MONTGOMERY
& ASSOCIATES
Water Resource Consultants

www.emontgomery.com

1550 East Prince Road
Tucson, AZ 85719

TEL 520-881-4912
FAX 520-881-1609

TUCSON PHOENIX SANTIAGO DE CHILE

TECHNICAL MEMORANDUM

DATE: January 5, 2012 **Project 605.31**

TO: Greg Ghidotti
RESOLUTION COPPER MINING LLC

FROM: Charlie King, Janis Blainer-Fleming, Kate Duke, and Todd Keay
MONTGOMERY & ASSOCIATES

SUBJECT: RESULTS OF DRILLING, CONSTRUCTION, AND TESTING AT HYDROLOGIC TEST WELL HRES-13, RESOLUTION COPPER MINING, PINAL COUNTY, ARIZONA

In accordance with a request from Mr. Greg Ghidotti, Resolution Copper Mining LLC (RCM), Montgomery & Associates (M&A) has prepared this Technical Memorandum to summarize results of drilling, construction, and testing at hydrologic test well HRES-13. The well was installed to characterize hydrogeologic conditions and provide a monitoring location in the western part of the Apache Leap Tuff (ALT) aquifer. Monitoring data obtained from HRES-13 have been incorporated into the RCM hydrologic monitoring program.

SUMMARY

A summary of drilling, construction, and testing operations and results is provided below:

1. Hydrologic test well HRES-13 is located on U.S. Forest Service land in Township 2 South, Range 13 East, in the SW ¼ of the NW ¼ of the NE ¼ of Section 7 ((D-2-13)07abc) in the Rancho Rio Creek drainage, approximately 3 kilometers south of Magma Mine Road.
2. Well HRES-13 was drilled and constructed during the period February 21 through March 4, 2011.
3. Total drilled depth is 278.9 meters below land surface (bls).

4. Geologic units encountered during drilling from land surface to total depth include Tertiary Apache Leap Tuff (Tal; 0 to 266.7 meters) and Whitetail Conglomerate (Tw; 266.7 to 278.9 meters).
5. The well was completed in the Tal with a single perforated interval from 129.0 to 262.2 meters bls; non-pumping water level was 143.44 meters bls on September 6, 2011.
6. Following installation of production casing, a 4-hour airlift test was conducted to develop the well and to provide preliminary aquifer hydraulic parameters; recovery data yielded an estimated transmissivity of 22 meters squared per day (m^2/d).
7. HRES-13 was equipped with dedicated pump and water level recording equipment on May 18, 2011.
8. A 12-hour constant-rate pumping test was conducted in the cased well; this test yielded an estimated transmissivity of 39 m^2/d and an estimated hydraulic conductivity of 4 x 10^{-4} centimeters per second (cm/s) in the ALT at this location.
9. Water samples were collected for laboratory chemical and isotopic analyses near the end of the airlift and constant-rate pumping tests.

INTRODUCTION

Hydrologic test well HRES-13 was drilled and constructed during the period February 21 through March 4, 2011. Well HRES-13 was drilled to:

- evaluate groundwater conditions in the western part of the Tal outcrop belt
- characterize Tal fracturing near the Apache Leap escarpment
- provide a groundwater level and groundwater quality monitoring location in the ALT aquifer.

The well was drilled through the Tal and into the Tw and completed to permit hydrologic testing within the Tal. Hydrologic test well HRES-13 is located on U.S. Forest Service land in Township 2 South, Range 13 East, in the SW ¼ of the NW ¼ of the NE ¼ of Section 7 ((D-2-13)07abc) in the Rancho Rio Creek drainage, approximately 3 kilometers south of Magma Mine Road. **Photograph 1** shows the layout for the HRES-13 well site during drilling operations. The well location is shown on **Figure 1**. A schematic diagram summarizing well construction details is shown on **Figure 2**. Other data summarized on the schematic diagram include: hydrogeologic units, drilling penetration rate, water production rate during air drilling operations, drilling methods, borehole geophysical logs, and groundwater level. A detailed lithologic log for the test well is provided in **Appendix A**.

DRILLING OPERATIONS

Hydrologic test well HRES-13 was drilled and constructed by Boart Longyear Drilling Services (Boart Longyear) of Salt Lake City, Utah, using a Lang LM-140 (Rig LK35A) top-head drive rotary drill rig. The well was drilled in accordance with technical specifications prepared by M&A. RCM personnel coordinated drilling contractor activities and purchase of well construction materials. Daily drilling reports were prepared by Boart Longyear personnel and were submitted to RCM for review. M&A personnel described drill cuttings samples and provided on-site monitoring during critical phases of drilling and construction of the well. RCM provided daily summaries of drilling progress. Daily summary data are provided in **Appendix B**.

Well HRES-13 was drilled to 278.9 meters bls, and then blank and perforated casing were installed to the designed depth. Final completion of the well was designed by M&A based on review of lithologic and hydrologic conditions encountered during drilling operations, and results of borehole geophysical logs.

Drilling Method

The borehole for well HRES-13 was drilled using the conventional air rotary drilling method for the surface borehole, and the dual-wall air reverse circulation method for the production interval of the borehole. Depths, drilling methods, and bit types and sizes are summarized in **Table 1**.

TABLE 1. SUMMARY OF DRILLING METHODS AND BOREHOLE DIAMETERS HYDROLOGIC TEST WELL HRES-13

Depth Interval (meters, bls)	Drilling Method	Bit Type	Borehole Diameter (inches)
0 – 9.1	conventional air rotary	tricone	17-1/2
9.1 – 278.9	reverse circulation air percussion	hammer	10-1/4

For the production portion of the borehole, the dual-wall air reverse circulation method was used to allow for measurement of groundwater production during drilling.

Drilling Fluid and Drill Cuttings Management

Air and water were the only fluids used during drilling operations. The drilling fluids were discharged to a cyclone to separate air from the fluid stream. The remaining drilling fluid and cuttings then flowed through a vibrating screen to remove coarse material. All drilling fluids and formation fluids produced during drilling and airlift testing were contained in portable tanks to allow fines to settle prior to removal from the well site. The drilling and formation fluids were removed from the site using vacuum trucks and deposited at a designated storage facility at the RCM West Plant site. Drill cuttings from the Tal were

collected in the bucket of a back-hoe, stored on site, and then spread on site after well construction was complete. Cuttings from the Tw were removed from site using vacuum trucks and deposited at the RCM West Plant site.

Monitoring of Drilling Conditions

During drilling operations, drill penetration rate was monitored by Boart Longyear by recording drill start and stop times for each 6.1-meter drill rod. A summary of drill penetration rate data is shown on **Figure 2.** In addition to drill penetration rate, rotational torque was monitored by drilling personnel, and zones of variable or increasing torque were noted as a potential indicator of fracturing. The field data recorded by Boart Longyear are on file at M&A. Borehole deviation surveys were conducted on a regular basis using a Totco mechanical drift recorder. Borehole deviation was less than 1 degree for the depth interval from land surface to 152 meters bls and remained at 1 degree for the depth interval from 152 meters to total depth of 278.9 meters bls.

Monitoring of Lithologic Conditions

Drill cuttings samples were collected at 10-foot intervals and placed in labeled bags. Lithologic descriptions for each sample were prepared in the field by M&A personnel. Splits of each sample were placed in plastic chip trays and were provided to RCM. Bulk cuttings samples are stored by RCM. The detailed lithologic descriptions are given in **Appendix A**.

Monitoring of Groundwater Conditions

At HRES-13, the depth interval from 9.1 to 278.9 meters bls was drilled using the dual-wall air reverse circulation method, and observations of natural groundwater production were made after drilling out each 6.1-meter drill rod beginning at a depth of approximately 80 meters bls. Prior to measurement of production rate, injection water was cut off from the airstream, and air circulation was continued for 10 to 15 minutes. When discharge stabilized, discharge rate was measured using a 2-gallon bucket and stop watch. Results of water production measurements made during drilling operations for well HRES-13 are summarized on **Figure 2**. First measurable water production rate was 0.3 L/s at a depth of 175 meters bls. Groundwater production rate varied between 1.1 and 1.6 L/s from 181 to 236 meters bls. Maximum groundwater production rate was 2.5 L/s at 248 and at 273 meters bls.

The discharge water was monitored for changes in water quality parameters including temperature, pH, specific conductance, and sand content. Temperature of the discharge water ranged from 18.5 to 20.7 degrees Celsius (ºC). The pH of the discharge water ranged from 8.06 to 8.24. The specific conductance of the discharge water ranged from 398 to 406 microsiemens per centimeter (µS/cm).

Photograph 1. Site layout at HRES-13 during drilling operations

BOREHOLE GEOPHYSICAL LOGGING

Borehole geophysical logging was conducted at hydrologic test well HRES-13 following drilling of the production borehole to total depth. Borehole geophysical logging services were provided by Southwest Exploration Services, LLC (SWE) of Gilbert, Arizona. Borehole geophysical logging was conducted on February 28 and March 1, 2011. The suite of geophysical logs included: 3-arm caliper, electrical resistivity, spontaneous potential, natural gamma ray, sonic, temperature, fluid resistivity, optical borehole imaging (OBI), borehole video, and acoustic borehole imaging (ABI). SWE submitted field logs in digital format to RCM. Summary geophysical logs for HRES-13 are provided on **Figure 2**. **Table 2** shows logs obtained and depth intervals for each type of log.

TABLE 2. SUMMARY OF BOREHOLE GEOPHYSICAL LOGS OBTAINED AT HYDROLOGIC TEST WELL HRES-13	
LOG	**DEPTH INTERVAL(S) (meters bls)**
Caliper	0 – 276
Temperature	144 – 276
Fluid Resistivity	144 – 276
Gamma ray	0 – 274
Electrical Resistivity (E-log)	151 – 276
Spontaneous Potential	151 – 276
Acoustic Borehole Imaging (ABI)	144 – 276
Optical Borehole Imaging (OBI)	0 – 144
Sonic	144 – 275
Borehole Video	0 – 145

ANALYSIS OF GEOLOGIC CONDITIONS

Geologic Contacts

Geologic contacts were picked based on analysis of drill cuttings samples, geophysical logs, and information obtained during drilling. **Table 3** is a summary of geologic units encountered at HRES-13.

TABLE 3. SUMMARY OF GEOLOGIC UNITS ENCOUNTERED AT HYDROLOGIC TEST WELL HRES-13	
Depth Interval (meters bls)	**Geologic Formation**
0 – 42.7	Apache Leap Tuff – Gray Unit (Talg)
42.7 – 249.0	Apache Leap Tuff – Brown Unit (Talb)
249.0 – 260.1	Apache Leap Tuff – Vitrophyre (Talv)
260.1 – 266.7	Apache Leap Tuff – Basal tuff (Talbt)
266.7 – 278.9	Whitetail Conglomerate (Tw)

Apache Leap Tuff (Tal)

The Tal at HRES-13 is 266.7 meters thick, and consists of Gray Unit (Talg) from land surface to 42.7 meters bls, Brown Unit (Talb) from 42.7 to a depth of 249.0 meters bls, vitrophyre (Talv) from 249.0 to 260.1 meters bls, and basal tuff (Talbt) from 260.1 to 266.7 meters bls. The Talg, Talb, and Talbt are dacite porphyry tuff with phenocrysts of potassium and plagioclase feldspars, quartz, biotite, and minor hornblende in an aphanitic to microcrystalline groundmass. The Talg and Talb are crystal-rich. The Talg is weakly

welded with pinkish-red groundmass; the Talb is densely welded with reddish-brown groundmass; the Talv has black glassy groundmass with the same phenocryst assemblage as the tuff. The Talbt is a non-welded whitish-pink dacitic tuff with fewer phenocrysts. Detailed lithologic descriptions based on drill cuttings samples are provided in **Appendix A**. Geophysical logs provided by SWE were used to confirm the formation depth intervals (**Table 3**; **Figure 2**).

Whitetail Conglomerate (Tw)

The upper 12.2 meters of the Tw was penetrated at HRES-13 and included Lacustrine unit (Tw2) from 266.7 to 278.9 meters bls. At HRES-13, Tw2 consists of reddish-brown, moderately lithified, thin bedded, slightly calcareous mudstones and siltstones, with minor gray limestone. The Tw1 conglomerate unit was not encountered at HRES-13.

Degree of Fracturing

A fracture summary log was prepared using borehole video and geophysical logs including OBI, ABI, sonic, and electrical resistivity. The borehole video, OBI and ABI logs were the primary sources for the fracture summary log. The sonic and electrical resistivity logs were used to confirm fracture zones. Fractures were qualitatively classified as minor, moderate, or major based on inspection of the logs. Minor fractures include joints and flow layer margins with no mineral filling generally less than 1 inch across. Moderate fractures include joints and faults with mineral filling or open voids ranging from about 1 to 6 inches across. Major fractures include faults or fault zones with mineral filling or open voids larger than about 6 inches across. Where ABI logs were not available, fractures zones were assigned using the sonic log to zones where acoustic travel time was larger than background. Intensity of the fracture was assigned based upon thickness of the anomalous zone. Major fractures were assigned to wide zones of slower acoustic travel. The fracture summary log is shown on **Figure 2**.

The fracture summary logs show that there is highly variable but mostly minor fracturing in the Tal and Tw. There are several zones of intense moderate to major fracturing. These fractures are high angle to vertical features, which confirms previous assessments that this region of the Tal is undergoing primarily extensional stresses due to its proximity to the Apache Leap escarpment.

Below water level a zone of moderate fracturing occurs in the Talb in the interval from about 169 to 181 meters bls. The largest major fracture zone below water level occurs in the Talv unit in the depth interval from about 249 to 258 meters bls. Additional major fracturing occurs near the bottom of the borehole in the Tw2 in the depth interval from about 271 to 272 meters bls. The depths of all three zones of fracturing correlate with increased water production rates measured during drilling.

WELL CONSTRUCTION

Construction at HRES-13 began with installation of 12-inch diameter blank steel surface casing. The surface casing was installed to 9.1 meters bls and cemented in place. The production interval for HRES-13 was constructed using 4-1/2-inch outside diameter blank and slotted, flush-threaded steel casing. A single interval of perforated casing was installed in the depth interval from 129.0 to 262.2 meters bls. Perforations are 0.125-inch wide by 2.5-inch long machine-cut slots, two slots per round, four rounds per foot, staggered (8 slots per foot). Two joints of blank steel casing were installed below the perforated interval. The bottom joint of casing was torch cut, tapered, and welded closed. Prior to installation of the production casing, the bottom of the borehole had sloughed to 276.5 meters bls. **Photograph 2** shows the drill crew installing production casing.

Photograph 2. Drill crew installing production casing at HRES-13

Materials installed in the annulus include 1/4-inch to 3/8-inch gravel pack, 3/8-inch bentonite chips, and 8 x 12 silica sand. All annular materials were installed using a tremie pipe. An annular bentonite seal was placed above the gravel pack near the base of the surface casing to ensure isolation of the aquifer from land surface. Gravel pack was capped with silica sand to minimize intrusion of bentonite from the seal into the gravel pack. A schematic diagram of well construction is shown on **Figure 2**. Hydrologic test well HRES-13 was developed by airlift pumping following installation of casing and annular materials. Development was conducted for about 4 hours on March 4 and 5, 2011.

The surface completion consists of an extension of the 12-inch steel surface casing to approximately 1 meter above land surface. The casing extension was cemented in place and secured with a locking cap. Horizontal and vertical well coordinates for the top of surface casing and top of the well cap were surveyed by Civiltec Engineering, Inc. of Phoenix, Arizona, on June 2, 2011. Survey data and computed land surface and measurement point elevations are provided in **Table 4**.

TABLE 4. SUMMARY OF SURVEY RESULTS FOR HYDROLOGIC TEST WELL HRES-13

Easting	494613.369
Northing	3681730.334
Elevation Top of 12-inch Surface Casing	1280.037
Elevation Land Surface	1279.21

Datum: UTM Zone 12 North (NAD27)-NGVD29 (meters)

PUMP INSTALLATION AND INSTRUMENTATION

A dedicated pump assembly was installed in hydrologic test well HRES-13 by Duncan Pump, of Phoenix, Arizona on May 18, 2011. Well HRES-13 was equipped with a stainless steel Grundfos Model 10S30-34 pump with a 3-horsepower, 460-volt, three-phase Grundfos Model MS4000 electric motor (Product No. 79354507). The pump was installed on 1-1/4-inch galvanized steel NPT column pipe with galvanized steel couplings at a depth of approximately 180 meters bls. The well was equipped with one 1-inch Schedule 80 PVC transducer/sounder access tube which extends from the wellhead to the top of the pump. The access tube is capped on the bottom and factory slotted in the lowermost 3 meters. The pump, motor, and column pipe are suspended from a steel and rubber sanitary well seal installed at the wellhead. An In-Situ Level TROLL 500 (S/N 194511; 100 psi non-vented) pressure transducer is currently installed at HRES-13.

HYDRAULIC TESTING

Airlift testing was conducted at HRES-13 following well construction to develop the well and provide preliminary aquifer parameters. After pump installation at HRES-13 a constant-rate pumping test was conducted to further develop the well and to investigate hydraulic parameters and water quality. Drawdown data were analyzed using the Cooper-Jacob (1946) drawdown method and recovery data were analyzed using the Theis (1935) recovery method implemented in the computer-based analytical aquifer test software AQTESOLV® for Windows, version 4.50.004 (Glenn M. Duffield, HydroSOLVE, Inc., 2008). Operational details and results of testing are included below.

HRES-13 Cased Well Airlift Test

Following casing installation at well HRES-13, a 4-hour airlift test was conducted. Discharge volumes and discharge rates were calculated by periodic measurement of storage tank levels during airlift testing. Due to the discharge head configuration, groundwater levels could not be measured during airlift pumping; however, groundwater level was measured prior to the test and during the recovery period. During recovery, water level was measured through the open airline (AQ pipe) using an electric water level sounder.

Screened interval is from 129.0 to 262.2 meters bls. Depth to pre-pumping water level was 143.9 meters bls. Airlifting started at 20:53 on March 4, and stopped at 00:56 on March 5, 2011. The discharge rate ranged from 0.6 to 1.6 L/s; average rate was 0.8 L/s. A graph of the recovery data and analysis is shown on **Figure 3**. Straight-line analysis using the Theis recovery method yields an estimated transmissivity of 22 m^2/d. Test data and results are summarized in **Table 5**.

TABLE 5. SUMMARY OF RESULTS FROM AIRLIFT TEST CONDUCTED AT HYDROLOGIC TEST WELL HRES-13

Test Interval (meters, bls)	Test Duration (hours)	Pre-pumping Water Level (meters, bls)	Average Discharge Rate (L/s)	Transmissivity (m^2/d)
143.9 – 262.2	4	143.9	0.8	22

HRES-13 Constant-rate Test

After dedicated pumping equipment was installed, a 12-hour constant-rate pumping test was conducted on June 3, 2011. Discharge assembly included a digital flowmeter, a pressure gage, gate valves to adjust flow rate, and a hose bib for obtaining water samples. Water pumped from HRES-13 was discharged to an un-named ephemeral wash in compliance with Arizona Department of Environmental Quality DeMinimis discharge regulations (area-wide discharge authorization AZDGP-60821).

During constant-rate testing, water levels were measured and recorded using the dedicated Level TROLL. Water levels were also measured periodically using an electric sounder. Pumping rate and line pressure were measured along with water quality parameters. Sand content of the water was measured using a calibrated 1-liter Imhoff cone. After pumping was complete water level recovery was monitored for a period equal to the pumping period.

Depth to pre-pumping water level was 143.42 meters bls. Pumping started at 09:30 and stopped at 21:30, on June 3, 2011. Average pumping rate was 0.8 L/s. Maximum drawdown at the well was approximately 3 meters. A graph of the data and analysis are shown on **Figure 4**. Straight-line analysis of drawdown data using the Cooper-Jacob method yields an estimated transmissivity of 32 m^2/d; analysis of recovery data using the Theis recovery method yields an estimated transmissivity of 39 m^2/d. Estimated hydraulic conductivity based on transmissivity of 39 m^2/d and saturated thickness of 118.8 meters (saturated perforated interval) is 4×10^{-4} cm/s. Test data and results are given in **Table 6**.

TABLE 6. SUMMARY OF CONSTANT-RATE TEST CONDUCTED AT HYDROLOGIC TEST WELL HRES-13	
Description of Hydrologic Testing Zone (meters bls)	**Cased well** (total depth 274.3 meters) perforated interval 129.0 to 262.2 meters bls
Test Type	Constant-rate pumping test
Geologic Units in Testing Zone	Tal
Test Duration (hours)	12
Pre-pumping Depth to Water (meters bls)	143.42
Average Discharge Rate (L/s)	0.8
Maximum Drawdown (meters)	3
Transmissivity from recovery data (m^2/d)	39
Saturated thickness (meters)	118.8 (water level to bottom of perforated zone)
Hydraulic Conductivity (cm/s)	4×10^{-4}

GROUNDWATER SAMPLING

Water quality parameters (temperature, pH, and specific conductance) were measured and recorded during both tests using a Myron-L parameter meter that was calibrated prior to each test. Groundwater samples were collected near the end of the airlift and constant-rate tests. Sample identifiers and water quality parameters for samples collected during testing operations are provided in **Table 7**. Data from groundwater samples collected during airlift tests are generally used as screening samples or to obtain an initial idea of water quality. Data considered to be most representative of the hydrochemical composition of formation water are those generated from samples collected at the end of pumping tests. Results of water quality analyses will be provided and discussed in a future report.

TABLE 7. WATER SAMPLES COLLECTED DURING TESTING OPERATIONS AT HYDROLOGIC TEST WELL HRES-13						
				Water Quality Parameters		
Sample Identifier	Sample Description	Date	Time	Temp (°C)	pH (s.u.)	Specific Conductance (µS/cm)
RESE-1003112	HRES-13, cased well airlift test	05-Mar-11	00:30	21.8	8.38	431
RESE-1003130	HRES-13, constant-rate pumping test	03-Jun-11	21:00	24.4	7.12	448

REFERENCES CITED

Cooper, H.H., and Jacob, C.E., 1946, **A generalized graphical method for evaluating formation constants and summarizing well field history:** in Transactions American Geophysical Union, vol. 27, pp. 526-534.

HydroSOLVE, Inc., 2008, **AQTESOLV for Windows 95/98/NT/2000/XP/Vista:** HydroSOLVE, Inc., Reston, Virginia, version 4.50.004 – Professional.

Theis, C.V., 1935, **The relationship between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage:** American Geophysical Union, Transactions, vol. 16, pp. 519-524; reprinted in Society of Petroleum Engineers, Pressure Transient Testing Methods, SPE Reprint Series (14), pp. 27-32, Dallas, Texas.

490,000 R. 12 E. 495,000 R. 13 E. 500,000 R. 14 E.

T. 1 S. / T. 2 S. / T. 3 S.

3,690,000 / 3,685,000 / 3,680,000 / 3,675,000

Top of the World
60
HRES-06
Corral
Middle
JI Ranch
HRES-14
HRES-12
DHRES-11
Queen Creek
HRES-15
Oak Flat
HRES-03
DHRES-14
HRES-17
Gila County
Pinal County
1,400
1,600
DHRES-09
Shaft No. 3
DHRES-10
Shaft No. 9
HRES-01
Oak Flat
DHRES-04
DHRES-03
DHRES-05
DHRES-02
HRES-02
HRES-04
DHRES-01
A-06
HRES-18
DHRES-08
HRES-16
DHRES-13
HRES-09
DHRES-07
HRES-05
Devils Canyon
HRES-07
MJ-11
HRES-10
Hackberry Canyon
Hackberry Windmill
HRES-13
DHRES-06
HRES-08
HRES-11
Town of Superior
177
Arnett Creek
Mineral Creek

EXPLANATION

- Watershed Boundary
- Perennial Reach

Groundwater Monitoring Sites

- Shallow Alluvial Aquifer Monitor Well
- Apache Leap Tuff Aquifer Monitor Well
- Deep Groundwater System Monitor Well
- Shaft

Elevation Range

(meters above mean sea level)

- 1,600 - 1,800
- 1,400 - 1,600
- 1,200 - 1,400
- 1,000 - 1,200
- 800 - 1,000
- 600 - 800

N

0 0.5 1 1.5 2

Miles

Resolution Copper Mining

HRES-13 WELL LOCATION

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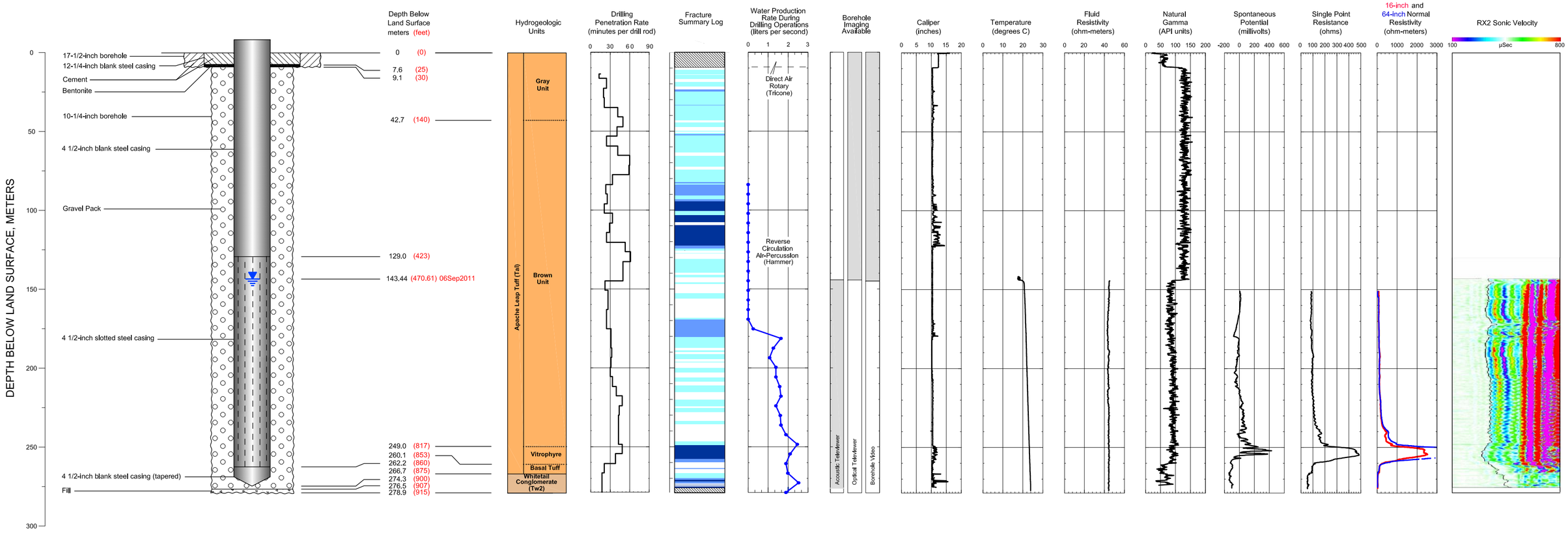
2012

FIGURE 1

\GIS-Tuc\Projects\605\605.31\Welloc_HRES_13.mxd\05Jan2012



CADASTRAL: (D-2-13)07abc	ADWR NO: 55-912967
NORTHING: 3681730.334	EASTING: 494613.369
LAND SURFACE ELEVATION: 1279.21	
DATUM: UTM12N, NAD 27, meters VERTICAL: NGVD 29 METERS	

EXPLANATION

- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing
- Non-Pumping Water Level

REGISTERED GEOLOGIST
CERTIFICATE NO.
25063
TODD
KEAY
Date Signed 5 Jan 2012
ARIZONA U.S.A.
Expires 6 Sept 2012

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HRES-13
SCHEMATIC DIAGRAM OF WELL CONSTRUCTION

Version: Jan. 5, 2012

FIGURE 2

605\WellSchematics_2011\HRES-13wsLOGS\05Jan2012

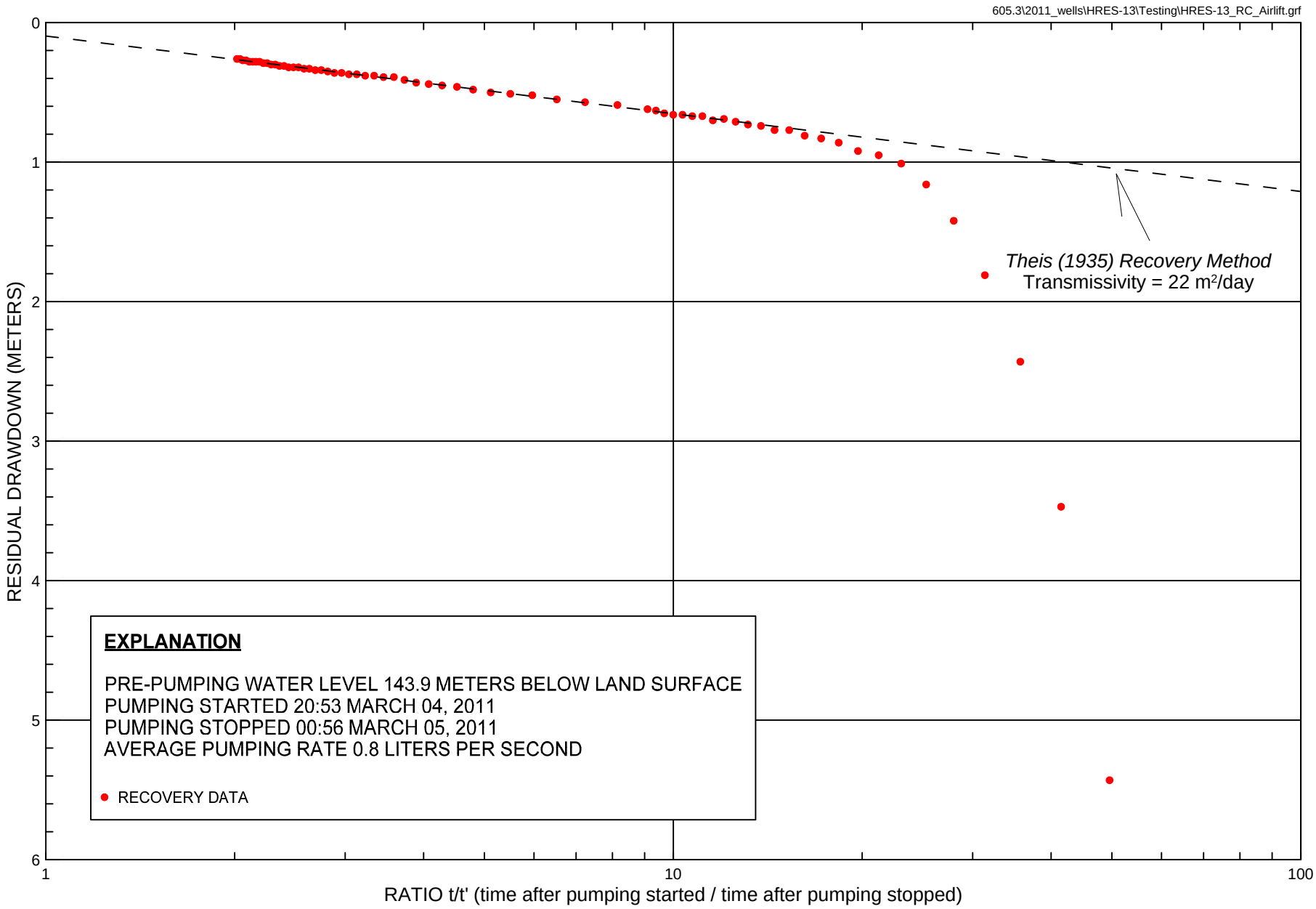

FIGURE 3. RECOVERY GRAPH FOR 4-HOUR AIRLIFT TEST AT CASED WELL HRES-13
RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

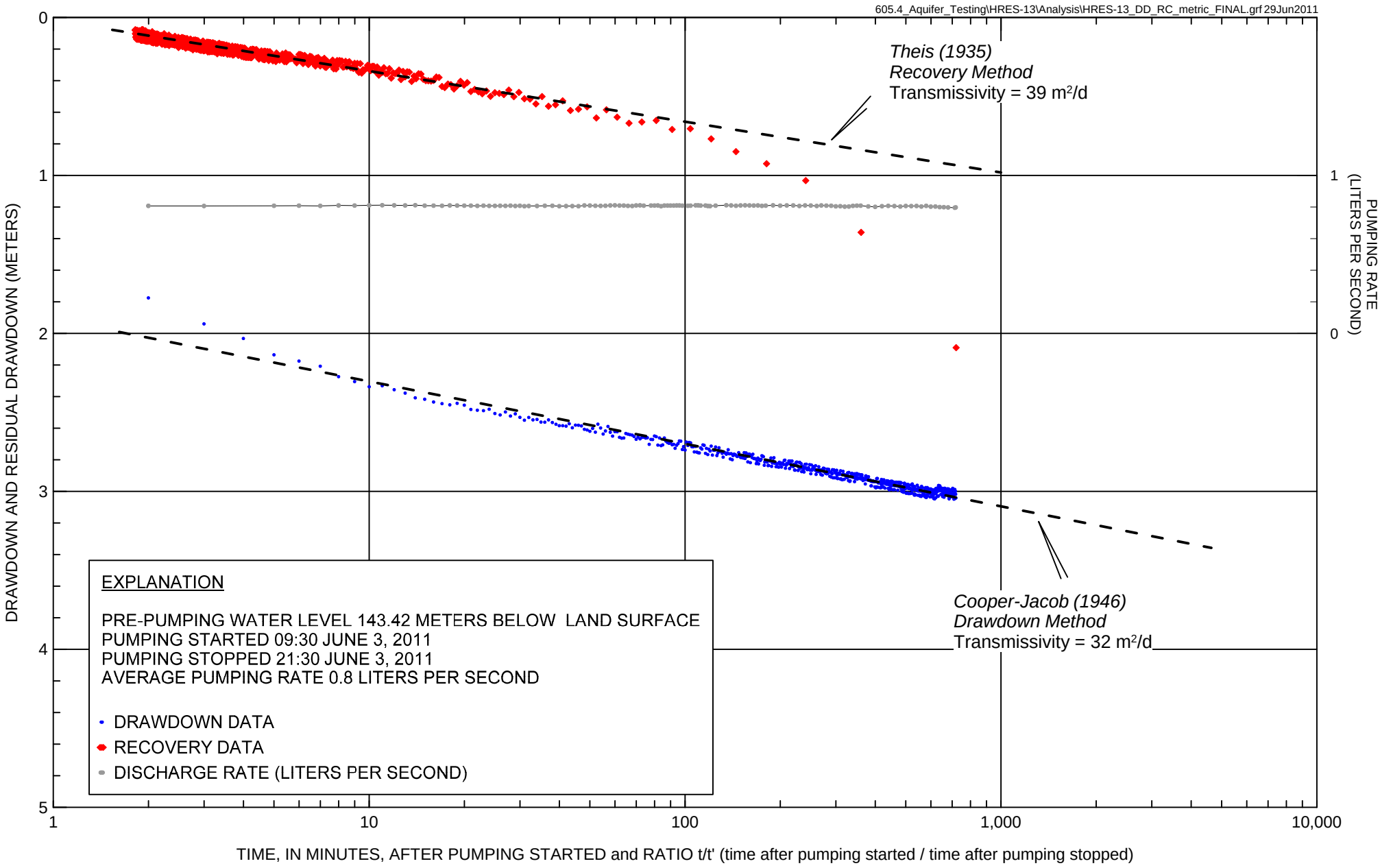

FIGURE 4. DRAWDOWN AND RECOVERY GRAPH FOR PUMPED WELL HRES-13 DURING 12-HOUR CONSTANT-RATE PUMPING TEST, RESOLUTION PROJECT

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LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Gray Unit (Talg)				
0 - 10	0.0 - 3.0	Gray Unit; pale red [10R6/2]; well lithified; porphyritic tuff with pinkish-red aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, trace magnetite; very trace lithic fragments of brown siltstone; reaction to acid: none	trace iron oxide (hematite)	DIRECT AIR ROTARY; Munsell Color Version: 2000 revised; angular chips up to 3.1 cm; 17.5" tricone starter bit
10 - 20	3.0 - 6.1	Gray Unit; pale red [10R6/2]; well lithified; porphyritic tuff with pinkish-red aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, trace magnetite; very trace lithic fragments of brown siltstone; reaction to acid: none	trace iron oxide (hematite)	angular chips up to 2.7 cm
20 - 30	6.1 - 9.1	Gray Unit; weak red [10R5/3]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, trace magnetite; very trace lithic fragments of black siltstone; reaction to acid: none	trace iron oxide (hematite)	angular chips up to 2.5 cm
30 - 40	9.1 - 12.2	Gray Unit; weak red [10R5/3]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, trace magnetite; very trace lithic fragments of black siltstone; reaction to acid: none	trace iron oxide (hematite)	DUAL-WALL REVERSE CIRCULATION AIR HAMMER; angular chips up to 1.4 cm; 10.25" air hammer R/C at 30'
40 - 50	12.2 - 15.2	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, trace magnetite; reaction to acid: none		angular chips up to 0.6 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Gray Unit (Talg)				
50 - 60	15.2 - 18.3	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of brown siltstone; reaction to acid: none		angular chips up to 0.4 cm
60 - 70	18.3 - 21.3	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of brown siltstone; reaction to acid: none		angular chips up to 0.5 cm
70 - 80	21.3 - 24.4	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of brown siltstone; reaction to acid: none		angular chips up to 0.8 cm
80 - 90	24.4 - 27.4	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of brown siltstone; reaction to acid: none		angular chips up to 0.6 cm
90 - 100	27.4 - 30.5	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of brown siltstone; reaction to acid: none		angular chips up to 0.5 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Gray Unit (Talg)				
100 - 110	30.5 - 33.5	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, trace magnetite; trace lithic fragments of brown siltstone; reaction to acid: none	very trace iron oxide (hematite)	angular chips up to 0.4 cm
110 - 120	33.5 - 36.6	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, trace magnetite; trace lithic fragments of brown siltstone; reaction to acid: none	very trace iron oxide (hematite)	angular chips up to 0.7 cm
120 - 130	36.6 - 39.6	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark brown siltstone; reaction to acid: none	very trace iron oxide (hematite)	angular chips up to 0.8 cm
130 - 140	39.6 - 42.7	Gray Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark reddish-brown siltstone; reaction to acid: none		angular chips up to 0.6 cm
APACHE LEAP TUFF - Brown Unit (Talb)				
140 - 150	42.7 - 45.7	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark reddish-brown siltstone; reaction to acid: none		subangular chips up to 0.4 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
150 - 160	45.7 - 48.8	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark reddish-brown siltstone; reaction to acid: none		subangular chips up to 0.6 cm
160 - 170	48.8 - 51.8	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark reddish-brown siltstone; reaction to acid: none		subangular chips up to 0.6 cm
170 - 180	51.8 - 54.9	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark reddish-brown siltstone; reaction to acid: none		subangular chips up to 0.5 cm
180 - 190	54.9 - 57.9	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.4 cm
190 - 200	57.9 - 61.0	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.4 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
200 - 210	61.0 - 64.0	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, trace magnetite; 1% lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.4 cm
210 - 220	64.0 - 67.1	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.3 cm
220 - 230	67.1 - 70.1	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.4 cm
230 - 240	70.1 - 73.2	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.5 cm
240 - 250	73.2 - 76.2	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 55% white anhedral plagioclase, 40% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.7 cm

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
250 - 260	76.2 - 79.2	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 55% white anhedral plagioclase, 40% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.6 cm
260 - 270	79.2 - 82.3	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 55% white anhedral plagioclase, 40% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.6 cm
270 - 280	82.3 - 85.3	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 55% white anhedral plagioclase, 40% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.5 cm
280 - 290	85.3 - 88.4	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 55% white anhedral plagioclase, 40% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.7 cm
290 - 300	88.4 - 91.4	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.6 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
300 - 310	91.4 - 94.5	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.6 cm
310 - 320	94.5 - 97.5	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-orange siltstone; reaction to acid: none		subangular chips up to 0.7 cm
320 - 330	97.5 - 100.6	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.6 cm
330 - 340	100.6 - 103.6	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.6 cm
340 - 350	103.6 - 106.7	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 58% white anhedral plagioclase, 35% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.7 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
350 - 360	106.7 - 109.7	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 58% white anhedral plagioclase, 35% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.9 cm
360 - 370	109.7 - 112.8	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 58% white anhedral plagioclase, 35% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 1.0 cm
370 - 380	112.8 - 115.8	Brown Unit; dusky red [10R3/4]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 58% white anhedral plagioclase, 35% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 1.1 cm
380 - 390	115.8 - 118.9	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 33% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 1.0 cm
390 - 400	118.9 - 121.9	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 33% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 1.1 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
400 - 410	121.9 - 125.0	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 33% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.9 cm
410 - 420	125.0 - 128.0	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 33% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.9 cm
420 - 430	128.0 - 131.1	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 60% white anhedral plagioclase, 33% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.7 cm
430 - 440	131.1 - 134.1	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 53% white anhedral plagioclase, 40% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.7 cm
440 - 450	134.1 - 137.2	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 53% white anhedral plagioclase, 40% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.8 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
450 - 460	137.2 - 140.2	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 53% white anhedral plagioclase, 40% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone and tan siltstone; reaction to acid: none		subangular chips up to 0.6 cm
460 - 470	140.2 - 143.3	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 53% white anhedral plagioclase, 40% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments (dark brownish-orange siltstone, trace tannish-yellow siltstone); reaction to acid: none	very trace iron oxide (hematite and limonite)	subangular chips up to 0.8 cm
470 - 480	143.3 - 146.3	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 53% white anhedral plagioclase, 40% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-orange siltstone; reaction to acid: none to weak	very trace iron oxide (hematite and limonite), trace calcite vein	subangular chips up to 0.7 cm
480 - 490	146.3 - 149.4	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 53% white anhedral plagioclase, 40% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-orange siltstone; reaction to acid: none to weak	very trace iron oxide (hematite and limonite), trace calcite vein	subangular chips up to 0.5 cm
490 - 500	149.4 - 152.4	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown and gray aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 53% white anhedral plagioclase, 40% quartz, 6% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-orange siltstone; reaction to acid: none to weak	trace calcite vein	subangular chips up to 0.6 cm

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Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
500 - 510	152.4 - 155.4	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 29% quartz, 5% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone; reaction to acid: none to weak	very trace calcite vein	subangular chips up to 0.4 cm
510 - 520	155.4 - 158.5	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 29% quartz, 5% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark brownish-red siltstone; reaction to acid: none to weak	very trace calcite vein	subangular chips up to 0.6 cm
520 - 530	158.5 - 161.5	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark brownish-red siltstone; reaction to acid: none to weak	very trace calcite vein	subangular chips up to 0.4 cm
530 - 540	161.5 - 164.6	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, very trace magnetite; very trace lithic fragments of dark brownish-red siltstone; reaction to acid: none		subangular chips up to 0.5 cm
540 - 550	164.6 - 167.6	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, very trace magnetite; reaction to acid: none to weak	trace calcite vein	subangular chips up to 0.7 cm

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Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
550 - 560	167.6 - 170.7	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 28% quartz, 7% black to bronzy biotite, very trace magnetite; reaction to acid: none to very weak	very trace calcite vein	subangular chips up to 0.5 cm
560 - 570	170.7 - 173.7	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 28% quartz, 7% black to bronzy biotite, very trace magnetite; reaction to acid: none		subangular chips up to 0.7 cm
570 - 580	173.7 - 176.8	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 28% quartz, 7% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark grayish brown siltstone; reaction to acid: none		subangular chips up to 0.5 cm
580 - 590	176.8 - 179.8	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 28% quartz, 7% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark grayish brown siltstone; reaction to acid: none	very trace iron oxide (hematite)	subangular chips up to 0.5 cm
590 - 600	179.8 - 182.9	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark grayish brown siltstone; reaction to acid: none		subangular chips up to 0.7 cm

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Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
600 - 610	182.9 - 185.9	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark grayish brown siltstone; reaction to acid: none		subangular chips up to 0.6 cm
610 - 620	185.9 - 189.0	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are up to 1 mm and consist of 65% white anhedral plagioclase, 30% quartz, 5% black to bronzy biotite, very trace magnetite; very trace lithic fragments of dark grayish brown siltstone; reaction to acid: none to weak	trace calcite vein	subangular chips up to 0.6 cm
620 - 630	189.0 - 192.0	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 34% quartz, 5% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish brown siltstone; reaction to acid: none to weak	trace calcite vein	subangular chips up to 0.5 cm
630 - 640	192.0 - 195.1	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark grayish brown siltstone; reaction to acid: none		subangular chips up to 0.6 cm
640 - 650	195.1 - 198.1	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark grayish brown siltstone; reaction to acid: none to weak	trace calcite vein, trace iron oxide (hematite and limonite)	subangular chips up to 0.8 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
650 - 660	198.1 - 201.2	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 5% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark grayish brown siltstone; reaction to acid: none to weak	very trace calcite, trace iron oxide (limonite), very trace iron oxide (hematite)	subangular chips up to 0.6 cm
660 - 670	201.2 - 204.2	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 34% quartz, 5% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown and reddish-brown siltstone; reaction to acid: none to weak	trace calcite vein, trace iron oxide (limonite), very trace iron oxide (hematite)	subangular chips up to 0.8 cm
670 - 680	204.2 - 207.3	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 34% quartz, 5% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown and reddish-brown siltstone, very trace tan chert fragments; reaction to acid: none	very trace calcite vein, very trace iron oxide (hematite and limonite)	subangular chips up to 0.7 cm
680 - 690	207.3 - 210.3	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 34% quartz, 5% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown and reddish-brown siltstone; reaction to acid: none	trace iron oxide (limonite)	subangular chips up to 0.5 cm
690 - 700	210.3 - 213.4	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown and reddish-brown siltstone; reaction to acid: none	very trace iron oxide (limonite)	subangular chips up to 0.6 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
700 - 710	213.4 - 216.4	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown and reddish-brown siltstone; reaction to acid: none		subangular chips up to 0.5 cm
710 - 720	216.4 - 219.5	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown and reddish-brown siltstone; reaction to acid: none		subangular chips up to 0.7 cm
720 - 730	219.5 - 222.5	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown, reddish-brown, and black siltstone; reaction to acid: none to weak	trace calcite vein, very trace iron oxide (hematite and limonite)	subangular chips up to 0.7 cm
730 - 740	222.5 - 225.6	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark grayish-brown, reddish-brown, and black siltstone; reaction to acid: none to weak	very trace calcite vein, very trace iron oxide (hematite and limonite)	subangular chips up to 0.7 cm
740 - 750	225.6 - 228.6	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark reddish-brown and black siltstone; reaction to acid: none to weak	trace calcite vein, very trace iron oxide (hematite and limonite)	subangular chips up to 0.6 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
750 - 760	228.6 - 231.6	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 60% white anhedral plagioclase, 35% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark reddish-brown and black siltstone; reaction to acid: none to weak	very trace calcite vein, very trace iron oxide (hematite and limonite)	subangular chips up to 0.7 cm
760 - 770	231.6 - 234.7	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 55% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark reddish-brown and black siltstone; reaction to acid: none to weak	very trace calcite vein	subangular chips up to 0.5 cm
770 - 780	234.7 - 237.7	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 55% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; 1% lithic fragments of dark reddish-brown and black siltstone; reaction to acid: none to weak	very trace calcite vein	subangular chips up to 0.6 cm
780 - 790	237.7 - 240.8	Brown Unit; dusky red [10R3/2]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark reddish-brown and black siltstone; reaction to acid: none to weak	trace calcite vein	subangular chips up to 0.6 cm
790 - 800	240.8 - 243.8	Brown Unit; dusky red [10R3/2] and reddish-brown [5YR5/4]; well lithified; porphyritic tuff with reddish-brown aphanitic to microcrystalline groundmass; phenocrysts are 1 to 2 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; trace lithic fragments of dark reddish-brown and black siltstone; reaction to acid: none		subangular chips up to 0.7 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Brown Unit (Talb)				
800 - 810	243.8 - 246.9	Brown Unit; reddish-brown [5YR5/4]; well lithified; porphyritic tuff with tannish-brown aphanitic to microcrystalline groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; reaction to acid: none		subangular chips up to 0.5 cm
APACHE LEAP TUFF - Vitrophyre (Talv)				
810 - 820	246.9 - 249.9	Vitrophyre; black [N2.5] and reddish-brown [5YR5/4]; well lithified; 70% vitrophyre with black, glassy groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite; 30% porphyritic tuff with tannish-brown aphanitic to microcrystalline groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; reaction to acid: none		subangular chips up to 0.8 cm
820 - 830	249.9 - 253.0	Vitrophyre; black [N2.5]; well lithified; 99% vitrophyre with black, glassy groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite; 1% porphyritic tuff with tannish-brown aphanitic to microcrystalline groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; reaction to acid: none		subangular chips up to 0.8 cm
830 - 840	253.0 - 256.0	Vitrophyre; black [N2.5]; well lithified; 98% vitrophyre with black, glassy groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite; 2% porphyritic tuff with tannish-brown aphanitic to microcrystalline groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; reaction to acid: none		subangular chips up to 0.9 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF - Vitrophyre (Talv)				
840 - 850	256.0 - 259.1	Vitrophyre; black [N2.5]; well lithified; 99% vitrophyre with black, glassy groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite; 1% porphyritic tuff with tannish-brown aphanitic to microcrystalline groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; reaction to acid: none		subangular chips up to 0.8 cm
850 - 860	259.1 - 262.1	Vitrophyre and Basal Tuff; black [N2.5] and reddish-brown [5YR5/4]; well lithified; 50% vitrophyre black, glassy groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite; 40% tannish-brown aphanitic to microcrystalline groundmass; phenocrysts are <1 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; 10% porphyritic tuff with white-pink aphanitic groundmass; phenocrysts are 1 to 2 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; reaction to acid: none		subangular chips up to 0.7 cm
APACHE LEAP TUFF - Basal Tuff (Talbt)				
860 - 870	262.1 - 265.2	Basal Tuff; pink [5YR8/3]; moderately to well lithified; 95% porphyritic tuff with white-pink aphanitic groundmass; phenocrysts are 1 to 2 mm and consist of 56% white anhedral plagioclase, 40% quartz, 4% black to bronzy biotite, very trace magnetite; 3% tannish-brown tuff; 2% black, glassy vitrophyre; reaction to acid: none		subangular chips up to 0.6 cm
WHITETAIL CONGLOMERATE - Lacustrine Unit (Tw2)				
870 - 880	265.2 - 268.2	Lacustrine Unit no. 2; dark reddish-brown [2.5YR3/4]; weakly to moderately lithified; 90% slightly calcareous, red siltstone and matrix; 5% gray limestone, 5% whitish-pink basal tuff, very trace black glassy vitrophyre; trace reddish-orange clay balls; reaction to acid: weak to moderate		subangular to subrounded chips up to 1.5 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-13
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
WHITETAIL CONGLOMERATE - Lacustrine Unit (Tw2)				
880 - 890	268.2 - 271.3	Lacustrine Unit no. 2; dark reddish-brown [2.5YR3/4]; moderately lithified; 98% slightly calcareous, red siltstone and matrix; 2% gray limestone; trace whitish-pink basal tuff; very trace black glassy vitrophyre; trace reddish-pink clay balls; reaction to acid: weak to moderate		subrounded chips up to 1.1 cm
890 - 900	271.3 - 274.3	Lacustrine Unit no. 2; dark reddish-brown [2.5YR3/4]; moderately lithified; 99% slightly calcareous, red siltstone and matrix; 1% gray limestone; trace whitish-pink basal tuff; very trace black glassy vitrophyre; trace reddish-pink clay balls; reaction to acid: weak to moderate		subrounded chips up to 1.4 cm
900 - 910	274.3 - 277.4	Lacustrine Unit no. 2; dark reddish-brown [2.5YR3/4]; moderately lithified; slightly calcareous, red siltstone and matrix; trace gray limestone; trace whitish-pink basal tuff; very trace black glassy vitrophyre; trace reddish-orange clay balls; reaction to acid: weak to moderate		subrounded chips up to 0.9 cm
910 - 915	277.4 - 278.9	Lacustrine Unit no. 2; dark reddish-brown [2.5YR3/4]; moderately lithified; slightly calcareous, red siltstone and matrix; trace gray limestone; trace whitish-pink basal tuff; very trace black glassy vitrophyre; trace reddish-orange clay balls; reaction to acid: weak to moderate		subrounded chips up to 1.3 cm

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL HRES-13

Date	Hole #	Reporter	Shift Change Depth (m)	Shift Change Depth (ft)	Progress in last 24 Hrs (m)	Progress in last 24 Hrs (ft)	Comments	Hole Type/Size	Hydro Data	Geology
18-Feb	HRES-13	J.Kent	0.00	0.00	0.00	0.00	LM-140 has been mobilized to site safely and successfully. Site set up will commence through the weekend.	Mobilization	N/A	N/A
19-Feb	HRES-13	D. Stalling	0.00	0.00	0.00	0.00	Mobilization of equipment from EP lay down yard to site continues. Crews are currently working on rig repairs with mechanic to replace lines, hydraulic pump and mast winch. Mud system has been cleaned with valves replaced which will be mobilized to site later today. Anticipate complete site set-up and final inspection by Monday.	Mobilization	N/A	N/A
20-Feb	HRES-13	E. Jung	0.00	0.00	0.00	0.00	Mobilization continues. Anticipate complete site set-up and final inspections tomorrow afternoon.	Mobilization	N/A	N/A
21-Feb	HRES-13	E. Jung	0.00	0.00	0.00	0.00	Completed site set-up at 1400hrs. Peeks Performance and RCM representatives conducted inspections, with no issues discovered. Currently rigging tooling to drill 17-1/4" starter bit for surface casing. Anticipate drilling to commence by late evening.	17-1/4" Starter Tri-Cone bit	N/A	N/A
22-Feb	HRES-13	E. Jung	4.57	15.00	4.57	15.00	Drilling was delayed and crew on standby until electrical inspections were completed at 0800hrs. Began drilling for surface casing at 0845hrs. Plan to set 10.67m of 12" surface casing. Currently drilling.	17-1/4" Starter Tri-Cone bit	N/A	Apache Leap Tuff (Tal)
23-Feb	HRES-13	E. Jung	9.14	30.00	4.57	15.00	Drilled to 9.14m - set and cemented 12" surface casing. On standby for 8hr cure on cement. Tripped in BHA - no air to hammer. Worked on rig and BHA, and corrected issues. Resumed drilling at 123hrs. Currently drilling.	10" Hammer RC Air	N/A	Apache Leap Tuff (Tal)
24-Feb	HRES-13	E. Jung	141.73	465.00	132.59	435.00	Drilling, making good progress. Penetration rate had been averaging ~20min per rod, and has slowed to ~1hr per rod in the last 12.2m to 18.3m. Took survey at 121.9m, Inc 0.75°. Plan for bit trip at 182.9m. Currently drilling.	10" Hammer RC Air w/ water injection.	Lost circulation at 114.3m. Regained returns to 80-90%. Driller noted fracture zone from 112.77m to 116.42m.	Apache Leap Tuff (Tal)

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL HRES-13

Date	Hole #	Reporter	Shift Change Depth (m)	Shift Change Depth (ft)	Progress in last 24 Hrs (m)	Progress in last 24 Hrs (ft)	Comments	Hole Type/Size	Hydro Data	Geology
25-Feb	HRES-13	D. Stalling	199.64	655.00	57.91	190.00	Crew tripped out for bit at 1700hrs and commenced drilling by 0115hrs. Drilling with a penetration rate of ~40mins per rod. Surveys taken at 152.4m and 182.9m with and Inc of 1°.	10" Hammer RC Air w/ water injection.	Drilling with good returns. Increased water production zone at 181.4m of 25gpm.	Apache Leap Tuff (Tal)
26-Feb	HRES-13	D. Stalling	278.89	915.00	79.25	260.00	Drilling reached TD by 0300hrs. Surveys taken at 213.4m & 243.8m show Inc 1°. Circulation has been halted while crew is takes water level readings hourly until geophysical logging is conducted. Logging is scheduled for tomorrow morning.	10" Hammer RC Air w/ water injection.	Water production increased to 30gpm up to TD.	**Apache Leap Tuff vitrophyre from 248.7m to 260.6m contact with Whitetail Conglomerate at 266.7m.**
27-Feb	HRES-13	E. Jung	278.89	915.00	0.00	0.00	Geophysical logging was re-scheduled due to poor condition of the road to drill site (snow accumulation). Logging will be conducted at 0800hrs tomorrow morning. Crew is conducting maintenance and repairs while on standby.	10" Hammer RC Air w/ water injection.	Latest static water level was measured at ~138m bls.	Whitetail Conglomerate (Tw)
28-Feb	HRES-13	E. Jung	278.89	915.00	0.00	0.00	Conducted geophysical logging from 0800hrs to 1300hrs. Encountered a bridge just below static water level, ~143.7m. Ran OBI and camera in the dry portion of hole. Crew will trip back in to open up hole. Will attempt to run the remainder of logging tools tomorrow at 0800hrs.	10" Open Hole	Static water level is 143.7m bls.	Whitetail Conglomerate (Tw)
1-Mar	HRES-13	E. Jung	278.89	915.00	0.00	0.00	Tripped in for a wiper run. Encountered bridge at 145.38m and 1.22m of fill on bottom. Geophysical logging commenced at 0930hrs. First three tools run successfully. Currently running ABI.	10" Open Hole	Static water level is 143m bls.	Whitetail Conglomerate (Tw)
2-Mar	HRES-13	E. Jung	278.89	915.00	0.00	0.00	Ran 4-1/2" casing as per casing schedule. Tripped in BQ rods to 262.11m to install gravel pack. Currently installing gravel pack.	4-1/2" HWT blank and perforated casing.	N/A	Whitetail Conglomerate (Tw)
3-Mar	HRES-13	E. Jung	278.89	915.00	0.00	0.00	Gravel pack installation continues. Gravel has been periodically bridging/plugging BQ pipe, in which case the crew has tripped back and pumped on BQ to clear blockage. Gravel pack installation is approximately half complete.	4-1/2" HWT blank and perforated casing.	N/A	Whitetail Conglomerate (Tw)

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL HRES-13

Date	Hole #	Reporter	Shift Change Depth (m)	Shift Change Depth (ft)	Progress in last 24 Hrs (m)	Progress in last 24 Hrs (ft)	Comments	Hole Type/Size	Hydro Data	Geology
4-Mar	HRES-13	D. Stalling	278.89	915.00	0.00	0.00	Crews finished gravel pack and bentonite seal installation successfully. Currently setting up to cement from 7.62m to surface. 101 pipe is on site to conduct well development.	4-1/2" HWT blank and perforated casing.	N/A	Whitetail Conglomerate (Tw)
5-Mar	HRES-13	D. Stalling	278.89	915.00	0.00	0.00	Crew finished cementing to surface. Tripped in 101 pipe to 268.2m and AQ to 237.7m to conduct the air lift test. Air lift test performed successfully from 2100hrs to 2500hrs with an equal recovery period. Crews will begin site break down and transport crates and some equipment to #9 lay down yard.	4-1/2" HWT blank and perforated casing.	Conducted air lift test. Water level before test was stabilized at 145.4m. Air lift test started at 2100hrs which sustained and average pumping rate of 11.5gpm for four hours, following with a four hour recovery. Final parameters were: pH=8.36, EC=430.2uS, T=21.9°C, ORP=52mV. The well has recovered quickly with the first level recored at 150.9m and rising.	Whitetail Conglomerate (Tw)
6-Mar	HRES-13	E. Jung	278.89	915.00	0.00	0.00	Site breakdown continues, with approximately half of the auxilliary equipment mobilized to the #9 laydown.	Mobilization	Water level was last recorded at ~143.56m bls. Cylindrical vault is welded in place and locked.	Whitetail Conglomerate (Tw)
7-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	Mobilization continues. Almost all auxiliary equipment has been staged at the East Plant laydown yard. The deck, drill rig, and doghouse are still at the site. Anticipate mobilizing the remaining equipment tomorrow.	Mobilization	N/A	Whitetail Conglomerate (Tw)
8-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	The drill rig has safely and successfully been mobilized to the East Plant lay down yard in preparation for the move out to HRES-14. The remaining doghouse and winch truck are to be moved later this afternoon with the backhoe onsite to complete site reclamation.	Mobilization	N/A	N/A

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL HRES-13

Date	Hole #	Reporter	Shift Change Depth (m)	Shift Change Depth (ft)	Progress in last 24 Hrs (m)	Progress in last 24 Hrs (ft)	Comments	Hole Type/Size	Hydro Data	Geology
9-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	Completed mobilizing all equipment off of the site to the East Plant laydown yard. Completed site clean up, and passed final inspection. Currently working on plans to mobilize to HRES-14.	Mobilization	N/A	N/A
10-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	Completing mobilization plan for the next site. Currently on standby.	Mobilization	N/A	N/A
11-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	LM-140 will be mobilized on March 17th to Devils Canyon. Currently all equipment is staged at the #9 laydown yard.	Mobilization	N/A	N/A
12-Mar	HRES-13	D. Stalling	278.89	915.00	0.00	0.00	LM-140 will be mobilized on March 17th to Devils Canyon. Currently all equipment is staged at the #9 laydown yard.	Mobilization	N/A	N/A
13-Mar	HRES-13	E. Jung	278.89	915.00	0.00	0.00	LM-140 will be mobilized on March 17th to Devils Canyon. Currently all equipment is staged at the #9 laydown yard.	Mobilization	N/A	N/A
14-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	LM-140 will be mobilized on March 17th to Devils Canyon. Currently all equipment is staged at the #9 laydown yard.	Mobilization	N/A	N/A
15-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	LM-140 will be mobilized on March 17th to Devils Canyon. Currently all equipment is staged at the #9 laydown yard.	Mobilization	N/A	N/A
16-Mar	HRES-13	J.Kent	278.89	915.00	0.00	0.00	LM-140 will be mobilized on March 17th to Devils Canyon. Currently all equipment is staged at the #9 laydown yard.	Mobilization	N/A	N/A