08	11 " " " "
	total vol: 82 gal					
	Bailer Additions:					
	Date	Gal				
	1/14/13	50				
	1/15/13	55				
		55				
		40				
	Total 240 gal					

Stabilization = Temp. $\pm 1^{\circ}\text{C}$, pH ± 0.2 units, Sp. Cond. $\pm 10\%$

COMMENTS: _____



WELL DEVELOPMENT

PROJECT NAME: Rio Algom Well Replacement WELL ID: mw 31-05-R
 PROJECT NO.: Rioal. Cond 1. 169. 05. 01 DATE: 1/15/13
 FORM COMPLETED BY: C. SHORT

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 66.40
 BOREHOLE DIAMETER (FT): φ.71
 WELL INNER DIAMETER (FT): φ.33
 SCREEN INTERVAL (FT, BTOC): 46-66

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 1/16/13
 WATER LEVEL INSTRUMENT USED: Keck - rental
 WATER LEVEL (FT, BTOC): 48.75
 LINEAR FEET OF WATER (FT): 17.65

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 11.7 gallons

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: bail/swab/bail
 S.C.V. = WATER VOLUME TO BE REMOVED (GAL): 58.3 WATER VOLUME ACTUALLY REMOVED (GAL): 137
 TIME DEVELOPMENT STARTED: 11:30 TIME DEVELOPMENT COMPLETED: 1:07
1/15/13

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
<u>YSI 656 MPS</u>	<u>1/15/13</u>	<u>CHS</u>	<u>Set pH, Sp. Cond</u>



MIS E DTCW
 12:47 48.75
 08:55 49.75
 0:35 50.75
 4:40 51.75
 3:26 52.75
 10:6 53.75

E 0:26 54.75

WATER QUALITY READINGS DURING DEVELOPMENT

Pasted
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DATE	TIME	VOLUME (gal)	TEMP °C °F	SP. COND (µS/CM)	pH	CONDION
11/15/13	11:30	Began bailing				
11/15/13	11:41	10	10.23	6580	6.34	sandy, silty
11/15/13	11:48	19	10.82	6662	6.66	" "
	11:58	32	10.74	6952	6.65	" "
	12:28	38 gal	scribble			
	12:40	40	10.94	6642	6.99	" "
	12:44	49	10.97	6779	6.79	" "
	12:48	57	10.67	6878	6.76	" "
	1:00	82	scribble			
	1:00	137	6 gal			

Stable

Stabilization = Temp. ±1°C, pH ±0.2 units, Sp. Cond. ±10%

COMMENTS: stabilized at 57 gal purged. continued to bail to remove sediment.



WELL DEVELOPMENT

PROJECT NAME: Rio Algam Well Replacement WELL ID: mw 31-70-R
 PROJECT NO.: Rioal. C 01. 169. 05. 01. DATE: ~~1/15/13~~ 1/15/13 CHS
 FORM COMPLETED BY: C. SHORT

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 81.40
 BOREHOLE DIAMETER (FT): φ.71
 WELL INNER DIAMETER (FT): φ.33
 SCREEN INTERVAL (FT, BTOC): 61-81

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 01/16/13
 WATER LEVEL INSTRUMENT USED: Kent - rental
 WATER LEVEL (FT, BTOC): 40.30
 LINEAR FEET OF WATER (FT): ~~41.10~~ 41.10

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height
 1 C.V. = 27.1 gallons

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Baril Kwab/pump
 S.C.V. = WATER VOLUME TO BE REMOVED (GAL): 135.6 WATER VOLUME ACTUALLY REMOVED (GAL): 163
 TIME DEVELOPMENT STARTED: 1510 TIME DEVELOPMENT COMPLETED: 0930
1/15/13 1/16/13

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI 556 MPS	1/15/13	CHS	3pt pH, Sp. Cond.
" " "	1/16/13	CHS	3pt pH, Sp. Cond.



WELL DEVELOPMENT

PROJECT NAME: Rio Algom Well Replacement WELL ID: mw 32-φ1-R
 PROJECT NO.: Rio Al. C φ1. 169. φ5. φ1 DATE: 1/16/13
 FORM COMPLETED BY: C. SIRT

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 61.40
 BOREHOLE DIAMETER (FT): φ. 71
 WELL INNER DIAMETER (FT): φ. 55
 SCREEN INTERVAL (FT, BTOC): 41-61

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: φ1/16/13
 WATER LEVEL INSTRUMENT USED: Kuck-ventil
 WATER LEVEL (FT, BTOC): 19.70
 LINEAR FEET OF WATER (FT): 41.70

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 27.5 gallons

+ 12 gallons (well install)

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Soil/Swab/Bail
 S.C.V. = WATER VOLUME TO BE REMOVED (GAL): 137.6 WATER VOLUME ACTUALLY REMOVED (GAL): 165
 TIME DEVELOPMENT STARTED: 1114 TIME DEVELOPMENT COMPLETED: 1256

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI 556 MPS	1/16/13	CHS	3 pt pH, Sp. Cond.



WELL DEVELOPMENT

PROJECT NAME: Rio Algon Well Replacement WELL ID: MW 32-62-R
 PROJECT NO.: Rioal. 2001. 169. 05. 01 DATE: 1/13/13
 FORM COMPLETED BY: C. SHORT

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): ~~66.8~~ 70.65
 BOREHOLE DIAMETER (FT): φ.71
 WELL INNER DIAMETER (FT): φ.35
 SCREEN INTERVAL (FT, BTOC): ~~50.6 - 70.6~~
50.25 - 70.25

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: φ1/φ8/13
 WATER LEVEL INSTRUMENT USED: Keck - rental
 WATER LEVEL (FT, BTOC): 49.97
 LINEAR FEET OF WATER (FT): 20.68

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 13.6 gallons

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Soil/swab/soil/pump
 5 C.V. = WATER VOLUME TO BE REMOVED (GAL): 68.2 WATER VOLUME ACTUALLY REMOVED (GAL): 81
 TIME DEVELOPMENT STARTED: 11:00 TIME DEVELOPMENT COMPLETED: 11:15

+ 7.5 gallons (well install)

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI 556 MPS	1/13/13	CHS	3 pt pH, Sp Cond.



WELL DEVELOPMENT

PROJECT NAME: Rio Algom Well Replacement WELL ID: MW 30-48 Kel-R
 PROJECT NO.: Rio Algom 169.45-41 DATE: 11/19/13
 FORM COMPLETED BY: L. Dalton

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 358.4'
 BOREHOLE DIAMETER (FT): 8.5" (φ)
 WELL INNER DIAMETER (FT): 4"
 SCREEN INTERVAL (FT, BTOC): 338'-358'

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 11/13 @ 1550
 WATER LEVEL INSTRUMENT USED: Rental - Keck
 WATER LEVEL (FT, BTOC): 322.50
 LINEAR FEET OF WATER (FT): 35.9'

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Swab, bail, pump

3 C.V. → WATER VOLUME TO BE REMOVED (GAL): 118.5 WATER VOLUME ACTUALLY REMOVED (GAL): 530
 TIME DEVELOPMENT STARTED: 1015 (11/19/13) TIME DEVELOPMENT COMPLETED: 1230 (11/19/13)
+400 gallons (well install) / 3 C.V. = 71 gallons (minimum purge w/ stabilization)

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI-556	11/19/13	LD	3pt-PH + Sp. Cond (1.413 μ s/cm)
YSI-556	11/10/13	LD	2pt-PH (9.07) + Sp. Cond (1.413 μ s/cm)



WATER QUALITY READINGS DURING DEVELOPMENT

6 gal. water

Σ=326' static

DATE	TIME	VOLUME (gal)	TEMP °C °F	SP. COND (µS/CM)	pH	CONDITION
1/4/13	1110	8	15.40	4,984	6.35	cloudy - brown
	1120	16	14.53	4,978	6.45	" - gray / ^{recharge} / 10 seconds
	1118	25	14.00	5,176	6.74	" " - pump intake @ 27 gals
	1439	55	17.27	5,135	6.34	" - @ - 2 gpm
	1508	95	16.81	5,137	6.17	slightly cloudy - 11. gray @ 1 gpm
	1532	120	16.33	5,168	6.26	" " "
	1558	148	18.16	5,120	6.20	" " intake = 345'
	1629	177	18.23	5,183	6.23	" " "
1/10/13	6854	190	10.37	5,073	6.32	mostly clear - intake @ 342' @ 1.75 gpm
	6943	210	17.57	5,118	6.74	" - intake = 357' @ 1.25 gpm
	1014	300	18.20	5,105	6.71	" - " @ 2.25 gpm
	1055	385	17.99	5,140	6.95	" - intake = 352' @ 2.25 gpm
	1110	425	17.84	5,136	6.81	" - " @ 2.9 gpm
	1125	440	17.94	5,139	6.79	" " "
	1145	480	17.80	5,163	6.72	" " "
	1225	520	17.86	5,182	6.79	" " "
	1230	530	17.88	5,180	6.77	" " "

recharge / 10 seconds @ 27 gals

intake = 345' @ 1.75 gpm
intake = 357' @ 1.25 gpm
intake = 352' @ 2.25 gpm
@ 2.9 gpm

Stabilization = Temp. ±1°C, pH ±0.2 units, Sp. Cond. ±10%

COMMENTS: Initially bailed 6 gallons to check water condition & then switched to swimming.



WELL DEVELOPMENT

PROJECT NAME: Rio Algom Well Replacement WELL ID: MW 31-01 Tra-R
 PROJECT NO.: Rioal. C001. 169.05.01 DATE: 4/29/13
 FORM COMPLETED BY: L. Dalton 4/13/13

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 213.40
 BOREHOLE DIAMETER (FT): 0.71
 WELL INNER DIAMETER (FT): 0.33
 SCREEN INTERVAL (FT, BTOC): 193-213

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 4/28/13
 WATER LEVEL INSTRUMENT USED: rental
 WATER LEVEL (FT, BTOC): 204.75
 LINEAR FEET OF WATER (FT): 8.65

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 5.7 gallons

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: swab/bail
 S.C.V. → WATER VOLUME TO BE REMOVED (GAL): 28.6 WATER VOLUME ACTUALLY REMOVED (GAL): _____
 TIME DEVELOPMENT STARTED: 11:30 (4/13/13) TIME DEVELOPMENT COMPLETED: _____

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI 556 MPS	1/13/13	CHS	3 pt pH, Sp. Cond
" " "	1/14/13	CHS	" "
" " "	1/17/13	CHS	" "
" " "	1.23.13	JH	3 pt pH, Sp. Cond.
" " "	1.29.13	JH	3 pt pH, Sp. Cond.
" " "	1.30.13	JH	" "



WELL DEVELOPMENT

PROJECT NAME: Rio Algom Well Replacement WELL ID: MW-31-02 Trb-R
 PROJECT NO.: Rioal. Cdp1. 169. ds. d1 DATE: 6/23/13
 FORM COMPLETED BY: J. Hiller

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 128.4
 BOREHOLE DIAMETER (FT): 0.71
 WELL INNER DIAMETER (FT): 0.33
 SCREEN INTERVAL (FT, BTOC): 108-128

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 01/08/13
 WATER LEVEL INSTRUMENT USED: Leck rental
 WATER LEVEL (FT, BTOC): 95.20
 LINEAR FEET OF WATER (FT): 32.90

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

1 cv = 21.7 gal

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Swab/bail, pump

5 cv = WATER VOLUME TO BE REMOVED (GAL): 108.6 WATER VOLUME ACTUALLY REMOVED (GAL): 116

TIME DEVELOPMENT STARTED: 1000 (1/23/13) TIME DEVELOPMENT COMPLETED: 6904 (1/30/13)

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI 556 M/S	1-23-13	JH	3 pt pH, Sp Cond
" " "	1-29-13	JH	3 pt pH, Sp Cond
" " "	1-30-13	JH	" " "



WELL DEVELOPMENT

PROJECT NAME: Rio Algon Well Replacement WELL ID: mw 32-45 Kdr-R
 PROJECT NO.: Rioal. Cdd 1. 169. 45. 41 DATE: 1/10/13
 FORM COMPLETED BY: L. Dalton

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 278
 BOREHOLE DIAMETER (FT): 0.71
 WELL INNER DIAMETER (FT): 0.33
 SCREEN INTERVAL (FT, BTOC): 257.6 - 277.6

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 1/10/13
 WATER LEVEL INSTRUMENT USED: Keck - rental
 WATER LEVEL (FT, BTOC): 256.55
 LINEAR FEET OF WATER (FT): 21.45

1 c.u. = 14.15 gallons

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: swab/bail, pump
 WATER VOLUME TO BE REMOVED (GAL): 70.8 WATER VOLUME ACTUALLY REMOVED (GAL): 77
 TIME DEVELOPMENT STARTED: 1545 (1/10/13) TIME DEVELOPMENT COMPLETED: 1008

5 c.u. =>
↓

+346 gallons (well install)

1/14/13

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
YSI-556	1/10/13	LD	(2pt - pH + Sp. Cond (1/10/13 us/cm))
YSI-556	1/11/13	LD	3pt - pH + Sp. Cond (1/11/13 us/cm)
YSI-556	1/12/13	CS	" "

1"

1"

CS

1"

1"



WELL DEVELOPMENT

PROJECT NAME: Rio Algom Well Replacement WELL ID: mw 32-50-R
 PROJECT NO.: Rioal. C001-169.05-01 DATE: 01/12/13
 FORM COMPLETED BY: L. Dalton

WELL CONSTRUCTION

WELL TOTAL DEPTH - FEET BELOW TOP OF CASING (FT, BTOC): 88.40
 BOREHOLE DIAMETER (FT): φ.71
 WELL INNER DIAMETER (FT): φ.33
 SCREEN INTERVAL (FT, BTOC): 68-88

WATER VOLUME CALCULATION

DATE/TIME OF MEASUREMENT: 01/08/13
 WATER LEVEL INSTRUMENT USED: Keck - rental
 WATER LEVEL (FT, BTOC): 50.39
 LINEAR FEET OF WATER (FT): 38.01

PURGE VOLUME CONVERSIONS (Use Well Casing diameter to determine Volume/Linear Foot)

1" = 0.04	1.5" = 0.09	2" = 0.17	3" = 0.38	4" = 0.66	6" = 1.5	8" = 2.6	10" = 4.1
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1 well casing volume = Volume/Linear Foot x Water Column Height

1 C.V. = 25.1 gallons

DEVELOPMENT CRITERIA

METHOD OF DEVELOPMENT: Swab, bail + pumping

5 C.V. = WATER VOLUME TO BE REMOVED (GAL): 125.4 WATER VOLUME ACTUALLY REMOVED (GAL): 140 gals.

TIME DEVELOPMENT STARTED: 1405 TIME DEVELOPMENT COMPLETED: 1645

WATER QUALITY INSTRUMENTS

INSTRUMENT	CALIBRATION PERFORMED	TECH	COMMENTS
<u>YSI-556</u>	<u>1/12/13</u>	<u>CS</u>	<u>3pt - pH + Sp. Cond. (1,413 µS/cm)</u>
<u>11</u>	<u>1/13/13</u>	<u>"</u>	<u>"</u>

APPENDIX E

Well Permits



STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER
District I

SCOTT A. VERHINES, P.E.
STATE ENGINEER

5550 San Antonio Drive NE
Albuquerque, NM 87109-4127
(505) 383-4000

October 24, 2012

ATTN: Mr. Billy Ray
Rio Algom Mining, LLC
P.O. Box 218
Grants, NM 87020.

OSE Well Nos. B-481-POD7 through B-481-POD14

Dear Mr. Ray:

Your permits to construct eight monitoring wells are enclosed. They have been approved subject to the enclosed conditions of approval.

Sincerely,

A handwritten signature in cursive script that reads "David B. Anderson".

David B. Anderson
Water Resource Specialist Senior

Enclosures (8)

**NEW MEXICO OFFICE OF THE STATE ENGINEER
 PERMIT TO DRILL A MONITORING WELL
 CONDITIONS OF APPROVAL**

1. These applications are approved provided that they are not exercised to the detriment of any others having existing rights, and are not contrary to the conservation of water in New Mexico nor detrimental to the public welfare of the state; and further subject to the following conditions of approval:

Permittee: Rio Algom Mining, LLC

Permit Number: B-481

Application File Date: October 22, 2012

Source: Alluvium

Monitoring Well Locations:

OSE File No.	Rio Algom's Well No.	Latitude (North)	Longitude (West)
B-481-POD7	MW 31-05-R	35° 24' 20.629"	107° 49' 18.518"
B-481-POD8	MW 30-68-R	35° 25' 6.936"	107° 50' 13.780"
B-481-POD9	MW 31-70-R	35° 24' 10.535"	107° 49' 25.499"
B-481-POD10	MW 32-02-R	35° 24' 20.749"	107° 49' 15.679"
B-481-POD11	MW 32-01-R	35° 23' 55.923"	107° 49' 16.441"
B-481-POD12	MW 5-03-R	35° 23' 28.874"	107° 48' 48.223"
B-481-POD13	MW 30-04-R	35° 24' 23.608"	107° 49' 18.452"
B-481-POD14	MW 5-73-R	35° 23' 13.273"	107° 48' 45.218"

2. No water shall be appropriated and beneficially used under this permit. No water shall be diverted from these wells, except for monitoring or testing purposes, unless permits to use water from these wells are acquired from the Office of the State Engineer. Well/aquifer testing shall not exceed ten cumulative days.
3. The wells shall be constructed by a well driller licensed in the State of New Mexico. The State of New Mexico requires on-site supervision of well drilling by the holder of a New Mexico Well Driller License or OSE-registered Drill Rig Supervisor.
4. Water well drilling and well drilling activities are regulated by the State Engineer pursuant to 19.27.4 NMAC, which prohibits construction of wells that allow groundwater to flow uncontrolled to land surface or move appreciably between geologic units. In the event that artesian conditions are encountered, the well driller shall immediately comply with 19.27.4.31 NMAC.

**NEW MEXICO OFFICE OF THE STATE ENGINEER
PERMIT TO DRILL A MONITORING WELL
CONDITIONS OF APPROVAL**

5. Well driller shall file a well record itemizing as-built well design and materials with the State Engineer (address: 5550 San Antonio Drive NE, Albuquerque, NM 87109), within 20 days after completion of the well. Well driller shall utilize the most recent form, available on the State Engineer's website at <<http://www.ose.state.nm.us>>. Aquifer/pump test data, if collected, shall be filed not later than ten (10) days after completion of the aquifer/pump test(s).
6. The Permit to Drill a Monitoring Well is valid for one year after the date of approval for construction purposes.
7. Upon expiration of DP-169, wells constructed pursuant to this permit shall be plugged and abandoned in accordance with an OSE-approved well plugging plan of operations. Any other abandoned wells on the Ambrosia Lake facility shall be plugged pursuant to Subsection C of 19.27.4.30 NMAC

Witness my hand and seal this 23rd day of October, A.D. 2012.

Scott A. Verhines, P.E., State Engineer

By:



David B. Anderson
Water Resource Specialist Senior

HU 50382
#72

File No. B-481

NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL WITH NO CONSUMPTIVE USE OF WATER



(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: <input type="checkbox"/> check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:15

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number:	Trn Number:
Trans Description (optional):	B-481-POD7
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

NW1/4 NW1/4 NW1/4 Section 32 T14N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):							
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)							
NM State Plane (NAD83) - In feet	NM West Zone <input type="checkbox"/>			X (in feet):			
	NM Central Zone <input type="checkbox"/>			Y (in feet):			
	NM East Zone <input type="checkbox"/>						
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>			Easting (in meters):			
	UTM Zone 12N <input type="checkbox"/>			Northing (in meters):			
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	24	min	20.629	sec
	Longitude:	-107	deg	49	min	18.518	sec
Land Grant (if applicable):							
Well is on Land Owned by (required): Rio Algom Mining, Llc							
Other Location Information (complete the below, if applicable):							
PLSS Quarters or Halves:		Section:		Township:		Range: County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:	
Hydrographic Survey:				Map:		Tract:	
Other description relating well to common landmarks, streets, or other:							
Well Information:							
Approximate depth of well (feet): 80.00				Outside Diameter of Well Casing (inches): 4.50			
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458			
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____							

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 31-05-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

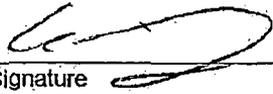
<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation; <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.</p>
--	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Applicant Signature 

Applicant Signature _____

2012 OCT 22 PM 1:15

ACTION OF THE STATE ENGINEER

This application is (check one):

- approved partially approved denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 23rd day of October 20 12, for the State Engineer,

Scott A. Verhines, P.E.
 State Engineer, State Engineer

By: 
 Signature

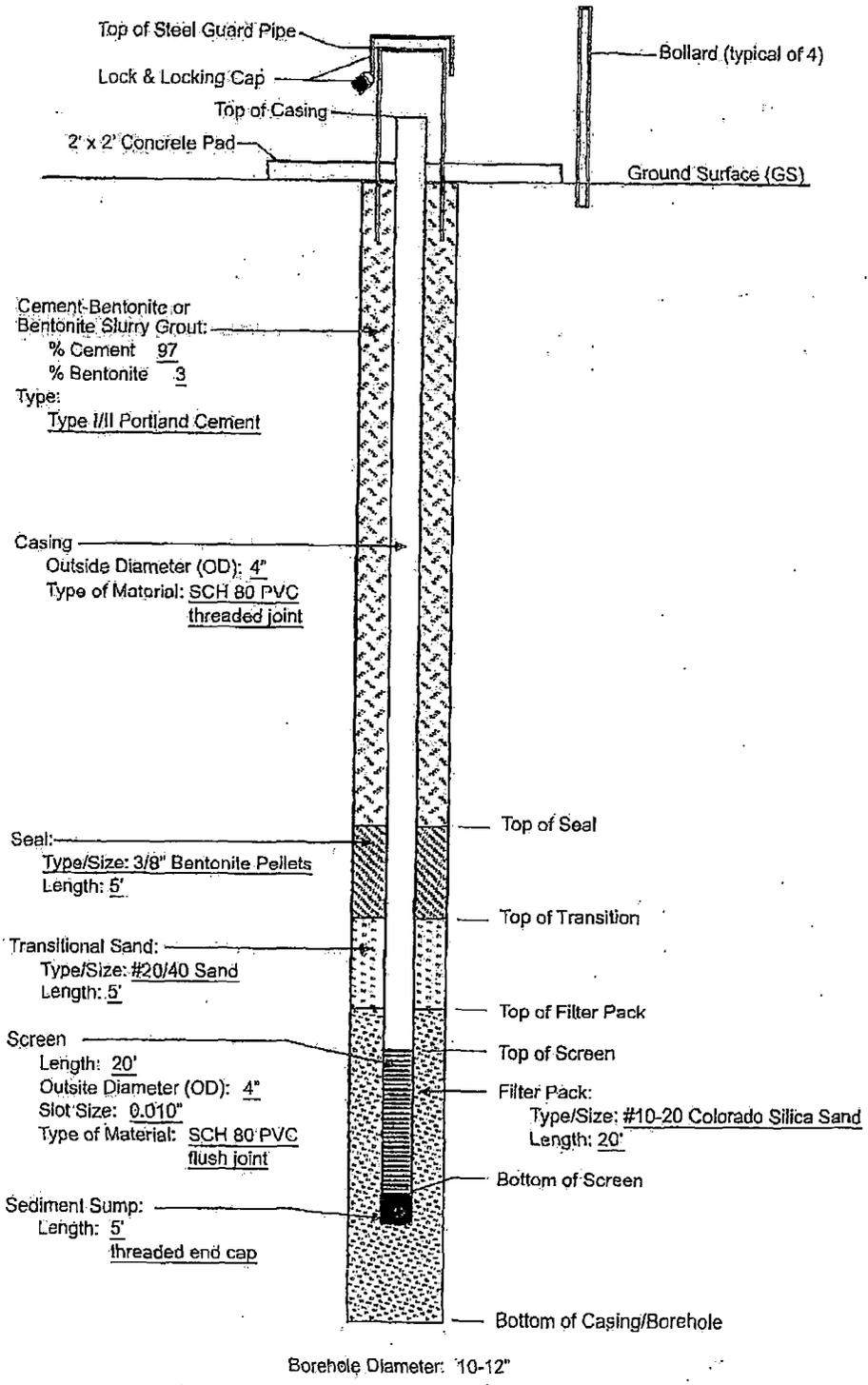
Print _____

Title: _____
 Print

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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NOT TO SCALE

2012 OCT 22 PM 1:15

INTERA

2012 OCT 22 PM 1:15

Figure 3
 Proposed Alluvial and Bedrock
 Well Construction Detail
 Rio Algom Work Plan

HCI-50382
#72

File No. B-481



NEW MEXICO OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER



(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray <input type="checkbox"/> check here if Agent	Contact or Agent: <input type="checkbox"/> check here if Agent
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505.287.8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2017 OCT 22 PM 1:15

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number:	Trn Number:
Trans Description (optional): B-481-P0D8	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

L+1 NW 1/4 Section 30 T14N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):							
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)							
NM State Plane (NAD83) - In feet	NM West Zone: <input type="checkbox"/>			X (in feet):			
	NM Central Zone: <input type="checkbox"/>				Y (in feet):		
	NM East Zone: <input type="checkbox"/>						
UTM (NAD83) - In meters	UTM Zone 13N: <input type="checkbox"/>			Easting (in meters):			
	UTM Zone 12N: <input type="checkbox"/>				Northing (in meters):		
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	25		min	6.936
	Longitude:	-107	deg	50	min	13.780	sec
Land Grant (if applicable):							
Well is on Land Owned by (required): Rio Algom Mining, LLC							
Other Location Information (complete the below, if applicable):							
PLSS Quarters or Halves:		Section:		Township:		Range: County:	
Lot No:	Block No:	Unit/Tract:	Subdivision:				
Hydrographic Survey:			Map:			Tract:	
Other description relating well to common landmarks, streets, or other:							
Well Information:							
Approximate depth of well (feet): 73.00				Outside Diameter of Well Casing (inches): 4.50			
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458			
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____							

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 30-68-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type: Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

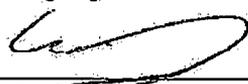
<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> Include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of,</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.</p>
--	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Applicant Signature 

Applicant Signature

2012 OCT 22 PM 1:15

ACTION OF THE STATE ENGINEER

This application is (check one):

- approved partially approved denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 23rd day of October 20 12, for the State Engineer,

Scott A. Verhines, P.E.
 State Engineer

State Engineer

By 

Signature

Print

Title:

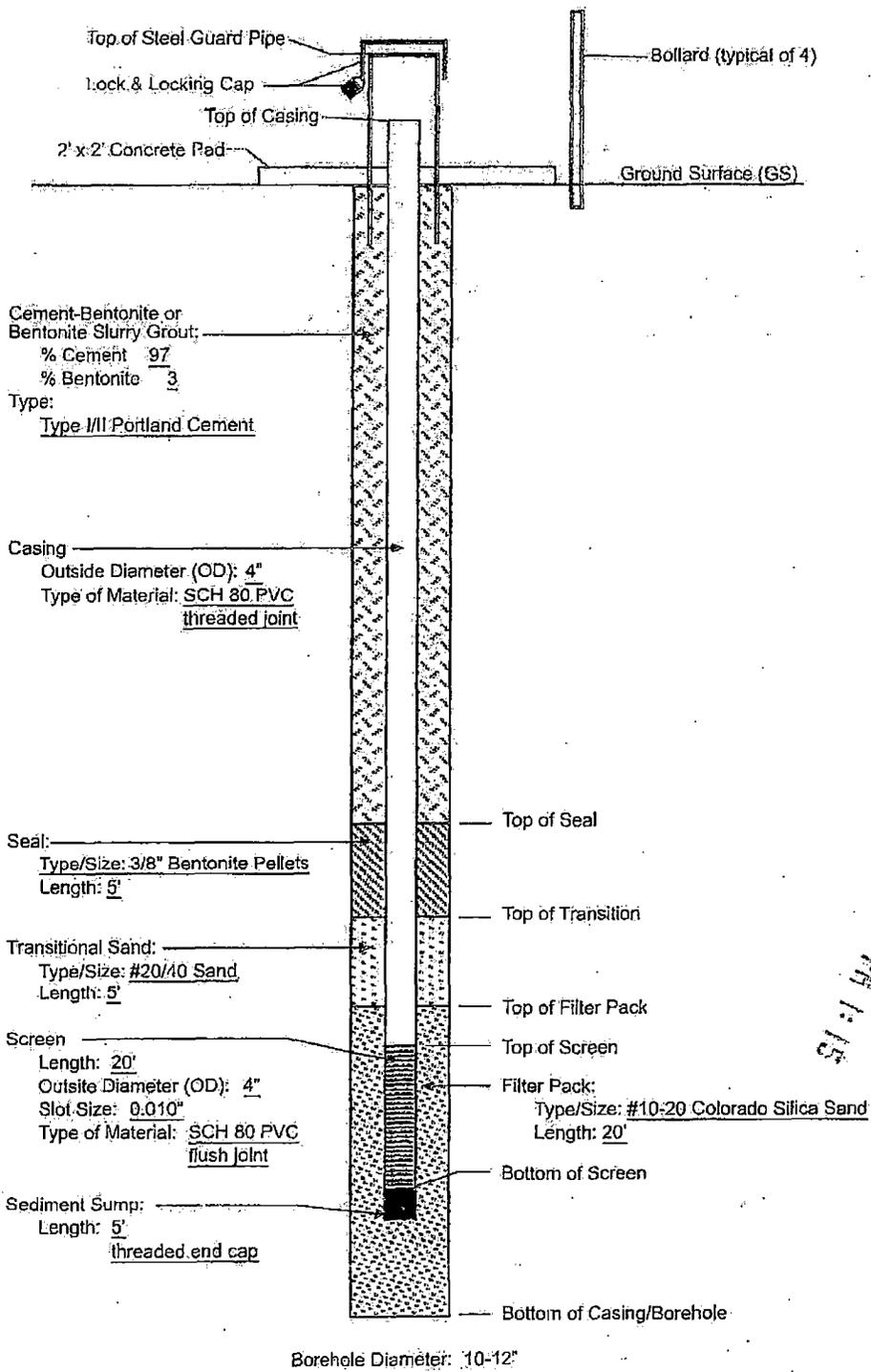
Print

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:

Trn Number:



2012 OCT 22 PM 1:15

NOT TO SCALE

INTEGRA

Figure 3
 Proposed Alluvial and Bedrock
 Well Construction Detail
 Rio Algom Work Plan

HA 50382
#72

File No. B-481



NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: <input type="checkbox"/> check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505-287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:12

OFFICE OF THE STATE ENGINEER
NEW MEXICO

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number:	Perm Number:
Trans Description (optional): B-481-P009	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

SE 1/4 NE 1/4 NE 1/4 Section 31 T14N R01W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):									
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)									
NM State Plane (NAD83) - In feet:	NM West Zone <input type="checkbox"/>			X (in feet):					
	NM Central Zone <input type="checkbox"/>			Y (in feet):					
	NM East Zone <input type="checkbox"/>								
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>			Easting (in meters):					
	UTM Zone 12N <input type="checkbox"/>			Northing (in meters):					
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	24	min	10.535	sec		
	Longitude:	-107	deg	49	min	25.499	sec		
Land Grant (if applicable):									
Well is on Land Owned by (required): Rio Algom Mining, LLC									
Other Location Information (complete the below, if applicable):									
PLSS Quarters or Halves:		Section:		Township:		Range:		County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:			
Hydrographic Survey:				Map:		Tract:			
Other description relating well to common landmarks, streets, or other:									
Well Information:									
Approximate depth of well (feet): 35.00				Outside Diameter of Well Casing (inches): 4.50					
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458					
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____									

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 31-70-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> Include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.</p>
--	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.


 Applicant Signature

Applicant Signature

RECEIVED
 2017 OCT 22 PM 1:15
 STATE ENGINEER'S OFFICE

ACTION OF THE STATE ENGINEER

This application is (check one):

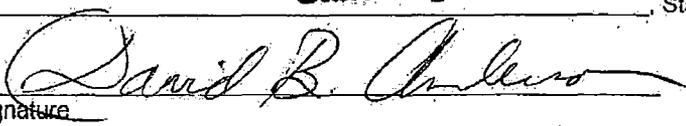
- approved
 partially approved
 denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (*please see attachment*).

Witness my hand and seal this 23rd day of October 20 12, for the State Engineer,

Scott A. Verhines, P.E.
 State Engineer

State Engineer

By: 
 Signature

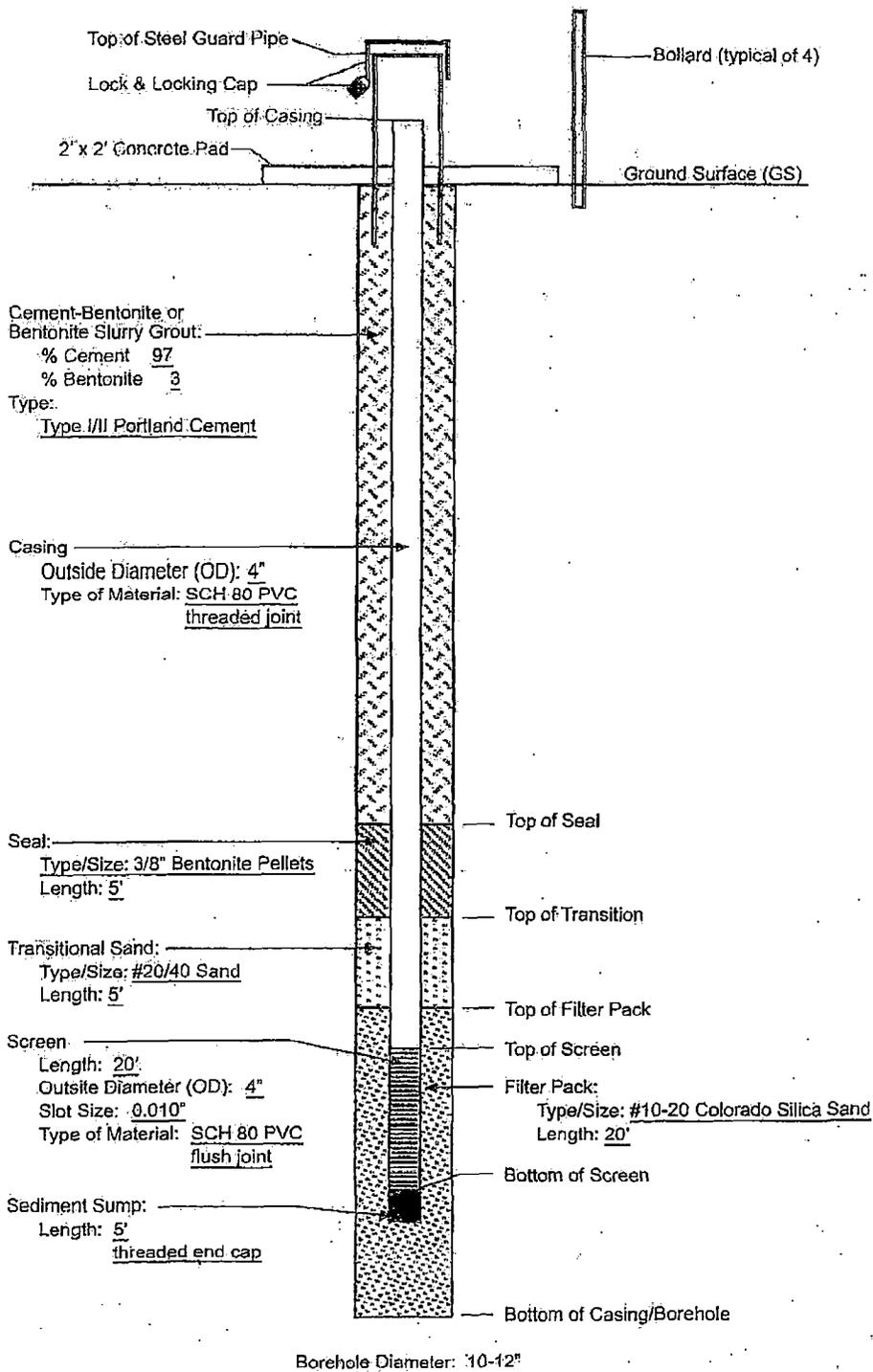
Print

Title:
 Print

FOR USE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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NOT TO SCALE

2012 OCT 22 PM 1:15

INTERA

Figure 3
Proposed Alluvial and Bedrock
Well Construction Detail
Rio Algom Work Plan

HU-50382
#72
Office of the State Engineer
Interstate Stream Commission

File No. B-481

NEW MEXICO OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER



(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: <input type="checkbox"/> check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:1
NEW MEXICO STATE ENGINEER
OFFICE OF THE STATE ENGINEER

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number:	Trn Number:
Trans Description (optional): B-481-POD10	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

NW¹/₄ NW¹/₄ NW¹/₄ Section 32 T14N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):				
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)				
NM State Plane (NAD83) - In feet	NM West Zone	<input type="checkbox"/>	X (in feet):	
	NM Central Zone	<input type="checkbox"/>	Y (in feet):	
UTM (NAD83) - In meters	NM East Zone	<input type="checkbox"/>		
	UTM Zone 13N	<input type="checkbox"/>	Easting (in meters):	
Lat/Long (WGS84) - To 1/10 th of second	UTM Zone 12N	<input type="checkbox"/>	Northing (in meters):	
	Latitude:	35	deg	24 min 20.749 sec
	Longitude:	-107	deg	49 min 15.679 sec
Land Grant (if applicable):				
Well is on Land Owned by (required): Rio Algom Mining, LLC				
Other Location Information (complete the below, if applicable):				
PLSS Quarters or Halves:		Section:	Township:	Range: County:
Lot No:	Block No:	Unit/Tract:	Subdivision:	
Hydrographic Survey:		Map:	Tract:	
Other description relating well to common landmarks, streets, or other:				
Well Information:				
Approximate depth of well (feet): 78.00			Outside Diameter of Well Casing (inches): 4.50	
Driller Name: Yellow Jacket Drilling			Driller License Number: 1458	
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____				

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 32-02-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation; <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.</p>
--	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.


 Applicant Signature

 Applicant Signature

2012 OCT 22 PM 1:15
 NEW MEXICO ENVIRONMENT DEPARTMENT

ACTION OF THE STATE ENGINEER

This application is (check one):

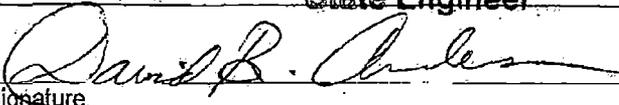
- approved
 partially approved
 denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 23rd day of October, 20 12, for the State Engineer,

Scott A. Verhines, P.E.

State Engineer, State Engineer

By: 
 Signature

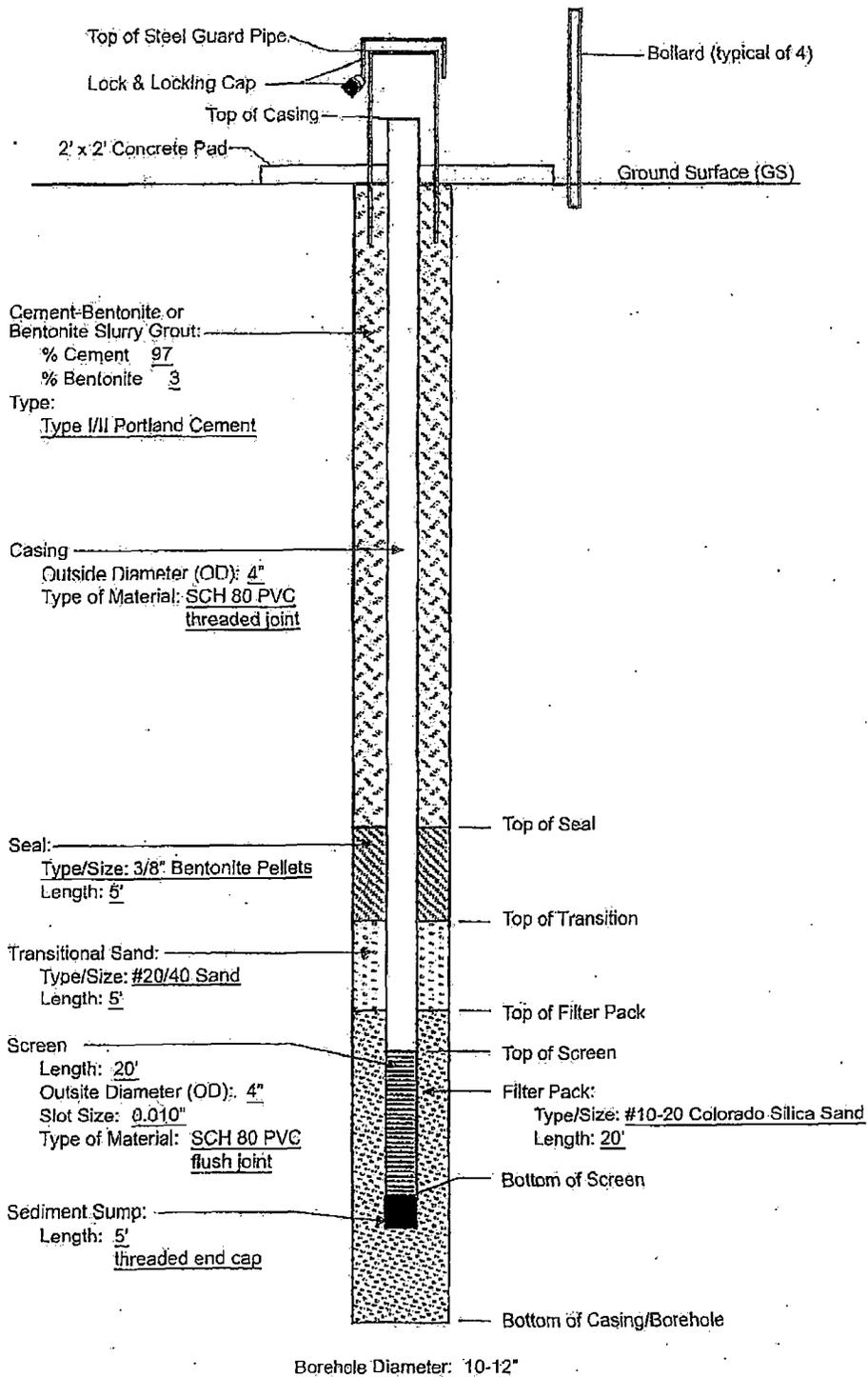
 Print

Title: _____
 Print

FOR USE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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NOT TO SCALE

2012 OCT 22 PM 1:16

INCERA

Figure 3
 Proposed Alluvial and Bedrock
 Well Construction Detail
 Rio Algom Work Plan

HC-50382
#72

File No. B-481

NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL WITH NO CONSUMPTIVE USE OF WATER



(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:16

NEW MEXICO DEPARTMENT OF REVENUE

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number:	Trn Number:
Trans Description (optional): B-481-POD11	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

NW 1/4 NW 1/4 SW 1/4 Section 30 T14N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):									
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)									
NM State Plane (NAD83) - In feet	NM West Zone <input type="checkbox"/>			X (in feet):					
	NM Central Zone <input type="checkbox"/>			Y (in feet):					
	NM East Zone <input type="checkbox"/>								
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>			Easting (in meters):					
	UTM Zone 12N <input type="checkbox"/>			Northing (in meters):					
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	23	min	55.923	sec		
	Longitude:	-107	deg	49	min	16.441	sec		
Land Grant (if applicable):									
Well is on Land Owned by (required): Rio Algom Mining, LLC									
Other Location Information (complete the below, if applicable):									
PLSS Quarters or Halves:		Section:		Township:		Range:		County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:			
Hydrographic Survey:				Map:		Tract:			
Other description relating well to common landmarks, streets, or other:									
Well Information:									
Approximate depth of well (feet): 58.50				Outside Diameter of Well Casing (inches): 4.50					
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458					
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____									

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 32-01-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:

Trn Number:

SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time-frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys; design data, and additional information shall be included to provide all essential facts relating to the request.</p>
--	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Applicant Signature 

Applicant Signature _____

2012 OCT 22 PM 1:16

ACTION OF THE STATE ENGINEER

This application is (check one):

approved partially approved denied

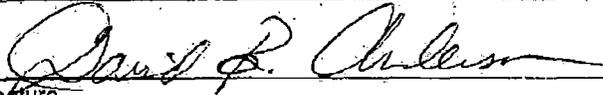
provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 23rd day of October, 20 12, for the State Engineer,

Scott A. Verhines, P.E.

State Engineer

_____, State Engineer

By: 
 Signature

Print

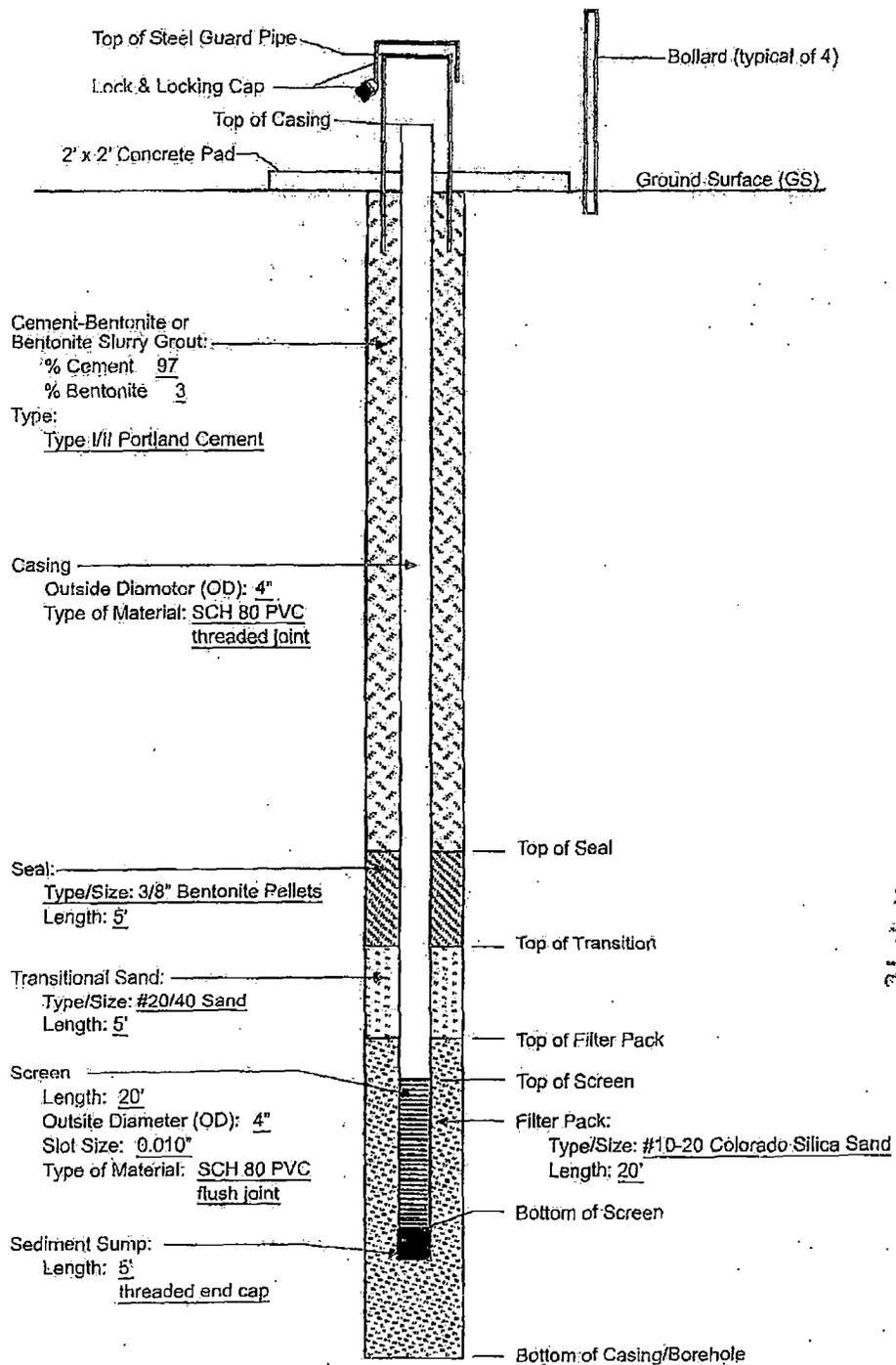
Title:
 Print

FOR USE INTERNAL USE

Application for Permit, Form wr-07

File Number:

Trn Number:



Borehole Diameter: 10-12"

2012 OCT 22 PM 1:16

NOT TO SCALE

INTERA

Figure 3
Proposed Alluvial and Bedrock
Well Construction Detail
 Rio Algom Work Plan

HCI-50382
#72

File No. B-481

NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:15

FOR OSE INTERNAL USE

Application for Permit; Form wr-07, Rev 5/11/11

File Number:	Trn Number:
Trans Description (optional): B-481-POB12	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

Lot 3 NW 1/4 Section 5 T13N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):							
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)							
NM State Plane (NAD83) - In feet:	NM West Zone <input type="checkbox"/>		X (in feet):				
	NM Central Zone <input type="checkbox"/>		Y (in feet):				
	NM East Zone <input type="checkbox"/>						
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>		Easting (in meters):				
	UTM Zone 12N <input type="checkbox"/>		Northing (in meters):				
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	23	min	28.874	sec
	Longitude:	-107	deg	48	min	48.223	sec
Land Grant (if applicable):							
Well is on Land Owned by (required): Rio Algom Mining, Llc							
Other Location Information (complete the below, if applicable):							
PLSS Quarters or Halves:		Section:		Township:		Range: County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:	
Hydrographic Survey:				Map:		Tract:	
Other description relating well to common landmarks, streets, or other:							
Well Information:							
Approximate depth of well (feet): 53.00				Outside Diameter of Well Casing (inches): 4.50			
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458			
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____							

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

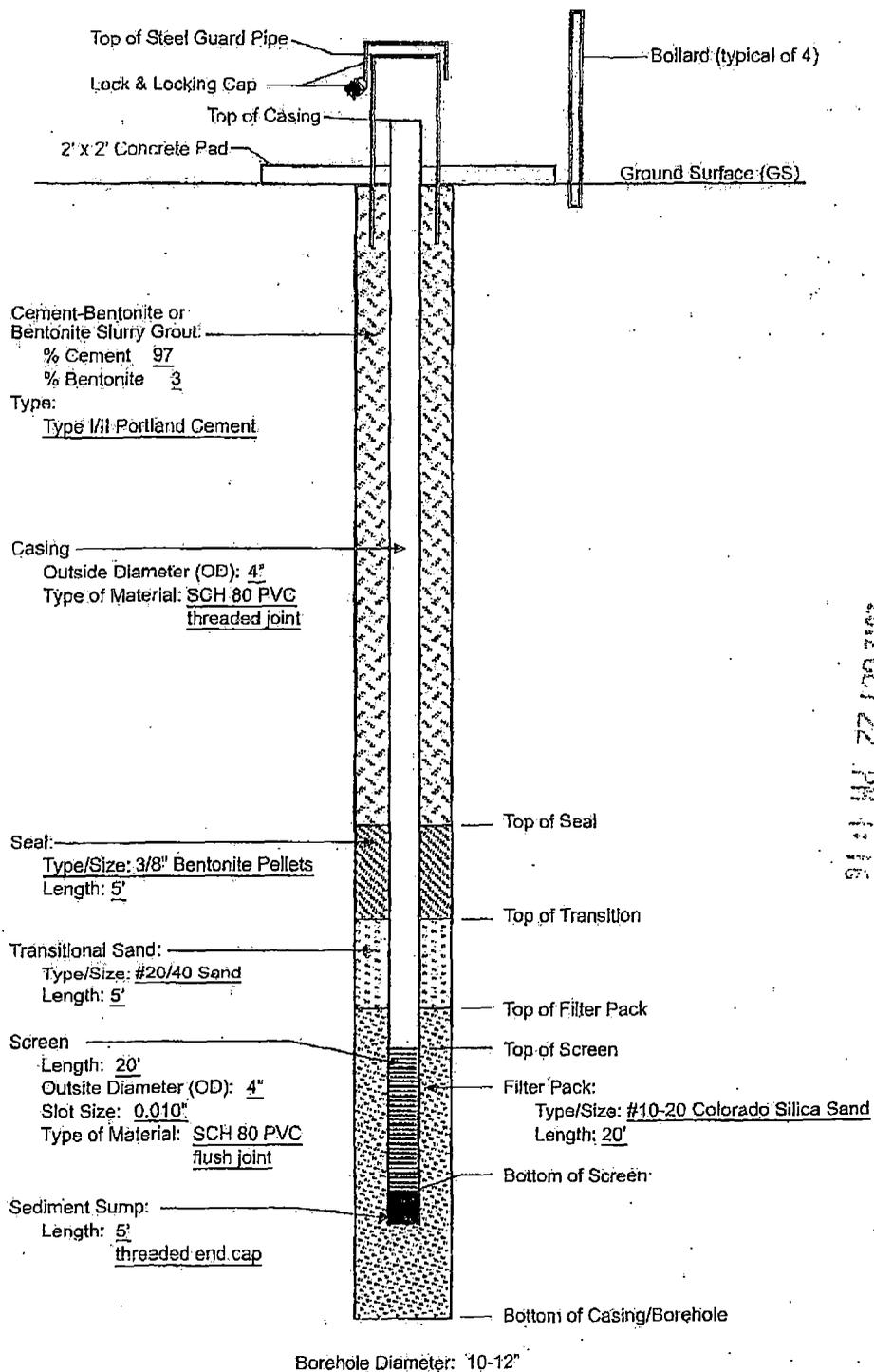
The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 5-03-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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2012 OCT 22 PM 4:16

NOT TO SCALE

INTERA

Figure 3
Proposed Alluvial and Bedrock
Well Construction Detail
 Rio Algom Work Plan



NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:16

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number:	Trn Number:
Trans Description (optional): B-481-POD13	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

SW 1/4 SW 1/4 SW 1/4 Section 29 T14N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):						
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)						
NM State Plane (NAD83) - In feet	NM West Zone <input type="checkbox"/>			X (in feet):		
	NM Central Zone <input type="checkbox"/>			Y (in feet):		
	NM East Zone <input type="checkbox"/>					
UTM (NAD83) - In meters:	UTM Zone 13N <input type="checkbox"/>			Easting (in meters):		
	UTM Zone 12N <input type="checkbox"/>			Northing (in meters):		
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	24	min	23.608 sec
	Longitude:	-107	deg	49	min	18.452 sec
Land Grant (if applicable):						
Well is on Land Owned by (required): Rio Algom Mining, Llc						
Other Location Information (complete the below, if applicable):						
PLSS Quarters or Halves:		Section:	Township:	Range:	County:	
Lot No:	Block No:	Unit/Tract:	Subdivision:			
Hydrographic Survey:			Map:		Tract:	
Other description relating well to common landmarks, streets, or other:						
Well Information:						
Approximate depth of well (feet): 90.00				Outside Diameter of Well Casing (inches): 4.50		
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458		
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____						

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

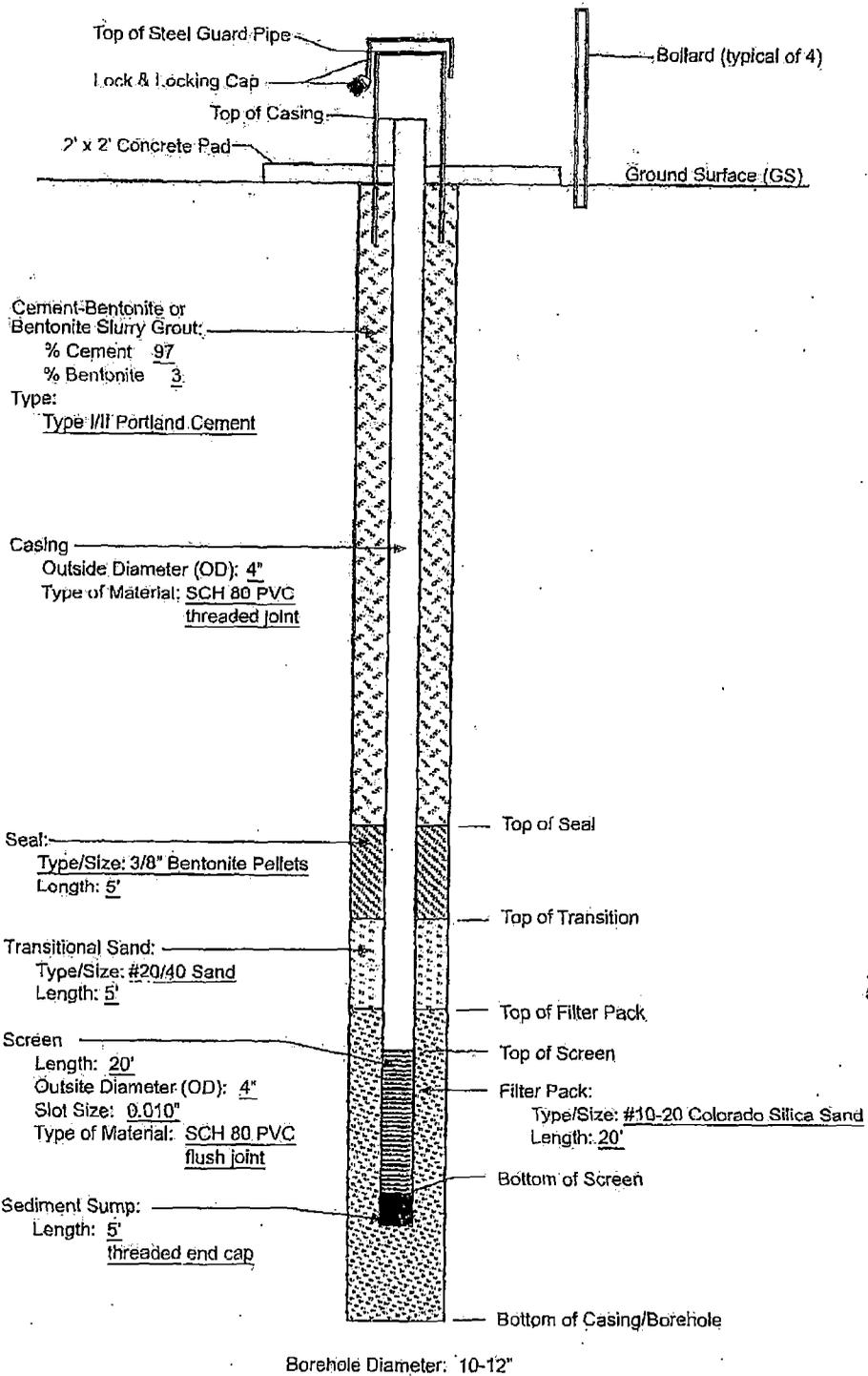
The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 30-04-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trm Number:
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2017 OCT 22 PM 1:16

2017 OCT 22 PM 1:16

NOT TO SCALE

INCERA

Figure 3
Proposed Alluvial and Bedrock
Well Construction Detail
Rio Algom Work Plan

44-50382
#72

File No. B-481

NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL WITH NO CONSUMPTIVE USE OF WATER



(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:16

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number:	Trn Number:
Trans Description (optional): B-481-POD14	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

NW¹/₄ SW¹/₄ NE¹/₄ Section 5 T13N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1.

OSE Well No. (if existing):									
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)									
NM State Plane (NAD83) - In feet	NM West Zone <input type="checkbox"/>			X (in feet):					
	NM Central Zone <input type="checkbox"/>			Y (in feet):					
	NM East Zone <input type="checkbox"/>								
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>			Easting (in meters):					
	UTM Zone 12N <input type="checkbox"/>			Northing (in meters):					
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg.	23	min	13.273	sec		
	Longitude:	-107	deg	48	min	45.218	sec		
Land Grant (if applicable):									
Well is on Land Owned by (required): Rio Algom Mining, LLC									
Other Location Information (complete the below, if applicable):									
PLSS Quarters or Halves:		Section:		Township:		Range:		County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:			
Hydrographic Survey:				Map:		Tract:			
Other description relating well to common landmarks, streets, or other:									
Well Information:									
Approximate depth of well (feet): 38.00				Outside Diameter of Well Casing (inches): 4.50					
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458					
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____									

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 5-73-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

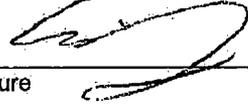
The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.</p>
--	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray _____
 Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.


 Applicant Signature

 Applicant Signature

2012 OCT 22 PM 1:16
 RECEIVED
 STATE ENGINEER

ACTION OF THE STATE ENGINEER

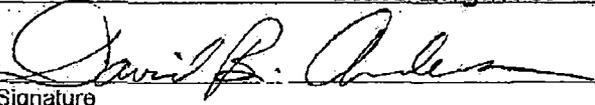
This application is (check one):

- approved partially approved denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (*please see attachment*).

Witness my hand and seal this 23rd day of October 20 12, for the State Engineer,

Scott A. Verhines, P.E.
 State Engineer, State Engineer

By: 
 Signature

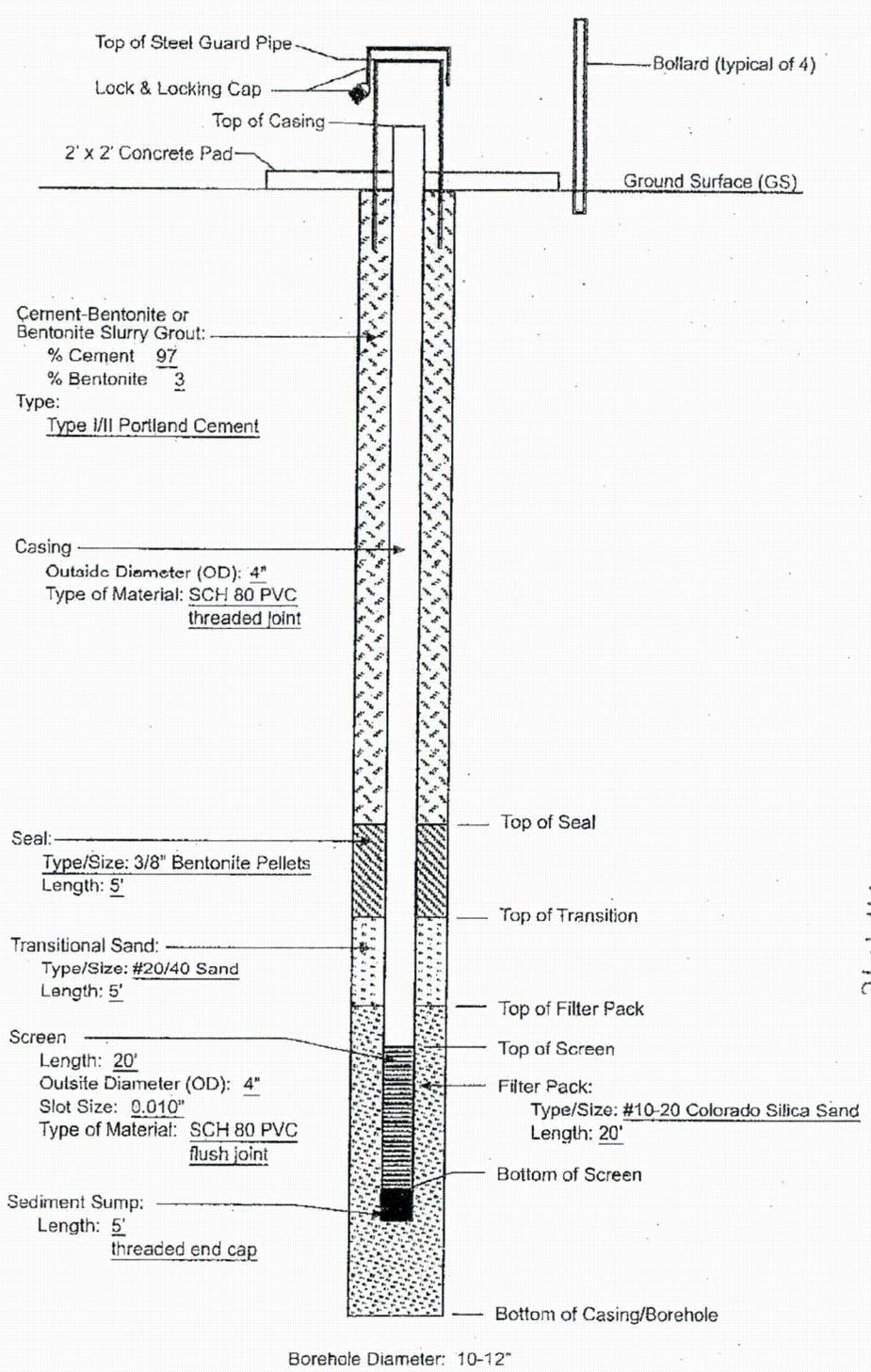
 Print

Title: _____
 Print

FOR USE INTERNAL USE

Application for Permit, Form wr-07

File Number: _____	Trn Number: _____
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NOT TO SCALE



Figure 3
 Proposed Alluvial and Bedrock
 Well Construction Detail
 Rio Algom Work Plan



STATE OF NEW MEXICO
OFFICE OF THE STATE ENGINEER

District I

SCOTT A. VERHINES, P.E.
STATE ENGINEER

5550 San Antonio Drive NE
Albuquerque, NM 87109-4127
(505) 383-4000

October 24, 2012

ATTN: Mr. Billy Ray
Rio Algom Mining, LLC
P.O. Box 218
Grants, NM 87020

OSE Well Nos. B-481-POD15 through B-481-POD17

Dear Mr. Ray:

Your permits to construct three monitoring wells are enclosed. They have been approved subject to the enclosed conditions of approval.

Sincerely,

A handwritten signature in cursive script that reads "David B. Anderson".

David B. Anderson
Water Resource Specialist Senior

Enclosures (3)

**NEW MEXICO OFFICE OF THE STATE ENGINEER
PERMIT TO DRILL A MONITORING WELL
CONDITIONS OF APPROVAL**

1. These applications are approved provided that they are not exercised to the detriment of any others having existing rights, and are not contrary to the conservation of water in New Mexico nor detrimental to the public welfare of the state; and further subject to the following conditions of approval:

Permittee: Rio Algom Mining, LLC

Permit Number: B-481

Application File Date: October 22, 2012

Source: Tres Hermanos B

Monitoring Well Locations:

OSE File No.	Rio Algom's Well No.	Latitude (North)	Longitude (West)
B-481-POD15	MW 31-02 Trb-R	35° 24' 8.935"	107° 49' 50.000"
B-481-POD16	MW 32-50 Trb-R	35° 24' 13.636"	107° 49' 0.530"
B-481-POD17	MW 5-08 Allu/Trb-R	35° 23' 6.148"	107° 48' 24.661"

2. No water shall be appropriated and beneficially used under this permit. No water shall be diverted from these wells, except for monitoring or testing purposes, unless permits to use water from these wells are acquired from the Office of the State Engineer. Well/aquifer testing shall not exceed ten cumulative days.
3. The wells shall be constructed by a well driller licensed in the State of New Mexico. The State of New Mexico requires on-site supervision of well drilling by the holder of a New Mexico Well Driller License or OSE-registered Drill Rig Supervisor.
4. Water well drilling and well drilling activities are regulated by the State Engineer pursuant to 19.27.4 NMAC, which prohibits construction of wells that allow groundwater to flow uncontrolled to land surface or move appreciably between geologic units. In the event that artesian conditions are encountered, the well driller shall immediately comply with 19.27.4.31 NMAC.
5. Well driller shall file a well record itemizing as-built well design and materials with the State Engineer (address: 5550 San Antonio Drive NE, Albuquerque, NM 87109), within 20 days after completion of the well. Well driller shall utilize the most recent form, available on the State Engineer's website at

**NEW MEXICO OFFICE OF THE STATE ENGINEER
PERMIT TO DRILL A MONITORING WELL
CONDITIONS OF APPROVAL**

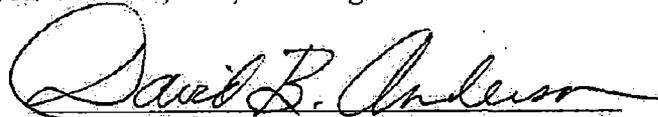
<<http://www.ose.state.nm.us>>. Aquifer/pump test data, if collected, shall be filed not later than ten (10) days after completion of the aquifer/pump test(s).

6. The Permit to Drill a Monitoring Well is valid for one year after the date of approval for construction purposes.
7. Upon expiration of DP-169, wells constructed pursuant to this permit shall be plugged and abandoned in accordance with an OSE-approved well plugging plan of operations. Any other abandoned wells on the Ambrosia Lake facility shall be plugged pursuant to Subsection C of 19.27.4.30 NMAC

Witness my hand and seal this 24th day of October, A.D. 2012.

Scott A. Verhines, P.E., State Engineer

By:



David B. Anderson
Water Resource Specialist Senior

HU-50382
#72
Office of the State Engineer
Interstate Stream Commission

NEW MEXICO OFFICE OF THE STATE ENGINEER

APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER



(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray <input type="checkbox"/> check here if Agent	Contact or Agent: <input type="checkbox"/> check here if Agent
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:16

FOR OSE INTERNAL USE

Application for Permit, Form-wr-07, Rev 5/11/11

File Number: B-481-P0015	Trn Number:
Trans Description (optional):	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

NW 1/4 SW 1/4 NE 1/4 Section 31 T14N R9W

Describe the well applicable to this application.

2. WELL:

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):									
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)									
NM State Plane (NAD83) - In feet	NM West Zone <input type="checkbox"/>			X (in feet):					
	NM Central Zone <input type="checkbox"/>			Y (in feet):					
	NM East Zone <input type="checkbox"/>								
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>			Easting (in meters):					
	UTM Zone 12N <input type="checkbox"/>			Northing (in meters):					
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	24	min	8.935	sec		
	Longitude:	-107	deg	49	min	50.000	sec		
Land Grant (if applicable):									
Well is on Land Owned by (required): Rio Algom Mining, Llc									
Other Location Information (complete the below, if applicable):									
PLSS Quarters or Halves:		Section:		Township:		Range:		County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:			
Hydrographic Survey:				Map:		Tract:			
Other description relating well to common landmarks, streets, or other:									
Well Information:									
Approximate depth of well (feet): 129.00				Outside Diameter of Well Casing (inches): 4.50					
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458					
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____									

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW-31-02 Trb-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

<p>Exploratory:</p> <input type="checkbox"/> include a description of any proposed pump test, if applicable.	<p>Monitoring:</p> <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.	<p>Pollution Control And / Or Recovery:</p> <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <ul style="list-style-type: none"> <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located. 	<p>De-Watering:</p> <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.	<p>Geo-Thermal:</p> <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.
---	--	---	--	---

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Applicant Signature 

Applicant Signature _____

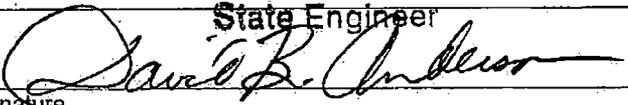
ACTION OF THE STATE ENGINEER

This application is (check one):
 approved partially approved denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 24th day of October 20 12, for the State Engineer,

Scott A. Verhines, P.E.
 _____, State Engineer
 State Engineer

By: 
 Signature _____

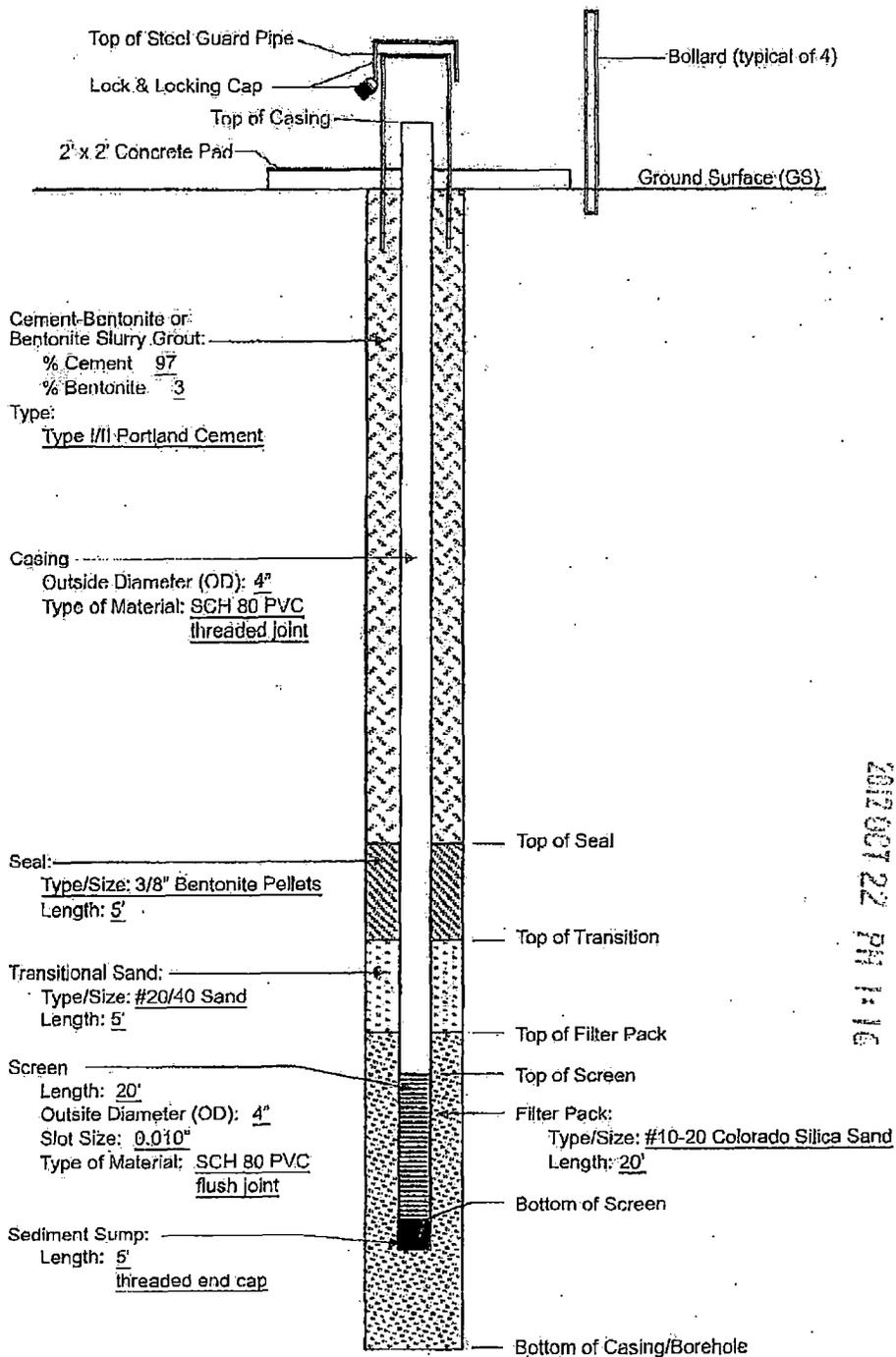
Print _____

Title: _____
 Print _____

FOR USE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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2012 OCT 22 PM 1:16

INTERA ENGINEERING, INC.

NOT TO SCALE

INTERA

Figure 3
Proposed Alluvial and Bedrock
Well Construction Detail
Rio Algom Work Plan

HCJ-50382
\$72

File No. B-481



NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And /Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

RECEIVED
 2019 OCT 22 PM 1:16

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number: B-481-P0016	Trn Number:
Trans Description (optional):	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

SW¼ NE¼ NW¼ Section 32 T14N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1.

OSE Well No. (if existing):							
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)							
NM State Plane (NAD83) - In feet	NM West Zone	<input type="checkbox"/>	X (in feet):				
	NM Central Zone	<input type="checkbox"/>	Y (in feet):				
	NM East Zone	<input type="checkbox"/>					
UTM (NAD83) - In meters	UTM Zone 13N	<input type="checkbox"/>	Easting (in meters):				
	UTM Zone 12N	<input type="checkbox"/>	Northing (in meters):				
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	24	min	13.636	sec
	Longitude:	-107	deg	49	min	0.530	sec
Land Grant (if applicable):							
Well is on Land Owned by (required): Rio Algom Mining, Llc							
Other Location Information (complete the below, if applicable):							
PLSS Quarters or Halves:		Section:		Township:		Range: County:	
Lot No:	Block No:	Unit/Tract:		Subdivision:			
Hydrographic Survey:			Map:			Tract:	
Other description relating well to common landmarks, streets, or other:							
Well Information:							
Approximate depth of well (feet): 129.00				Outside Diameter of Well Casing (inches): 4.50			
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458			
Additional well descriptions are attached: <input type="checkbox"/> Yes <input checked="" type="checkbox"/> No If yes, how many _____							

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 32-50 Trb-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

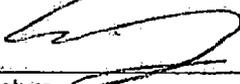
<p>Exploratory:</p> <input type="checkbox"/> include a description of any proposed pump test, if applicable.	<p>Monitoring:</p> <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.	<p>Pollution Control And / Or Recovery:</p> <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <ul style="list-style-type: none"> <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located. 	<p>De-Watering:</p> <input type="checkbox"/> include a description of the proposed dewatering operation; <ul style="list-style-type: none"> <input type="checkbox"/> the estimated duration of the operation; <input type="checkbox"/> the maximum amount of water to be diverted; <input type="checkbox"/> a description of the need for the dewatering operation; and, <input type="checkbox"/> a description of how the diverted water will be disposed of. 	<p>Geo-Thermal:</p> <input type="checkbox"/> include a description of the geothermal heat exchange project; <ul style="list-style-type: none"> <input type="checkbox"/> the amount of water to be diverted and re-injected for the project; <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.
---	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Applicant Signature 

Applicant Signature _____

ACTION OF THE STATE ENGINEER

This application is (check one):

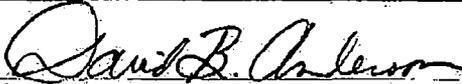
- approved partially approved denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 24th day of October, 20 12, for the State Engineer,

Scott A. Verhines, P.E.
State Engineer

_____, State Engineer

By: 
Signature

Print

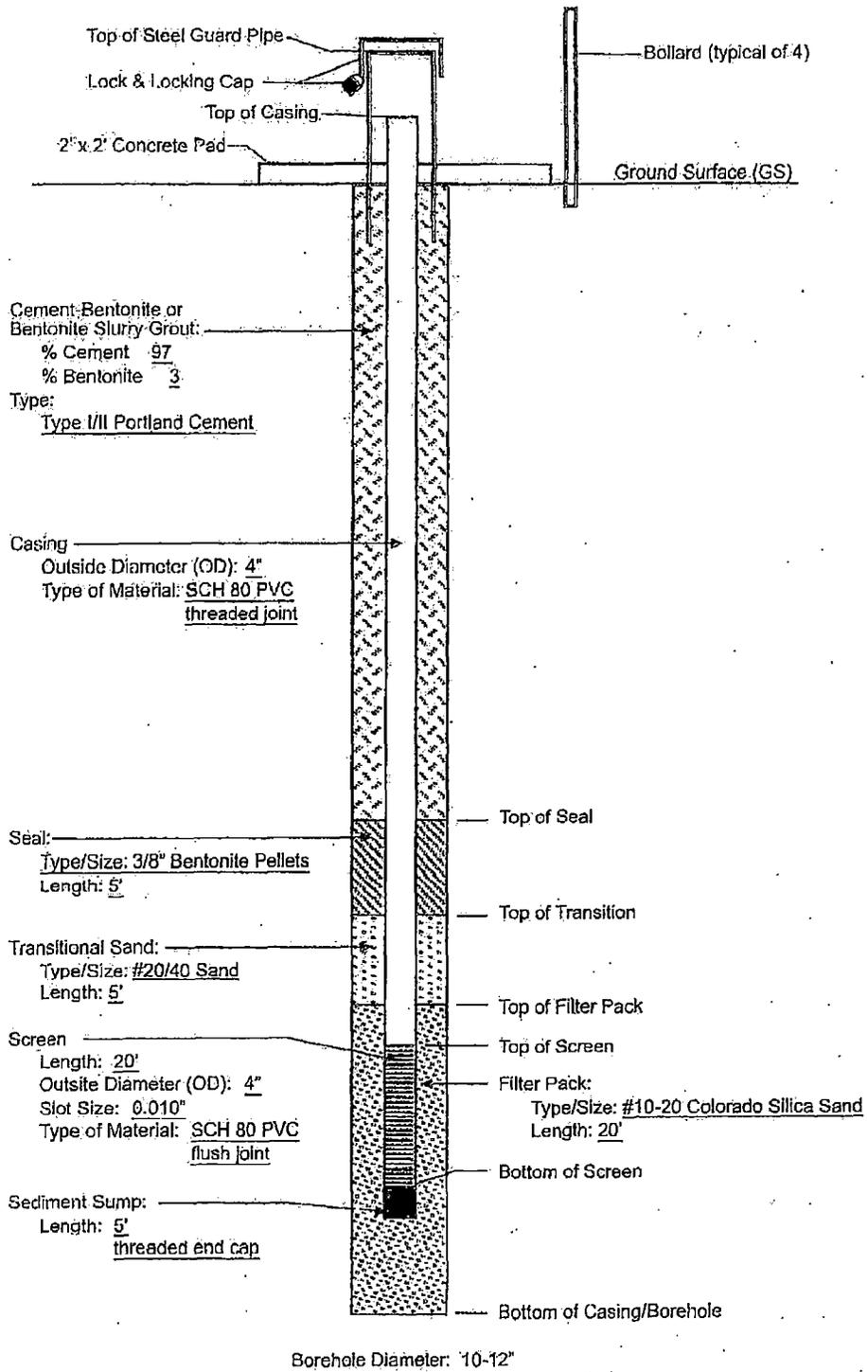
Title:
Print

2012 OCT 22 PM 1:15

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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2017 OCT 22 PM 1:10

DATE REVISION
 APPROVAL (SIGNED)

NOT TO SCALE

INTEGRA

Figure 3
 Proposed Alluvial and Bedrock
 Well Construction Detail
 Rio Algom Work Plan

HCI-50382
#72

File No. B-481



NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 04 22 PM 1:15

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number: B-481-POD17	Trn Number:
Trans Description (optional):	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

SW 1/4 SE 1/4 NE 1/4 Section 5 T13N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):							
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), or Lat/Long (WGS84)							
NM State Plane (NAD83) - In feet	NM West Zone <input type="checkbox"/>		X (in feet):				
	NM Central Zone <input type="checkbox"/>		Y (in feet):				
	NM East Zone <input type="checkbox"/>						
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>		Easting (in meters):				
	UTM Zone 12N <input type="checkbox"/>		Northing (in meters):				
Lat/Long (WGS84) - To 1/10 th of second	Latitude:	35	deg	23	min	6.148	sec
	Longitude:	-107	deg	48	min	24.661	sec
Land Grant (if applicable):							
Well is on Land Owned by (required): Rio Algom Mining, Llc							
Other Location Information: (complete the below, if applicable):							
PLSS Quarters or Halves:		Section:		Township:		Range: County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:	
Hydrographic Survey:				Map:		Tract:	
Other description relating well to common landmarks, streets, or other:							
Well Information:							
Approximate depth of well (feet): 85.00				Outside Diameter of Well Casing (inches): 4.50			
Driller Name: Yellow Jacket Drilling				Driller License Number: 1458			
Additional well descriptions are attached: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If yes, how many, <u>13</u>							

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the well is to monitor groundwater quality under DP-169. The well is to replace the existing well of the same name which is dry or is no longer in use do to well damage. Monitoring will continue for the duration of DP-169.

MW 5-08 Allu/Trb-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.</p>
--	--	---	---	--

ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.


 Applicant Signature

 Applicant Signature

2012 OCT 22 PM 1:16

ACTION OF THE STATE ENGINEER

This application is (check one):

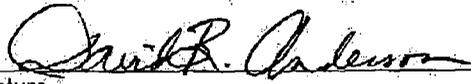
- approved partially approved denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 24th day of October 20 12, for the State Engineer,

Scott A. Verhines, P.E.
 State Engineer

_____, State Engineer

By: 
 Signature

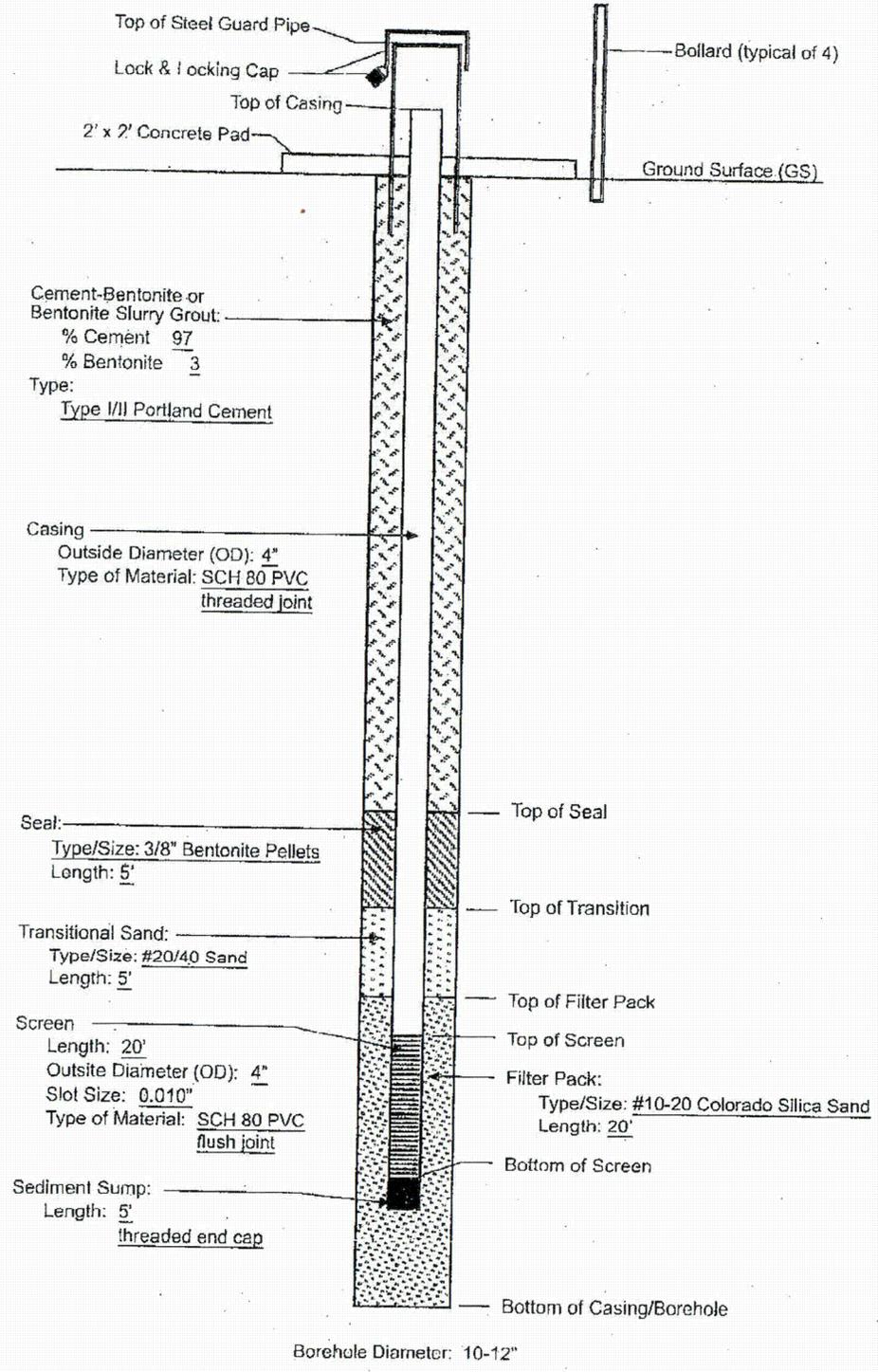
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Title:
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FOR USE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trm Number:
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2012 OCT 22 PM 1:10
 10/22/12 1:10 PM
 10/22/12 1:10 PM

NOT TO SCALE



Figure 3
 Proposed Alluvial and Bedrock
 Well Construction Detail
 Rio Algom Work Plan

**NEW MEXICO OFFICE OF THE STATE ENGINEER
 PERMIT TO DRILL A MONITORING WELL
 CONDITIONS OF APPROVAL**

1. These applications and artesian well plans of operation are hereby partially denied and partially approve, provided that they are not exercised to the detriment of any others having existing rights, and are not contrary to the conservation of water in New Mexico nor detrimental to the public welfare of the state; and further subject to the following conditions of approval:

Permittee: Rio Algom Mining, LLC

Permit Number: B-481

Application File Date: October 22, 2012

Source: B-481-POD18 – Tres Hermanos A
 B-481-POD19 – Dakota
 B-481-POD20 – Dakota

Monitoring Well Locations:

OSE File No.	Rio Algom's Well No.	Latitude (North)	Longitude (West)
B-481-POD18	MW 31-01 Tra-R	35° 24' 9.452"	107° 49' 49.364"
B-481-POD19	MW 30-48 KD-R	35° 24' 30.982"	107° 49' 38.948"
B-481-POD20	MW 32-45 KD-R	35° 23' 54.773"	107° 49' 1.688"

2. No water shall be appropriated and beneficially used under this permit. No water shall be diverted from these wells, except for monitoring or testing purposes, unless permits to use water from these wells are acquired from the Office of the State Engineer. Well/aquifer testing shall not exceed ten cumulative days.
3. The wells shall be constructed by a well driller licensed in the State of New Mexico. The State of New Mexico requires on-site supervision of well drilling by the holder of a New Mexico Well Driller License or OSE-registered Drill Rig Supervisor.
4. OSE pre-installation inspection of well casing is waived. Pressure testing and/or bond logging are waived provided that the well is constructed properly and in accordance with these conditions of approval.
5. OSE witnessing of annular grouting is required and shall be facilitated when an OSE observer is onsite. OSE inspection and witnessing may be requested during normal working hours by calling David Anderson at the OSE District 1 Office at (505) 383-4000 at least 48 hours in advance.

**NEW MEXICO OFFICE OF THE STATE ENGINEER
PERMIT TO DRILL A MONITORING WELL
CONDITIONS OF APPROVAL**

6. The Artesian Plan of Operations requests use of 6-8% bentonite-enriched cement. High solids bentonite powder is allowed as a cement additive under OSE and AWWA standards. AWWA standards for water wells limit the bentonite addition to neat cement slurry to not more than 6% by weight. Therefore, the request to use more than 6% bentonite is denied. Supplemental bentonite powder increases water demand for the slurry at a rate of approximately 0.65 gallon of water per 1% increment of bentonite by dry weight content above the fundamental water demand of 5.2 gallons of water per 94-lb. sack of cement.
7. Pre-bentonite cement slurry shall consist of 5.2 gallons of water per 94-lb. sack of Portland cement, not to exceed 6.0 gallons of water per 94 lb. cement. The request to use greater than 6.0 gallons of water per 94-lb. sack of Portland cement is denied.
8. The bentonite shall be hydrated separately with its required increment of water before being mixed into the cement slurry. If water is otherwise added to the combination of dry ingredients or the dry bentonite blended into wet cement, the alkalinity of the cement will restrict yield of the bentonite powder, resulting in excess free water in the slurry and enhanced cement shrinkage upon curing.
9. OSE grants applicant's requested variance pursuant to Subsection D of 19.27.4.31 NMAC. OSE approves use of 4-inch Schedule 80 PVC casing provided that permittee and driller employ an appropriate schedule of grouting lifts and/or fluid-filled casing in order to not exceed casing RHCP and to provide an appropriate factor of safety. Schedule 80 PVC does not have the collapse or thermal resistance of artesian casing identified in 19.27.4 NMAC. Downhole pressure differentials created by the placement of fluid sealants can collapse casing pipe due to improper balancing of fluids and sealants. In addition, neat cement slurry's heat of hydration may cause deformation of PVC casing. Driller should take appropriate precautions to minimize the threat of thermal deformation of well casing. OSE shall not be held responsible for improper balancing of fluids, interval grouting, and/or well development that result in damage to the well. An appropriate schedule of grouting lifts and grout set time should be reviewed with the casing manufacturer prior to initiation of grouting.
10. The neat cement slurry shall be pumped using a tremie pipe to fill the annular space of the well from the origin of the seal within the artesian stratum to land surface. Flow of undiluted cement out of the top of the annular space shall be established with the tremie pipe suspended in the annulus. The lower end of the tremie shall remain immersed in the cement slurry for the duration of pumping. The tremie pipe may be gradually removed as cement level in the annulus rises.

**NEW MEXICO OFFICE OF THE STATE ENGINEER
PERMIT TO DRILL A MONITORING WELL
CONDITIONS OF APPROVAL**

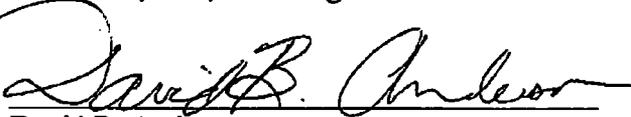
The request to not displace grout at land surface is denied unless permittee shows cause as to why the request should be allowed.

11. Well driller shall file a well record itemizing as-built well design and materials with the State Engineer (address: 5550 San Antonio Drive NE, Albuquerque, NM 87109), within 20 days after completion of the well. Well driller shall utilize the most recent form, available on the State Engineer's website at <<http://www.ose.state.nm.us>>. Aquifer/pump test data, if collected, shall be filed not later than ten (10) days after completion of the aquifer/pump test(s).
12. The Permit to Drill a Monitoring Well is valid for one year after the date of approval for construction purposes.
13. Upon expiration of DP-169, wells constructed pursuant to this permit shall be plugged and abandoned in accordance with an OSE-approved well plugging plan of operations. Any other abandoned wells on the Ambrosia Lake facility shall be plugged pursuant to Subsection C of 19.27.4.30 NMAC

Witness my hand and seal this 25th day of October, A.D. 2012.

Scott A. Verhines, P.E., State Engineer

By:


David B. Anderson

Water Resource Specialist Senior

HC1-50382
#72

File No. B-481



NEW MEXICO OFFICE OF THE STATE ENGINEER



APPLICATION FOR PERMIT TO DRILL A WELL
WITH NO CONSUMPTIVE USE OF WATER

(check applicable box):

For fees, see State Engineer website: <http://www.ose.state.nm.us/>

<input type="checkbox"/> Exploratory	<input type="checkbox"/> De-Watering	<input type="checkbox"/> Geo-Thermal
<input checked="" type="checkbox"/> Monitoring	<input type="checkbox"/> Pollution Control And / Or Recovery	
<input type="checkbox"/> Temporary Request - Requested Start Date:		Requested End Date:

1. APPLICANT(S)

Name: Rio Algom Mining, LLC	Name:
Contact or Agent: Billy Ray check here if Agent <input type="checkbox"/>	Contact or Agent: check here if Agent <input type="checkbox"/>
Mailing Address: 5 miles north of Hwy 509 and 605	Mailing Address:
City: Grants	City:
State: NM Zip Code: 87020	State: Zip Code:
Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work): 505 287-8851	Phone: <input type="checkbox"/> Home <input type="checkbox"/> Cell Phone (Work):
E-mail: Billy.WM.Ray@bhpbilliton.com	E-mail:

2012 OCT 22 PM 1:14
STATE ENGINEER
ASST. DIR. OF REG. & PERMITS

FOR OSE INTERNAL USE

Application for Permit, Form wr-07, Rev 5/11/11

File Number: B-481-P0018	Trm Number: 517015
Trans Description (optional):	
Sub-Basin:	
PCW/LOG Due Date:	PBU Due Date:

SW¹/₄ NW¹/₄ NE¹/₄ Section 31 T14N R9W

Describe the well applicable to this application.

2. WELL

NOTE: If more than one (1) well, complete Attachment 1

OSE Well No. (if existing):							
Location (Required): Coordinate location must be New Mexico State Plane (NAD 83), UTM (NAD 83), <u>or</u> Lat/Long (WGS84)							
NM State Plane (NAD83) - In feet	NM West Zone <input type="checkbox"/>		X (in feet):				
	NM Central Zone <input type="checkbox"/>		Y (in feet):				
	NM East Zone <input type="checkbox"/>						
UTM (NAD83) - In meters	UTM Zone 13N <input type="checkbox"/>		Easting (in meters):				
	UTM Zone 12N <input type="checkbox"/>		Northing (in meters):				
Lat/Long (WGS84) - To 1/10 ^m of second	Latitude:	35	deg	24	min	9.452	sec
	Longitude:	-107	deg	49	min	49.364	sec
Land Grant (if applicable):							
Well is on Land Owned by (required): Rio Algom Mining, Llc							
Other Location Information (complete the below, if applicable):							
PLSS Quarters or Halves:		Section:		Township:		Range: County:	
Lot No:		Block No:		Unit/Tract:		Subdivision:	
Hydrographic Survey:				Map:		Tract:	
Other description relating well to common landmarks, streets, or other:							
Well Information:							
Approximate depth of well (feet): 245.00				Outside Diameter of Well Casing (inches): 4.50			
Driller Name: Yellow Jacket Drilling, Llc.				Driller License Number: WD-1458			
Additional well descriptions are attached: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No If yes, how many <u>13</u>							

3. ADDITIONAL STATEMENTS OR EXPLANATIONS

The purpose of the following replacement wells (listed seperatly) are to monitor groundwater quality under DP-169. The wells are being installed to replace the existing wells of the same name which are either dry or are no longer in use do to well damage. Monitoring of the replacement wells will continue for the duration of DP-169. Below is a list of all fourteen (14) wells proposed to be replaced.

Well information above is for: MW 31-01 Tra-R

FOR OSE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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SPECIFIC REQUIREMENTS

The applicant must include the following, as applicable to each well type. Please check the appropriate boxes, to indicate the information has been included and/or attached to this application:

<p>Exploratory: <input type="checkbox"/> include a description of any proposed pump test, if applicable.</p>	<p>Monitoring: <input checked="" type="checkbox"/> include the reason for the monitoring well, and, <input checked="" type="checkbox"/> the duration of the planned monitoring.</p>	<p>Pollution Control And / Or Recovery: <input type="checkbox"/> include a plan for pollution control/recovery, that includes the following: <input type="checkbox"/> a description of the need for the pollution control or recovery operation. <input type="checkbox"/> the estimated maximum period of time for completion of the operation. <input type="checkbox"/> the annual diversion amount. <input type="checkbox"/> the annual consumptive use amount. <input type="checkbox"/> the maximum amount of water to be diverted and injected for the duration of the operation. <input type="checkbox"/> the method and place of discharge. <input type="checkbox"/> the method of measurement of water produced and discharged. <input type="checkbox"/> the source of water to be injected. <input type="checkbox"/> the method of measurement of water injected. <input type="checkbox"/> the characteristics of the aquifer. <input type="checkbox"/> the method of determining the resulting annual consumptive use of water and depletion from any related stream system. <input type="checkbox"/> proof of any permit required from the New Mexico Environment Department. <input type="checkbox"/> an access agreement if the applicant is not the owner of the land on which the pollution plume control or recovery well is to be located.</p>	<p>De-Watering: <input type="checkbox"/> include a description of the proposed dewatering operation, <input type="checkbox"/> the estimated duration of the operation, <input type="checkbox"/> the maximum amount of water to be diverted, <input type="checkbox"/> a description of the need for the dewatering operation, and, <input type="checkbox"/> a description of how the diverted water will be disposed of.</p>	<p>Geo-Thermal: <input type="checkbox"/> include a description of the geothermal heat exchange project, <input type="checkbox"/> the amount of water to be diverted and re-injected for the project, <input type="checkbox"/> the time frame for constructing the geothermal heat exchange project, and, <input type="checkbox"/> the duration of the project. <input type="checkbox"/> preliminary surveys, design data, and additional information shall be included to provide all essential facts relating to the request.</p>
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ACKNOWLEDGEMENT

I, We (name of applicant(s)), Billy Ray

Print Name(s)

affirm that the foregoing statements are true to the best of (my, our) knowledge and belief.

Applicant Signature 

Applicant Signature _____

ACTION OF THE STATE ENGINEER

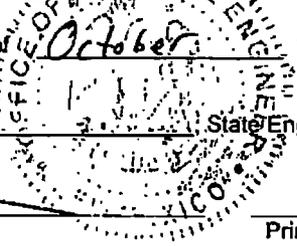
This application is (check one):

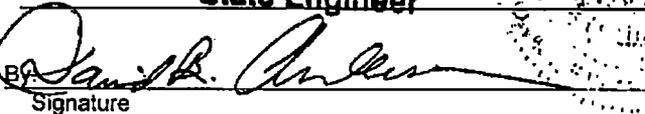
approved partially approved denied

provided it is not exercised to the detriment of any others having existing rights, and is not contrary to the conservation of water in New Mexico nor detrimental to the public welfare and further subject to the attached conditions of approval (please see attachment).

Witness my hand and seal this 25th day of October, 2012, for the State Engineer,

Scott A. Verhines, P.E.
 State Engineer



Signature 

State Engineer _____
 Print _____

Title: 41:1 WJ 22 OCT 22 PM 1:14
 Print _____

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FOR USE INTERNAL USE

Application for Permit, Form wr-07

File Number:	Trn Number:
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