MONTGOMERY & ASSOCIATES
Water Resource Consultants

www.elmontgomery.com

1550 East Prince Road
Tucson, AZ 85719

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

TUCSON PHOENIX SANTIAGO DE CHILE

TECHNICAL MEMORANDUM

DATE: May 13, 2011 **Project 605.31**

TO: Greg Ghidotti
RESOLUTION COPPER MINING LLC

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

SUBJECT: RESULTS OF DRILLING, CONSTRUCTION, EQUIPPING, AND TESTING AT HYDROLOGIC TEST WELLS HRES-10 AND HRES-11, 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, equipping, and testing at hydrologic test wells HRES-10 and HRES-11. The wells were installed to characterize hydrogeologic conditions in the Apache Leap Tuff (Tal) in the southeast extent of the Tal outcrop area near Mineral Creek. Monitoring data obtained from HRES-10 and HRES-11 will be incorporated into the RCM hydrologic monitoring program.

HRES-10 SUMMARY

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

1. Hydrologic test well HRES-10 is located on land owned by Government Springs Ranch LLC, in Township 2 South, Range 13 East, in the SW ¼ of the NE ¼ of the NE ¼ of Section 12 ((D-2-13)12aac), east of Lyons Creek, about 1 mile north of Mineral Creek.

2. Well HRES-10 was drilled and constructed during the period April 16 through May 3, 2010.
3. Total drilled depth for HRES-10 is 471.2 meters below land surface (bls).
4. Geologic units encountered during drilling from land surface to total depth include Quaternary-Tertiary Gila Conglomerate (QTg; 0 to 19.8 meters), Tal (19.8 to 413.6 meters), and Whitetail Conglomerate (Tw; 413.6 to 471.2 meters).
5. HRES-10 was completed within the Tal, with two perforated intervals (48.1 to 121.3 and 212.7 to 334.8 meters bls); non-pumping water level is approximately 13 meters bls.
6. Airlift testing in the open borehole and with a packer isolating selected zones indicates that the majority of productivity is concentrated in the upper part of the Apache Leap Tuff aquifer (ALT aquifer) at well HRES-10.
7. HRES-10 was equipped with dedicated pump and water level recording equipment on July 26 and 27, 2010.
8. A 10-hour constant-rate pumping test was conducted in the cased well; this test yielded an estimated transmissivity of approximately 60 m^2/d and an estimated hydraulic conductivity of 9 x 10^{-4} cm/s in the upper ALT aquifer at this location. No response to pumping was observed at the adjacent CT Windmill well.
9. Water samples were collected for laboratory chemical and isotopic analyses during both airlift and constant-rate pumping tests.

HRES-11 SUMMARY

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

1. Hydrologic test well HRES-11 is located on land owned by the State of Arizona, in Township 2 South, Range 13 East, in the NE ¼ of the NE ¼ of the SE ¼ of Section 15 ((D-2-13)15daa), on the drainage divide between Mineral Creek and Devils Canyon.
2. Well HRES-11 was drilled and constructed during the period May 8 through May 18, 2010.
3. Total drilled depth is 338.6 meters bls.
4. Geologic units encountered during drilling from land surface to total depth include Tal (0 to 327.6 meters) and Tw (327.6 to 338.6 meters).
5. HRES-11 was completed within the Tal, with a single perforated interval from 182.3 to 328.6 meters bls; non-pumping water level is approximately 195 meters bls.
6. Following installation of production casing, an 8-hour airlift test was conducted to develop the well and provide preliminary aquifer parameters.
7. The well was equipped with dedicated pump and water level recording equipment on July 27 and 28, 2010.
8. A 48-hour constant-rate pumping test was conducted in the cased well; this test yielded an estimated transmissivity of approximately 10 m^2/d and an estimated hydraulic conductivity of 1 x 10^{-4} cm/s in the ALT aquifer at this location.
9. Water samples were collected for laboratory chemical and isotopic analyses during both airlift and constant-rate pumping tests.

INTRODUCTION

Hydrologic test wells HRES-10 and HRES-11 were drilled and constructed during the period April 16 through May 18, 2010. The wells were drilled to:

- evaluate groundwater conditions in the ALT aquifer in the southeast extent of the Tal outcrop belt (HRES-10)
- evaluate groundwater conditions in the ALT aquifer upgradient of the Mineral Creek springs (HRES-11)
- provide groundwater level and groundwater quality monitoring points.

The wells were drilled into the Tw and completed to permit hydrologic testing within the Tal. Hydrologic test well HRES-10 is located on land owned by Government Springs Ranch LLC, in Township 2 South, Range 13 East, in the SW ¼ of the NE ¼ of the NE ¼ of Section 12 ((D-2-13)12aac), east of Lyons Creek, about 1 mile north of Mineral Creek. **Photograph 1** shows the layout for the HRES-10 well site during drilling operations. Hydrologic test well HRES-11 is located on land owned by the State of Arizona, in Township 2 South, Range 13 East, in the NE ¼ of the NE ¼ of the SE ¼ of Section 15 ((D-2-13)15daa), on the drainage divide between Mineral Creek and Devils Canyon. **Photograph 2** shows the layout for HRES-11 during drilling operations. **Figure 1** shows the locations for HRES-10 and HRES-11. **Figures 2 and 3** are schematic diagrams of well construction for the test wells. Other data summarized on the schematic diagrams include: hydrogeologic units, drilling penetration rate, water production rate during drilling operations, and borehole geophysical logs. Detailed lithologic logs for the test wells are provided in **Appendix A**.

DRILLING OPERATIONS

Hydrologic test wells HRES-10 and HRES-11 were 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 wells were drilled in accordance with technical specifications prepared by M&A. Mr. Richard Parkins of Boart Longyear supervised drilling, construction, and airlift testing activities at the drill sites. 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 wells. RCM provided daily summaries of drilling progress. Daily summary data are provided in **Appendix B**.

Wells HRES-10 and HRES-11 were drilled to 471.2 and 338.6 meters bls, respectively, and then blank and perforated casing were installed to the designed depths. Final completion of the wells were designed by Mr. Todd Keay and Ms. Kate Duke of M&A based on review of lithologic and hydrologic conditions encountered during drilling operations, and results of borehole geophysical logs.

Drilling Method

The boreholes for HRES-10 and HRES-11 were drilled using the conventional mud rotary method for the surface casing borehole, and the dual-wall air reverse circulation and air-assisted flooded reverse circulation methods for the production interval of the borehole. Depths, drilling methods, and bit types and sizes are summarized in **Table 1**. **Photograph 3** shows the bottom hole assembly for dual-wall reverse circulation drilling at HRES-11.

TABLE 1. SUMMARY OF DRILLING METHODS AND BOREHOLE DIAMETERS HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

Well	Depth Interval (meters)	Drilling Method	Bit Type	Borehole Diameter (inches)
HRES-10	0 – 28.6	conventional mud rotary	tricone	17-1/2
	28.6 – 72.2	reverse circulation air percussion	hammer	10
	72.2 – 471.2	air-assisted flooded reverse circulation	tricone	9-7/8
HRES-11	0 – 6.1	conventional air rotary	tricone	17-1/2
	6.1 – 252.1	reverse circulation air percussion	hammer	10
	252.1 – 338.6	air-assisted flooded reverse circulation	tricone	9-7/8

For the production portion of the borehole at HRES-10 and HRES-11, the dual-wall air reverse circulation method was used to allow for measurement of groundwater production during drilling. At HRES-10, at a depth of 72 meters bls, slow drilling progress necessitated change to the air-assisted flooded reverse drilling method for the remainder of the borehole. At HRES-11, at a depth of 252.1 meters bls, the drilling method was changed to the air-assisted flooded reverse drilling method when unstable borehole conditions were encountered.

Drilling Fluid and Drill Cuttings Management

Air and water were used during drilling operations for the production interval of the boreholes. When air methods were used, 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 cuttings. All drilling fluids and formation fluids were contained in portable tanks to allow fines to settle prior to removal from the well site. At HRES-10, formation fluids were removed from the site using vacuum trucks, and then deposited at a designated storage facility at the RCM West Plant Site. At HRES-11, formation fluids were discharged to a nearby stock pond. Drill cuttings were collected in the bucket of a back-hoe, stored on site, and then spread on site after well construction was complete.

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 long drill rod. A summary of drill

penetration rate data for each well is shown on **Figures 2 and 3**. 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 also conducted on a regular basis using a Totco mechanical drift recorder. At HRES-10, borehole deviation was 1 degree or less for the depth interval from land surface to 313 meters bls using dual-wall air reverse circulation and air-assisted flooded reverse circulation drilling methods. Borehole deviation increased during drilling of the Tw. Maximum borehole deviation was 2.75 degrees at a depth of 459 meters bls. At HRES-11, borehole deviation was 1.25 degrees or less for the depth interval from land surface to 229 meters bls. Borehole deviation was not measured in the lower 110 meters of the borehole.

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 have been palletized and stored at the core storage facility at the East Plant site. Detailed lithologic descriptions are given in **Appendix A**.

Monitoring of Groundwater Conditions

When the dual-wall air reverse circulation method was used, it was possible to monitor for the presence of groundwater, and to determine approximately where groundwater inflow zones were encountered. Water production could not be monitored during air-assisted flooded reverse circulation drilling at HRES-10 or HRES-11.

At HRES-10, the depth interval from 28.6 to 72.2 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. 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 a stop watch. Results were recorded in the hydrologist's notes. Results of flow measurements made during drilling operations for well HRES-10 are summarized on **Figure 2**. First measurable water production rate at HRES-10 was 2.5 L/s at a depth of 51.8 meters bls. Measured water production rate was 4.3 L/s at 60 meters bls. Maximum measured groundwater production rate was 8.2 L/s at 66.1 meters bls. At HRES-11, the depth interval from 6 to 252 meters bls was drilled using the dual-wall air reverse circulation method and groundwater production was measured. Results of flow measurements made during drilling operations for well HRES-11 are summarized on **Figure 3**. First measurable water production rate at HRES-11 was 0.25 L/s at a depth of 242.9 meters bls. Maximum measured groundwater production rate was 1.5 L/s at 249 and 251.5 meters bls. Discharge water for the wells was monitored for changes in water quality parameters (temperature, pH, specific conductance, and sand content). **Photograph 4** shows M&A personnel measuring water quality parameters during drilling at

HRES-10. **Table 2** is a summary of water quality parameters measured during drilling operations.

TABLE 2. WATER QUALITY PARAMETERS OBTAINED DURING AIR DRILLING OPERATIONS AT HRES-10 AND HRES-11

Well	Depth (meters bls)	Water Production Rate (L/s)	Temperature (degrees Celsius)	pH (standard units)	Specific Conductance (microSiemens per centimeter)
HRES-10	54.0	2.5	21.3	7.76	796.8
	66.1	4.3	19.2	7.56	738.7
	72.2	8.2	19.7	7.55	736.5
HRES-11	242.9	0.2	14.6	7.11	251.9
	249.0	1.5	21.1	7.32	385.3
	251.5	1.5	21.9	7.31	367.6

Slow drilling progress at HRES-10 and borehole instability at HRES-11 necessitated change to the air-assisted flooded reverse drilling method.

Photograph 1. Site layout at HRES-10 during drilling operations

Photograph 2. Site layout at HRES-11 during drilling operations

Photograph 3. Air-hammer downhole assembly at HRES-11

Photograph 4. M&A personnel measuring water quality parameters during drilling at HRES-10

BOREHOLE GEOPHYSICAL LOGGING

Borehole geophysical logging was conducted when the boreholes for HRES-10 and HRES-11 reached total depth. Borehole geophysical logging services were provided by Southwest Exploration Services, LLC (SWE) of Gilbert, Arizona. Borehole geophysical logging was conducted at HRES-10 on April 25, 2010, and at HRES-11 on May 15, 2010. The suite of geophysical logs obtained included: electrical resistivity (E-log), spontaneous potential (SP), natural gamma ray, sonic, temperature, and acoustic borehole imaging (ABI). An optical borehole imaging log (OBI) was obtained at HRES-11 in the unsaturated part of the Tal. SWE submitted field logs in digital and hard copy format to RCM. Summary geophysical logs for HRES-10 and HRES-11 are provided on **Figures 2 and 3**.

ANALYSIS OF GEOLOGIC CONDITIONS

Geologic Contacts and Degree of Fracturing

Geologic contacts were picked based on analysis of drill cutting samples, geophysical logs, and information obtained during drilling. A log summarizing interpretation of lithologic descriptions, during drilling is shown on **Figures 2 and 3**. **Table 3** is a summary of geologic units at HRES-10 and HRES-11.

TABLE 3. SUMMARY OF GEOLOGIC UNITS DRILLED FOR HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

Geologic Formation	Depth Interval (meters)	
	HRES-10	HRES-11
Gila Conglomerate (QTg)	0 – 19.8	Not present
Apache Leap Tuff – White Unit (Talw)	19.8 – 67.1	Not present
Apache Leap Tuff – Gray Unit (Talg)	67.1 – 179.8	0 – 125.0
Apache Leap Tuff – Brown Unit (Talb)	179.8 – 406.9	125.0 – 318.5
Apache Leap Tuff – Vitrophyre (Talv)	406.9 – 413.6	318.5 – 326.1
Apache Leap Tuff – Basal tuff (Talbt)	Not present	326.1 – 327.6
Whitetail Conglomerate (Tw)	413.6 – 471.2	327.6 – 338.6

Fracture summary logs were prepared using geophysical logs including ABI, OBI, sonic, and electrical resistivity. Where available, the ABI or OBI logs were the primary sources for the fracture summary logs. If ABI or OBI logs were not available, sonic logs were used to classify fractures. 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 or OBI 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. Fracture summary logs are shown on **Figures 2 and 3**.

Gila Conglomerate (QTg)

The QTg was encountered at HRES-10 but not at HRES-11. At HRES-10, the unit is 19.8 meters thick. It consists of approximately 55 percent sand, 35 percent clayey silt, and 10 percent gravel. The gravel fraction contains schist, clear and white vein quartz, purple, orange, and buff quartzite, and trace amounts of diabase, limestone, and Tal. In general, the gravel fraction has iron oxide staining and the matrix material has weak to moderate acid reaction. At HRES-10, the unit is weakly lithified. A very trace amount of calcite was noted in the sand fraction below a depth of 12.2 meters.

Surface casing was installed for the entire interval drilled through the QTg to isolate it from the Tal below. In the vicinity of HRES-10, the QTg is known to yield only a small amount of water to the nearby CT Well. Because the unit was completed with blank surface casing, geophysical logs were not obtained in the QTg at HRES-10. The degree of fracturing of the QTg at HRES-10 is believed to be very minor as indicated by the lack of fracture evidence in drill cuttings samples and low yield at the nearby CT Well. Only very trace fracture-filling, sand-sized calcite crystals were observed in the drill cuttings.

Apache Leap Tuff (Tal)

At HRES-10, the Tal is 393.8 meters thick and consists of White Unit (Talw) from 19.8 to 67.1 meters bls, Gray Unit (Talg) from 67.1 to 179.8 meters bls, Brown Unit (Talb) from 179.8 to 406.9 meters bls, and vitrophyre (Talv) from 406.9 to 413.6 meters bls. The basal tuff (Talbt) is not present at HRES-10. The Talw, Talg, and Talb are dacite porphyry tuff with phenocrysts of potassium and plagioclase feldspar, quartz, and biotite, and trace amounts of pumice and lithic fragments. The Talw consists of approximately 70 percent white to pale pink groundmass and 30 percent phenocrysts. The Talg is a welded crystal-rich tuff with approximately 50 percent pale pinkish-brown groundmass and 50 percent phenocrysts. The Talb is a densely welded crystal-rich tuff with approximately 50 percent reddish-brown cryptocrystalline groundmass and 50 percent phenocrysts. Two zones with glassy groundmass and abundant smoky quartz were encountered in the Talb at HRES-10 in the depth intervals from 201.2 to 237.7 and 376.4 to 406.9 meters bls. The Talv has a black glassy groundmass and the same phenocryst assemblage as the tuff. The contact between the Talw and Talg is distinguishable in drill cuttings, but the contact between the Talg and Talb is less distinct, and was picked where normal resistivity increased (**Figure 2**).

The E-Logs for HRES-10 indicate low resistivity for the depth interval from 28.6 to 42.7 meters bls, slightly higher resistivity from 42.7 to approximately 67 meters bls, moderate to

high resistivity from 67 to 406.9 meters bls. These are interpreted to be relatively unwelded upper Talw, partially welded lower Talw, and welded Talg and densely welded Talb, respectively (**Figure 2**). Normal resistivity increased for the depth interval from 406.9 to 413.6 where the Talv occurs.

Evidence of fracturing in the Tal at HRES-10 was noted in drill cuttings by the presence of calcite and quartz crystals, talc, slickensides, and mineral staining (iron oxide and manganese oxide) on fracture surfaces. Trace evidence of fracturing was noted in drill cuttings for the entire interval of Tal. The ABI log indicates that fractures are common throughout the Tal and that most of the fractures are low angle features. It also indicates very dense fracturing from approximately 227 to 334, 342 to 345, and 360 to 368 meters bls. Below a depth of 349 meters, the quality of the ABI log is poor, but fracture zones are discernable until a depth of 408 meters. The fracture summary log for HRES-10 is shown on **Figure 2**.

At HRES-11, the Tal is 327.6 meters thick and consists of Talg from land surface to 125.0 meters bls, Talb from 125.0 to 318.5 meters bls, Talv from 318.5 to 326.1 meters bls, and Talbt from 326.1 to 327.6 meters bls. The Talg, Talb and Talbt are dacite porphyry tuff with phenocrysts of potassium and plagioclase feldspar, quartz, and biotite, and trace amounts of pumice and lithic fragments. The Talg is welded crystal-rich tuff with approximately 55 percent pinkish-brown cryptocrystalline groundmass and 45 percent phenocrysts. The Talb is densely welded crystal-rich tuff with approximately 55 percent reddish-brown cryptocrystalline groundmass and 45 percent phenocrysts. The upper 19.8 meters are deeply weathered. The Talv has a black glassy groundmass and the same phenocryst assemblage as the tuff units. The Talbt is unwelded and has approximately 80 percent pink aphanitic groundmass and 20 percent phenocrysts.

The E-Logs for HRES-11 indicate low to moderate resistivity for the depth interval from 195 to 318 meters bls, very high resistivity from 318 to 326 meters bls, and low resistivity from 326 to328 meters bls. These are interpreted to be densely welded Talb, Talv, and unwelded Talbt, respectively (**Figure 3**).

Fracturing at HRES-11 within the Tal was noted in drill cuttings by the presence of calcite crystals, soft white clay chips, and mineral staining (mostly iron oxide) on fracture surfaces. A sample of the white clay material was analyzed using the RCM PIMA shortwave infrared spectrometer. The spectra for the sample indicate an 84 percent match to standard spectra for montmorillonite and 16 percent match to standard spectra for stilbite, which suggests the material is altered zeolite. The drill cuttings sample from the depth interval from 246.9 to 253.0 meters contained 10 to 25 percent of the material. The ABI log indicates that minor fractures are common throughout the Tal and that most of the fractures are low angle features. The ABI log indicates major fracturing for the following depth intervals: 240 to 243, 246 to 252, and 938 to 1,020 meters. These intervals also correspond to large washouts on the caliper log. In the unsaturated portion of the Tal, the OBI log indicates common minor to moderate fracturing. The fracture summary log for HRES-11 is shown on **Figure 3**.

Whitetail Conglomerate (Tw)

The upper 57.6 meters of the Tw was penetrated at HRES-10 and included conglomerate unit Tw3 only. At HRES-10, Tw3 consists of moderately lithified clast-supported conglomerate with 40 percent gravel, 40 percent sand, and 20 percent reddish-brown silt. The gravel fraction contains schist, quartzite, diabase, and trace limestone. At HRES-10, the contact between the Tal and the Tw at a depth of 413.6 meters bls was confirmed by a decrease in normal resistivity, and an increase in spontaneous potential (**Figure 2**). Evidence of fracturing was not indicated in drill cuttings samples or on the geophysical logs.

The upper 11.0 meters of the Tw was penetrated at HRES-11, and included conglomerate unit (Tw3) only. At HRES-11, Tw3 consists of moderately lithified clast-supported conglomerate with 50 percent gravel, 40 percent sand, and 10 percent reddish-brown silt. The gravel fraction contains diabase, chert, schist, and quartzite. At HRES-11 the contact between Tal and Tw3 at a depth of 327.6 meters bls was confirmed by a change in character of the ABI log, a substantial decrease in normal resistivity, and a slight decrease in gamma ray activity. Evidence of fracturing was not indicated in drill cuttings samples or on the geophysical logs.

Borehole Fluids

The temperature and fluid resistivity logs were examined to determine borehole fluid characteristics for wells HRES-10 and HRES-11. In a typical borehole with little or no fluid circulation, temperature of stabilized borehole fluids would generally increase with depth following the regional geothermal gradient.

At HRES-10, the fluid temperature decreased from 25 to18 degrees Celsius for the depth interval from 4 to 53 meters bls. Below 53 meters bls, borehole fluid temperature increased steadily with depth to slightly more than 31 degrees Celsius at the bottom of the borehole. At HRES-10, three fracture zones noted previously correspond to marked changes in borehole fluid temperature and indicate water producing zones. For the zone from 324 to 331 meters bls, fluid temperature decrease correlates with sub-horizontal fractures; at 345 meters bls, fluid temperature increase correlates with a major fracture; and at 411 meters bls, fluid temperature increase correlates with a possible fracture zone. At HRES-10, borehole fluid resistivity decreased steadily with depth from slightly less than 24 ohm-meters (ohm-m) in the upper part of the borehole to slightly more than 16 ohm-m in the bottom of the borehole, indicating a slightly less productive zone at the bottom of the borehole (**Figure 2**).

At HRES-11, borehole fluid temperature increased steadily with depth from about 45 to 48 degrees Celsius. Three groundwater inflow zones are indicated by the temperature log from 240 to 243, 246 to 252, and 938 to 1,020 meters bls. Borehole fluid resistivity decreased slightly below the upper two fracture zones, indicating possible inflow at the fractures, and a slightly less productive zone below a depth of 252 meters (**Figure 3**).

WELL CONSTRUCTION

Construction at HRES-10 and HRES-11 began with installation of 12-inch diameter blank steel surface casing. At HRES-10, 28.6 meters of surface casing was installed and cemented in place, and at HRES-11, 6.1 meters of surface casing was installed. The production interval for the wells was constructed using 4-1/2-inch outside diameter (1/4-inch wall thickness), blank and perforated, flush-threaded steel casing. Perforations are 1/8-inch wide by 3-inch long machine-cut slots, two slots per round, four rounds per foot, staggered (8 slots per foot). The bottom joint of casing was torch cut, tapered, and welded closed. Prior to installation of the production casing at HRES-10, the bottom of the borehole was backfilled with gravel pack to 344.1 meters bls. Bentonite seals were placed in the backfill from 416.4 to 412.1 and from 349.6 to 344.1 meters bls. A summary of casing installation is provided in **Table 4**.

TABLE 4. SUMMARY OF 4-INCH CASING INSTALLATION DEPTHS FOR HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

	HRES-10	HRES-11
Perforated Interval(s) (meters, bls)	48.1 – 121.3 212.7 – 334.8	182.3 – 328.6
Total Casing Depth (meters)	340.9	334.6

Materials installed in the annulus included 1/4-inch to 3/8-inch gravel pack, 3/8-inch bentonite chips, and 8x12 silica sand. All annular materials were installed using a tremie pipe. Annular bentonite seals at HRES-10 were placed above and below the lower perforated interval, and below the upper perforated interval to ensure isolation of the aquifer zones. Gravel pack between the two perforated intervals at HRES-10 was capped at the top and bottom of the interval with silica sand to minimize intrusion of bentonite from the seal into the gravel pack. Schematic diagrams of well construction are shown on **Figures 2 and 3**.

Hydrologic test wells HRES-10 and HRES-11 were developed by airlift pumping and surging following installation of casing and annular materials. At HRES-10, development was conducted in the upper part of the well for about 12 hours on May 2 and 3, 2010. Development in the lower part of the well was terminated when sand was produced from annular materials. At HRES-11, development occurred for about 4 hours on May 17 and was followed by an 8-hour airlift test on May 18, 2010 to further develop the well.

Surface completions consist 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

August 3, 2010. Survey data and computed land surface and measurement point elevations are provided in **Table 5**.

TABLE 5. SUMMARY OF SURVEY RESULTS FOR HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

	HRES-10	HRES-11
	(meters)	(meters)
Easting	503194.911	500174.557
Northing	3681673.233	3679488.366
Elevation Top of 12-inch Surface Casing	894.733	1,056.501
Elevation Land Surface	893.85	1,055.71
Elevation Top of 1-inch PVC Sounder Access	894.58	1,056.44

Datum: UTM Zone 12 North (NAD27)-NGVD29

PUMP INSTALLATION AND INSTRUMENTATION

Dedicated pump assemblies were installed in hydrologic test wells HRES-10 and HRES-11 by Layne Christensen Company, Water Supply/Environmental Division (Layne), of Chandler, Arizona. The Grundfos pumps were specified by M&A in accordance with hydraulic parameters computed during initial testing, well dimensions, and the desired pumping rate for each well. The wells were equipped with 1-inch PVC sounder access tubes which extend from the wellhead to the top of the pump. Each sounder access tube is capped on the bottom and factory slotted in the lowermost 3 meters. The pump, motor, and column pipe in each well are suspended from a steel and rubber sanitary well seal installed at the wellhead.

Well HRES-10 was equipped with a stainless steel Grundfos Model 40S15-5 pump with a 1.5-horsepower, 230-volt, single-phase Grundfos Model MS402 electric motor on July 26, 2010. The pump was installed on 1-1/2-inch galvanized steel column pipe with galvanized steel couplings at a depth of 31.1 meters bls. A pump control panel was welded to the outside of the well vault so that personnel from Government Springs Ranch can pump the well for livestock watering without opening the vault. Well HRES-11 was equipped with a Grundfos Model 10S30-34 pump with a 3-horsepower, 230-volt, single-phase Grundfos Model MS4000 electric motor on July 27 and 28, 2010. The pump was installed on 1-1/4-inch steel pipe at a depth of about 244 meters bls.

Wells HRES-10 and HRES-11 were equipped with Level TROLL pressure transducer dataloggers manufactured by In-Situ Inc., of Ft. Collins, Colorado. The transducers are programmed to measure and record water levels every 6 hours. At HRES-10, a 30 psi, non-

vented Level TROLL was installed on July 27, 2010, and at HRES-11, a 100 psi, non-vented Level TROLL was installed on July 28, 2010.

HYDRAULIC TESTING

Initial characterization of the ALT aquifer at well HRES-10 was accomplished by conducting a series of short-term airlift tests and packer airlift tests in different zones within the open borehole. Once the well was constructed, and dedicated pumping equipment was installed, a 10-hour constant rate pumping test was conducted. At well HRES-11 an 8-hour airlift test was conducted in the cased well followed by a 48-hour constant-rate pumping test once dedicated pumping equipment was installed. Operational details and results of testing are included below.

Airlift Tests

Short-term airlift tests were conducted at HRES-10 during drilling and prior to well construction, and at HRES-11 following well construction. At HRES-10, three short-term airlift tests were conducted in the open borehole during drilling operations, and three were conducted in the open borehole with a packer installed at different depths after the borehole had been drilled to total depth. Open borehole airlift testing was not conducted at HRES-11during drilling due to deep water level and instability of the borehole; however, a test was conducted in the cased well. Discharge volumes and airlift rates were calculated by periodic measurement of storage tank levels. Approximate borehole volumes and total discharge volumes are summarized in **Table 6**.

TABLE 6. SUMMARY OF AIRLIFT TESTING CONDUCTED AT HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

Well	Test Type and Date	Test Interval (meters, bls)	Approximate Borehole Volume (liters)	Approximate Total Discharge Volume (liters)
HRES-10	Open borehole during drilling 19 Apr 2010	4.6 – 85.3	4,100	105,000
HRES-10	Open borehole during drilling 23-24 Apr 2010	5.7 – 380.4	19,000	115,000
HRES-10	Open borehole during drilling 26 Apr 2010	5.8 – 471.2	23,600	145,000
HRES-10	Open borehole packer @ 390.7 27 Apr 2010	390.7 – 471.2	4,000	0
HRES-10	Open borehole packer @ 312.9 27-28 Apr 2010	312.9 – 471.2	8,000	36,000
HRES-10	Open borehole packer @ 204.8 29 Apr 2010	204.8 – 471.2	13,000	23,000
HRES-11	Cased well 17 May 2010	182.3 – 328.6	7,000	68,832

Due to the discharge head configuration, groundwater levels could not be measured during airlift pumping; however, groundwater level measurements were obtained prior to each test and during the recovery period. During recovery, water level was measured through the open airline (dual-wall drill pipe or AQ drill pipe) using an electric water level sounder. Recovery data were analyzed using the Theis recovery method (1935) implemented in the computer-based analytical aquifer test software AQTESOLV® for Windows, version 4.50.004 (Glenn M. Duffield, HydroSOLVE, Inc., 2008).

HRES-10 Open Borehole Airlift Tests During Drilling Operations

Three open borehole airlift tests were conducted between April 19 and 26, 2010. Test intervals extended from non-pumping water level to drilled depth of the borehole at the time each test was conducted (85.3, 380.4, and 471.2 m bls, respectively). Test intervals were selected based on evidence of fracturing in drill cuttings, drilling behavior and water production during drilling. Graphs of recovery data and analyses for the three open borehole airlift tests are shown on **Figure 4**. Transmissivity values calculated based on these airlift tests are approximate

but indicate that the majority of the water produced at HRES-10 comes from the upper part of the borehole. A summary of test data and results of the analyses are provided in **Table 7**.

TABLE 7. SUMMARY OF RESULTS FROM AIRLIFT TESTS CONDUCTED DURING DRILLING AT HYDROLOGIC TEST WELL HRES-10

Test Interval (meters, bls) and Test Date	Test Duration (minutes)	Pre-pumping Water Level (meters)	Average Discharge Rate (L/s)	Transmissivity (m^2/d)
4.6 – 85.3 19 Apr 2010	240	4.6	7.32	30
5.7 – 380.4 23 to 24 Apr 2010	193	5.7	10.0	25
5.8 – 471.2 26 Apr 2010	240	5.8	10.0	27

HRES-10 Open Borehole Airlift Tests with Packer Installed

Three airlift packer tests were conducted after HRES-10 was drilled to total depth (471.2 meters bls) between April 27 and 29, 2010. An inflatable packer assembly was used in the open borehole to isolate test zones. Tests were conducted with the packer assembly installed at 390.7, 312.9, and 204.8 meters bls. The goal of packer airlift testing was to investigate variability in transmissivity associated with changes in geologic unit (Tw to Tal) and with changes in fracture density within the Tal. Test data and results are summarized in **Table 8**.

The lowermost test interval (packer at 390.7 meters bls) extended through the lower 23 meters of Tal (including approximately 7 m of vitrophyre) and the upper 58 meters of Tw. Airlifting could not be sustained in this interval which indicates that transmissivity is very small.

Calculated transmissivities are also small in the test intervals with the packer set further up the hole at two depths within the Tal (312.9 and 204.8 meters bls). Graphs of the recovery data and analysis are shown on **Figure 5**. Straight line analyses using the Theis recovery method yield small estimated transmissivity values on the order of 0.4 to 2 m^2/day. These values are consistent with results of the open borehole airlift testing discussed above which indicate that the majority of water produced at HRES-10 is yielded by the upper part of the ALT aquifer.

TABLE 8. SUMMARY OF RESULTS FROM OPEN-HOLE, AIRLIFT PACKER TESTS AT HYDROLOGIC TEST WELL HRES-10				
Test Interval (meters, bls)	**Test Duration (minutes)**	**Pre-pumping Water Level Below Packer (meters)**	**Average Discharge Rate (L/s)**	**Transmissivity (m^2/d)**
390.7 – 471.2	5	5.83	No discharge	Not calculated
390.7 – 471.2	7	18	No discharge	Not calculated
312.9 – 471.2	190	6.89	2.6	2
204.8 – 471.2	240	10.82	1.6	0.4

HRES-11 Cased Well Airlift Test

Following casing installation at well HRES-11, an 8-hour airlift test was conducted on May 18, 2010 to develop the well and to investigate hydraulic parameters and water quality in the ALT aquifer at this location. Screened interval is from 182.3 to 328.6 meters bls. Depth to pre-pumping water level was 193.7 meters bls. Airlifting started at 01:00 and stopped at 09:00, on May 18, 2010. The discharge rate was erratic due to surging and ranged from 0.8 to 8.0 L/s; average rate was 2.3 L/s. A graph of the recovery data and analysis is shown on **Figure 6**. Straight-line analysis using the Theis recovery method yields an estimated transmissivity of 18 m^2/d. Average hydraulic conductivity, based on saturated perforated interval of 134.9 meters, is 2 x 10^{-4} cm/s. Test data and results are summarized in **Table 9**.

TABLE 9. SUMMARY OF RESULTS FROM AIRLIFT TEST CONDUCTED IN CASED WELL AT HYDROLOGIC TEST WELL HRES-11					
Perforated Interval (meters bls)	**Test Duration**	**Pre-pumping Water Level (meters, bls)**	**Average Discharge Rate (L/s)**	**Transmissivity (m^2/d)**	**Hydraulic Conductivity (cm/s)**
182.3 – 328.6	8 hours	193.7	2.3	18	2 x 10^{-4}

Constant-rate Pumping Tests

Constant-rate pumping tests were conducted in the cased wells HRES-10 and HRES-11 during the period from September 21 through 24, 2010. Discharge assembly included a GPI digital flowmeter, a pressure gage, gate valves to adjust flow rate, and a hose bib for obtaining water samples. Water discharged from HRES-10 was contained in a Baker tank and later disposed at the West Plant site; water from HRES-11 was discharged to a nearby stock pond.

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

Water level drawdown data from the pumped wells were analyzed for transmissivity using the semi-logarithmic, straight-line graphical procedure developed by Cooper and Jacob (1946). Water level recovery data for pumped wells were analyzed for transmissivity using the semi-logarithmic, straight-line recovery analysis technique developed by Theis (1935). Operation details and aquifer parameters determined from analysis of data obtained during the pumping tests are summarized in **Table 10**.

HRES-10 Constant-rate Test

A 10-hour constant-rate pumping test was conducted at well HRES-10 on September 24, 2010. Depth to pre-pumping water level was 12.60 meters bls. Pumping started at 09:45 and stopped at 19:45, on September 24, 2010. Average pumping rate was 1.7 L/s. Maximum drawdown at the well occurred near the end of the pumping period and was 37.27 meters. A summary of test data and the results of the analysis are given in **Table 10**. A graph of the data and analysis is shown on **Figure 7**. Straight-line analysis of drawdown data using the Cooper-Jacob method yields an estimated transmissivity of 50 m^2/d; analysis of recovery data using the Theis recovery method yields an estimated transmissivity of 60 m^2/d. Average hydraulic conductivity based on transmissivity of 60 m^2/d and saturated thickness of 73.2 meters (top perforated zone) is 9 x 10^{-4} cm/s.

CT Windmill is a well located approximately 33 m to the northeast of HRES-10. It is completed in the QTg and upper Tal at a depth of approximately 30 meters. A pressure transducer installed at CT Windmill to monitor water level during the constant-rate test at HRES-10 showed no discernable response to pumping.

HRES-11 Constant-rate Test

A 48-hour constant-rate pumping test was conducted at well HRES-11 during the period September 21 to September 23, 2010. Depth to pre-pumping water level was 193.88 meters bls. Pumping started at 10:05 on September 21 and stopped at 10:05 on September 23, 2010.

Average pumping rate was 0.6 L/s. Maximum drawdown at the well occurred near the end of the pumping period and was 11.15 meters. A summary of test data and the results of the analysis are given in **Table 10**. A graph of the recovery data and analysis is shown on **Figure 8**. Straight-line analysis of drawdown data using the Cooper-Jacob method yields an estimated transmissivity of 10 m^2/d; analysis of recovery data using the Theis recovery method yields an estimated transmissivity of 10 m^2/d. Average hydraulic conductivity, based on a saturated interval of 134.7 meters, is 1 x 10^{-4} cm/s.

TABLE 10. SUMMARY OF CONSTANT-RATE TESTS CONDUCTED IN HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

WELL IDENTIFIER	HRES-10	HRES-11
Description of Hydrologic Testing Zone (meters bls):	**Cased well** (total depth 344.1 meters): perforated intervals 48.1 to 121.3 and 212.7 to 334.8 meters bls	**Cased well** (total depth 338.6 meters): perforated interval 182.3 to 328.6 meters bls
Approximate Borehole Volume (liters)	3260	1400
Test Type	Constant-rate pumping test	Constant-rate pumping test
Geologic Units in Testing Zone	Apache Leap Tuff	Apache Leap Tuff
Test Duration (hours):	10	48
Pre-pumping Depth to Water (meters bls):	12.60	193.88
Average Discharge Rate (L/s):	1.7	0.6
Maximum Drawdown (meters):	37.27	11.15
Transmissivity from recovery data (m^2/d):	60	10
Saturated thickness (meters):	73.2 (top perforated zone)	134.7 (water level to base of perforated interval)
Hydraulic Conductivity (cm/s):	9 x 10^{-4}	1 x 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 each airlift test, periodically during drilling operations, and at the end of the constant-rate pumping tests. Sample identifiers and field parameters for samples collected during drilling and testing operations are provided in **Table 11**. Data from groundwater samples collected during drilling or toward the end of 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. These results and associated discussion are provided in M&A (2011).

TABLE 11. WATER SAMPLES COLLECTED DURING DRILLING AND TESTING AT HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

Sample Identifier	Sample Description	Date	Time	Field Parameters		
				Temp (°C)	pH (s.u.)	Specific Conductance (µS/cm)
RESE-1000298	HRES-10 during drilling at 72.2 meters	19-Apr-10	00:00	19.7	7.55	736.5
RESE-1000299	HRES-10 end of 4-hour test at 85.3 meters	19-Apr-10	23:30	19.5	7.67	693.7
RESE-1003152	HRES-10 end of 3.2-hour test at 380.4 meters	24-Apr-10	00:22	19.8	7.64	705.6
RESE-1003153	HRES-10 end of 4-hour test at 471.2 meters	26-Apr-10	05:45	19.9	7.92	700.0
RESE-1003154	HRES-10 end of 3.2-hour test with packer at 312.9 meters	28-Apr-10	03:00	23.5	8.05	632.0
RESE-1003155	HRES-10 end of 4-hour test with packer at 204.8 meters	29-Apr-10	11:30	25.1	8.53	608.3
RESE-1003156	HRES-11 end of 8-hour test in cased well	18-May-10	08:15	26.4	8.21	354.0
RESE-1003174	HRES-11 end of 48-hour test	23-Sep-10	08:45	27.5	7.28	274.6
RESE-1003175	HRES-10 end of 10-hour test	24-Sep-10	19:30	19.9	6.97	736.2

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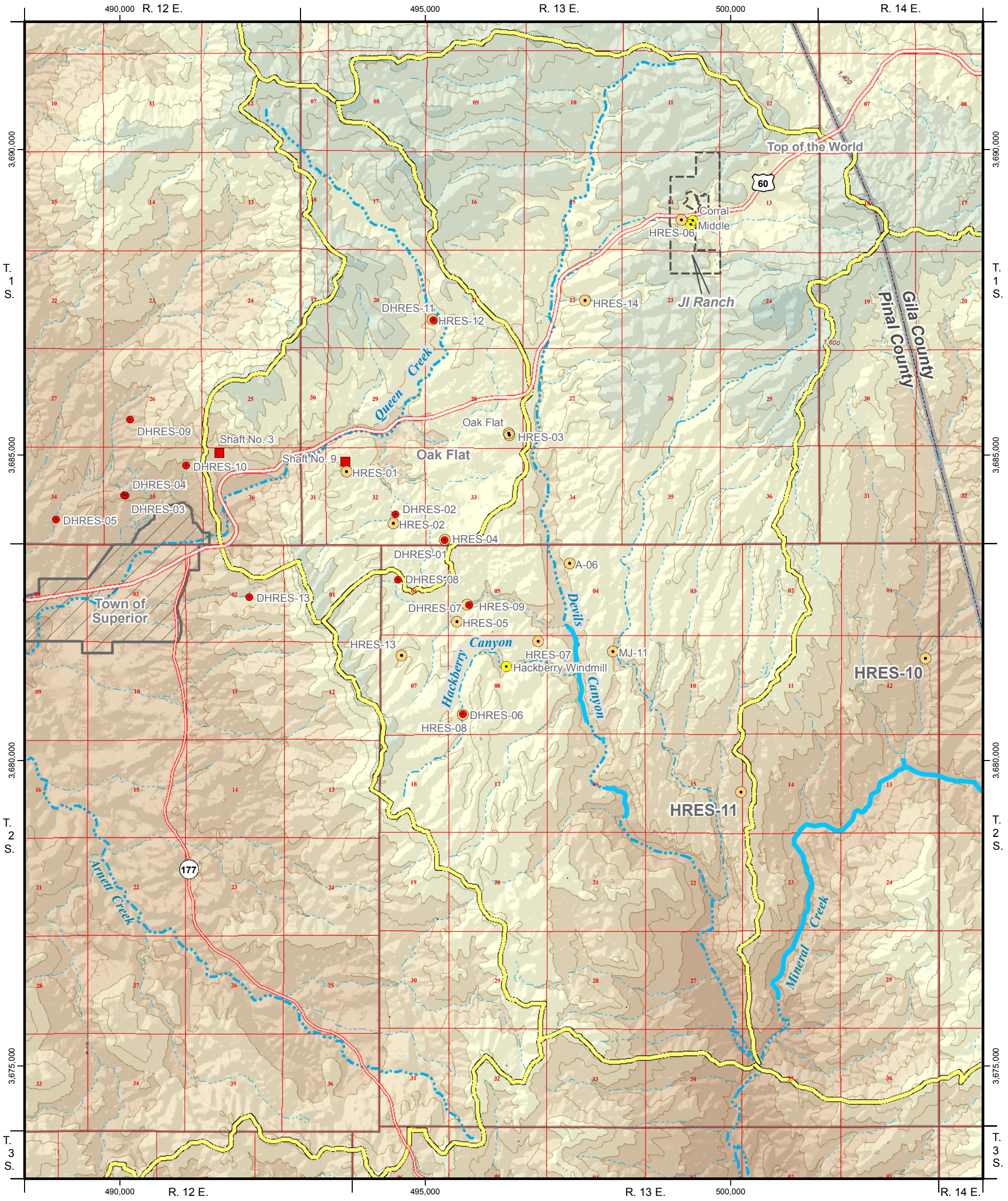
Theis, C.V., 1935, **The relationship between the lowering of the piezometric surface and the rate and duration of discharge of a well using ground-water storage:** American Geophysical Union, Transactions, vol. 16, pp. 519-524; reprinted in Society of Petroleum Engineers, Pressure Transient Testing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



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

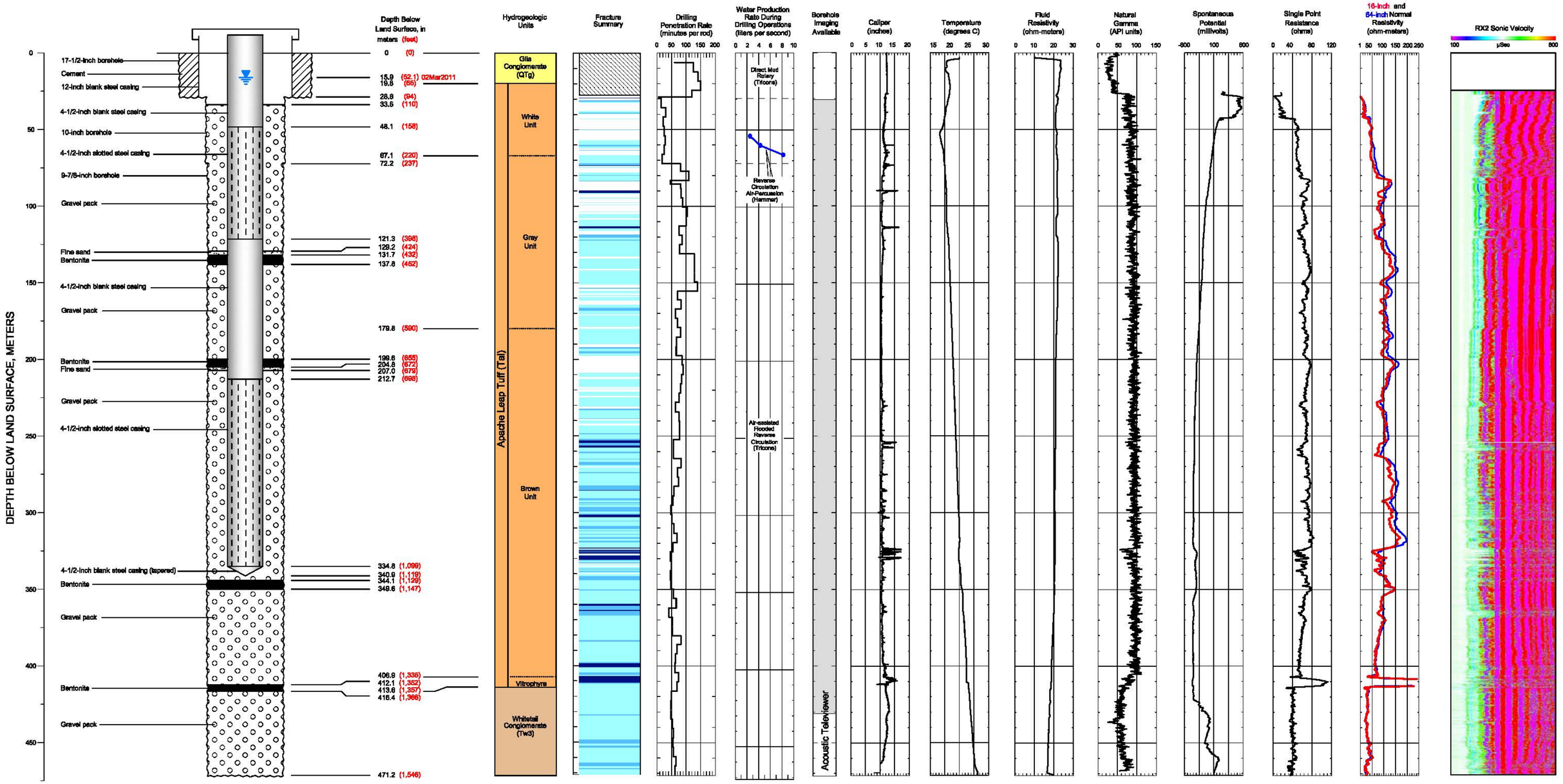
HRES-10, HRES-11 WELL LOCATIONS

MONTGOMERY & ASSOCIATES
Water Resource Consultants

2011

FIGURE 1

\GIS-Tuc\Projects\605\605.3\Welloc_HRES_10_11.mxd\11May2011



CADASTRAL: (D-2-13) 12aac	ADWR NO: 55-911941
NORTHING: 3681673.233	EASTING: 503194.911
LAND SURFACE ELEVATION: 893.85	
DATUM: UTM12N, NAD27, 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 13MAY2011 ARIZONA U.S.A. Expires 6/30/2012

Resolution Copper Mining

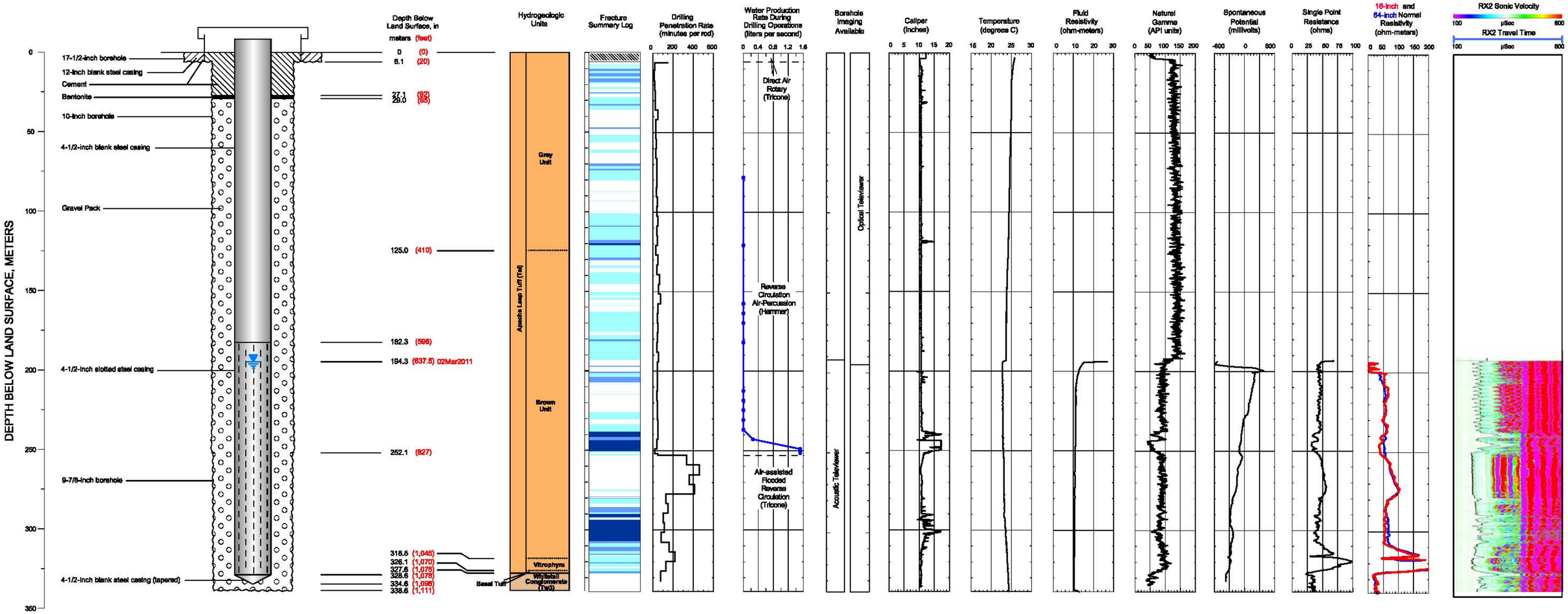
MONTGOMERY & ASSOCIATES Water Resource Consultants

HRES-10
SCHEMATIC DIAGRAM OF WELL CONSTRUCTION

Version: May 13, 2011

FIGURE 2

605\WellSchematics_2010\HRES-10wsLOGS\13May2011



REGISTERED GEOLOGIST
CERTIFICATE NO.
25063
TODD
KEAY
Date Signed 13 MAR 2012
ARIZONA U.S.A.
Expires 6/30/2012

CADASTRAL: (D-2-13)15daa	ADWR NO: 55-912021
NORTHING: 3679488.366	EASTING: 500174.557
LAND SURFACE ELEVATION: 1,055.71	
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

Resolution Copper Mining

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Water Resource Consultants

HRES-11
SCHEMATIC DIAGRAM OF WELL CONSTRUCTION

Version: May 13, 2011

FIGURE 3

605\WellSchematics_2010\HRES-11wsLOGS\13May2011

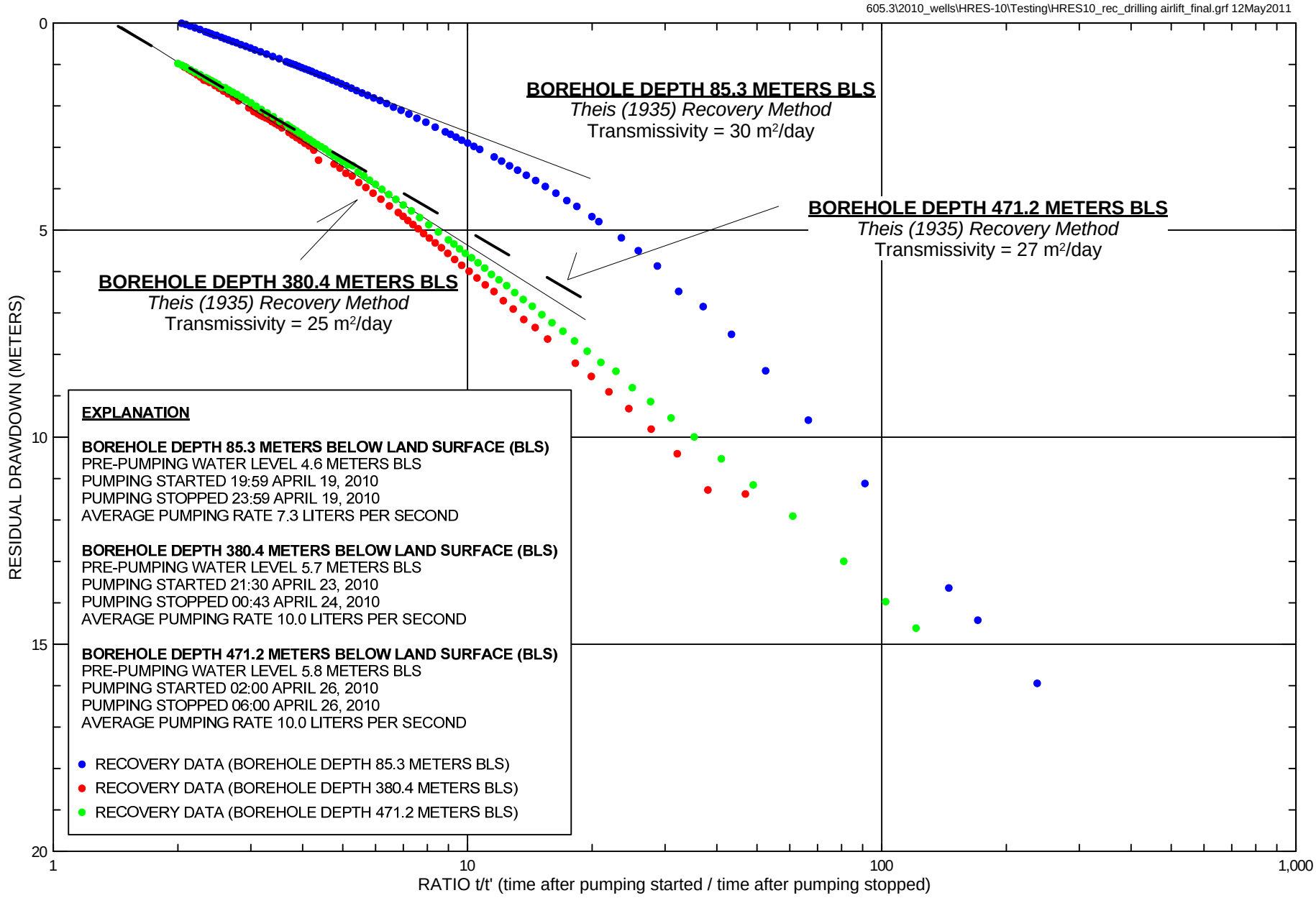

FIGURE 4. RECOVERY GRAPH FOR OPEN BOREHOLE AIRLIFT TESTS AT WELL HRES-10 (OPEN BOREHOLE DEPTHS 85.3, 380.4, AND 471.2 METERS BLS) RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

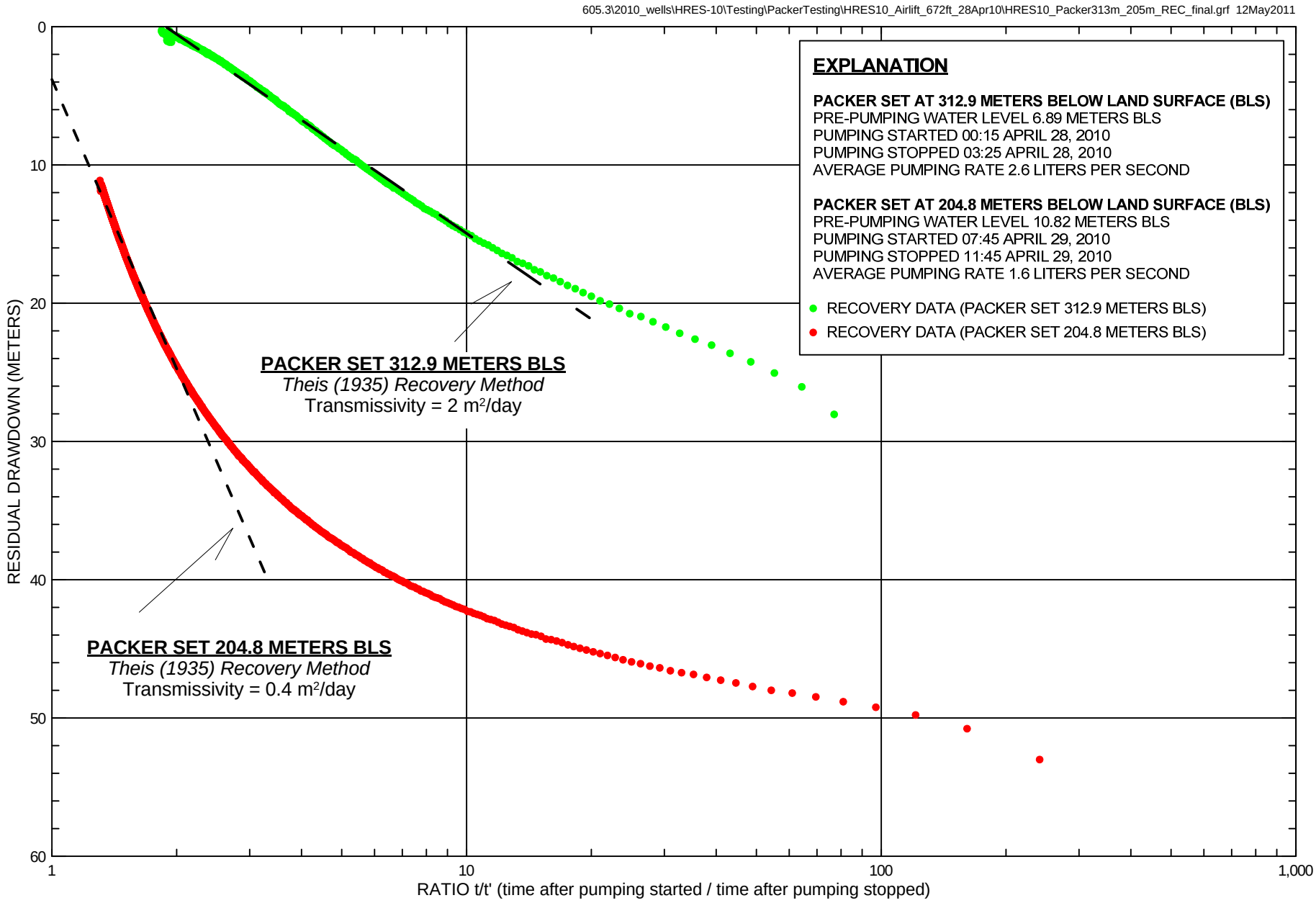

FIGURE 5. RECOVERY GRAPH FOR OPEN BOREHOLE PACKER AIRLIFT TESTS AT WELL HRES-10 (PACKER SET AT 204.8 AND 312.9 METERS BELOW LAND SURFACE) RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

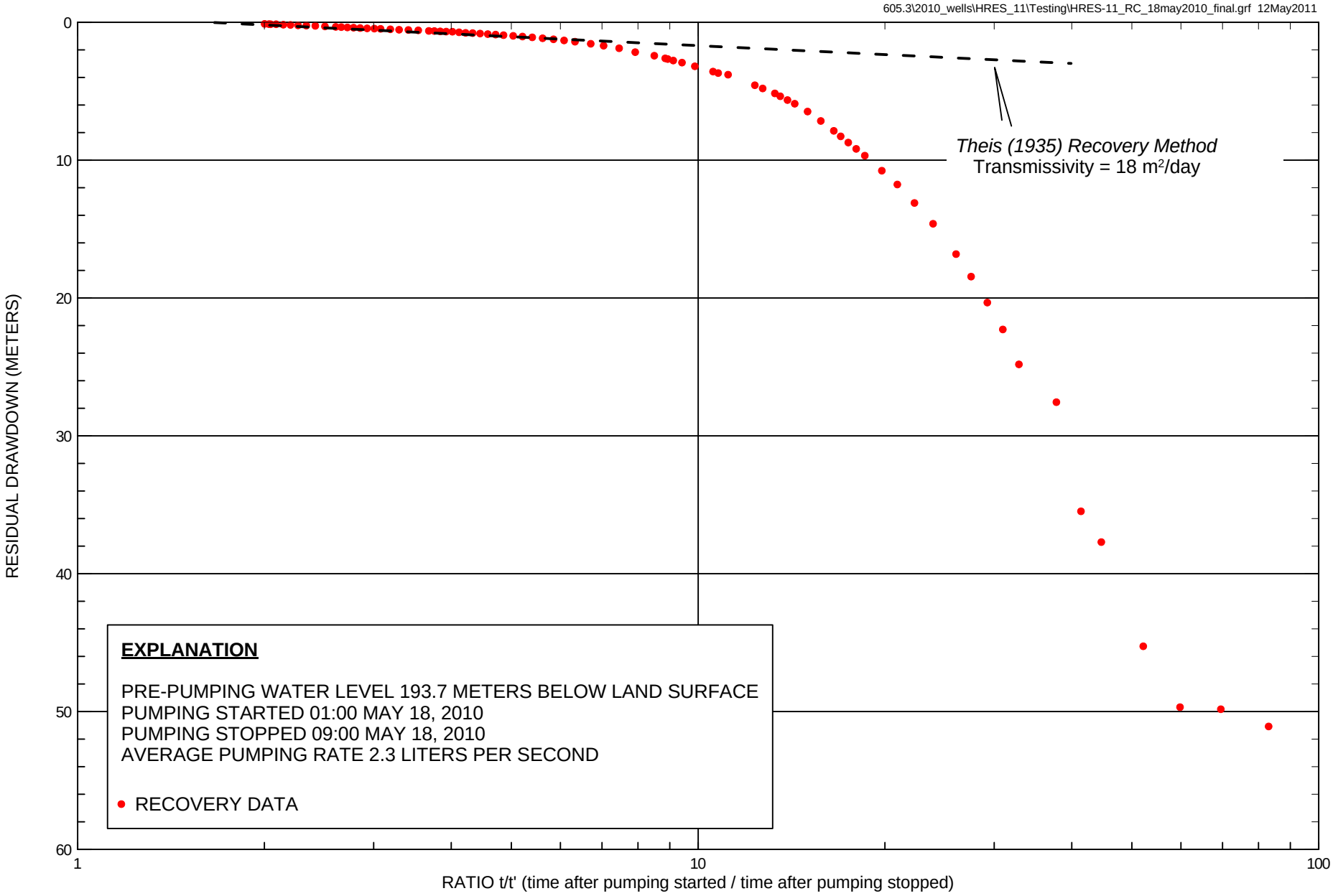

FIGURE 6. RECOVERY GRAPH FOR 8-HOUR AIRLIFT TEST AT CASED WELL HRES-11
RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

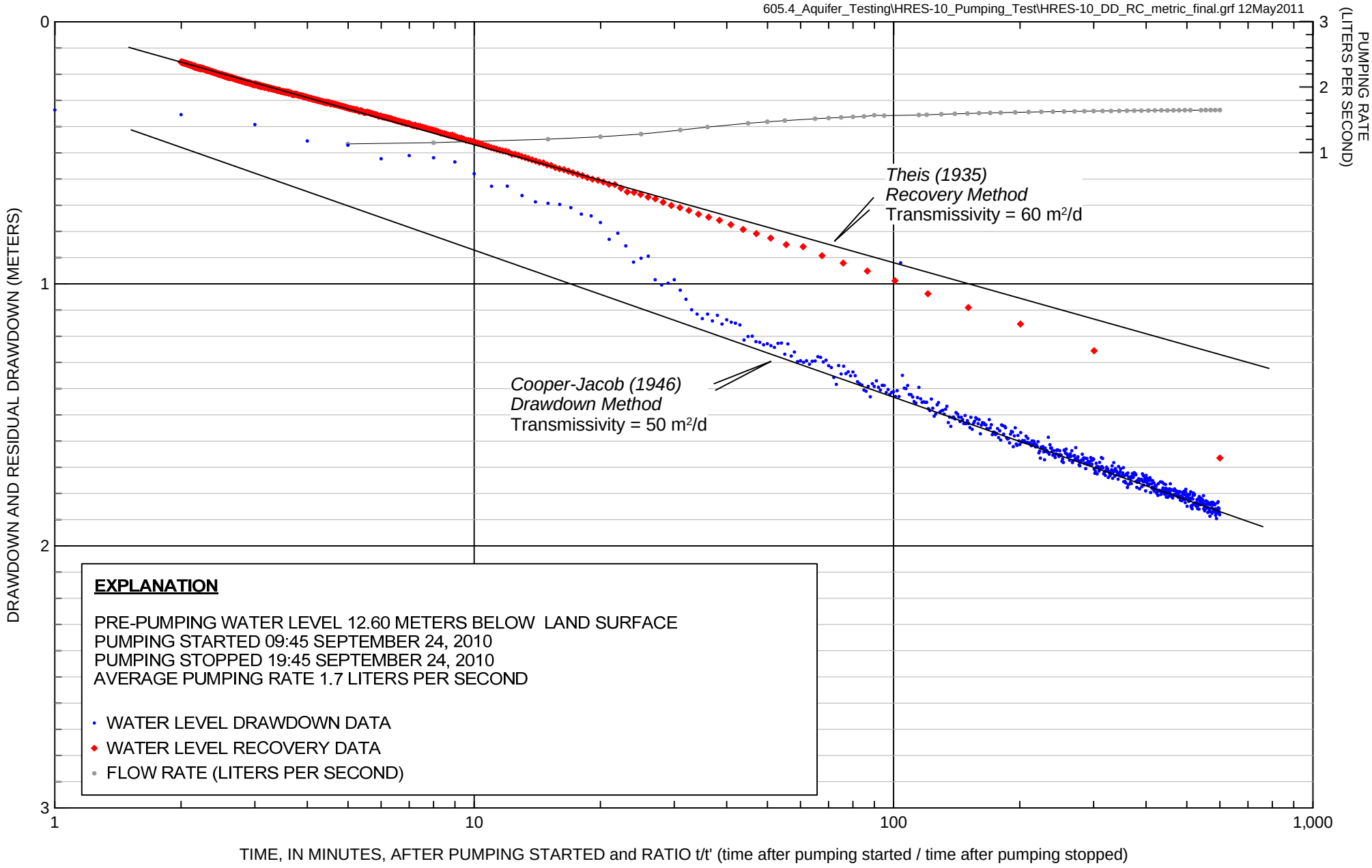

FIGURE 7. DRAWDOWN AND RECOVERY GRAPH FOR PUMPED WELL HRES-10 DURING CONSTANT-RATE PUMPING TEST, RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

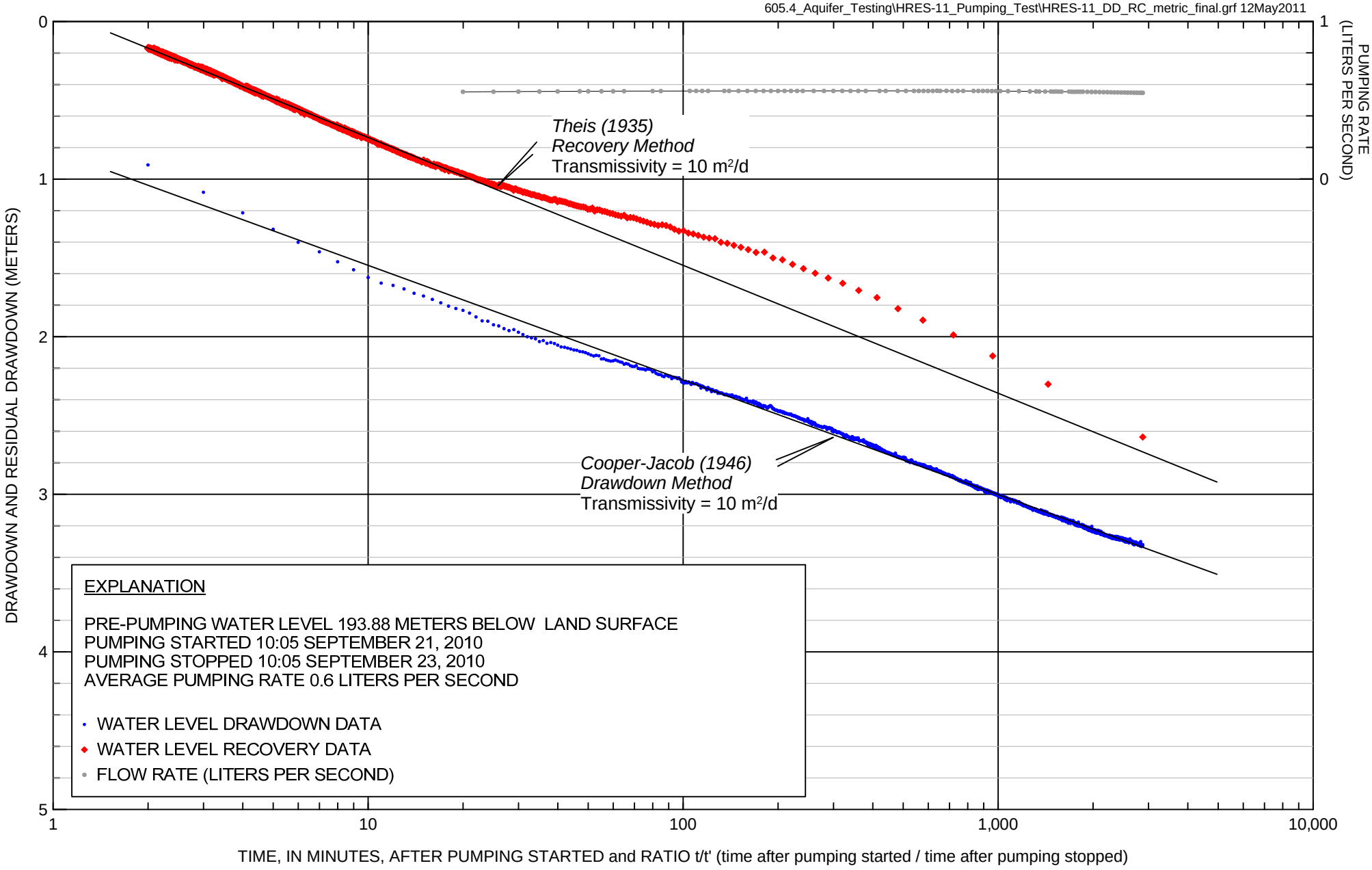

FIGURE 8. DRAWDOWN AND RECOVERY GRAPH FOR PUMPED WELL HRES-11 DURING CONSTANT-RATE PUMPING TEST, RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
GILA CONGLOMERATE (QTg)				
0 - 10	0.0 - 3.0	Matrix-supported conglomerate; light olive gray [5Y6/2]; weakly lithified; silty sand; cut chips are clasts of 60% silvery schist, 20% clear and white vein quartz (possibly from schist), 20% purple, orange and buff quartzite; trace epidote; trace black, white and green diabase; trace Apache Leap tuff with overall sample is 75% sand, 15% silt, and 10% gravel; reaction to acid: weak	trace iron oxide staining on clasts	MUD ROTARY; Munsell Color Version: 2000 Revised Edition; subangular to subrounded chips up to 0.3 cm
10 - 20	3.0 - 6.1	Matrix-supported conglomerate; light olive gray [5Y6/2]; weakly lithified; gravelly sand; cut chips are clasts of 60% silvery schist with trace chloritic alteration, 20% clear and white vein quartz (possibly from schist), 20% purple, orange and buff quartzite; trace epidote; trace black, white and green diabase; trace Apache Leap tuff with overall sample is 75% sand, 15% gravel, and 10% silt; reaction to acid: weak	trace iron oxide staining on clasts, trace chloritic alteration on schist clasts	subangular to subrounded chips up to 0.6 cm
20 - 30	6.1 - 9.1	Matrix-supported conglomerate; yellowish brown [10YR5/4]; weakly lithified; silty sand; cut chips are clasts of 60% silvery schist with trace chloritic alteration, 20% clear and white vein quartz (possibly from schist), 20% purple, orange and buff quartzite; trace epidote; trace black, white and green diabase; trace Apache Leap tuff with trace reddish-orange limestone, and trace matrix chips of reddish-brown sandy siltstone; overall sample is 50% sand, 40% silt, and 10% gravel; reaction to acid: weak	some iron oxide staining on clasts	subangular to subrounded chips up to 1.0 cm
30 - 40	9.1 - 12.2	Matrix-supported conglomerate; light olive brown [2.5YR5/3]; moderately lithified; silt and sand; cut chips are clasts of 35% orange, buff, red and purple quartzite with trace epidote, 30% silvery schist, 15% matrix chips of yellowish-brown silty sandstone, 10% gray limestone, and 10% white and clear vein quartz (possibly from Pinal Schist); overall sample is 47% sand, 45% silt, and 8% gravel; reaction to acid: weak to moderate	some iron oxide staining on clasts	subangular to subrounded chips up to 1.0 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
GILA CONGLOMERATE (QTg)				
40 - 50	12.2 - 15.2	Matrix-supported conglomerate; light olive brown [2.5YR5/3]; moderately lithified; clast-supported conglomerate; cut chips are clasts of 85% mixed lithologies including silvery schist, orange, red, purple and buff quartzite, light grayish-brown limestone, white, black and green diabase, white and clear vein quartz; trace light pink Apache Leap tuff with 15% matrix chips of brown silty sandstone; overall sample is 47% sand, 45% silt, and 8% gravel; reaction to acid: moderate	common iron oxide staining on clasts and matrix, trace calcite in sand fraction	subangular to subrounded chips up to 0.9 cm; trace clay balls
50 - 60	15.2 - 18.3	Matrix-supported conglomerate; brown [10YR5/3]; moderately lithified; silty sand; cut chips are clasts of 95% mixed lithologies including silvery schist, orange, red, purple and buff quartzite, increased white, black and green diabase, white and clear vein quartz; trace light pink Apache Leap tuff with trace light grayish-brown limestone; 5% matrix chips of brown silty sandstone; overall sample is 48% sand, 43% silt, and 9% gravel; reaction to acid: weak	common iron oxide staining on clasts and matrix, very trace calcite crystals in sand fraction	subangular to subrounded chips up to 0.9 cm
APACHE LEAP TUFF- White Unit (Tal)				
60 - 70	18.3 - 21.3	White Unit; light brownish gray [10YR6/2]; well lithified; tuff and some conglomerate; 80% light yellowish-white to very light pink tuff with 80% groundmass and 20% tiny phenocrysts of quartz, feldspar, and biotite; 20% clast-supported conglomerate consisting of clasts of orange, purple and red quartzite, diabase, schist, and clear quartz; reaction to acid: none	trace iron oxide staining on clasts	subrounded chips up to 1.4 cm
70 - 80	21.3 - 24.4	White Unit; light gray [2.5YR7/2]; well lithified; tuff with 70% very light pink groundmass and 30% tiny phenocrysts of quartz, feldspar, and biotite; trace lithic fragments; some quartz crystals up to 0.2 cm; trace clasts from overlying conglomerate; reaction to acid: none		subrounded chips up to 1.6 cm; some fines, likely mixture of drill mud and sticky disintegrating pumice fragments
80 - 90	24.4 - 27.4	White Unit; very pale brown [10YR7/3]; well lithified; tuff with 70% very light pink groundmass and 30% tiny phenocrysts of quartz, feldspar, and biotite; trace lithic fragments; some quartz crystals are up to 0.2 cm; trace clasts from overlying conglomerate; reaction to acid: none	trace iron oxide staining	subrounded chips up to 1.1 cm; some fines

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- White Unit (Tal)				
90 - 100	27.4 - 30.5	White Unit; pink [7.5YR7/3]; well lithified; tuff with 70% very light pink groundmass and 30% tiny phenocrysts of quartz, feldspar, and biotite; some quartz crystals are up to 0.2 cm; trace pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining, trace 0.7cm vein calcite	MUD ROTARY, REVERSE CIRCULATION - AIR HAMMER; subangular to subrounded chips up to 1.4 cm; abundant cement chips
100 - 110	30.5 - 33.5	White Unit; pink [7.5YR7/3]; well lithified; tuff with 70% very light pink groundmass and 30% tiny phenocrysts of quartz, feldspar, and biotite; some quartz crystals are up to 0.2 cm; trace pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining (trace on fracture surfaces), trace vein quartz	subangular to subrounded chips up to 1.5 cm; abundant cement chips
110 - 120	33.5 - 36.6	White Unit; pinkish gray [7.5YR7/2]; well lithified; tuff with 70% very light pink groundmass and 30% tiny phenocrysts of quartz, feldspar, and biotite; some quartz crystals are up to 0.2 cm; trace pumice; trace lithic fragments; reaction to acid: very weak	trace iron oxide staining, trace vein calcite	subangular to subrounded chips up to 0.5 cm; trace cement chips
120 - 130	36.6 - 39.6	White Unit; pinkish gray [7.5YR7/2]; well lithified; tuff with 70% very light pink groundmass and 30% phenocrysts of quartz, feldspar, and bronzy biotite; larger phenocrysts; trace pumice; trace lithic fragments; reaction to acid: very weak	trace iron oxide staining, trace vein calcite	subangular to subrounded chips up to 0.3 cm
130 - 140	39.6 - 42.7	White Unit; pink [5YR7/3]; well lithified; tuff with 70% very light pink groundmass and 30% phenocrysts of quartz, feldspar, and bronzy biotite; trace pumice; trace lithic fragments; reaction to acid: very weak	trace iron oxide staining	subangular to subrounded chips up to 0.5 cm; abundant cement chips
APACHE LEAP TUFF- Gray Unit (Tal)				
140 - 150	42.7 - 45.7	Gray Unit; pink [5YR7/3]; well lithified; tuff with 70% pink aphanitic groundmass and 30% small phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace pumice; trace lithic fragments of quartzite; reaction to acid: weak	trace iron oxide staining	subangular to subrounded chips up to 0.7 cm; trace cement chips
150 - 160	45.7 - 48.8	Gray Unit; pink [5YR7/3]; well lithified; tuff with 70% pink aphanitic groundmass and 30% small phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of quartzite; reaction to acid: weak	trace iron oxide staining, trace calcite	subangular to subrounded chips up to 0.8 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Gray Unit (Tal)				
160 - 170	48.8 - 51.8	Gray Unit; pink [5YR7/3]; well lithified; crystal-rich tuff with 60% pink aphanitic groundmass and 40% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of quartzite; reaction to acid: weak	trace iron oxide staining, trace calcite	subangular to subrounded chips up to 1.1 cm
170 - 180	51.8 - 54.9	Gray Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 60% pink aphanitic groundmass and 40% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace pumice; trace lithic fragments of quartzite; reaction to acid: very weak	trace iron oxide staining, trace calcite	subangular to subrounded chips up to 1.3 cm
180 - 190	54.9 - 57.9	Gray Unit; pale red [10R6/3]; well lithified; crystal-rich tuff with 50% darker pink aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of quartzite; reaction to acid: very weak	trace iron oxide staining, trace calcite	subangular to subrounded chips up to 0.5 cm
190 - 200	57.9 - 61.0	Gray Unit; pale red [10R6/3]; well lithified; crystal-rich tuff with 45% darker pink aphanitic groundmass and 55% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace pumice; trace lithic fragments of quartzite; reaction to acid: none	trace iron oxide staining	subangular to subrounded chips up to 0.6 cm
200 - 210	61.0 - 64.0	Gray Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, very trace magnetite; trace light gray pumice; trace lithic fragments of orange quartzite and black, white and red diabase; reaction to acid: none	trace iron oxide staining	subangular to subrounded chips up to 0.9 cm
210 - 220	64.0 - 67.1	Gray Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace light gray pumice; trace lithic fragments of orange quartzite; reaction to acid: none	trace iron oxide staining	subangular to subrounded chips up to 1.0 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- Gray Unit (Tal)				
220 - 230	67.1 - 70.1	Gray Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace light gray pumice; trace lithic fragments of orange quartzite; reaction to acid: none		subangular to subrounded chips up to 1.0 cm
230 - 240	70.1 - 73.2	Gray Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% larger phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; increased light gray pumice; trace lithic fragments of orange quartzite; reaction to acid: weak	some calcite vug fill, trace vein calcite, trace flat fracture surfaces	REVERSE CIRCULATION - AIR HAMMER, AIR-ASSISTED FLOODED REVERSE CIRCULATION; subangular to subrounded chips up to 2.8 cm
240 - 250	73.2 - 76.2	Gray Unit; pale red [10R6/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; increased light gray pumice; trace lithic fragments of orange quartzite; reaction to acid: none	trace iron oxide staining, trace flat fracture surfaces with slickensides, iron oxide staining and crushed talcy fracture material	subangular to subrounded chips up to 2.0 cm
250 - 260	76.2 - 79.2	Gray Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 50% grayish-pink aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; light gray pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining, trace calcite	subangular to subrounded chips up to 3.2 cm, mostly 1.5 cm
260 - 270	79.2 - 82.3	Gray Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 50% grayish-pink aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; light gray pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining, trace flat fracture surfaces, trace slickensides, very trace calcite	subangular to subrounded chips up to 1.6 cm
APACHE LEAP TUFF- Brown Unit (Tal)				
270 - 280	82.3 - 85.3	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich tuff with 50% pinkish-gray aphanitic groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining, very trace calcite	subangular to subrounded chips up to 2.5 cm

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
280 - 290	85.3 - 88.4	Brown Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich welded tuff with 40% reddish-brown aphanitic to cryptocrystalline groundmass and 60% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of dark gray shale, red quartzite, and diabase; reaction to acid: very weak	trace iron oxide staining, trace calcite vug fill, trace vein calcite, trace flat fracture surfaces, trace slickensides	subangular to subrounded chips up to 2.3 cm
290 - 300	88.4 - 91.4	Brown Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich welded tuff with 40% reddish-brown aphanitic to cryptocrystalline groundmass and 60% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of dark gray shale, red quartzite, and diabase; reaction to acid: very weak to weak	trace iron oxide staining, trace calcite vug fill, trace vein calcite	subangular to subrounded chips up to 1.5 cm
300 - 310	91.4 - 94.5	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of dark gray shale, red quartzite, and diabase; reaction to acid: very weak	trace iron oxide staining, trace calcite vug fill, trace vein calcite, trace soft white fracture material (gypsum?), increase in fracture material	subangular to subrounded chips up to 3.2 cm, mostly 1.8 cm
310 - 320	94.5 - 97.5	Brown Unit; weak red [5YR5/2]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; increased feldspar; trace pumice; trace lithic fragments of dark gray shale, red quartzite, and diabase; reaction to acid: very weak	trace iron oxide staining, less fracture material	subangular to subrounded chips up to 1.4 cm
320 - 330	97.5 - 100.6	Brown Unit; weak red [5YR5/2]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of dark gray shale, red quartzite, and diabase; reaction to acid: none	trace iron oxide staining (limonite and hematite), trace flat fracture surfaces	subangular to subrounded chips up to 2.6 cm

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
330 - 340	100.6 - 103.6	Brown Unit; weak red [5YR5/2]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of dark gray shale, red quartzite, and diabase; reaction to acid: very weak	trace iron oxide staining (limonite and hematite), less fracture surfaces	subangular to subrounded chips up to 2.7 cm
340 - 350	103.6 - 106.7	Brown Unit; weak red [5YR5/2]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of dark gray shale, red quartzite, and diabase; reaction to acid: none	trace iron oxide staining (limonite and hematite), very trace slickensides	subangular to subrounded chips up to 1.2 cm
350 - 360	106.7 - 109.7	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace pumice; trace lithic fragments of schist, diabase, and quartzite; reaction to acid: very weak	trace iron oxide staining, trace calcite vug fill, trace vein quartz, very trace slickensides	subangular to subrounded chips up to 1.3 cm
360 - 370	109.7 - 112.8	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine, trace magnetite; trace pumice; trace lithic fragments of schist; reaction to acid: none to very weak	trace iron oxide staining, trace calcite vug fill, very trace slickensides	subangular to subrounded chips up to 2.2 cm
370 - 380	112.8 - 115.8	Brown Unit; weak red [10R5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace lithic fragments of schist, diabase, and quartz; reaction to acid: very weak	trace iron oxide staining, trace calcite vug fill, trace flat fracture surfaces, very trace slickensides	subangular to subrounded chips up to 1.8 cm

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
380 - 390	115.8 - 118.9	Brown Unit; weak red [10R5/4], dark reddish gray [10R4/1]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace paler pink tuff; reaction to acid: very weak	trace iron oxide staining, trace calcite vug fill and on fracture surfaces, trace flat fracture surfaces, very trace slickensides	subangular to subrounded chips up to 2.0 cm
390 - 400	118.9 - 121.9	Brown Unit; weak red [10R5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with abundant pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace pumice; trace paler pink tuff; reaction to acid: none to very weak	trace iron oxide staining, trace vein calcite, 1 chip pink calcite, very trace slickensides	subangular to subrounded chips up to 1.9 cm
400 - 410	121.9 - 125.0	Brown Unit; weak red [10R5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown to pinkish-orange aphanitic to cryptocrystalline groundmass with abundant pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace medium gray and purple pumice; reaction to acid: very weak	trace iron oxide staining, trace subhedral and euhedral calcite crystals on fracture surfaces, very trace slickensides, open fracture evidence	subangular to subrounded chips up to 1.5 cm
410 - 420	125.0 - 128.0	Brown Unit; red [2.5YR5/6]; well lithified; crystal-rich welded tuff with 50% reddish-brown to pinkish-orange aphanitic to cryptocrystalline groundmass with abundant pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, very bronzy biotite, trace sanidine; trace magnetite; reaction to acid: none to very weak	trace iron oxide staining, trace euhedral calcite crystals, trace slickensides, open fracture evidence	subangular to subrounded chips up to 1.5 cm
420 - 430	128.0 - 131.1	Brown Unit; red [2.5YR5/6]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; trace medium gray and purple pumice; reaction to acid: none to very weak		subangular to subrounded chips up to 2.0 cm, mostly 1.0 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 (Tal)				
430 - 440	131.1 - 134.1	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; trace medium gray and purple pumice; reaction to acid: none to very weak	trace iron oxide staining, trace manganese oxide, trace calcite, very trace slickensides	subangular to subrounded chips up to 1.0 cm
440 - 450	134.1 - 137.2	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; trace medium gray and purple pumice; reaction to acid: none to very weak	trace iron oxide staining, trace calcite, very trace slickensides	subangular to subrounded chips up to 1.1 cm
450 - 460	137.2 - 140.2	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; trace medium gray and purple pumice; reaction to acid: none to very weak	trace iron oxide staining, trace manganese oxide, trace calcite, very trace slickensides	subangular to subrounded chips up to 0.8 cm
460 - 470	140.2 - 143.3	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; trace medium gray and purple pumice; reaction to acid: none to very weak	trace iron oxide staining, trace manganese oxide, very trace calcite, very trace slickensides, 1 chip with calcite in partially filled vug	subangular to subrounded chips up to 2.5 cm, mostly 1.6 cm
470 - 480	143.3 - 146.3	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; trace medium gray and purple pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, very trace calcite, very trace slickensides	subangular to subrounded chips up to 2.1 cm

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
480 - 490	146.3 - 149.4	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; increase in mafic minerals; trace amphibole; reaction to acid: none	trace iron oxide staining, trace manganese oxide, very trace calcite, very trace slickensides	subangular to subrounded chips up to 1.9 cm
490 - 500	149.4 - 152.4	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass with trace tiny pink orthoclase blebs and 50% phenocrysts of quartz, feldspar, black biotite, trace sanidine; slightly less mafic minerals; trace amphibole; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace vein calcite and clear yellowish quartz crystals, very trace slickensides, trace nontronite	subangular to subrounded chips up to 1.5 cm
500 - 510	152.4 - 155.4	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; trace pumice; trace lithic fragments of quartzite; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace calcite	subangular to subrounded chips up to 1.4 cm
510 - 520	155.4 - 158.5	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-gray aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; less mafic; trace pumice; trace lithic fragments of dark purple quartzite; reaction to acid: none	trace iron oxide staining, trace calcite, subhedral to euhedral quartz, open fracture evidence	subangular to subrounded chips up to 1.8 cm
520 - 530	158.5 - 161.5	Brown Unit; reddish brown [2.5YR5/4]; well lithified; crystal-rich welded tuff with 50% reddish-gray aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; trace pumice; reaction to acid: none	trace iron oxide staining	subangular to subrounded chips up to 1.7 cm
530 - 540	161.5 - 164.6	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% pinkish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; trace pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining (1 chip with limonite on fracture surface), trace large vein calcite with manganese oxide	subangular to subrounded chips up to 2.4 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 (Tal)				
540 - 550	164.6 - 167.6	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% pinkish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; more pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining, trace calcite	subangular to subrounded chips up to 2.8 cm, mostly 1.0 cm
550 - 560	167.6 - 170.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; more pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace calcite crystals up to 0.5cm	subangular to subrounded chips up to 2.1 cm
560 - 570	170.7 - 173.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace flat fracture surfaces, trace calcite	subangular to subrounded chips up to 1.5 cm
570 - 580	173.7 - 176.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; trace pumice; trace lithic fragments; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace calcite	subangular to subrounded chips up to 0.9 cm
580 - 590	176.8 - 179.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace calcite, trace euhedral quartz crystals stained with manganese oxide, 1 chip with layered vein of quartz, manganese oxide, calcite, open fracture evidence	subangular to subrounded chips up to 1.7 cm
590 - 600	179.8 - 182.9	Brown Unit; weak red [10R4/3], reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown aphanitic to cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and black biotite; trace pumice; trace dark lithic fragments; reaction to acid: none	trace iron oxide staining, trace calcite, more quartz, open fracture evidence	subangular to subrounded chips up to 1.9 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
600 - 610	182.9 - 185.9	Brown Unit; weak red [10R4/2], reddish brown [2.5YR4/6]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass with dark gray glassy patches; 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace pumice; reaction to acid: none	trace iron oxide staining, very trace flat fracture surfaces, very trace slickensides	subangular to subrounded chips up to 0.6 cm
610 - 620	185.9 - 189.0	Brown Unit; weak red [10R4/2], reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass with dark gray glassy patches; 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace vein calcite, very trace slickensides	subangular to subrounded chips up to 1.7 cm
620 - 630	189.0 - 192.0	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass with dark gray glassy patches; 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace pumice; less quartz; less smoky quartz; reaction to acid: none	trace iron oxide staining, trace manganese oxide (some speckled, some earthy), trace veins with manganese oxide and calcite, trace euhedral quartz crystals on fracture surfaces, open fracture evidence	subangular to subrounded chips up to 3.7 cm
630 - 640	192.0 - 195.1	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass with dark gray glassy patches; 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, very trace vein calcite, very trace slickensides	subangular to subrounded chips up to 1.4 cm
640 - 650	195.1 - 198.1	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass with dark gray glassy patches; 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace pumice; less smoky quartz; reaction to acid: none	trace iron oxide staining, trace manganese oxide, very trace vein calcite, very trace vein quartz, very trace slickensides	subangular to subrounded chips up to 1.4 cm
650 - 660	198.1 - 201.2	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass with dark gray glassy patches; 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, very trace vein calcite, trace slickensides	subangular to subrounded chips up to 1.0 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
660 - 670	201.2 - 204.2	Brown Unit; dark reddish gray [2.5YR3/1]; well lithified; crystal-rich glassy tuff with 50% dark gray and reddish-brown glassy groundmass and 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace dark gray fiamme-like pumice; trace light gray to pink pumice; reaction to acid: none	trace iron oxide staining, very trace vein calcite	subangular to subrounded chips up to 3.0 cm
670 - 680	204.2 - 207.3	Brown Unit; dark reddish gray [2.5YR3/1]; well lithified; crystal-rich glassy tuff with 50% purplish-brown and dark brown glassy groundmass and 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace dark gray fiamme-like pumice; trace light gray to pink pumice; reaction to acid: none	trace iron oxide staining, very trace vein calcite, very trace slickensides	subangular to subrounded chips up to 1.6 cm
680 - 690	207.3 - 210.3	Brown Unit; dark reddish gray [2.5YR3/1]; well lithified; crystal-rich glassy tuff with 50% purplish-brown and dark brown glassy groundmass and 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace dark gray fiamme-like pumice; trace light gray to pink pumice; reaction to acid: none	trace iron oxide staining, very trace slickensides	subangular to subrounded chips up to 2.5 cm
690 - 700	210.3 - 213.4	Brown Unit; dark reddish gray [2.5YR3/1], dusky red [2.5YR3/2]; well lithified; crystal-rich glassy tuff with 50% purplish-brown and dark brown glassy groundmass and 50% phenocrysts of clear quartz, smoky quartz, feldspar, and black biotite; trace dark gray fiamme-like pumice; trace light gray to pink pumice; reaction to acid: none	very trace calcite	subangular to subrounded chips up to 1.4 cm
700 - 710	213.4 - 216.4	Brown Unit; dark reddish gray [2.5YR3/1]; well lithified; crystal-rich glassy tuff with 55% dark gray, dark brown and reddish-brown glassy groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace gray pumice; reaction to acid: none	trace iron oxide staining, very trace slickensides	subangular to subrounded chips up to 1.8 cm
710 - 720	216.4 - 219.5	Brown Unit; dark reddish gray [2.5YR4/1]; well lithified; crystal-rich glassy tuff with 55% dark brown glassy groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace light pink and gray pumice; reaction to acid: none	trace iron oxide staining, trace slickensides, trace flat fracture surfaces, trace green serpentine on fracture surfaces	subangular to subrounded chips up to 4.3 cm

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
720 - 730	219.5 - 222.5	Brown Unit; dark reddish gray [2.5YR4/1]; well lithified; crystal-rich glassy tuff with 55% dark brown glassy groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace light pink and gray pumice; trace beige pumice; trace reddish brown tuff; reaction to acid: none	trace iron oxide staining, trace slickensides, very trace serpentine on fracture surfaces	subangular to subrounded chips up to 1.1 cm
730 - 740	222.5 - 225.6	Brown Unit; dark reddish gray [2.5YR4/1]; well lithified; crystal-rich glassy tuff with 55% dark brown glassy groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace light pink and gray pumice; trace beige disintegrated pumice; trace lithic; reaction to acid: none	trace iron oxide staining, trace slickensides	subangular to subrounded chips up to 1.0 cm
740 - 750	225.6 - 228.6	Brown Unit; dark reddish gray [2.5YR4/1]; well lithified; crystal-rich glassy tuff with 44% dark grayish-brown glassy groundmass, 8% orangish-brown glassy groundmass, 3% pink cryptocrystalline groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; reaction to acid: none	trace iron oxide staining, very trace slickensides	subangular to subrounded chips up to 1.5 cm
750 - 760	228.6 - 231.6	Brown Unit; dark reddish gray [2.5YR4/1], weak red [10R4/3]; well lithified; crystal-rich glassy tuff with 39% dark brown glassy groundmass, 16% reddish-brown groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, very trace slickensides	subangular to subrounded chips up to 1.9 cm
760 - 770	231.6 - 234.7	Brown Unit; weak red [2.5YR4/2], dark reddish gray [2.5YR4/1]; well lithified; crystal-rich glassy tuff with 23% dark brown glassy groundmass, 22% reddish-brown groundmass, and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace pumice; less feldspar; reaction to acid: none	trace iron oxide staining, trace manganese oxide, very trace slickensides	subangular to subrounded chips up to 1.3 cm
770 - 780	234.7 - 237.7	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich glassy tuff with 23% dark brown glassy groundmass, 22% reddish-brown cryptocrystalline groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace light pink and gray pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide	subangular to subrounded chips up to 3.0 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
Resolution Copper Mining
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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
780 - 790	237.7 - 240.8	Brown Unit; reddish brown [5YR4/3]; well lithified; crystal-rich tuff with 55% brown cryptocrystalline groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace light pink and gray pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide	subangular to subrounded chips up to 3.2 cm
790 - 800	240.8 - 243.8	Brown Unit; reddish brown [5YR4/3]; well lithified; crystal-rich tuff with 55% brown cryptocrystalline groundmass, some glassy groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; trace light pink and gray pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide	subangular to subrounded chips up to 2.5 cm
800 - 810	243.8 - 246.9	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 55% brown cryptocrystalline groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; light pink and gray pumice; trace light pink and orange tuff; reaction to acid: none	trace iron oxide staining, trace manganese oxide with calcite on fracture surfaces, trace vein calcite, trace flat fracture surfaces, trace slickensides	subangular to subrounded chips up to 1.9 cm
810 - 820	246.9 - 249.9	Brown Unit; reddish brown [5YR4/3]; well lithified; crystal-rich tuff with 55% brown cryptocrystalline groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; light pink and gray pumice; trace tuff with dark gray aphanitic matrix; reaction to acid: none	trace iron oxide staining (hematite), trace manganese oxide on fracture surfaces, trace vein calcite	subangular to subrounded chips up to 2.0 cm
820 - 830	249.9 - 253.0	Brown Unit; reddish brown [5YR4/3]; well lithified; crystal-rich tuff with 55% brown cryptocrystalline groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; light pink and gray pumice; trace recrystallized pumice(?) with tiny phenocrysts; reaction to acid: none	trace iron oxide staining (limonite)	subangular to subrounded chips up to 1.4 cm
830 - 840	253.0 - 256.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 55% brown cryptocrystalline groundmass and 45% phenocrysts of clear quartz, smoky quartz, feldspar, and biotite; light pink and gray pumice; trace recrystallized pumice(?) with tiny phenocrysts; reaction to acid: none	trace manganese oxide	subangular to subrounded chips up to 2.0 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
840 - 850	256.0 - 259.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% brown to reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; less feldspar; reaction to acid: none	trace iron oxide staining, trace manganese oxide (a lot speckled), trace vein calcite	subangular to subrounded chips up to 2.9 cm
850 - 860	259.1 - 262.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% brown to reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace calcite, trace slickensides	subangular to subrounded chips up to 2.6 cm
860 - 870	262.1 - 265.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% brown to reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace calcite, trace euhedral quartz crystals on fracture surfaces, open fracture evidence	subangular to subrounded chips up to 1.7 cm
870 - 880	265.2 - 268.2	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% brown to reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; less pumice; reaction to acid: none	trace iron oxide staining (limonite), trace manganese oxide, trace slickensides	subangular to subrounded chips up to 1.6 cm
880 - 890	268.2 - 271.3	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% brown to reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; more pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, ~1% slickensides on fracture material, trace vein calcite	subangular to subrounded chips up to 1.0 cm
890 - 910	271.3 - 277.4	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% brown to reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining (limonite), trace manganese oxide, trace slickensides, trace calcite	subangular to subrounded chips up to 2.0 cm, mostly <1.0 cm
910 - 920	277.4 - 280.4	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide on fracture surfaces, very trace slickensides	subangular to subrounded chips up to 3.9 cm, mostly 1.5 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
920 - 930	280.4 - 283.5	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide on fracture surfaces, very trace slickensides, very trace sand-sized calcite	subangular to subrounded chips up to 1.0 cm
930 - 940	283.5 - 286.5	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; more feldspar; reaction to acid: none	trace iron oxide staining, very trace slickensides, very trace vein calcite	subangular to subrounded chips up to 1.8 cm
940 - 950	286.5 - 289.6	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide on fracture surfaces, trace white talc	subangular to subrounded chips up to 2.1 cm
950 - 960	289.6 - 292.6	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining (limonite on fracture surfaces), trace manganese oxide on fracture surfaces, very trace slickensides, trace vein calcite, trace vein quartz	subangular to subrounded chips up to 3.5 cm, mostly 1.5 cm
960 - 970	292.6 - 295.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining (limonite on fracture surfaces), trace manganese oxide on fracture surfaces, very trace slickensides, (depth 960-961ft) 1% very large vein calcite, pieces over 2.0 cm, trace talc	subangular to subrounded chips up to 1.5 cm
970 - 980	295.7 - 298.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining (limonite on fracture surfaces), trace manganese oxide, very trace slickensides, trace euhedral quartz crystals with manganese oxide staining, open fracture evidence	subangular to subrounded chips up to 1.4 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
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Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
980 - 990	298.7 - 301.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	some iron oxide staining (limonite and hematite) on fracture surfaces, manganese oxide, trace calcite	subangular to subrounded chips up to 2.0 cm
990 - 1,000	301.8 - 304.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 49% reddish-brown cryptocrystalline groundmass and 49% phenocrysts of quartz, feldspar, and biotite; 2% light gray and light pink pumice; reaction to acid: none	trace iron oxide staining (limonite on fracture surfaces), trace manganese oxide (speckled on fracture surfaces), trace calcite	subangular to subrounded chips up to 3.5 cm, mostly 1.8 cm
1,000 - 1,010	304.8 - 307.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace euhedral quartz on fracture surfaces with manganese oxide, open fracture evidence	subangular to subrounded chips up to 1.5 cm
1,010 - 1,020	307.8 - 310.9	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining (limonite and hematite) on fracture surfaces, trace calcite	subangular to subrounded chips up to 2.0 cm
1,020 - 1,030	310.9 - 313.9	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace lithic fragment of green quartzite fragment; reaction to acid: none	trace iron oxide staining, trace dendritic manganese oxide, trace calcite, very trace slickensides	subangular to subrounded chips up to 1.0 cm
1,030 - 1,040	313.9 - 317.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace lithic fragment of green quartzite fragment; reaction to acid: none	trace iron oxide staining, trace manganese oxide coating on fractures, trace calcite, trace euhedral quartz crystals on fracture surfaces with manganese oxide coating, open fracture evidence	subangular to subrounded chips up to 2.7 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
1,040 - 1,050	317.0 - 320.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace lithic fragment of green quartzite fragment; reaction to acid: none	trace iron oxide staining, trace manganese oxide coating on fractures, very trace calcite	subangular to subrounded chips up to 3.5 cm, mostly 1.2 cm
1,050 - 1,060	320.0 - 323.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide coating on fractures, trace calcite	subangular to subrounded chips up to 2.6 cm
1,060 - 1,070	323.1 - 326.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide coating on fractures, trace large calcite veins, trace euhedral quartz crystals, open fracture evidence	subangular to subrounded chips up to 4.4 cm; almost all large chips
1,070 - 1,080	326.1 - 329.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide coating on fractures, trace large calcite veins, some veins show quartz and calcite layering, 1 chip shows euhedral quartz covering multiple sides, open fracture network evidence	subangular to subrounded chips up to 3.1 cm, mostly <1.0 cm
1,080 - 1,090	329.2 - 332.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, 1% calcite, 1% tiny euhedral quartz crystals on fracture surfaces, moderate open fractures	subangular to subrounded chips up to 1.9 cm; almost all large chips
1,090 - 1,100	332.2 - 335.3	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace manganese oxide, 5% layered veins calcite and euhedral quartz crystals, trace white flaky vein material (gypsum?), open fracture evidence	subangular to subrounded chips up to 3.0 cm; chip size is more variable, small to large

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
1,100 - 1,110	335.3 - 338.3	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 50% reddish-brown cryptocrystalline groundmass, some light orange glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, very trace manganese oxide, 1% calcite veins, 1% euhedral quartz on fracture surfaces, trace calcite and quartz layered veins, open fracture evidence	subangular to subrounded chips up to 3.5 cm; smaller chips
1,110 - 1,120	338.3 - 341.4	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown to orange-pink cryptocrystalline groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; reaction to acid: none	trace iron oxide staining, very trace manganese oxide, trace slickensides, 1% calcite veins, 1% euhedral quartz on fracture surfaces, trace calcite and quartz layered veins, open fracture evidence	subangular to subrounded chips up to 2.8 cm, mostly 1.6 cm
1,120 - 1,130	341.4 - 344.4	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 49% reddish-brown to orange-pink cryptocrystalline groundmass and 49% phenocrysts of quartz, feldspar, and biotite; 2% light gray and light pink pumice; trace lithic fragments of grayish-green schist; diabase; reaction to acid: none	trace iron oxide staining, very trace manganese oxide, trace calcite, very trace quartz	subangular to subrounded chips up to 2.9 cm, mostly 1.3 cm
1,130 - 1,140	344.4 - 347.5	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 54% reddish-brown to pinkish-orange cryptocrystalline groundmass and 44% phenocrysts of quartz, feldspar, black biotite; 2% lithic fragments of green quartzite (up to 3.9cm); silvery schist (up to 3.1cm); trace black, white and green diabase; reaction to acid: none	trace iron oxide staining and manganese oxide on fracture surfaces, trace vein calcite	subangular to subrounded chips up to 4.0 cm, mostly 1.7 cm
1,140 - 1,150	347.5 - 350.5	Brown Unit; reddish brown [5YR4/4]; well lithified; crystal-rich tuff with 55% reddish-brown to orange cryptocrystalline groundmass and 45% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; trace light gray pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide on fracture surfaces, very trace slickensides, very trace calcite, very trace euhedral quartz crystals, very tiny open fracture evidence	subangular to subrounded chips up to 1.0 cm
1,150 - 1,160	350.5 - 353.6	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 55% reddish-brown to orange cryptocrystalline groundmass and 44% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; 1% light gray pumice; reaction to acid: none	trace iron oxide staining (limonite and hematite) on fracture surfaces, very trace calcite, very trace white greasy talc	subangular to subrounded chips up to 3.1 cm, mostly 1.3 cm

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Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
1,160 - 1,170	353.6 - 356.6	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 55% reddish-brown to orange cryptocrystalline groundmass and 44% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; 1% light gray pumice; reaction to acid: none	trace iron oxide staining (hematite), trace manganese oxide on fracture surfaces, very trace vein calcite, very trace vein quartz, very trace slickensides	subangular to subrounded chips up to 1.4 cm
1,170 - 1,180	356.6 - 359.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 55% reddish-brown to orange cryptocrystalline groundmass and 44% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; 1% light gray pumice; reaction to acid: none	very trace manganese oxide on quartz, very trace slickensides, very trace euhedral quartz on fracture with manganese coating, trace tiny open fractures	subangular to subrounded chips up to 2.5 cm
1,180 - 1,190	359.7 - 362.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 55% reddish-brown to orange cryptocrystalline groundmass and 44% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; 1% light gray pumice; reaction to acid: none	some iron oxide staining (hematite on fracture surface), trace manganese oxide on fracture surfaces, trace white talc, trace calcite	subangular to subrounded chips up to 2.0 cm
1,190 - 1,200	362.7 - 365.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 55% paler orange cryptocrystalline groundmass and 44% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; 1% light gray pumice; reaction to acid: none	trace iron oxide staining (hematite on fracture surface), trace manganese oxide on fracture surfaces, trace calcite, very trace euhedral quartz on fracture surfaces with manganese oxide coating, tiny open fracture evidence	subangular to subrounded chips up to 3.1 cm
1,200 - 1,210	365.8 - 368.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 55% orange cryptocrystalline groundmass, some glassy groundmass and 45% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; some medium gray pumice; reaction to acid: none	trace iron oxide staining (hematite on fracture surface), trace manganese oxide	subangular to subrounded chips up to 2.6 cm; mostly larger chips
1,210 - 1,220	368.8 - 371.9	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 55% orange cryptocrystalline groundmass, some glassy groundmass and 45% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; some medium gray pumice; reaction to acid: none	trace iron oxide staining, trace manganese oxide, trace slickensides, trace white talc	subangular to subrounded chips up to 1.2 cm; small chips

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
1,220 - 1,230	371.9 - 374.9	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 54% orange cryptocrystalline groundmass, some glassy groundmass and 44% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; some medium gray pumice; 2% reddish-gray glassy tuff, trace diabase; reaction to acid: none	trace iron oxide staining (limonite), trace manganese oxide, trace large 1.0 cm calcite crystals	subangular to subrounded chips up to 3.1 cm; mostly large chips
1,230 - 1,240	374.9 - 378.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich tuff with 44% reddish-brown cryptocrystalline groundmass, some glassy, 11% reddish-gray glassy groundmass and 44% phenocrysts of quartz, feldspar, black biotite; trace tiny lithic fragment of green quartzite; some medium gray pumice; reaction to acid: none	trace iron oxide staining (limonite and hematite), trace manganese oxide, trace calcite	subangular to subrounded chips up to 2.0 cm
1,240 - 1,250	378.0 - 381.0	Brown Unit; dark reddish gray [2.5YR4/1]; well lithified; crystal-rich tuff with 47% pinkish-gray glassy groundmass and 47% phenocrysts of quartz, feldspar, black and bronzy biotite; trace tiny lithic fragment of green quartzite; 1% light to medium gray pumice; 5% reddish-brown tuff; reaction to acid: none	trace iron oxide staining, trace flat fracture surfaces, trace manganese oxide	subangular to subrounded chips up to 2.8 cm
1,250 - 1,260	381.0 - 384.0	Brown Unit; dark reddish gray [2.5YR3/1], weak red [2.5YR4/2]; well lithified; crystal-rich tuff with 49% dark reddish-gray glassy groundmass and 49% phenocrysts of quartz, feldspar, black and bronzy biotite; trace tiny lithic fragment of green quartzite; trace light to medium gray pumice; 2% reddish-brown tuff; reaction to acid: none	trace iron oxide staining	subangular to subrounded chips up to 1.1 cm
1,260 - 1,270	384.0 - 387.1	Brown Unit; reddish brown [2.5YR4/3], dark reddish gray [2.5YR4/1]; well lithified; crystal-rich tuff with 35% reddish-brown glassy groundmass, 15% dark reddish-gray groundmass and 50% phenocrysts of quartz, feldspar, black and bronzy biotite; trace tiny lithic fragment of green quartzite; trace light to medium gray pumice; reaction to acid: none	trace iron oxide staining, very trace calcite	subangular to subrounded chips up to 1.5 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-10
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
1,270 - 1,280	387.1 - 390.1	Brown Unit; dark reddish gray [2.5YR3/1], weak red [2.5YR4/2]; well lithified; crystal-rich tuff with 51% dark reddish-gray cryptocrystalline to glassy groundmass, 9% reddish-brown groundmass and 40% phenocrysts of quartz, feldspar, and biotite; trace tiny lithic fragment of green quartzite; trace light gray pumice; reaction to acid: none	trace iron oxide staining on fracture surfaces, trace manganese oxide on fracture surfaces, trace calcite, trace vein quartz	subangular to subrounded chips up to 2.7 cm
1,280 - 1,290	390.1 - 393.2	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown to orange cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace dark gray tuff with trace lithic fragments of light brown chert and green quartzite; reaction to acid: none	trace iron oxide staining (hematite on fracture surface), very trace light green serpentine	subangular to subrounded chips up to 0.9 cm
1,290 - 1,300	393.2 - 396.2	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown to orange cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace dark gray tuff with trace lithic fragment of green quartzite; reaction to acid: none	trace iron oxide staining (hematite on fracture surface), trace manganese oxide on fracture surfaces, trace vein quartz	subangular to subrounded chips up to 2.0 cm, mostly <1.0 cm
1,300 - 1,310	396.2 - 399.3	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown to orange cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace dark gray tuff with trace lithic fragment of green quartzite; reaction to acid: none	trace iron oxide staining (hematite on fracture surface), trace manganese oxide on fracture surface	subangular to subrounded chips up to 1.8 cm
1,310 - 1,320	399.3 - 402.3	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown to orange cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace dark gray tuff with trace lithic fragment of green quartzite; reaction to acid: none	trace iron oxide staining (hematite on fracture surface), trace manganese oxide on fracture surfaces, trace vein quartz, trace clear hexagonal blades of soft crystal, brucite?	subangular to subrounded chips up to 0.9 cm
1,320 - 1,330	402.3 - 405.4	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich tuff with 50% reddish-brown to orange cryptocrystalline to glassy groundmass and 50% phenocrysts of quartz, feldspar, and biotite; trace pumice; trace dark gray tuff with trace lithic fragment of green quartzite; reaction to acid: none	trace iron oxide staining (hematite on fracture surface), trace manganese oxide on fracture surfaces, very trace slickensides, very trace calcite, trace vein quartz	subangular to subrounded chips up to 0.9 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
1,330 - 1,340	405.4 - 408.4	Brown Unit; reddish brown [2.5YR4/4], dark gray [2.5Y3/1]; well lithified; crystal-rich tuff with 45% reddish-brown to orange cryptocrystalline to glassy groundmass and 45% phenocrysts of quartz, feldspar, and biotite, trace pink pumice; 10% dark gray vitrophyre with phenocrysts; reaction to acid: none	trace iron oxide staining (hematite on fracture surface)	subangular to subrounded chips up to 2.1 cm
APACHE LEAP TUFF- Vitrophyre (Tal)				
1,340 - 1,350	408.4 - 411.5	Vitrophyre; greenish black [10Y2.5/1]; well lithified; 99% black vitrophyre with phenocrysts of white feldspar; trace dark gray pumice with black biotite; 1% orange glassy tuff; reaction to acid: none	trace serpentine, white talc silicate and calcite on fracture surfaces	subangular to subrounded chips up to 2.5 cm
1,350 - 1,360	411.5 - 414.5	Vitrophyre; greenish black [10Y2.5/1]; well lithified; 99% black vitrophyre with phenocrysts of white feldspar; trace dark gray pumice with black biotite; 1% orange glassy tuff with trace vein quartz; reaction to acid: none	trace serpentine, white talc silicate and calcite on fracture surfaces, trace vein quartz	subangular to subrounded chips up to 1.6 cm
WHITETAIL CONGLOMERATE (Tw3)				
1,360 - 1,370	414.5 - 417.6	Conglomerate Unit Tw3; reddish brown [5YR4/3], greenish black [10Y2.5/1], and dusky red [10R3/4]; well lithified; clast-supported conglomerate and some vitrophyre; cut chips are 80% clasts of black, white and green diabase with trace magnetite; silvery schist, purple quartzite, white vein quartz, and trace matrix chips of reddish-brown sandy siltstone; 20% black vitrophyre; overall sample is trace silt; reaction to acid: weak	common iron oxide staining (hematite)	subangular chips up to 1.9 cm
1,370 - 1,380	417.6 - 420.6	Conglomerate Unit Tw3; reddish brown [5YR4/3], greenish black [10Y2.5/1], and dusky red [10R3/4]; well lithified; clast-supported conglomerate and some vitrophyre; cut chips are 80% clasts of black, white and green diabase with trace magnetite; silvery schist, purple quartzite, pink arkosic quartzite, white vein quartz, and trace matrix chips of reddish-brown silty sand; 20% black vitrophyre; overall sample is trace silt; reaction to acid: weak	common iron oxide staining (hematite)	subangular chips up to 1.1 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
WHITETAIL CONGLOMERATE (Tw3)				
1,380 - 1,390	420.6 - 423.7	Conglomerate Unit Tw3; reddish brown [5YR4/3], dusky red [10R3/4]; well lithified; clast-supported conglomerate and some vitrophyre; cut chips are 80% clasts of black, white and green diabase with trace magnetite; silvery schist, purple quartzite, pink arkosic quartzite, white vein quartz, and trace matrix chips of reddish-brown sandy siltstone; 20% black vitrophyre; overall sample is 50% gravel, 40% sand, and 10% silt; reaction to acid: weak	common iron oxide staining (hematite), trace manganese oxide, trace green serpentine	subangular chips up to 1.0 cm
1,390 - 1,400	423.7 - 426.7	Conglomerate Unit Tw3; reddish brown [5YR4/3]; well lithified; clast-supported conglomerate; cut chips are clasts of black, white and green diabase with trace magnetite; silvery schist, purple and green quartzite, pink arkosic quartzite; trace disintegrating pumice ball (from up hole), and trace matrix chips of reddish-brown silty sandstone; overall sample is 20% silt, 35% sand, 45% gravel; reaction to acid: weak	common iron oxide staining (hematite and limonite)	subangular chips up to 1.7 cm
1,400 - 1,410	426.7 - 429.8	Conglomerate Unit Tw3; reddish brown [5YR4/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of black, white and green diabase with trace magnetite; silvery schist, purple quartzite, pink arkosic quartzite, and trace matrix chips of reddish-brown silty sandstone; overall sample is 25% silt, 35% sand, 40% gravel; reaction to acid: weak	common iron oxide staining (hematite)	subangular chips up to 1.5 cm, trace Tal from uphole
1,410 - 1,420	429.8 - 432.8	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of silvery schist, purple, pink, white, red and green quartzite, white vein quartz, black, white and green diabase, and trace matrix chips of reddish brown silty sandstone; overall sample is 15% silt, 50% sand, 35% gravel; reaction to acid: weak	common iron oxide staining (hematite)	subangular chips up to 0.8 cm; trace clay balls

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
WHITETAIL CONGLOMERATE (Tw3)				
1,420 - 1,430	432.8 - 435.9	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of more black, white and green diabase, less silvery schist, purple, pink, white, red and green quartzite, light gray and orange limestone, white vein quartz, and trace matrix chips of reddish brown silty sandstone; overall sample is 15% silt, 60% sand, 25% gravel; reaction to acid: strong	common iron oxide staining (hematite)	subangular chips up to 1.3 cm; trace clay balls
1,430 - 1,440	435.9 - 438.9	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery schist, purple, pink, white, red and green quartzite, white vein quartz, trace light gray and orange limestone, and trace matrix chips of reddish brown silty sandstone; overall sample is 15% silt, 35% sand, 50% gravel; reaction to acid: moderate	common iron oxide staining (hematite), trace calcite	subangular chips up to 1.4 cm; trace clay balls
1,440 - 1,450	438.9 - 442.0	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery schist, purple, pink, white, red and green quartzite, white vein quartz, and trace matrix chips of reddish brown silty sandstone; overall sample is 15% silt, 55% sand, 30% gravel; reaction to acid: weak	common iron oxide staining (hematite), trace manganese oxide	subangular chips up to 1.0 cm; trace clay balls
1,450 - 1,460	442.0 - 445.0	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace pink and green limestone; trace orange chert, and trace matrix chips of reddish brown silty sandstone; overall sample is 15% silt, 55% sand, 30% gravel; reaction to acid: moderate	common iron oxide staining (hematite)	subangular chips up to 1.3 cm; trace clay balls

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
WHITETAIL CONGLOMERATE (Tw3)				
1,460 - 1,470	445.0 - 448.1	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace orange chert, and trace matrix chips of reddish brown silty sandstone; overall sample is 15% silt, 45% sand, 40% gravel; reaction to acid: weak	common iron oxide staining (hematite)	subangular chips up to 1.9 cm; trace clay balls
1,470 - 1,480	448.1 - 451.1	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace brown limestone, and trace matrix chips of reddish brown silty sandstone; overall sample is 20% silt, 40% sand, 40% gravel; reaction to acid: weak to moderate	common iron oxide staining (hematite)	subangular chips up to 2.2 cm; trace clay balls
1,480 - 1,490	451.1 - 454.2	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace red limestone, and trace matrix chips of reddish brown silty sandstone; overall sample is 30% silt, 30% sand, 40% gravel; reaction to acid: weak to moderate	common iron oxide staining (hematite)	subangular chips up to 2.5 cm; trace clay balls
1,490 - 1,500	454.2 - 457.2	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace gray limestone, and trace matrix chips of reddish brown silty sandstone; overall sample is 20% silt, 30% sand, 50% gravel; reaction to acid: weak to moderate	common iron oxide staining (hematite)	subangular chips up to 2.5 cm; trace clay balls

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
WHITETAIL CONGLOMERATE (Tw3)				
1,500 - 1,510	457.2 - 460.2	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace gray limestone; trace red shale, and trace matrix chips of reddish brown silty sandstone; overall sample is 20% silt, 30% sand, 50% gravel; reaction to acid: weak	common iron oxide staining (hematite)	subangular chips up to 2.3 cm; trace clay balls
1,510 - 1,520	460.2 - 463.3	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are 90% clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace gray limestone; trace red shale; 10% matrix chips of brown silty sandstone; overall sample is 37% silt, 32% sand, 31% gravel; reaction to acid: weak to moderate	common iron oxide staining (hematite)	subangular chips up to 1.4 cm; trace clay balls
1,520 - 1,530	463.3 - 466.3	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace gray limestone; trace red shale, and trace matrix chips of brown silty sandstone; overall sample is 10% silt, 60% sand, 30% gravel; reaction to acid: weak to moderate	common iron oxide staining (hematite)	subangular chips up to 1.3 cm
1,530 - 1,540	466.3 - 469.4	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace red shale; trace gray limestone in sand fraction, and trace matrix chips of brown silty sandstone; overall sample is 15% silt, 50% sand, 35% gravel; reaction to acid: weak to moderate	common iron oxide staining (hematite)	subangular chips up to 1.0 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
WHITETAIL CONGLOMERATE (Tw3)				
1,540 - 1,546	469.4 - 471.2	Conglomerate Unit Tw3; dark reddish brown [5YR3/3]; moderately to well lithified; clast-supported conglomerate; cut chips are clasts of less black, white and green diabase, more silvery and greenish-silver schist, purple, pink, white, red and green quartzite, white vein quartz; trace red shale; trace gray and red limestone, and trace matrix chips of brown silty sandstone; overall sample is 20% silt, 45% sand, 35% gravel; reaction to acid: weak to moderate	common iron oxide staining (hematite)	AIR-ASSISTED FLOODED REVERSE CIRCULATION; subangular chips up to 1.2 cm; trace clay balls

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-11
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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
0 - 5	0.0 - 1.5	Brown Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 45% light pink aphanitic groundmass and 40% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace yellowish-gray and white pumice; trace lithic fragments of quartzite, diabase and chert; reaction to acid: none to very weak	weathered with a bleached color to the tuff and some silt; trace iron oxide staining	DIRECT AIR ROTARY; Munsell Color Version: 2000 Revised Edition; subangular to subrounded up to 4.2 cm
5 - 10	1.5 - 3.0	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich tuff with 45% pinkish-brown aphanitic groundmass and 40% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace yellowish-gray and white pumice; trace lithic fragments of quartzite, diabase and chert; reaction to acid: none	weathered with 25% silt; trace iron oxide staining, trace manganese oxide	subangular to subrounded up to 3.0 cm
10 - 15	3.0 - 4.6	Brown Unit; reddish brown [5YR5/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace yellowish-gray and white pumice; trace lithic fragments of quartzite, diabase, chert and light purple very fine grained volcanic; trace large silt clumps; reaction to acid: none	weathered with 10% silt; trace iron oxide staining	subangular to subrounded up to 3.9 cm
15 - 20	4.6 - 6.1	Brown Unit; reddish brown [5YR5/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace yellowish-gray and white pumice; trace lithic fragments of quartzite, diabase and light purple very fine grained volcanic; trace silt clumps; reaction to acid: none	weathered with 15% silt; trace iron oxide staining	DIRECT AIR ROTARY; subangular to subrounded up to 2.9 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
20 - 25	6.1 - 7.6	Brown Unit; reddish brown [5YR5/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace yellowish-gray and white pumice; trace lithic fragments of quartzite; trace silt clumps; reaction to acid: none	weathered with 30% silt and rock flour; trace iron oxide staining	DUAL-WALL REVERSE CIRCULATION AIR HAMMER; subangular to subrounded up to 2.0 cm
25 - 30	7.6 - 9.1	Brown Unit; light reddish brown [2.5YR6/3]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; reaction to acid: none	weathered with 50% silt; trace iron oxide staining, very trace manganese oxide	subangular to subrounded up to 0.8 cm
30 - 35	9.1 - 10.7	Brown Unit; pink [5YR7/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; abundant silt balled around tuff chips; reaction to acid: none	weathered with 60% silt; trace iron oxide staining	subangular to subrounded up to 1.9 cm
35 - 40	10.7 - 12.2	Brown Unit; pink [5YR7/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; abundant loose silt clumps; reaction to acid: none	weathered with 60% silt; trace iron oxide staining	subangular to subrounded up to 0.9 cm
40 - 45	12.2 - 13.7	Brown Unit; light reddish brown [5YR6/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass, 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; abundant loose silt clumps; reaction to acid: none	weathered with 60% silt; no to trace iron oxide staining	subangular to subrounded up to 1.2 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-11
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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
45 - 50	13.7 - 15.2	Brown Unit; light reddish brown [5YR6/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace light gray pumice; trace lithic fragments of quartzite and diabase; abundant loose silt clumps; reaction to acid: none	weathered with 60% silt; no to trace iron oxide staining, trace manganese oxide	subangular to subrounded up to 1.5 cm
50 - 55	15.2 - 16.8	Brown Unit; pale red [10R6/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace light gray pumice; trace lithic fragments of quartzite and diabase; trace silt balls; reaction to acid: none	weathered with 15% silt; trace iron oxide staining (hematite)	subangular to subrounded up to 1.6 cm
55 - 65	16.8 - 19.8	Brown Unit; light reddish brown [5YR6/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace light gray pumice; trace lithic fragments of quartzite and diabase; abundant silt balls; reaction to acid: none	weathered with 60% silt; no to trace iron oxide staining	subangular to subrounded up to 1.8 cm
65 - 75	19.8 - 22.9	Brown Unit; pale red [10R6/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace light gray pumice; trace lithic fragments of quartzite and diabase; reaction to acid: none	trace silt; no to trace iron oxide staining	subangular to subrounded up to 1.0 cm
75 - 85	22.9 - 25.9	Brown Unit; pale red [10R6/4]; well lithified; crystal-rich tuff with 50% pinkish-brown aphanitic groundmass and 50% phenocrysts of clear and smoky anhedral quartz, anhedral to euhedral clear and white feldspar, euhedral bronzy biotite, very trace magnetite; trace medium gray pumice; trace lithic fragments of quartzite and diabase; reaction to acid: none	no to trace silt; no to trace iron oxide staining, trace drusy quartz on tuff chip (open fracture)	subangular to subrounded up to 1.0 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
85 - 95	25.9 - 29.0	Brown Unit; pale red [10R6/4]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy biotite, very trace magnetite; trace gray pumice; trace lithic fragments of quartzite and basalt; reaction to acid: none	no to trace iron oxide staining, trace flat fracture surface	subangular to subrounded up to 1.3 cm; chips mostly ground fine
95 - 105	29.0 - 32.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy biotite, very trace magnetite; trace gray pumice; trace lithic fragments of quartzite, diabase and chert; reaction to acid: none	no to trace iron oxide staining, trace flat fracture surface, trace nontronite	subangular to subrounded up to 0.7 cm; chips mostly ground fine
105 - 115	32.0 - 35.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy biotite, very trace magnetite; trace gray pumice; trace lithic fragments of quartzite; diabase and chert; reaction to acid: none	trace iron oxide staining (mostly on lithics)	subangular to subrounded up to 1.1 cm; chips mostly ground fine
115 - 120	35.1 - 36.6	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass and 49% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy biotite, very trace magnetite; 1% light gray pumice; trace lithic fragments of quartzite, diabase, chert, siltstone and schist; abundant well rounded 0.3 cm diameter quartz grains; reaction to acid: none	trace iron oxide staining, trace manganese oxide on lithic	subangular to subrounded up to 1.9 cm; chips mostly ground fine
120 - 130	36.6 - 39.6	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass with lighter pink orthoclase blebs and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy biotite, very trace magnetite; trace pumice; trace lithic fragments of quartzite; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 0.6 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
130 - 140	39.6 - 42.7	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass with lighter pink orthoclase blebs and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy biotite, very trace magnetite; trace pumice; trace lithic fragments of quartzite; reaction to acid: none	no to trace iron oxide staining, trace manganese oxide on lithic	subangular to subrounded up to 1.3 cm; chips mostly ground fine
140 - 150	42.7 - 45.7	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass with lighter pink orthoclase blebs and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy biotite, very trace magnetite; trace pumice; trace lithic fragments of quartzite and medium gray fine grained volcanics; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 0.9 cm; chips mostly ground fine
150 - 160	45.7 - 48.8	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass with lighter pink orthoclase blebs and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy biotite, very trace magnetite; trace pumice; trace lithic fragments of quartzite and dark gray shale; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 0.6 cm; chips mostly ground fine
160 - 170	48.8 - 51.8	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% pinkish-brown cryptocrystalline groundmass with lighter pink orthoclase blebs and 50% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy biotite, very trace magnetite; trace medium gray pumice; trace lithic fragments of quartzite and schist; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 1.2 cm; chips mostly ground fine
170 - 180	51.8 - 54.9	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% pinkish-brown cryptocrystalline groundmass with lighter pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy biotite, very trace magnetite; trace medium gray pumice; trace lithic fragments of quartzite; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 1.1 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
180 - 190	54.9 - 57.9	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% pinkish-brown cryptocrystalline groundmass with more lighter pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy biotite, very trace magnetite; trace medium gray pumice; trace lithic fragments of quartzite; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 0.8 cm; chips mostly ground fine
190 - 200	57.9 - 61.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% pinkish-brown cryptocrystalline groundmass with more lighter pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy biotite, very trace magnetite; trace medium gray pumice; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 1.0 cm; chips mostly ground fine
200 - 210	61.0 - 64.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% pinkish-brown cryptocrystalline groundmass with more lighter pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy biotite, very trace magnetite; trace medium gray pumice; trace lithic fragments of diabase; reaction to acid: none	trace iron oxide staining	subangular to subrounded up to 1.3 cm; chips mostly ground fine
210 - 220	64.0 - 67.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% pinkish-brown cryptocrystalline groundmass with more lighter pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy biotite, very trace magnetite; trace medium gray pumice; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
220 - 230	67.1 - 70.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace medium gray pumice; reaction to acid: none		subangular to subrounded up to 0.9 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
230 - 240	70.1 - 73.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, only slightly more bronzy weathered biotite, very trace magnetite; trace medium gray pumice; trace lithic of quartzite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine
240 - 250	73.2 - 76.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, only slightly more bronzy weathered biotite, very trace magnetite; trace dark gray flattened gray pumice; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine
250 - 260	76.2 - 79.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy weathered biotite, very trace magnetite; trace dark gray flattened gray pumice; reaction to acid: none	trace flat fracture surface	subangular to subrounded up to 1.5 cm; chips mostly ground fine
260 - 270	79.2 - 82.3	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace dark gray flattened gray pumice; reaction to acid: none		subangular to subrounded up to 0.9 cm; chips mostly ground fine
270 - 280	82.3 - 85.3	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace dark gray flattened gray pumice; trace lithic fragments of diabase and quartzite; reaction to acid: none	trace iron oxide staining	subangular to subrounded up to 1.0 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
280 - 290	85.3 - 88.4	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace medium to dark gray flattened gray pumice; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 1.0 cm; chips mostly ground fine
290 - 300	88.4 - 91.4	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace medium to dark gray flattened gray pumice; reaction to acid: none	no to trace iron oxide staining, very trace tiny calcite crystals	subangular to subrounded up to 1.1 cm; chips mostly ground fine
300 - 310	91.4 - 94.5	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar; more bronzy weathered biotite, very trace magnetite; trace medium to dark gray flattened gray pumice; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 1.1 cm; chips mostly ground fine
310 - 320	94.5 - 97.5	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, bronzy weathered biotite, very trace magnetite; trace medium to dark gray flattened gray pumice; trace native copper on pumice fragment; trace lithic of diabase; reaction to acid: none	no to trace iron oxide staining, very trace tiny calcite crystals	subangular to subrounded up to 1.1 cm; chips mostly ground fine
320 - 330	97.5 - 100.6	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace medium to dark gray flattened gray pumice; trace lithic of quartzite; reaction to acid: none	no to trace iron oxide staining	subangular to subrounded up to 1.2 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
330 - 340	100.6 - 103.6	Brown Unit; reddish brown [5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace medium to dark gray flattened gray pumice; trace lithic of quartzite; reaction to acid: none	trace iron oxide staining	subangular to subrounded up to 1.1 cm; chips mostly ground fine
340 - 350	103.6 - 106.7	Brown Unit; reddish brown [5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass with pink orthoclase blebs and 40% phenocrysts of clear and smoky quartz, clear and white feldspar, trace bronzy weathered biotite, very trace magnetite; trace medium to dark gray flattened gray pumice; trace lithic of quartzite; reaction to acid: none	trace iron oxide staining (limonite)	subangular to subrounded up to 0.8 cm; chips mostly ground fine
350 - 360	106.7 - 109.7	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite and chalcedony; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
360 - 370	109.7 - 112.8	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
370 - 380	112.8 - 115.8	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.1 cm; chips mostly ground fine
380 - 390	115.8 - 118.9	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
390 - 400	118.9 - 121.9	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 3.2 cm; chips mostly ground fine
400 - 410	121.9 - 125.0	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
410 - 420	125.0 - 128.0	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
420 - 430	128.0 - 131.1	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.2 cm; chips mostly ground fine
430 - 440	131.1 - 134.1	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
440 - 450	134.1 - 137.2	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine
450 - 460	137.2 - 140.2	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, very trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
460 - 470	140.2 - 143.3	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.5 cm; chips mostly ground fine
470 - 480	143.3 - 146.3	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
480 - 490	146.3 - 149.4	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
490 - 500	149.4 - 152.4	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.5 cm; chips mostly ground fine
500 - 510	152.4 - 155.4	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine
510 - 520	155.4 - 158.5	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
520 - 530	158.5 - 161.5	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
530 - 540	161.5 - 164.6	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
540 - 550	164.6 - 167.6	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
550 - 560	167.6 - 170.7	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
560 - 570	170.7 - 173.7	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
570 - 580	173.7 - 176.8	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
580 - 590	176.8 - 179.8	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.5 cm; chips mostly ground fine
590 - 600	179.8 - 182.9	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	trace chalcedony	subangular to subrounded up to 1.0 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
600 - 610	182.9 - 185.9	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
610 - 620	185.9 - 189.0	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass;, 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
620 - 630	189.0 - 192.0	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, very trace magnetite; trace lithic fragments of quartzite; reaction to acid: none		subangular to subrounded up to 0.6 cm; chips mostly ground fine
630 - 640	192.0 - 195.1	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
640 - 650	195.1 - 198.1	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.1 cm; chips mostly ground fine
650 - 660	198.1 - 201.2	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.4 cm; chips mostly ground fine
660 - 670	201.2 - 204.2	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular to subrounded up to 0.8 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
670 - 680	204.2 - 207.3	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none		subangular to subrounded up to 1.5 cm; chips mostly ground fine
680 - 690	207.3 - 210.3	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine
690 - 700	210.3 - 213.4	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.5 cm; chips mostly ground fine
700 - 710	213.4 - 216.4	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
710 - 720	216.4 - 219.5	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine
720 - 730	219.5 - 222.5	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
730 - 740	222.5 - 225.6	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-11
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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
740 - 750	225.6 - 228.6	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	5-10% white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular to subrounded up to 0.8 cm; chips mostly ground fine
750 - 760	228.6 - 231.6	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular to subrounded up to 0.4 cm; chips mostly ground fine
760 - 770	231.6 - 234.7	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular to subrounded up to 0.4 cm; chips mostly ground fine
770 - 780	234.7 - 237.7	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none		subangular to subrounded up to 1.0 cm; chips mostly ground fine
780 - 790	237.7 - 240.8	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 40% reddish-brown cryptocrystalline groundmass and 60% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular to subrounded up to 0.8 cm; chips mostly ground fine
790 - 800	240.8 - 243.8	Brown Unit; dark reddish brown [2.5YR3/4]; well lithified; crystal-rich welded tuff with 40% reddish-brown cryptocrystalline groundmass and 60% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm, trace chalcedony	subangular to subrounded up to 1.5 cm; chips mostly ground fine
800 - 810	243.8 - 246.9	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich welded tuff with 40% reddish-brown cryptocrystalline groundmass and 60% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	10% white montmorillinite as soft, flaky, mostly loose angular to subangular chips up to 2.0 cm; also on fracture surfaces, trace chalcedony	subangular to subrounded up to 3.5 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
810 - 820	246.9 - 249.9	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich welded tuff with 40% reddish-brown cryptocrystalline groundmass and 60% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	25% white montmorillinite as soft, flaky, loose angular to subangular chips up to 4.0 cm, trace chalcedony	subangular to subrounded up to 1.5 cm; chips mostly ground fine
820 - 830	249.9 - 253.0	Brown Unit; reddish brown [2.5YR5/3]; well lithified; crystal-rich welded tuff with 40% reddish-brown cryptocrystalline groundmass and 60% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	10% white montmorillinite as soft, flaky, loose angular to subangular chips up to 1.5 cm	DUAL-WALL REVERSE CIRCULATION AIR HAMMER, AIR-ASSISTED FLOODED REVERSE CIRCULATION; subangular up to 2.0 cm; chips mostly ground fine
830 - 840	253.0 - 256.0	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 40% reddish-brown cryptocrystalline groundmass and 60% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	>5% white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular up to 0.6 cm; chips mostly ground fine
840 - 850	256.0 - 259.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	>5% white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular up to 0.8 cm; chips mostly ground fine
850 - 860	259.1 - 262.1	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none to very weak	trace calcite coating on trace chips	subangular up to 0.8 cm; chips mostly ground fine
860 - 870	262.1 - 265.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular up to 1.0 cm; chips mostly ground fine
870 - 880	265.2 - 268.2	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular up to 1.0 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
880 - 890	268.2 - 271.3	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular up to 1.4 cm; chips mostly ground fine
890 - 900	271.3 - 274.3	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of diabase and quartzite; reaction to acid: none to very weak	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm; trace calcite coating on trace chips, trace chalcedony	subangular up to 1.5 cm; chips mostly ground fine
900 - 910	274.3 - 277.4	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular to subrounded up to 2.5 cm; chips mostly ground fine to medium
910 - 920	277.4 - 280.4	Brown Unit; reddish brown [2.5YR4/3]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none to very weak	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm; trace calcite coating on trace chips	subangular up to 0.5 cm; chips mostly ground fine
920 - 930	280.4 - 283.5	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm	subangular up to 0.8 cm; chips mostly ground fine
930 - 940	283.5 - 286.5	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace chalcedony	subangular up to 1.0 cm; chips mostly ground fine
940 - 950	286.5 - 289.6	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none		subangular to subrounded up to 2.0 cm; chips mostly ground fine

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
950 - 960	289.6 - 292.6	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none		subangular to subrounded up to 0.8 cm; chips mostly ground fine
960 - 970	292.6 - 295.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	>5% white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm, trace chalcedony	subangular to subrounded up to 1.2 cm; chips mostly ground fine
970 - 980	295.7 - 298.7	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 50% reddish-brown cryptocrystalline groundmass and 50% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.2 cm; trace yellowish brown smoky quartz coating on trace chips, trace chalcedony	subangular up to 1.2 cm; chips mostly ground fine
980 - 990	298.7 - 301.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace yellowish brown smoky quartz coating on trace chips	subangular up to 1.2 cm; chips mostly ground fine
990 - 1,000	301.8 - 304.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	trace yellowish brown smoky quartz coating on trace chips, trace chalcedony	subangular up to 1.1 cm; chips mostly ground fine
1,000 - 1,010	304.8 - 307.8	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite; magnetite; trace lithic fragments of quartzite; reaction to acid: none	trace yellowish brown smoky quartz coating on trace chips, trace chalcedony	subangular up to 1.4 cm; chips mostly ground fine

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-11
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Brown Unit (Tal)				
1,010 - 1,020	307.8 - 310.9	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	trace yellowish brown smoky quartz coating on trace chips, trace chalcedony	subangular to subrounded up to 0.8 cm; chips mostly ground fine
1,020 - 1,030	310.9 - 313.9	Brown Unit; reddish brown [2.5YR4/4]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none to very weak	trace calcite, loose, white, subangular chips to 0.4 cm, trace chalcedony	subangular to subrounded up to 1.5 cm; chips mostly ground fine
1,030 - 1,040	313.9 - 317.0	Brown Unit; red [2.5YR4/6]; well lithified; crystal-rich welded tuff with 70% orange brown cryptocrystalline groundmass and 30% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; reaction to acid: none	>5% white montmorillinite as soft, flaky, loose angular to subangular chips up to 1.0 cm, trace chalcedony	subangular to subrounded up to 1.0 cm; chips mostly ground fine
1,040 - 1,045	317.0 - 318.5	Brown Unit; red [2.5YR4/6]; well lithified; crystal-rich welded tuff with 60% reddish-brown cryptocrystalline groundmass and 40% phenocrysts of quartz, white feldspar, bronzy weathered biotite, trace magnetite; trace lithic fragments of quartzite; reaction to acid: none	trace white montmorillinite as soft, flaky, loose angular to subangular chips up to 0.4 cm, trace chalcedony	subangular up to 2.0 cm; chips mostly ground medium to coarse
APACHE LEAP TUFF- Vitrophyre (Tal)				
1,045 - 1,050	318.5 - 320.0	Vitrophyre; very dark gray [2.5Y3/1]; well lithified; black vitrophyre with phenocrysts of white feldspar and trace black biotite; reaction to acid: none		subangular up to 1.5 cm; chips mostly ground medium to coarse
1,050 - 1,060	320.0 - 323.1	Vitrophyre; very dark gray [2.5Y3/1]; well lithified; black vitrophyre with phenocrysts of white feldspar and trace black biotite; reaction to acid: none	trace green serpentine on fracture surfaces	subangular up to 1.0 cm; chips mostly ground medium to coarse
1,060 - 1,070	323.1 - 326.1	Vitrophyre; dark reddish gray [2.5YR3/1]; well lithified; vitrophyre and basal tuff; 80% black vitrophyre with phenocrysts of white feldspar and trace black biotite; 20% unwelded tuff with 80% dark reddish-brown cryptocrystalline groundmass and 20% phenocrysts of quartz, feldspar, biotite, hornblende, trace magnetite; reaction to acid: none	trace green serpentine on fracture surfaces of vitrophyre chips	subangular up to 3.2 cm; chips mostly ground fine to medium

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Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
APACHE LEAP TUFF- Basal Tuff (Tal)				
1,070 - 1,075	326.1 - 327.7	Basal Tuff; pale red [10R6/4]; moderately to well lithified; unwelded tuff with 80% pinkish-white aphanitic groundmass and 20% phenocrysts of biotite, quartz, white feldspar, hornblende, trace magnetite; reaction to acid: none		subangular up to 3.0 cm; chips mostly ground fine
WHITETAIL CONGLOMERATE (Tw3)				
1,075 - 1,080	327.7 - 329.2	Conglomerate Unit Tw3; weak red [10R4/3]; well lithified; clast-supported conglomerate and tuff; 20% unwelded tuff; 80% clast-supported conglomerate consisting of clasts of black, white and green diabase with trace magnetite, silvery schist, purple, pink, white, red and green quartzite, white vein quartz, gray limestone, red chert; trace matrix chips of reddish-brown silty sandstone; and trace clay balls; overall sample is 50% gravel, 40% sand, 10% silt; reaction to acid: moderate to strong		subangular up to 1.0 cm; chips mostly ground fine to medium
1,080 - 1,090	329.2 - 332.2	Conglomerate Unit Tw3; dusky red [10R3/3]; well lithified; clast-supported conglomerate; cut chips are clasts of black, white and green diabase with trace magnetite, silvery schist, purple, pink, white, red and green quartzite, white vein quartz, gray limestone, red chert; and trace matrix chips of reddish-brown silty sandstone; overall sample is 50% gravel, 40% sand, 10% silt; reaction to acid: moderate to strong		subangular up to 3.4 cm; chips mostly ground fine to medium
1,090 - 1,100	332.2 - 335.3	Conglomerate Unit Tw3; weak red [10R5/3]; well lithified; clast-supported conglomerate; cut chips are clasts of black, white and green diabase with trace magnetite, silvery schist, purple, pink, white, red and green quartzite, white vein quartz, gray limestone, red chert; and trace matrix chips of reddish-brown silty sandstone; overall sample is 50% gravel, 40% sand, 10% silt; reaction to acid: moderate to strong		subangular up to 3.0 cm; chips mostly ground fine to medium
1,100 - 1,110	335.3 - 338.3	Conglomerate Unit Tw3; weak red [10R5/3]; well lithified; clast-supported conglomerate; cut chips are clasts of black, white and green diabase with trace magnetite, silvery schist, purple, pink, white, red and green quartzite, white vein quartz, gray limestone, red chert; and trace matrix chips of reddish-brown silty sandstone; overall sample is 50% gravel, 40% sand, 10% silt; reaction to acid: moderate to strong		subangular up to 2.2 cm; chips mostly ground fine to medium

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL HRES-11
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Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
WHITETAIL CONGLOMERATE (Tw3)				
1,110 - 1,115	338.3 - 339.9	Conglomerate Unit Tw3; weak red [10R5/3]; well lithified; clast-supported conglomerate; cut chips are clasts of black, white and green diabase with trace magnetite, silvery schist, purple, pink, white, red and green quartzite, white vein quartz, gray limestone, red chert; and trace matrix chips of reddish-brown silty sandstone; overall sample is 50% gravel, 40% sand, 10% silt; reaction to acid: moderate to strong		AIR-ASSISTED FLOODED REVERSE CIRCULATION; subangular up to 1.2 cm; chips mostly ground fine to medium

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

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
10-Apr	HRES-10	E. Jung	0.00	0.00	0.00	0.00	Mobilization to Mineral Creek is going well. Semi round trips are 5 hours. Crew is doing a great job working safely and efficiently, with excellent professional courtesy towards the residents of the Dripping Springs Road area. Anticipate complete mobilization by late next week.	Mobilization	N/A	N/A
11-Apr	HRES-10	E. Jung	0.00	0.00	0.00	0.00	Mobilization to Mineral Creek continues, and is going well. Anticipate complete mobilization by late this week.	Mobilization	N/A	N/A
12-Apr	HRES-10	J.Kent	0.00	0.00	0.00	0.00	Completed mobilizing equipment from Shaft #9 to Mineral Creek, working on setting up HRES-10. Anticipate mobilizing drill rig to Mineral Creek later this week.	Mobilization	N/A	N/A
13-Apr	HRES-10	J.Kent	0.00	0.00	0.00	0.00	Crews are setting up the laydown yard at Mineral Creek and starting to mobilize equipment to HRES-10. Semi is scheduled to arrive tomorrow to mobilize the LM-140 from Shaft #9 to Mineral Creek .	Mobilization	N/A	N/A
14-Apr	HRES-10	A. Jergenson	0.00	0.00	0.00	0.00	Crew is continuing with the mobilization. They are now moving equipment from the laydown yard in Mineral Creek to the HRES-10 site. This process is going well and anticipate getting the rig along with the rest of the equipment to the site Thursday.	Mobilization	N/A	N/A
15-Apr	HRES-10	E. Jung	0.00	0.00	0.00	0.00	Mobilized LM 140 drill rig to HRES-10. Set up continues. Anticipate complete site set up by 1200 hrs.	Mobilization	N/A	N/A
16-Apr	HRES-10	E. Jung	0.00	0.00	0.00	0.00	Completed set up of HRES-10. Completed final drill site inspection. Corrected the minor findings of the site inspection. Anticipate drilling of surface casing borehole to begin tonight.	Mobilization	N/A	N/A
17-Apr	HRES-10	E. Jung	24.38	80.00	24.38	80.00	Began drilling at 0000hrs last night. Penetration rate is slow. Expect to reach surface borehole TD this evening.	17.5" starter tri-cone	N/A	QTg from surface to 20-21m. Tal from 20-21m to present.
18-Apr	HRES-10	E. Jung	28.65	94.00	4.27	14.00	Drilled to surface borehole TD, 28.66m @ 1415hrs yesterday. Ran 12" surface casing and filled annulus with cement, 0000hrs. Set up bottom hole assembly and for reverse air. Began tripping in at 1200hrs. Currently tripping in.	10" RC Hammer	N/A	QTg from surface to 20-21m. Tal from 20-21m to 28.66m.

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

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
19-Apr	HRES-10	E. Jung	78.64	258.00	49.99	164.00	Drilled with hammer to 72.25m and flooded out. Tripped for tri-cone bit. Currently drilling, making good progress.	9 7/8" Tri-cone Flooded Reverse	Hole started producing water @ 54.15m (40gpm). 1/2 hour air-lift test @ 72.25m (120-140gpm)	Tal
20-Apr	HRES-10	J.Kent	100.58	330.00	21.95	72.00	Drilling, took survey at 76m 0.25°. Continued drilling to 85m, decision was made to trip out to remove the bit and complete an airlift test. Tripped back in to 77m and began airlift test at 2000hrs. Completed airlift test and recovery, tripped in drill string, and began drilling 0700hrs. Currently drilling, penetration rate has slowed ~85mins per rod. Drill foreman anticipates that the penetration rate will pick up as they add more weight to the drill string.	9-7/8 Tri-Cone Flooded Reverse	Static water level before airlift test was 4.5m below land surface. Started airlift test at 2000hrs and continued for four hours at 120gpm, minor spikes to 200gpm at the beginning of the test. Let water level recover for four hours and measured it at 4.5m below land surface. Currently drilling utilizing water with no mud products.	Tal-Driller noted a fractured zone between 91.7-92.6m
21-Apr	HRES-10	J.Kent	167.03	548.00	66.45	218.00	Drilling, making good progress. Took survey at 149m 0.25°. Crew tripped out 48m and added eight drill collars for more weight to help with the penetration rate. Currently drilling.	9-7/8 Tri-Cone Flooded Reverse	Drilling utilizing water with no mud products.	Tal
22-Apr	HRES-10	E. Jung	267.61	878.00	100.58	330.00	Penetration rate increased due to addition of drill collars yesterday. Currently drilling, making good progress.	9-7/8" Tri-Cone Flooded Reverse	Drilling utilizing water with no mud products.	Tal Evidence of open fracturing at: 122m-125m, 167.7m-170.7m, 176.8m 179.9m
23-Apr	HRES-10	E. Jung	380.39	1248.00	112.78	370.00	Drilling, making good progress. Took survey at 304.88m (1 degree). Took survey at 317.07m (2 degrees). Currently tripping out for an air-lift test.	9-7/8" Tri-Cone Flooded Reverse	Drilling utilizing water with no mud products.	Tal-Fracture zones: 189-192m, 216.5-219.5m, 243.9-246.95m, 292.7-295.7m
24-Apr	HRES-10	E. Jung	380.39	1248.00	0.00	0.00	Tripped out and conducted air lift test. Reconfigured bottom hole assembly to attempt to pull back the 2 degree survey of last. Currently drilling.	9-7/8" Tri-Cone Flooded Reverse	3 1/4 hr air lift test, and 3 hr recovery test beginning @ 2130hrs - 157gpm average. Static water level, 3.65m below surface. After recovery, water level was 5m below surface. Drilling utilizing water with no mud products.	Tal

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-Apr	HRES-10	E. Jung	471.22	1546.00	90.83	298.00	TD hole @ 471.22m. Surven taken at 426.83m, 2 1/2°. Survey taken at 457.32m, 2 3/4°. Tripped out for geophysical logging. Logging commenced at 1815hrs. Anticipate completion by 0000hrs.	9-7/8" Tri-Cone Flooded Reverse	Drilled to TD utilizing water with no mud products. Air lift test is scheduled to be conducted after the conclusion of geophysical logging.	Tal to 416.14m. Tw from 416.14m - 471.34m (TD)
26-Apr	HRES-10	E. Jung	471.22	1546.00	0.00	0.00	Geophysical logging team arrived on site at 1800hrs. Completed logging at 0000hrs. Successful completion of full suite of geophysical logging tools. Conducted 4hr air lift and 4 hr recovery test 0100hrs - 1000hrs. Currently mobilizing equipment and setting up to run packer.	9 7/8" Open hole	Before conducting air lift test, static water level 4.09m below surface. 4hr air lift test: 150-160gpm. Water level after 4hr recovery: 5.06m below surface.	Tw
27-Apr	HRES-10	J.Kent	471.22	1546.00	0.00	0.00	Mobilized packer, 3-11/16" pipe, stainless steel air line, liquid inflation chamber, aq pipe, diverter, and transducers to drill site. Set up and tripped in equipment for packer test, started testing first zone.	9-7/8" Open hole packer test	Currently scheduled to run packer test on three different zones 392m, 315m, and 205m.	Tw
28-Apr	HRES-10	J.Kent	471.22	1546.00	0.00	0.00	Tripped aq pipe (air line) and packer assembly to 392m and 315m for the airlift tests. Currently waiting on water level to equilibrize before conducting final airlift test at 205m.	9-7/8" Open hole packer test	Attempted two airlift test at 395m both produced minimal water. Airlift test at 315m produced 30-40gpm for 3hrs. Static water level in the annulus and inside the aq pipe was ~4.4m below land surface for both tests. Airlift test at 205m has been delayed until the water level equilibrizes.	Tw
29-Apr	HRES-10	E. Jung	471.22	1546.00	0.00	0.00	Conducted final 4hr airlift test at 205m starting at 0730hrs. Currently monitoring recovery.	9-7/8" Open hole packer test	Airlift test at 205m produced 30gpm for 4hrs. Static water level before test, 9.25m below surface. Draw down to 49.3m after pump test. Recovery exceedingly slow - plan to monitor until midnight.	Tw

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

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
30-Apr	HRES-10	E. Jung	471.22	1546.00	0.00	0.00	Monitored airlift test recovery until midnight. Tripped out packer assembly. Set up to run casing. Currently running casing as per casing schedule.	9-7/8" Open hole packer test	Static water level after 16 1/2hr recovery, ~21m below surface.	Tw
1-May	HRES-10	E. Jung	471.22	1546.00	0.00	0.00	Installed 4 1/2 " HWT blank and perforated casing as per the casing schedule. Currently installing gravel pack, bentonite chips, and choke sand per schedule.	4 1/2" HWT casing	N/A	Tw
2-May	HRES-10	E. Jung	471.22	1546.00	0.00	0.00	Installing gravel pack, bentonite chips, and choke sand per schedule. Estimate completion of gravel pack and start of well development pump tests at around 1600hrs.	4 1/2" HWT casing	N/A	Tw
3-May	HRES-10	E. Jung	471.22	1546.00	0.00	0.00	Conducted well development air lifts. Tagged gravel and installed additional to 28.66m. Currently rigging down for demobilization.	4 1/2" HWT casing	Conducted well development air lifts @ 134m (1845hrs and again @0000hrs), and 340.85m (0200hrs), to allow for gravel pack settling and to remove any sediments. Discontinued deeper air lift upon production of some silica sand (choke sand) in returns.	Tw
4-May	HRES-10	A. Jergenson	0.00	0.00	0.00	0.00	Crews are currently breaking down the site and staging equipment for mobilization to HRES-11. Anticipate starting mobilization Thursday.	Demobilization	N/A	N/A
5-May	HRES-10	A. Jergenson	0.00	0.00	0.00	0.00	Road and site construction completed today at 1200hrs. Crews setting up to begin mobilizing equipment to HRES-11; anticipate mobilizing the LM-140 tomorrow at afternoon.	Demobilization	N/A	N/A
6-May	HRES-11	E. Jung	0.00	0.00	0.00	0.00	Breaking down and mobilizing equipment to HRES-11. Drill rig was mobilized to HRES-11 safely and successfully this afternoon.	Mobilization	N/A	N/A
7-May	HRES-11	E. Jung	0.00	0.00	0.00	0.00	Mobilization continues. Anticipate complete site demobilization from HRES-10, and complete site set up on HRES-11 by Sunday am.	Mobilization	N/A	N/A
8-May	HRES-11	E. Jung	0.00	0.00	0.00	0.00	Mobilzation to and site set up of HRES-11 complete. Anticipate drilling to begin this afternoon/evening.	Mobilization	N/A	N/A

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELLS HRES-10 AND HRES-11

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-May	HRES-11	E. Jung	38.71	127.00	0.00	0.00	Drilled to 20 ft. for surface casing. Set surface casing and concrete. Currently driling with 10" hammer. Penetration rate is very good.	10" RC Hammer	N/A	Tal
10-May	HRES-11	E. Jung	175.87	577.00	137.16	450.00	Drilling, making great progress. Survey @ 76m, 1.25 degrees. Survey @ 107m, 1.125 degrees. Survey @ 137m, 1.125 degrees. Tripped for bit at cross shift. Currently tripping.	10" RC Hammer	N/A	Tal
11-May	HRES-11	A. Jergenson	252.07	827.00	76.20	250.00	Tripped back in after bit change and commenced drilling at 1700hrs. Took surveys at 198.12m, 1.25°, and 228.6m, 1.16°. Pulled back to clean the hole encountered several bridges while lowering back to bottom. Hole stablilty was deterioriating, decsison was made to trip out and swtich to flooded reverse utilizing mud.	10" RC Hammer	Started producing water 240m at 12gpm.	Tal
12-May	HRES-11	A. Jergenson	254.51	835.00	2.44	8.00	Set up to drill flooded reverse utilizing a 9-7/8" tri-cone. Tripped into hole and reamed down to 252m, and circulated on the hole. Encountered fill at 245m. Currently drilling, penetration rate is slow.	9 7/8" Tri-cone Flooded Reverse	Drilling utilizing mud.	Tal
13-May	HRES-11	E. Jung	275.84	905.00	21.34	70.00	Drilling, penetration rate slow. Began tripping out at 1200 hrs (277.4m) to add weight (collars) to the drill string - improve penetration. Currently tripping.	9 7/8" Tri-cone Flooded Reverse	Drilling utilizing mud. Loosing approx. 15,000 of fluids per 24hrs.	Tal
14-May	HRES-11	E. Jung	316.69	1039.00	40.84	134.00	Added weight on bit improved penetration rate. Drilling ~ 2hrs per rod. Anticipate reachingTD this evening, and the start of geophysical logging late tonight.	9 7/8" Tri-cone Flooded Reverse	Drilling utilizing mud. Losing approx. 10,000 -15,000gal of fluids per 24hrs.	Tal - Hit vitrophyre at 318.6m
15-May	HRES-11	E. Jung	339.85	1115.00	23.16	76.00	TD hole @ 339.85m. Circulated on hole through the night. Began trippin out @ 0200hrs for geophysical logging. Successfully completed running geophysical logging suite from 0900 - 1500hrs. Set up to run casing. Currently running casing as per casing schedule.	9 7/8" Tri-cone Flooded Reverse	Static water level during geophysical logging @ 193.9m below surface.	Tw from 327.74m to TD
16-May	HRES-11	E. Jung	339.85	1115.00	0.00	0.00	Ran casing as per casing schedule. Currently installing gravel pack. Anticipate well development operations to begin tonight.	4 1/2" HWT casing	Anticipate well development operations tonight.	Tw
16-May	HRES-11	E. Jung	339.85	1115.00	0.00	0.00	Installed gravel pack to 30.5m below surface. Currently conducting well development air-lifts.	4 1/2" HWT casing	Well development operations began at 1230hrs.	Tw

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-May	HRES-11	E. Jung	339.85	1115.00	0.00	0.00	Conducted well development air lift and recovery tests from 1300hrs - 0000hrs, and from 0100hrs - 1700hrs. Currently monitoring recovery.	4 1/2" HWT casing	Air lift test produced 20-30gpm for 7 hrs. Static water level approaching 195.7m below surface.	Tw
19-May	HRES-11	K. Duke	339.85	1115.00	0.00	0.00	Breaking down site and mobilizing equipment.	4 1/2" HWT casing	Air lift test completed.	Tw
20-May	HRES-11	K. Duke	339.85	1115.00	0.00	0.00	Well completion is complete. Breaking down of the site continues and is progressing quite well. Anticipate mobilization to DHRES-8/ #9 Laydown yard starting tomorrow.	Mobilization	N/A	Tw
21-May	HRES-11	E. Jung	339.85	1115.00	0.00	0.00	Began mobilization to #9 laydown/DHRES-8. Currently moving equipment to transfer site and loading onto semis hauling to #9 laydown.	Mobilization	N/A	N/A
22-May	HRES-11	E. Jung	339.85	1115.00	0.00	0.00	Mobilization continues - going well. Moved rig off of HRES-11 to Hwy 77 & Dripping Springs Rd. Heavy hauler is scheduled for Monday, for transport to #9 laydown.	Mobilization	N/A	N/A
23-May	HRES-11	E. Jung	339.85	1115.00	0.00	0.00	Mobilization continues - going well. Heavy hauler is scheduled for Monday, for transport to #9 laydown.	Mobilization	N/A	N/A
24-May	HRES-11	E. Jung	339.85	1115.00	0.00	0.00	Transported drill rig from Dripping Springs Rd. to #9 laydown. Demobilization from HRES-11 and ranch transfer continues. Anticipate complete demobilization by 5-25.	Mobilization	N/A	N/A