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TECHNICAL MEMORANDUM

DATE: December 8, 2011 **Project 605.31**

TO: Greg Ghidotti
RESOLUTION COPPER MINING LLC

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

SUBJECT: RESULTS OF DRILLING, CONSTRUCTION, AND TESTING AT HYDROLOGIC TEST WELL DHRES-09, RESOLUTION COPPER MINING, PINAL COUNTY, ARIZONA

In accordance with a request from Mr. Greg Ghidotti, Resolution Copper Mining LLC (RCM), Montgomery & Associates (M&A) has prepared this Technical Memorandum to summarize results of drilling, construction, and testing at hydrologic test well DHRES-09. The well was installed to characterize hydrogeologic conditions in the deep groundwater system west of the Concentrator Fault and east of the Main Fault, and to provide a monitoring point for the deep groundwater system during on-going dewatering operations. Monitoring data obtained from DHRES-09 have been incorporated into the RCM hydrologic monitoring program.

SUMMARY

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

1. Hydrologic test well DHRES-09 is located on land owned by RCM, in Township 1, South, Range 12 East, in the SW ¼ of the NE ¼ of the SW ¼ of Section 26 ((D-1-12)26cac), at West Plant site.
2. Well DHRES-09 was drilled and constructed during the period July 16 through August 6, 2010.
3. Total drilled depth is 662.9 meters below land surface (bls).
4. Geologic units encountered during drilling from land surface to total depth include younger Precambrian diabase (pCdiab) and Upper Dripping Spring Quartzite (pCdsu),

and older Precambrian Pinal Schist (pCpi). The Main Fault was intercepted during drilling of DHRES-09.

5. The well was completed in pCdsu, pCdiab, and Main Fault breccia with three perforated intervals from 131.2 to 277.5, 490.9 to 509.2, and 600.6 to 631.1 meters bls; non-pumping water level was 40.84 meters bls on September 1, 2011.
6. An 8-hour open borehole airlift test was conducted in the pCdsu during drilling operations; data were not suitable for analysis using straight-line methods.
7. A 2-hour open borehole packer airlift test was conducted in the pCdiab, Main Fault breccia and pCpi after the hole was drilled to total depth; analysis of recovery data yields an estimated transmissivity of 0.2 square meters per day (m^2/d).
8. An 8-hour airlift test was conducted to develop the well and provide data for computing hydraulic parameters in the pCdsu, pCdiab, and Main Fault breccia. Data were not suitable for analysis using straight-line methods.
9. DHRES-09 was equipped with dedicated pump and water level recording equipment on June 11, 2011.
10. A 24-hour constant-rate pumping test was conducted in the cased well; this test yielded an estimated transmissivity of 0.6 m^2/d and an estimated hydraulic conductivity of 3.6×10^{-6} centimeters per second (cm/s).
11. Water samples were collected for laboratory chemical and isotopic analyses near the end of the open borehole, cased well airlift, and constant-rate tests.

INTRODUCTION

Hydrologic test well DHRES-09 was drilled and constructed during the period July 16 through August 6, 2010. Well DHRES-09 was drilled to:

- evaluate groundwater conditions in the Precambrian units between the Main Fault and Concentrator Fault
- characterize lithology north of the historic mine workings
- provide a groundwater level and groundwater quality monitoring location in the deep groundwater system during on-going dewatering of existing mine workings

The well was drilled through the Main Fault and into the pCpi and completed to permit hydrologic testing within the pCdiab, pCdsu, and Main Fault breccia. Hydrologic test well DHRES-09 is located on land owned by RCM, in Township 1 South, Range 12 East, in the SW ¼ of the NE ¼ of the SW ¼ of Section 26 ((D-1-12)26cac), at West Plant site. **Photograph 1** shows the layout of the DHRES-09 well site during drilling operations. The well location is shown on **Figure 1**. A schematic diagram summarizing well construction details is shown on **Figure 2**. Other data summarized on the schematic diagram include: hydrogeologic units, drilling penetration rate, water production rate during air drilling operations, drilling methods, and borehole geophysical logs. A detailed lithologic log for the test well is provided in **Appendix A**.

Photograph 1. Site layout at DHRES-09 during drilling operations

DRILLING OPERATIONS

Hydrologic test well DHRES-09 was drilled and constructed by Boart Longyear Drilling Services (Boart Longyear) of Salt Lake City, Utah, using a Lang LM-140 (Rig LK35A) top-head drive rotary drill rig. DHRES-09 was drilled in accordance with technical specifications prepared by M&A. RCM personnel coordinated drilling contractor activities and purchase of well construction materials. Daily drilling reports were prepared by Boart Longyear personnel and were submitted to RCM for review. M&A personnel described drill cuttings samples and provided on-site monitoring during critical phases of drilling and construction of the well. RCM provided daily summaries of drilling progress. Daily summary data are provided in **Appendix B**.

Well DHRES-09 was drilled to total depth of 662.9 meters bls, and blank and perforated casing were installed to a depth of 647.1 meters bls. Final completion of the well was designed by M&A based on review of lithologic and hydrologic conditions encountered during drilling operations, and results of borehole geophysical logs.

Drilling Method

The borehole for well DHRES-09 was drilled using the conventional air rotary drilling method for the surface borehole, and 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**.

TABLE 1. SUMMARY OF DRILLING METHODS AND BOREHOLE DIAMETERS HYDROLOGIC TEST WELL DHRES-09

Depth Interval (meters bls)	Drilling Method	Bit Type	Borehole Diameter (inches)
0 – 12.2	conventional air rotary	tricone	17
12.2 – 487.7	dual-wall air reverse	hammer	10
487.7 – 662.9	air-assisted flooded reverse	tricone	9-7/8

For the production portion of the borehole, the dual-wall air reverse circulation method was initially used to allow for measurement of groundwater production during drilling. However, at a depth of 487.7 meters bls, slow drilling progress necessitated a change to the air-assisted flooded reverse circulation drilling method for the remainder of drilling.

Drilling Fluid and Drill Cuttings Management

Air and water were used during drilling operations. The drilling fluids were discharged to a cyclone to separate air from the fluid stream. The remaining drilling fluid and cuttings then flowed through a vibrating screen to remove coarse cuttings. All drilling fluids and formation fluids produced during drilling and testing were discharged to a designated storage facility at the RCM West Plant site. Drill cuttings from the pCdiab, pCdsu, and pCpi were collected in the bucket of a back-hoe, stored on site, and then spread on site after well construction was complete. Cuttings that contained evidence of sulfide mineralization were removed from site and deposited at a designated storage facility at the RCM West Plant site.

Monitoring of Drilling Conditions

During drilling operations, drill penetration rate was monitored by Boart Longyear by recording drill start and stop times for each 6.1-meter drill rod. Drill penetration rate data are summarized on **Figure 2**. In addition to drill penetration rate, rotational torque was monitored by drilling personnel, and zones of variable or increasing torque were noted as a potential indicator of fracturing. The field data recorded by Boart Longyear are on file at M&A.

Borehole deviation surveys were conducted on a regular basis using a Totco mechanical drift recorder. Borehole deviation was less than 2 degrees for the depth interval from land surface to 401 meters bls using dual-wall air reverse rotary drilling methods. Borehole deviation ranged between 2 and 3 degrees from 401 to 622.9 meters bls. Maximum borehole deviation was 3 degrees at a depth of 400.1 meters bls.

Monitoring of Lithologic Conditions

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

Monitoring of Groundwater Conditions

When the dual-wall air reverse circulation drilling method was used, it was possible to monitor for the presence of groundwater, and to determine approximately where groundwater inflow zones were encountered (**Figure 2**). Water production could not be monitored during flooded reverse circulation drilling at DHRES-09.

At DHRES-09, the depth interval from 12.2 to 487.7 meters bls (the pCdsu and upper portion of the pCdiab) 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, production rate was measured using a 2-gallon bucket and stop watch, and results were recorded on the drillers' field log. Results of discharge measurements made during drilling operations for well DHRES-09 are summarized on **Figure 2**. First measurable water production rate at DHRES-09 was 0.6 L/s at a depth of 158 meters bls. For the drilled interval from 158 to 487 meters bls, the average measured groundwater production rate was 1.6 L/s, with a maximum rate of 2.9 L/s at 268 meters bls.

The discharge water was monitored for changes in water quality parameters including temperature, pH, specific conductance, and sand content. Temperature of the discharge water ranged from 23.4 to 29.5 degrees Celsius (ºC), with an average of 26.5ºC. The pH of the discharge water ranged from 6.49 to 8.62, with an average of 8.13. The specific electrical conductance of the discharge water generally decreased with depth and ranged from 673 to 831 microSiemens per centimeter (µS/cm), with an average of 766 µS/cm.

Slow drilling progress necessitated a change to the air-assisted flooded reverse drilling method at a depth of 487.7 meters bls. Groundwater was first encountered in the Precambrian units at about 158 meters bls, but static water level in the completed well is approximately 39 meters bls.

BOREHOLE GEOPHYSICAL LOGGING

Borehole geophysical logging was conducted in two stages at hydrologic test well DHRES-09. The first stage of logging was conducted following drilling of the borehole to a depth of 335 meters bls, and the second stage of logging was conducted after drilling of the

production borehole to total depth. Borehole geophysical logging services were provided by Southwest Exploration Services, LLC (SWE) of Gilbert, Arizona.

The first suite of geophysical logs was obtained on July 21, 2010; logs obtained included: short and long normal resistivity, single point resistance, spontaneous potential, dual induction, natural gamma ray, sonic, temperature, fluid resistivity, 3-arm caliper, and acoustic and optical borehole imaging (ABI and OBI). The second suite of geophysical logs was obtained on July 29, 2010; logs obtained included: short and long normal resistivity, single point resistance, spontaneous potential, natural gamma ray, sonic, temperature, fluid resistivity, 3-arm caliper, magnetic susceptibility, and ABI. **Table 2** shows logs obtained and depth intervals for each type of log. SWE provided field and final logs in digital format to RCM staff. The borehole geophysical logs are shown on **Figure 2**.

TABLE 2. SUMMARY OF BOREHOLE GEOPHYSICAL LOGS OBTAINED AT DHRES-09

LOG	DEPTH INTERVAL(S) (meters bls)
Caliper	0 – 334 248 – 660
Temperature	142 – 334 330 – 660
Fluid resistivity	142 – 334 330 – 660
Natural gamma ray	0 – 334 248 – 660
Normal resistivity, single point resistance, and spontaneous potential	140 – 334 310 – 661
Dual induction	0 – 145
Magnetic susceptibility	310 - 661
Acoustic borehole imaging (ABI)	114 – 333 317 – 661
Optical borehole imaging (OBI)	0 – 102
Sonic	130 – 332 320 – 661

ANALYSIS OF GEOLOGIC CONDITIONS

Geologic Contacts

Geologic contacts were picked based on analysis of drill cuttings samples, geophysical logs, and information obtained during drilling. **Table 3** is a summary of geologic contacts at DHRES-09.

TABLE 3. SUMMARY OF GEOLOGIC UNITS ENCOUNTERED AT HYDROLOGIC TEST WELL DHRES-09	
Depth Interval (meters bls)	**Geologic Formation**
0 – 134.1 274.3 – 621.8	Precambrian Diabase (pCdiab)
134.1 – 274.3	Upper Dripping Spring Quartzite (pCdsu)
621.8 – 630.5	Main Fault breccia
630.5 – 662.9	Pinal Schist (pCpi)

Younger Precambrian units

The younger Precambrian units encountered during drilling at DHRES-09 include the pCdiab and pCdsu. At DHRES-09, the younger Precambrian sequence is 630.5 meters thick and occurs in the depth interval from land surface to 630.5 meters bls.

Diabase (pCdiab)

The pCdiab is the youngest of the younger Precambrian units at DHRES-09 and occurs as two thick sills both above and below pCdsu; total thickness is 481.6 meters. The pCdiab occurs in the depth intervals from land surface to 134.1 meters, and 274.3 to 621.8 meters bls. The diabase consists of plagioclase laths and pyroxene with common magnetite; pCdsu xenoliths are common in the lower interval. At DHRES-09, the diabase is oxidized from land surface to 30.5 meters, from 42.7 to 88.4 meters, and from 115.8 to 134.1 meters bls. The unit is serpentinized or propylitically altered from 274.3 to 621.8 meters, bls. The lower interval of diabase contains trace amounts of calcite and pyrite, occasional vein quartz, and interspersed zones of up to 30 percent quartzite xenoliths.

Upper Dripping Spring Quartzite (pCdsu)

The pCdsu at DHRES-09 is 140.2 meters thick and consists of interbedded quartzite, shale, and siltstone. The pCdsu occurs from 134.1 to 274.3 meters bls. For the depth interval from 134.1 to 167.6 meters bls, it consists mostly of brown, red, black, and purple fine-grained, finely laminated quartzite, shale, and siltstone, with common iron oxide staining of hematite and limonite, and trace amounts of calcite. For the depth interval from 167.6 to 198.1 meters bls, the pCdsu consists mostly of white and light gray fine- to medium-grained quartzite with sugary texture and abundant iron oxide (hematite) staining. For the depth interval from 198.1 to 253.0 meters bls, the pCdsu consists mostly of purplish-black, purplish-brown, and greenish-gray fine-grained quartzite and siltstone with trace amounts of iron oxide staining and vein quartz. For the depth interval from 253.0 to 274.3 meters bls, the pCdsu consists mostly of orange-red to red, fine- to medium-grained quartzite with common to abundant iron oxide staining (hematite) and trace amounts of calcite.

Main Fault Breccia

The Main Fault breccia at DHRES-09 is 8.7 meters thick and occurs in the depth interval from 621.8 to 630.5 meters bls. It consists of 50 to 80 percent purplish-black, very fine-grained silty quartzite and 20 to 50 percent light to dark green, altered diabase with trace amounts of calcite and very trace amounts of pyrite. The sample from 627.9 to 630.5 meters bls contained 10 percent white vein quartz, trace amounts of schist, and trace amounts of light green clay on fracture surfaces.

Older Precambrian

Pinal Schist (pCpi)

The pCpi at DHRES-09 is greater than 32.4 meters thick and consists of silvery, dark gray schist with trace to 1 percent white vein quartz, trace amounts of calcite, and minor iron oxide (hematite) staining. The pCpi occurs in the depth interval from 630.5 to 662.9 meters bls. The intervals from 630.5 to 637.0 and 661.4 to 662.9 meters bls contain up to 15 percent white vein quartz.

Degree of Fracturing

A fracture summary log was prepared using geophysical logs including ABI, OBI, sonic, and electrical resistivity. Where available, the ABI and OBI logs were the primary sources for the fracture summary log. Where imaging logs were not available or were of poor quality, sonic logs were used to classify fractures. Electrical resistivity logs were also 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 bedding planes with no mineral filling generally less than 1 inch across. Moderate fractures include joints and faults with mineral filling or open voids ranging from about 1 to 6 inches across. Major fractures include faults or fault zones with mineral filling or open voids larger than about 6 inches across. Where ABI logs were not available, fractures zones were assigned using the sonic log to zones where acoustic travel time was larger than background. Intensity of fracturing was assigned based upon thickness of the anomalous zone. Major fractures were assigned to wide zones of slower acoustic travel. The fracture summary log is shown on **Figure 2**.

The fracture summary logs indicate highly variable but mostly minor fracturing in the pCdiab, less fracturing in the pCpi, and abundant, mostly moderate fracturing in the pCdsu. The largest major fracture zone in the pCdsu at a depth of 268 meters bls correlates with the depth of maximum water production rate observed during drilling of DHRES-09.

WELL CONSTRUCTION

Construction at DHRES-09 began with installation of 12-inch diameter blank steel surface casing. The surface casing was installed to 12.2 meters bls and cemented in place. The production casing string for DHRES-09 consists of 4-1/2-inch outside diameter blank and slotted, flush-threaded steel casing. Three perforated intervals were installed in the depth intervals from 131.2 to 277.5, 490.9 to 509.2, and 600.6 to 631.1 meters bls. Perforations are 0.125-inch wide by 2.5-inch long machine-cut slots, two slots per round, four rounds per foot, staggered (8 slots per foot). The bottom joint of casing was torch cut, tapered and welded closed. Prior to installation of the production casing, the bottom of the borehole was backfilled with gravel pack to 653.2 meters bls. A bentonite seal was placed above the gravel backfill from 653.2 to 649.2 meters bls.

Materials installed in the annulus included 1/4-inch to 3/8-inch Tacna gravel, 3/8-inch bentonite chips, and 8x12 silica sand. All annular materials were installed using a tremie pipe. Annular bentonite seals were placed above and below each perforated interval to ensure isolation of the aquifer zones. Gravel pack outside each perforated interval 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. A schematic diagram of well construction is shown on **Figure 2**. On August 6, 2010, following installation of casing and annular materials, hydrologic test well DHRES-09 was developed by airlift pumping for about 8 hours.

The surface completion for DHRES-09 consists of an extension of the 12-inch steel surface casing to approximately 1 meter above land surface. The casing extension was cemented in place and secured with a locking cap. Transducer cables pass from DHRES-09 to the telemetry installation in an underground conduit. The telemetry system consists of a CR-850 datalogger system manufactured by Campbell Scientific of Logan, Utah, that allows remote connection through a cell modem. Data are available on the M&A Hydrogeometrics website at https://hydrogeometrics.com/vdv/Index.php.

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 January 11, 2011. Survey data and computed land surface elevation are provided in **Table 4**.

TABLE 4. SUMMARY OF SURVEY RESULTS FOR HYDROLOGIC TEST WELL DHRES-09	
Easting	490169.131
Northing	3685587.891
Elevation Top of 12-inch Surface Casing	949.713
Elevation Land Surface	949.05

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

PUMP INSTALLATION AND INSTRUMENTATION

A dedicated pump assembly was installed in hydrologic test well DHRES-09 by Duncan Pump, of Phoenix, Arizona on June 11, 2011. Well DHRES-09 was equipped with a stainless steel Grundfos Model 5S30-48DS pump with a 3-horsepower, 460-volt, three-phase Grundfos Model MS4000 electric motor (Product No. 79354507). The pump was installed on 1-1/4-inch galvanized steel API column pipe with galvanized steel couplings at a depth of 274.3 meters bls. The well was equipped with one 1-inch Schedule 80 PVC transducer/sounder access tube which extends from the wellhead to the top of the pump. The transducer/sounder access tube is capped on the bottom and factory slotted in the lowermost 6 meters. The pump, motor, and column pipe are suspended from a steel and rubber sanitary well seal installed at the wellhead. A dedicated Geokon Model 4500S vibrating-wire pressure transducer (S/N 10-30857; 700 KPa; non-vented) is installed in the well to monitor water level in the pCdiab and pCdsu at this location.

HYDRAULIC TESTING

Initial characterization of the deep groundwater system at DHRES-09 was accomplished by conducting a short-term airlift test and a packer airlift test in the open borehole. Following well construction, a short-term airlift test was conducted in the cased well. After installation of pumping equipment, a constant-rate pumping test was conducted. Operational details and results of testing are included below.

Airlift Tests

Short-term airlift tests were conducted at DHRES-09 during drilling, prior to well construction, and following well construction. Discharge volumes and airlift rates were calculated by periodic measurement of storage tank levels. Test parameters and results are summarized in **Table 5**.

Due to the discharge head configuration, groundwater levels could not be measured during airlift pumping; however, groundwater level measurements were obtained before each test and during the recovery period. During recovery, water level was measured through the open airline (dual-wall drill pipe or AQ 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).

DHRES-09 Open Borehole Airlift Test During Drilling Operations

During drilling at well DHRES-09, an 8-hour airlift test was conducted to investigate hydraulic parameters and water quality in the deep groundwater system associated with the pCdsu and pCdiab at this location. Test interval extended from non-pumping water level of 72.3 meters bls to drilled depth of 335.0 meters bls. Airlifting started at 17:51 on July 21, and stopped at 01:52 on July 22, 2010. The discharge rate decreased from 6.7 to 1.9 L/s over the duration of the test; average rate was 3.6 L/s. A graph of the recovery data is shown on **Figure 3**. At the end of the recovery period residual drawdown was 29.1 meters which suggests that some part of the formation was dewatered during the test. Data were not suitable for analysis using straight-line methods. Test parameters are summarized in **Table 5**.

DHRES-09 Open Borehole Airlift Test with Packer Installed

An airlift packer test was conducted after DHRES-09 was drilled to total depth (662.9 meters bls) to investigate hydraulic parameters and water quality in the deep groundwater system below the pCdsu (pCdiab, pCpi, and Main Fault breccia). An inflatable packer was used in the open borehole to isolate the zone between 325.4 meters bls and the bottom of the borehole at 662.9 meters. **Photograph 2** shows the packer being installed at DHRES-09. Depth to pre-pumping water level was 41.1 meters bls. Airlifting started at 12:35 and stopped at 14:38, on July 30, 2010. The discharge rate varied between 0.1 and 0.3 L/s; average rate was 0.2 L/s. A graph of the recovery data and analysis is shown on **Figure 4**. Straight-line analysis using the Theis recovery method yields an estimated transmissivity of 0.2 m^2/d. Test parameters and results are summarized in **Table 5**.

Photograph 2. Drillers installing inflatable packer into open borehole at DHRES-09

DHRES-09 Cased Well Airlift Test

Following casing installation at well DHRES-09, an 8-hour airlift test was conducted to develop the well and to investigate hydraulic parameters and water quality in the deep groundwater system at this location. Screened intervals are from 131.2 to 277.5 meters bls, from 490.9 to 509.2 meters bls, and from 600.6 to 631.1 meters bls. Depth to pre-pumping water level was 29.0 meters bls. Airlifting started at 13:45 and stopped at 21:45 on August 6, 2010. The discharge rate ranged from 0.1 to 0.4 L/s; average rate was 0.3 L/s. At the end of the recovery period residual drawdown was approximately 20 meters. This is similar to the residual drawdown observed in the initial open borehole airlift test described above and again suggests dewatering of the formation during the test. A graph of the recovery data is shown on **Figure 5**. Data were not suitable for analysis using straight-line methods. Test parameters are summarized in **Table 5**.

TABLE 5. SUMMARY OF RESULTS FROM AIRLIFT TESTS CONDUCTED AT HYDROLOGIC TEST WELL DHRES-09					
Test Type and Date	**Perforated Interval(s) (meters bls)**	**Test Duration (hours)**	**Pre-pumping Water Level (meters, bls)**	**Average Discharge Rate (L/s)**	**Transmissivity (m^2/d)**
Open borehole during drilling 21-11 Jul 2010	0 – 335.0 (open hole)	8	72.3	4.0	N/A
Open borehole packer @ 325.4 30 Jul 2010	325.4 – 662.9 (open hole)	2	41.1	0.18	0.2
Cased well 6 Aug 2010	131.2 – 277.5 490.9 – 509.2 600.6 – 631.1	8	29.0	0.30	N/A

Constant-rate Test

A 24-hour constant-rate pumping test was conducted at well DHRES-09 to investigate hydraulic parameters and water quality in the deep groundwater system (primarily pCdsu and pCdiab at this location). Discharge assembly included a Blancett digital flowmeter, a pressure gage, gate valves to adjust flow rate, and a hose bib for obtaining water samples. Water pumped from DHRES-09 was contained in a Baker tank and later disposed at the West Plant site.

During constant-rate testing, water levels were measured and recorded using a pressure transducer and data logger. Water levels were also measured periodically using an electric sounder. During testing, pumping rate, line pressure, sand content of the water, and water quality parameters were monitored. After pumping stopped, water level recovery was measured for 24 hours. Operational details are summarized in **Table 6**.

The 24-hour constant-rate pumping test started at 14:15 on September 1 and stopped at 14:15 on September 2, 2011. Depth to pre-pumping water level was 40.5 meters bls. Average pumping rate was 0.4 L/s. Maximum drawdown at well DHRES-09 was 31.6 meters. A graph of the data and analysis is shown on **Figure 6**. Straight-line analysis of drawdown data using the Cooper-Jacob (1946) drawdown method yields an estimated transmissivity of 0.8 m^2/d; analysis of recovery data using the Theis (1935) recovery method yields an estimated transmissivity of 0.6 m^2/d. Average hydraulic conductivity based on transmissivity of 0.6 m^2/d and saturated thickness of 195.1 meters (combined saturated perforated interval) is 4 x 10^{-6} cm/s. A summary of test data and the results of the analysis are given in **Table 6**.

TABLE 6. SUMMARY OF CONSTANT-RATE TEST CONDUCTED AT HYDROLOGIC TEST WELL DHRES-09	
Description of Hydrologic Testing Zone:	**Cased well** (total depth 649.2 meters) perforated intervals 131.2 to 277.5, 490.9 to 509.2, and 600.6 to 631.1 meters bls
Test Type	Constant-rate pumping test
Geologic Units in Testing Zone	Upper Dripping Spring Quartzite, Diabase, Main Fault Breccia
Test Duration (hours):	24
Pre-pumping Depth to Water (meters bls):	40.5
Average Discharge Rate (L/s):	0.4
Maximum Drawdown (meters):	31.6
Transmissivity from recovery data (m^2/d):	0.6
Saturated thickness (meters):	195.1 (combined saturated perforated interval)
Hydraulic Conductivity (cm/s):	4×10^{-6}

GROUNDWATER SAMPLING

Water quality parameters (temperature, pH, and specific conductance) were measured and recorded during testing using a Myron-L parameter meter that was calibrated prior to each test. Groundwater samples were collected near the end of each test, except the packer airlift test. Sample identifiers and water quality parameters for samples collected during testing operations are given in **Table 7**. 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. Results of water quality analyses will be provided and discussed in a future report.

TABLE 7. WATER SAMPLES COLLECTED DURING TESTING OPERATIONS AT HYDROLOGIC TEST WELL DHRES-09						
				Water Quality Parameters		
Sample Identifier	Sample Description	Date	Time	Temp (°C)	pH (s.u.)	Specific Conductance (µS/cm)
RESE-1003167	DHRES-09, airlift during drilling at 335.0 meters	21-Jul-10	23:20	28.0	8.14	823.2
RESE-1003159	DHRES-09, cased airlift	06-Aug-10	21:05	26.1	8.20	733.2
RESE-1003206	DHRES-09, constant-rate pumping test	02-Sep-11	13:45	29.1	7.34	954.2

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

3,690,000 T. 1 S.

3,685,000

3,680,000 T. 2 S.

3,675,000 T. 3 S.

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

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

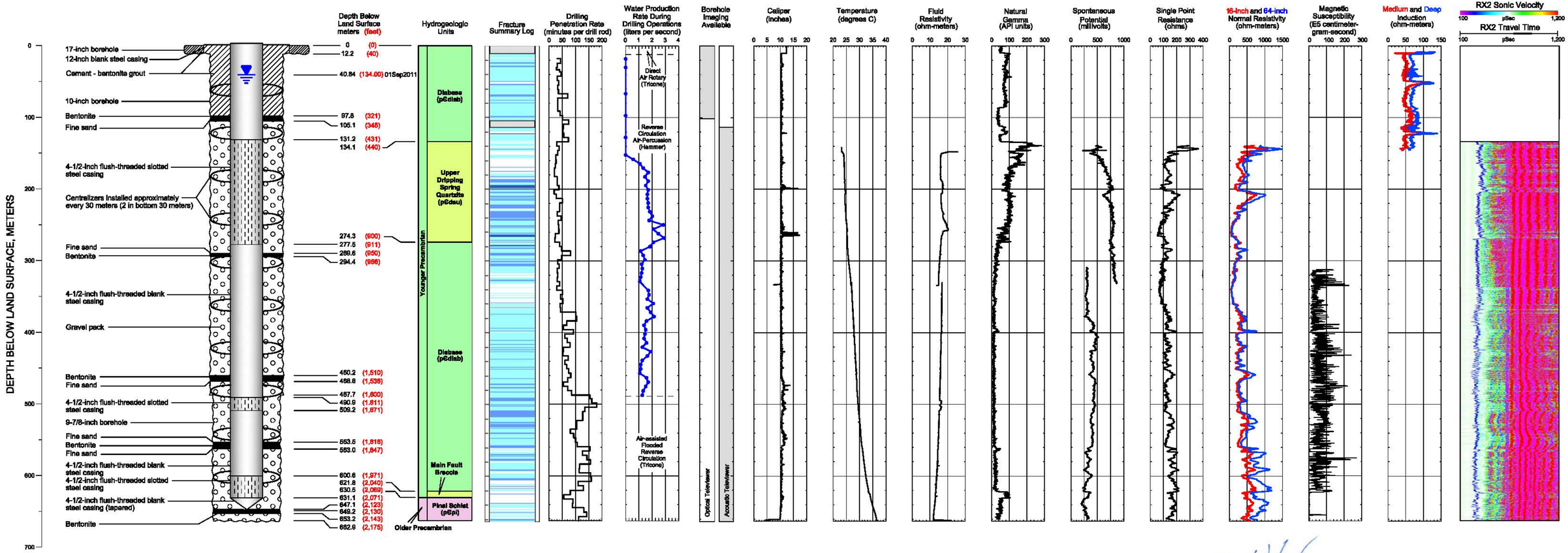
DHRES-09 WELL LOCATION

MONTGOMERY & ASSOCIATES
Water Resource Consultants

2011

FIGURE 1

\GIS-Tuc\Projects\605\605.3\Welloc_DHRES_09.mxd\08Dec2011



REGISTERED GEOLOGIST
CERTIFICATE NO.
25063
TODD
KEAY
Date Signed 6/13/12
ARIZONA U.S.A.
Expires 6/30/2012

CADASTRAL: (D-1-12) 26ccc	ADWR NO: 55-912289
NORTHING: 3585587.891	EASTING: 490169.131
LAND SURFACE ELEVATION: 949.05	
DATUM: NAD 27 VERTICAL: NGVD 29 METERS	

Non-pumping Water Level

EXPLANATION

- No Data
- No Fracturing Evident
- Minor Fracturing
- Moderate Fracturing
- Major Fracturing

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DHRES-09
SCHEMATIC DIAGRAM OF WELL CONSTRUCTION

Version: Dec. 8, 2011

FIGURE 2

506\WellSchematics_2010\DHRES-9-WS-LOGS\08Dec2011

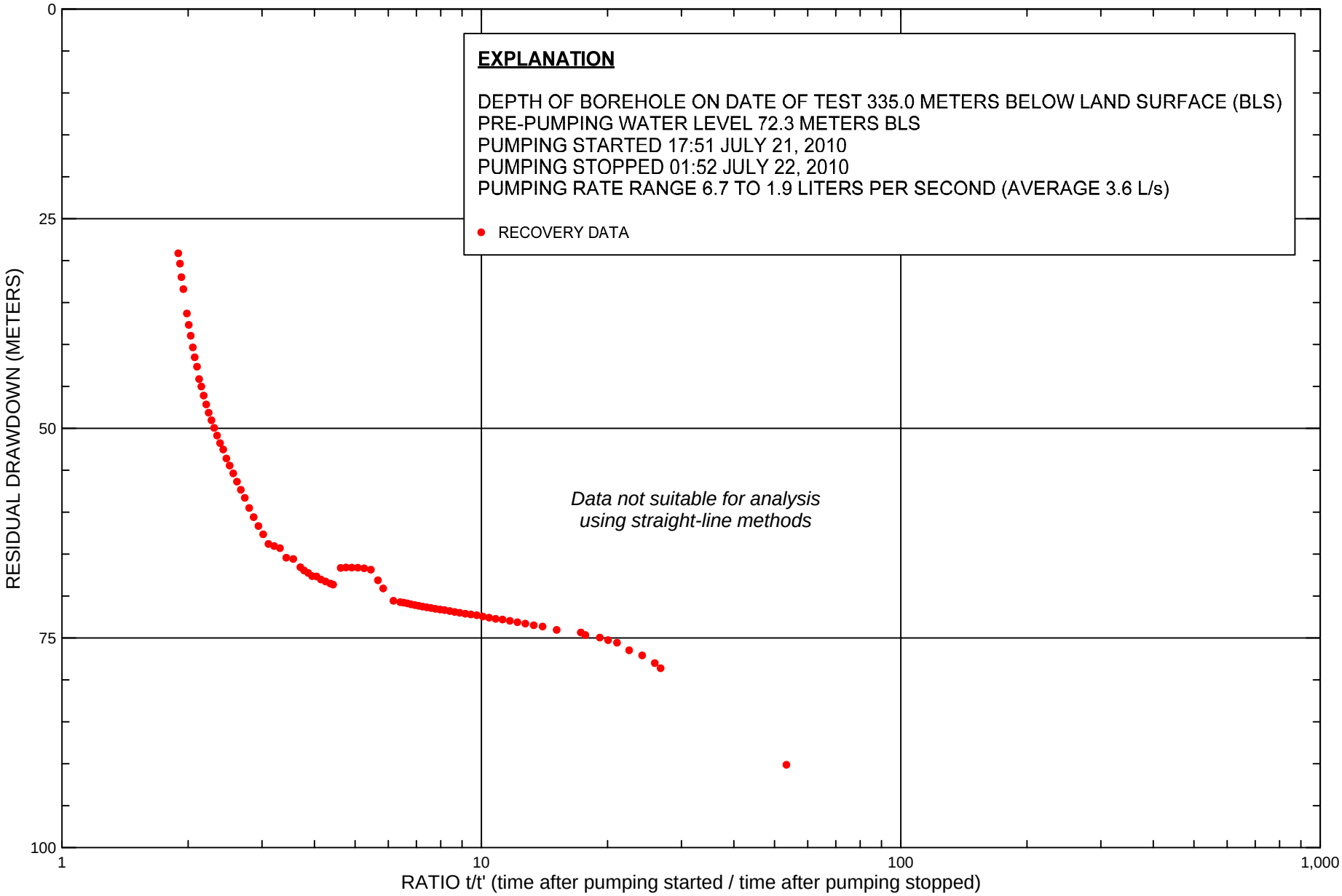

FIGURE 3. RECOVERY GRAPH FOR OPEN BOREHOLE AIRLIFT TEST AT WELL DHRES-09
RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

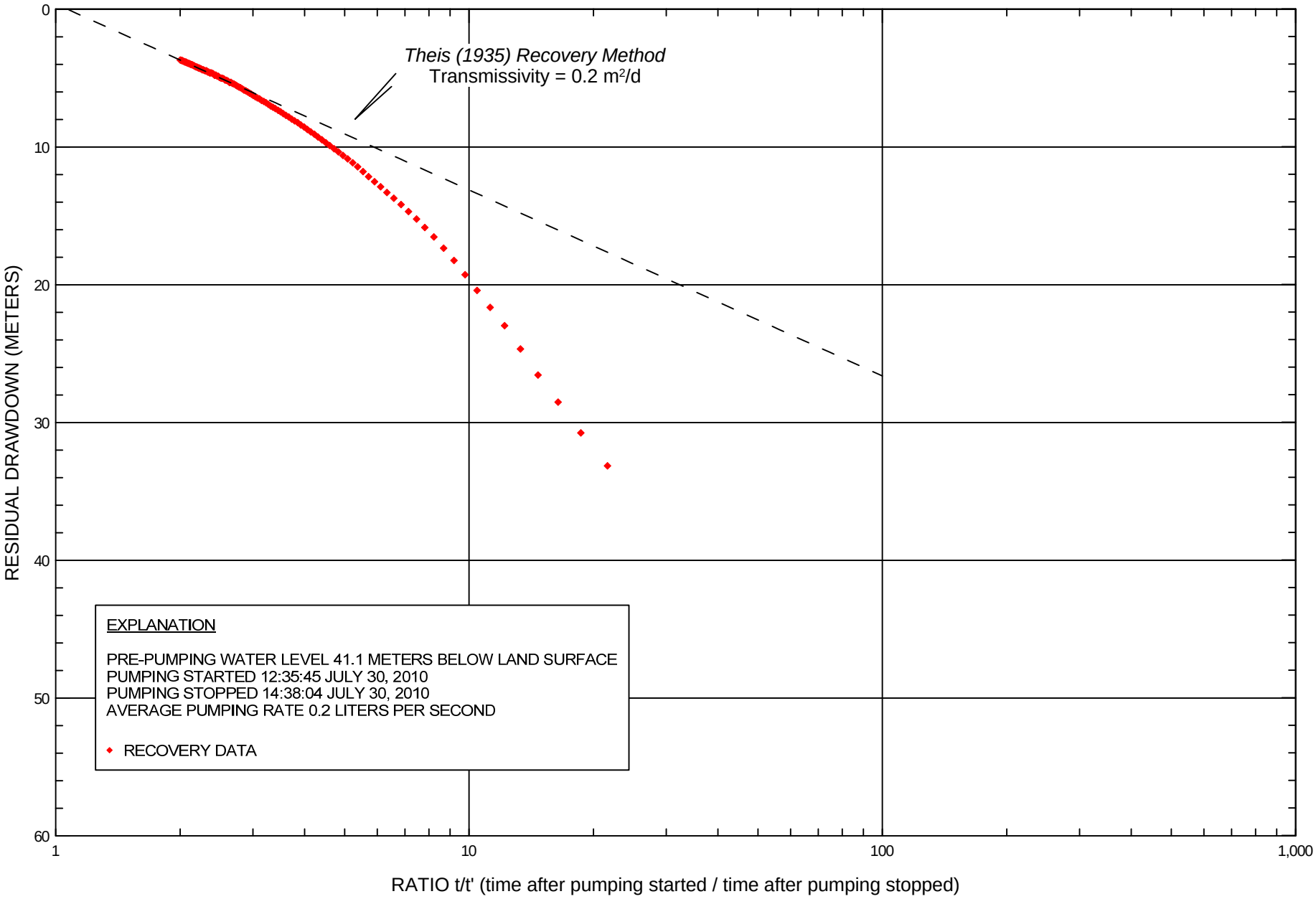

FIGURE 4. RECOVERY GRAPH FOR OPEN BOREHOLE PACKER AIRLIFT TEST AT WELL DHRES-09 (PACKER INSTALLED AT 325.4 METERS BELOW LAND SURFACE) RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

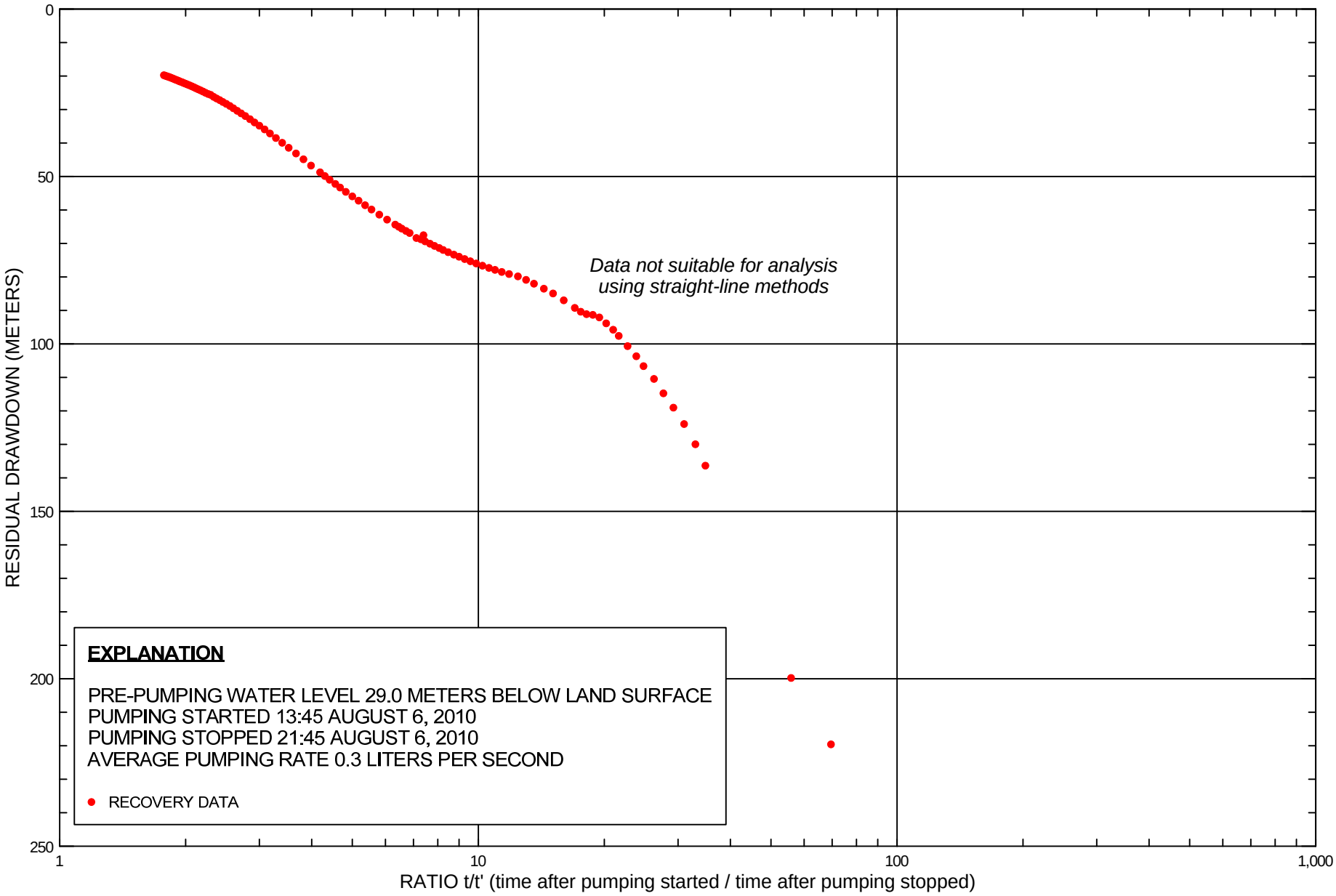

FIGURE 5. RECOVERY GRAPH FOR 8-HOUR AIRLIFT TEST AT CASED WELL DHRES-09
RESOLUTION PROJECT

605 - Resolution_HydroCharacterization\605.3\2010_wells\DHRES-09\Testing\DHRES-09_RC_Airlift.grf

MONTGOMERY & ASSOCIATES

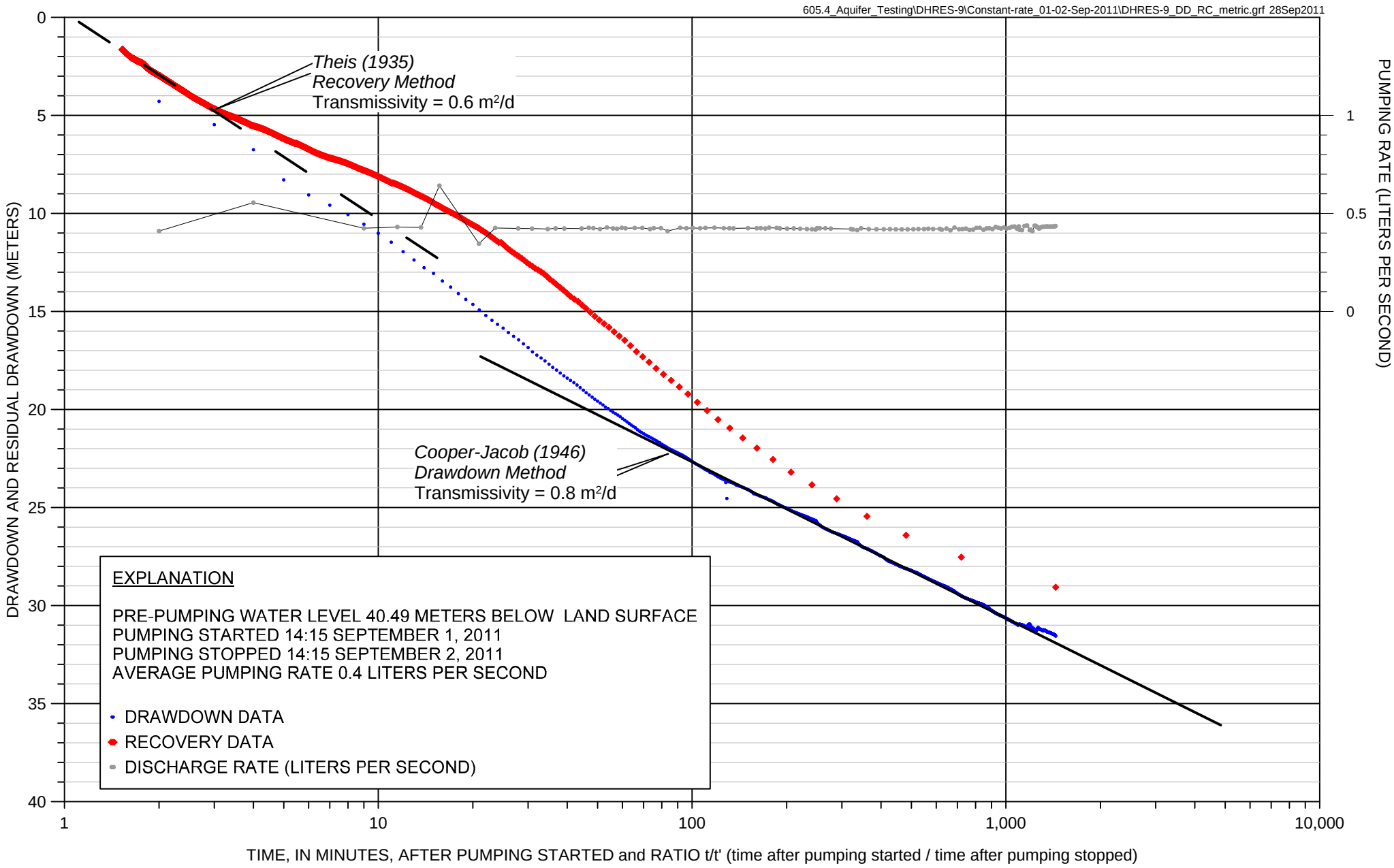

FIGURE 6. DRAWDOWN AND RECOVERY GRAPH FOR PUMPED WELL DHRES-9 DURING 24-HOUR CONSTANT-RATE PUMPING TEST, RESOLUTION PROJECT

MONTGOMERY & ASSOCIATES

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
0 - 10	0.0 - 3.0	Weathered diabase; reddish brown [5YR4/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, trace magnetite, very very trace olivine, trace clay and silt balls; reaction to acid: none	weathered; abundant iron oxide staining (hematite and some limonite), trace slickensides	CONVENTIONAL AIR ROTARY; Munsell Color Version: 2000 revised edition; subangular chips up to 0.7 cm; mostly sand-sized cuttings
10 - 20	3.0 - 6.1	Weathered diabase; brown [10YR4/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene; reaction to acid: none	weathered; abundant iron oxide staining (hematite and some limonite), trace flat fracture surfaces	subangular chips up to 3.4 cm
20 - 30	6.1 - 9.1	Weathered diabase; black [N2.5], brown [10YR5/3], and red [10R4/6]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, very trace magnetite; reaction to acid: moderate	weathered; abundant iron oxide staining (hematite and some limonite), trace calcite	subangular chips up to 2.1 cm
30 - 40	9.1 - 12.2	Weathered diabase; black [N2.5], brown [10YR5/3], and red [10R4/6]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene; reaction to acid: strong	weathered; abundant iron oxide staining (hematite and some limonite), trace clear calcite crystals	subangular chips up to 1.7 cm
40 - 50	12.2 - 15.2	Weathered diabase; dark grayish brown [10YR4/2], black [N2.5], and dusky red [10R3/4]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene; trace orange-brown clay balls; trace brown silt; reaction to acid: moderate	weathered; common iron oxide staining (hematite and limonite), trace calcite crystals, trace flat fracture surfaces with hematite, epidote and/or calcite	REVERSE CIRCULATION AIR PERCUSSION; subangular chips up to 2.6 cm
50 - 60	15.2 - 18.3	Weathered diabase; black [N2.5], weak red [10R4/4], and pale olive [5Y6/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene; trace orange-brown clay balls; trace brown silt; reaction to acid: moderate	weathered; common iron oxide staining (hematite and limonite), trace calcite crystals, trace flat fracture surfaces with hematite, limonite and/or calcite	subangular chips up to 2.7 cm
60 - 70	18.3 - 21.3	Weathered diabase; black [N2.5], weak red [10R4/4], and pale olive [5Y6/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene; reaction to acid: moderate	weathered; abundant iron oxide staining (hematite and limonite), trace small calcite crystals, trace flat fracture surfaces with hematite, limonite and/or calcite	subangular chips up to 2.0 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
70 - 80	21.3 - 24.4	Weathered diabase; black [N2.5], weak red [10R4/4], and pale olive [5Y6/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene; reaction to acid: moderate	weathered; abundant iron oxide staining (hematite and limonite), trace small calcite crystals, trace flat fracture surfaces with hematite, limonite and/or calcite, trace black fracture coating (manganese oxide?)	subangular chips up to 2.1 cm
80 - 90	24.4 - 27.4	Weathered diabase; black [N2.5], weak red [10R4/4], and pale olive [5Y6/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, very trace magnetite; reaction to acid: weak to moderate	weathered; abundant iron oxide staining (hematite and limonite), trace small calcite crystals, some flat fracture surfaces with hematite, limonite and/or calcite	subangular chips up to 2.2 cm
90 - 100	27.4 - 30.5	Weathered diabase; black [N2.5], weak red [10R4/4], and pale olive [5Y6/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, trace biotite, very trace magnetite; reaction to acid: moderate	weathered; abundant iron oxide staining (hematite and limonite), trace small calcite crystals, some flat fracture surfaces with hematite, limonite and/or calcite	subangular chips up to 1.8 cm
100 - 110	30.5 - 33.5	Diabase; greenish black [5GY2.5/1] and some dusky red [10R3/4]; well lithified; 85% black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite, trace amphibole, trace quartz; 15% heavily oxidized red, orange and black diabase; reaction to acid: very weak	some iron oxide staining (hematite and limonite), very trace calcite on fracture surfaces with hematite and limonite	subangular chips up to 2.8 cm
110 - 120	33.5 - 36.6	Diabase; greenish black [5GY2.5/1]; well lithified; 92% black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite, 8% heavily oxidized diabase; reaction to acid: very weak	fresh, unweathered; some iron oxide staining (hematite and limonite), trace green and black serpentinization on fresh diabase, ?	subangular chips up to 2.0 cm
120 - 130	36.6 - 39.6	Diabase; black [N2.5] and greenish gray [5GY5/1]; well lithified; black, white and green diabase with 50% plagioclase, 50% pyroxene, trace quartz, common magnetite; reaction to acid: very weak	fresh, unweathered, trace heavily-oxidized diabase; trace iron oxide staining (hematite and limonite), trace green and black serpentinization, trace calcite on fracture surfaces with serpentine or iron oxide staining	subangular chips up to 2.4 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
130 - 140	39.6 - 42.7	Diabase; black [N2.5] and greenish gray [5GY5/1]; well lithified; 99% black, white and green diabase with 50% plagioclase, 50% pyroxene, trace quartz, common magnetite; reaction to acid: none to very weak	fresh, unweathered, 1% heavily-oxidized diabase; trace iron oxide staining (hematite and limonite), trace green and black serpentinization, trace calcite on fracture surfaces with serpentine or iron oxide staining	subangular chips up to 2.7 cm
140 - 150	42.7 - 45.7	Oxidized diabase; dark brown [7.5YR3/2]; well lithified; brown, red and black diabase with 50% plagioclase, 50% pyroxene; trace fresh black, white and green diabase with magnetite; reaction to acid: moderate	heavily-oxidized; abundant iron oxide staining (hematite and some limonite), common calcite on fracture surfaces and in veins	subangular chips up to 1.5 cm
150 - 160	45.7 - 48.8	Oxidized diabase; dark brown [7.5YR3/2], greenish black [5GY2.5/1], and dusky red [10R3/4]; well lithified; 80% brown, red and black diabase with 50% plagioclase, 50% pyroxene, 20% fresh black, white and green diabase with trace magnetite; reaction to acid: strong	heavily-oxidized; common to abundant iron oxide staining (hematite and some limonite), common calcite on fracture surfaces and in veins	subangular chips up to 2.1 cm
160 - 170	48.8 - 51.8	Oxidized diabase; dark brown [7.5YR3/2], dusky red [10R3/4], and reddish yellow [7.5YR6/6]; well lithified; brown, red and black diabase with 50% plagioclase, 50% pyroxene; trace fresh black, white and green diabase with trace magnetite; reaction to acid: moderate to strong	heavily-oxidized; abundant iron oxide staining (hematite and limonite), common calcite on fracture surfaces and in veins	subangular chips up to 1.7 cm
170 - 180	51.8 - 54.9	Oxidized diabase; dark brown [7.5YR3/2] and dusky red [10R3/4]; well lithified; brown, red and black diabase with 50% plagioclase, 50% pyroxene; trace fresh black, white and green diabase with trace magnetite, trace reddish-brown claystone; reaction to acid: moderate	heavily-oxidized; abundant iron oxide staining (hematite and limonite), common calcite on fracture surfaces and in veins	subangular chips up to 2.3 cm
180 - 190	54.9 - 57.9	Oxidized diabase; dark brown [7.5YR3/2] and dusky red [10R3/4]; well lithified; brown, red and black diabase with 50% plagioclase, 50% pyroxene, common magnetite; trace fresh black, white and green diabase; trace reddish-brown claystone; reaction to acid: weak to moderate	heavily-oxidized; abundant iron oxide staining (hematite and limonite), trace calcite on fracture surfaces	subangular chips up to 1.8 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
190 - 200	57.9 - 61.0	Oxidized diabase; black [N2.5], white [N8], and dusky red [10R3/4]; well lithified; black and white diabase; 50% plagioclase, 50% pyroxene, trace quartz, common to abundant magnetite; reaction to acid: weak	some to common iron oxide staining (hematite and limonite), very trace calcite on fracture surfaces	subangular chips up to 1.5 cm
200 - 210	61.0 - 64.0	Oxidized diabase; dark grayish brown [10YR4/2]; well lithified; black and white diabase; 50% plagioclase, 50% pyroxene, trace quartz, common to abundant magnetite; reaction to acid: moderate	some to common iron oxide staining (hematite and limonite), trace subhedral clear calcite crystals	subangular chips up to 2.1 cm
210 - 220	64.0 - 67.1	Oxidized diabase; dark grayish brown [10YR4/2]; well lithified; black and white diabase; 50% plagioclase, 50% pyroxene, trace quartz, common to abundant magnetite; reaction to acid: moderate	common to abundant iron oxide staining (hematite and limonite), trace subhedral clear calcite crystals	subangular chips up to 1.8 cm, mostly 0.6 cm
220 - 230	67.1 - 70.1	Oxidized diabase; dark grayish brown [10YR4/2]; well lithified; black and white diabase; 50% plagioclase, 50% pyroxene, trace quartz, abundant magnetite; reaction to acid: moderate	common to abundant iron oxide staining (hematite and limonite), trace calcite crystals and calcite on fracture surfaces	subangular chips up to 2.0 cm
230 - 240	70.1 - 73.2	Oxidized diabase; dark grayish brown [10YR4/2] and black [N2.5]; well lithified; black and white diabase; 50% plagioclase, 50% pyroxene, trace quartz, abundant magnetite; reaction to acid: weak to moderate	some iron oxide staining (hematite and limonite), trace calcite crystals and calcite on fracture surfaces	subangular chips up to 1.7 cm
240 - 250	73.2 - 76.2	Oxidized diabase; dark grayish brown [10YR4/2] and black [N2.5]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, common magnetite, trace quartz; reaction to acid: moderate	some to common iron oxide staining (hematite and limonite), trace subhedral clear calcite crystals (1 up to 0.4 cm), trace calcite on fracture surfaces	subangular chips up to 1.7 cm, mostly 1.0 cm
250 - 260	76.2 - 79.2	Oxidized diabase; black [N2.5] and brown [10YR5/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, trace magnetite, trace quartz; reaction to acid: moderate	common iron oxide staining (hematite and some limonite), trace calcite on fracture surfaces	subangular chips up to 0.7 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
260 - 270	79.2 - 82.3	Oxidized diabase; black [N2.5] and brown [10YR5/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, trace quartz; reaction to acid: moderate to strong	some to common iron oxide staining (hematite and limonite), common small calcite crystals, trace subhedral calcite crystals and calcite on fracture surfaces	subangular chips up to 1.0 cm
270 - 280	82.3 - 85.3	Oxidized diabase; black [N2.5] and brown [10YR5/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, trace magnetite, trace quartz; reaction to acid: moderate	some to common iron oxide staining (hematite and limonite), trace subhedral calcite crystals and calcite on fracture surfaces	subangular chips up to 1.4 cm, mostly 1.0 cm
280 - 290	85.3 - 88.4	Oxidized diabase; black [N2.5] and brown [10YR5/3]; well lithified; black, white and red diabase with 50% plagioclase, 50% pyroxene, common magnetite, trace quartz; reaction to acid: moderate	common iron oxide staining (hematite and limonite) mostly on fracture surfaces, trace calcite on fracture surfaces	subangular chips up to 1.8 cm, mostly 1.0 cm
290 - 300	88.4 - 91.4	Diabase; black [N2.5]; well lithified; 90% black and green diabase with 50% plagioclase, 50% pyroxene; reaction to acid: moderate	10% heavily-oxidized diabase; some iron staining (hematite and limonite) on fracture surfaces, trace green serpentinization, trace calcite on fracture surfaces	subangular chips up to 2.3 cm, larger chips
300 - 310	91.4 - 94.5	Diabase; black [N2.5] and white [N8]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite; reaction to acid: weak	very trace iron oxide staining (hematite), trace black and green serpentinization, trace calcite on fracture surfaces	subangular chips up to 0.9 cm
310 - 320	94.5 - 97.5	Diabase; black [N2.5] and white [N8]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite; reaction to acid: weak	very trace iron oxide staining (hematite), trace black and green serpentinization, trace calcite on fracture surfaces, trace pyrite	subangular chips up to 1.5 cm
320 - 330	97.5 - 100.6	Diabase; black [N2.5] and white [N8]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite; reaction to acid: weak	very trace iron oxide staining (hematite), trace black and green serpentinization, trace calcite on fracture surfaces	subangular chips up to 1.4 cm, mostly <0.8 cm
330 - 340	100.6 - 103.6	Diabase; black [N2.5] and white [N8]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite; reaction to acid: weak	very trace iron oxide staining (hematite), trace green and black serpentinization, trace calcite on fracture surfaces	subangular chips up to 1.0 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
340 - 350	103.6 - 106.7	Diabase; black [N2.5] and white [N8]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite; reaction to acid: weak	very trace iron oxide staining (hematite), trace green and black serpentinization, trace calcite on fracture surfaces	subangular chips up to 1.5 cm, mostly <0.7 cm
350 - 360	106.7 - 109.7	Diabase; black [N2.5] and white [N8]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, common magnetite; reaction to acid: very weak	some iron oxide staining (hematite and limonite) on fracture surfaces, trace green and black serpentinization on fractures, very trace calcite	subangular chips up to 2.6 cm, almost all large chips
360 - 370	109.7 - 112.8	Diabase and Basalt; greenish black [5GY2.5/1]; well lithified; 85% black, light gray and green diabase with 50% plagioclase, 50% pyroxene, common magnetite; 15% black aphanitic basalt with very trace olivine and common magnetite; reaction to acid: moderate	trace iron oxide staining (hematite and limonite), trace white vein quartz, common calcite on fracture surfaces	subangular chips up to 1.6 cm
370 - 380	112.8 - 115.8	Oxidized Diabase; greenish black [5GY2.5/1]; well lithified; black, white and red diabase with much smaller crystals of plagioclase and pyroxene, trace quartz, common magnetite; reaction to acid: weak	some iron oxide staining, trace white vein quartz, trace calcite	subangular chips up to 1.5 cm
380 - 390	115.8 - 118.9	Oxidized Diabase; greenish black [5GY2.5/1]; well lithified; black, white and red diabase with much smaller crystals of plagioclase and pyroxene, trace quartz, common magnetite; reaction to acid: moderate to strong	common iron oxide staining (hematite and limonite), trace green serpentinization on fractures, some calcite veins and on fracture surfaces	subangular chips up to 1.3 cm
390 - 400	118.9 - 121.9	Oxidized Diabase; dark brown [7.5YR3/2]; well lithified; red, black and white diabase with much smaller crystals of plagioclase and pyroxene, trace quartz, trace magnetite; reaction to acid: strong	abundant iron oxide staining (hematite), trace green serpentinization on fractures, common calcite veins and on fractures	subangular chips up to 2.5 cm, mostly 1.0 cm
400 - 410	121.9 - 125.0	Oxidized Diabase; greenish black [10Y2.5/1] and light greenish gray [10Y7/1]; well lithified; 99% brown, red, black and white diabase with much smaller crystals of plagioclase and pyroxene, trace quartz, trace magnetite; 1% light brownish-gray fine-grained quartzite; reaction to acid: strong	abundant iron oxide staining (hematite and some limonite), common calcite veins and on fractures	subangular chips up to 1.6 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
410 - 420	125.0 - 128.0	Diabase; greenish black [10Y2.5/1] and light greenish gray [10Y7/1]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, some magnetite; reaction to acid: weak	some iron oxide staining (hematite and limonite), trace vein quartz, very trace calcite	subangular chips up to 1.2 cm
420 - 430	128.0 - 131.1	Diabase; greenish black [10Y2.5/1] and light greenish gray [10Y7/1]; well lithified; black and white diabase with 50% plagioclase, 50% pyroxene, some magnetite; reaction to acid: weak	some iron oxide staining (hematite and limonite) on fractures, very trace calcite	subangular chips up to 2.0 cm
430 - 440	131.1 - 134.1	Diabase; greenish black [10Y2.5/1] and dark greenish gray [10Y4/1]; well lithified; black and white diabase with much smaller crystals of 50% plagioclase, 50% pyroxene, some magnetite, very trace brownish-green olivine; reaction to acid: weak	some iron oxide staining (hematite and limonite) on fractures, very trace calcite	subangular chips up to 1.6 cm
UPPER DRIPPING SPRING QUARTZITE (pCdsu)				
440 - 450	134.1 - 137.2	Quartzite; brown [10YR5/3]; well lithified; 90% light brown, brown and red fine to medium-grained, finely laminated quartzite; 10% light brown and dark brown shale; reaction to acid: weak	abundant iron oxide staining (hematite and some limonite), trace white vein quartz, trace flat fracture surfaces, trace manganese oxide	angular to subangular chips up to 2.0 cm
450 - 460	137.2 - 140.2	Quartzite; light yellowish brown [2.5Y6/3]; well lithified; light brown, brown and red fine to medium-grained, finely laminated quartzite; trace light brown and dark brown shale; reaction to acid: none	abundant iron oxide staining (hematite and some limonite), trace flat fracture surfaces	angular to subangular chips up to 1.4 cm
460 - 470	140.2 - 143.3	Quartzite and Shale; dark gray [N4] and red [10R4/6]; well lithified; 70% red, brown and dark brown quartzite and shale; 30% black very well lithified siltstone and shale; reaction to acid: none to very weak	abundant iron oxide staining (hematite and some limonite), trace flat fracture surfaces with very trace calcite	angular to subangular chips up to 1.7 cm
470 - 480	143.3 - 146.3	Shale and Quartzite; dark gray [N4] and greenish gray [10Y5/1]; well lithified; 55% black very well lithified siltstone and shale; 45% olive-brown fine-grained quartzite; reaction to acid: none to very weak	some iron oxide staining (hematite), trace flat fracture surfaces with very trace calcite, trace manganese oxide	angular to subangular chips up to 1.2 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
UPPER DRIPPING SPRING QUARTZITE (pCdsu)				
480 - 490	146.3 - 149.4	Quartzite and Shale; black [N2.5] and red [10R4/6]; well lithified; 60% red, brown and light gray fine to medium-grained very competent quartzite; 40% black very well lithified siltstone and shale; trace brown calcareous finely laminated shale; reaction to acid: strong	common iron oxide staining (hematite), trace clear vein quartz, trace calcite veinlets	angular to subangular chips up to 1.8 cm, (mostly 1.0 cm)
490 - 500	149.4 - 152.4	Shale and Quartzite; black [N2.5] and red [10R4/6]; well lithified; 65% black very well lithified siltstone and shale; 35% red, brown, gray and dark gray fine to medium-grained quartzite; reaction to acid: weak to moderate	some to common iron oxide staining (hematite), trace calcite	angular to subangular chips up to 1.4 cm
500 - 510	152.4 - 155.4	Quartzite and Shale; black [N2.5] and dusky red [10R3/4]; well lithified; 60% red, brown, gray and dark gray fine to medium-grained quartzite and dark purplish-brown shale; 40% black very well lithified siltstone and shale; trace light brown and grayish-green very finely laminated shale; reaction to acid: none to very weak	some to common iron oxide staining (hematite), trace white to clear vein quartz, trace manganese oxide	angular to subangular chips up to 2.8 cm
510 - 520	155.4 - 158.5	Quartzite and Shale; black [N2.5] and dusky red [10R3/4]; well lithified; 50% red, brown, gray and dark gray fine to medium-grained quartzite; 30% dark purple and dark brown siltstone and shale; 20% black very well lithified siltstone and shale; trace light brown and grayish-green very finely laminated shale; reaction to acid: very weak	some to common iron oxide staining (hematite), trace white to clear vein quartz (1 up to 2.0 cm), trace manganese oxide	angular to subangular chips up to 2.0 cm
520 - 530	158.5 - 161.5	Quartzite and Shale; black [N2.5] and some dusky red [10R3/4]; well lithified; 80% dark purple, dark brown and black very well lithified siltstone and shale; 15% red and brown fine-grained competent quartzite; 5% possible black basalt; reaction to acid: weak	some iron oxide staining (hematite), trace small calcite crystals	angular to subangular chips up to 1.7 cm
530 - 540	161.5 - 164.6	Quartzite and Shale; brown [10YR5/4] and olive gray [5Y5/2]; well lithified; light brown, pink and light green, fine-grained, very finely laminated quartzite and shale; trace dark purple siltstone and shale; reaction to acid: very weak	common iron oxide staining (hematite and limonite), trace large calcite crystals (up to 0.4 cm)	subangular chips up to 2.2 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
UPPER DRIPPING SPRING QUARTZITE (pCdsu)				
540 - 550	164.6 - 167.6	Quartzite and Shale; brown [10YR5/4], olive gray [5Y5/2], and reddish brown [5YR5/4]; well lithified; light brown, pink, light and dark green, fine-grained, very finely laminated quartzite and shale; reaction to acid: very weak to weak	common iron oxide staining (hematite and limonite), trace clear vein quartz	subangular chips up to 1.8 cm
550 - 560	167.6 - 170.7	Quartzite; weak red [10R5/4]; well lithified; white to light gray stained pink sugary fine to medium-grained quartzite; trace orange clay balls, trace green quartzite; reaction to acid: weak	abundant iron oxide staining (hematite) disseminated, trace manganese oxide	subangular to subrounded chips up to 1.2 cm
560 - 570	170.7 - 173.7	Quartzite; weak red [10R5/4]; well lithified; white to light gray stained pink sugary fine to medium-grained quartzite; trace green quartzite; reaction to acid: weak to moderate	abundant iron oxide staining (hematite) disseminated	subangular to subrounded chips up to 1.3 cm
570 - 580	173.7 - 176.8	Quartzite; weak red [10R5/4]; well lithified; white to light gray stained pink sugary fine to medium-grained quartzite; trace gray quartzite; reaction to acid: weak	abundant iron oxide staining (hematite) disseminated, trace manganese oxide, very trace small calcite crystals	subangular to subrounded chips up to 1.1 cm
580 - 590	176.8 - 179.8	Quartzite; dark reddish gray [10R3/1], light brown [7.5YR6/3], and weak red [10R5/4]; well lithified; reddish-pink, dark purplish-brown and light grayish-green fine-grained quartzite; reaction to acid: weak	abundant iron oxide staining (hematite) disseminated, trace manganese oxide, very trace small calcite crystals	subangular to subrounded chips up to 1.3 cm
590 - 600	179.8 - 182.9	Quartzite; light reddish brown [5YR6/3]; well lithified; light brownish-pink sugary fine-grained quartzite; trace light gray and light green quartzite; reaction to acid: moderate	common iron oxide staining (hematite) disseminated, trace light gray vein quartz, trace calcite, trace manganese oxide	subangular to subrounded chips up to 0.9 cm
600 - 610	182.9 - 185.9	Quartzite; weak red [10R5/4]; well lithified; white and light gray, stained dark pink sugary fine to medium-grained quartzite; trace dark gray quartzite; reaction to acid: weak	abundant iron oxide staining (hematite) disseminated, trace manganese oxide, very trace small calcite crystals	subangular to subrounded chips up to 0.8 cm
610 - 620	185.9 - 189.0	Quartzite; weak red [10R5/4]; well lithified; white and light gray, stained dark pink sugary fine to medium-grained quartzite; trace dark gray quartzite; reaction to acid: very weak	abundant iron oxide staining (hematite) disseminated, some manganese oxide especially on fractures	subangular to subrounded chips up to 1.2 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
UPPER DRIPPING SPRING QUARTZITE (pCdsu)				
620 - 630	189.0 - 192.0	Quartzite; pale red [10R6/4]; well lithified; white and light gray, stained pink sugary fine to medium-grained quartzite; trace dark gray quartzite; reaction to acid: weak	abundant iron oxide staining (hematite) disseminated, trace manganese oxide, trace small calcite crystals	subrounded chips up to 0.6 cm
630 - 640	192.0 - 195.1	Quartzite; light red [2.5YR6/6] and reddish black [10R2.5/1]; well lithified; white and light gray, stained dark pink sugary fine to medium-grained quartzite; trace dark gray quartzite; trace orange silt and clay; reaction to acid: very weak	abundant iron oxide staining (hematite) disseminated, some manganese oxide especially on fractures	subangular to subrounded chips up to 1.0 cm
640 - 650	195.1 - 198.1	Quartzite; light red [2.5YR6/6] and reddish black [10R2.5/1]; well lithified; 95% light brownish-pink and orange-pink sugary fine to medium-grained quartzite; 5% dark gray quartzite; trace orange siltstone; trace orange silt and clay; reaction to acid: none to very weak	abundant iron oxide staining (hematite) disseminated, some manganese oxide	subangular to subrounded chips up to 1.2 cm
650 - 660	198.1 - 201.2	Quartzite; light reddish brown [2.5YR6/3] and reddish black [10R2.5/1]; well lithified; light brownish-pink, orange-pink and dark reddish-gray fine-grained quartzite; trace orange siltstone; trace orange silt and clay; reaction to acid: none to very weak	abundant iron oxide staining (hematite) disseminated, some manganese oxide, trace white vein quartz, very trace calcite	subangular to subrounded chips up to 1.6 cm
660 - 670	201.2 - 204.2	Quartzite; reddish gray [5YR5/2]; well lithified; brown, light brownish-pink, orange-pink and dark reddish-gray very fine-grained quartzite; reaction to acid: very weak	some to common iron oxide staining (hematite) disseminated, trace white vein quartz	subangular chips up to 1.8 cm
670 - 680	204.2 - 207.3	Quartzite; dark reddish gray [10R4/1]; well lithified; purplish-black very fine-grained quartzite; trace pinkish-orange quartzite; reaction to acid: none to very weak	trace iron staining, very trace gray vein quartz	subangular chips up to 2.5 cm
680 - 690	207.3 - 210.3	Quartzite; dark reddish gray [10R4/1]; well lithified; purplish-black and brownish-black very fine-grained quartzite; trace pinkish-orange quartzite; reaction to acid: none to very weak	trace iron oxide staining	subangular chips up to 1.0 cm
690 - 700	210.3 - 213.4	Quartzite; dark reddish gray [10R4/1] and greenish gray [10Y6/1]; well lithified; 60% purplish-black very fine-grained quartzite; 40% light grayish-green very fine-grained quartzite; reaction to acid: none		subangular chips up to 0.9 cm

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UPPER DRIPPING SPRING QUARTZITE (pCdsu)				
700 - 710	213.4 - 216.4	Quartzite; dark reddish gray [10R3/1] and dark gray [5Y4/1]; well lithified; 55% light grayish-green very fine-grained quartzite; 40% light grayish-green very fine-grained quartzite; reaction to acid: none to very weak	very trace iron oxide staining	subangular chips up to 1.0 cm
710 - 720	216.4 - 219.5	Quartzite; dark reddish gray [10R3/1] and dark greenish gray [10Y4/1]; well lithified; 50% light grayish-green very fine-grained quartzite; 50% light grayish-green very fine-grained quartzite; reaction to acid: none to very weak	trace iron oxide staining (hematite)	subangular chips up to 1.3 cm
720 - 730	219.5 - 222.5	Quartzite; dark reddish gray [10R3/1] and greenish gray [10Y5/1]; well lithified; 65% purplish-brown very fine-grained quartzite; 35% light greenish-gray very fine-grained quartzite; reaction to acid: none to very weak	trace iron oxide staining	subangular chips up to 1.5 cm
730 - 740	222.5 - 225.6	Quartzite; dusky red [10R3/2]; well lithified; 90% purplish-brown very fine-grained quartzite; 10% dark greenish-gray very fine-grained quartzite; reaction to acid: very weak to weak	some iron oxide staining, trace calcite crystals	subangular chips up to 1.3 cm
740 - 750	225.6 - 228.6	Quartzite; dusky red [10R3/2] and dark greenish gray [10Y4/1]; well lithified; 50% purplish-brown very fine-grained quartzite; 50% dark greenish-gray very fine-grained quartzite; reaction to acid: very weak to weak	trace iron oxide staining (hematite), trace flat fracture surfaces with hematite and calcite	subangular chips up to 1.4 cm
750 - 760	228.6 - 231.6	Quartzite; dark reddish gray [10R3/1]; well lithified; 60% purplish-brown very fine-grained quartzite; 40% greenish-gray very fine-grained quartzite; trace reddish-brown quartzite; reaction to acid: none to very weak	trace iron oxide staining (hematite), trace manganese oxide	subangular chips up to 1.3 cm
760 - 770	231.6 - 234.7	Quartzite; reddish black [10R2.5/1]; well lithified; 95% dark purplish-brown and dark purplish-gray fine-grained quartzite; 5% grayish-green and brown fine-grained quartzite; reaction to acid: none to very weak	trace iron oxide staining, trace clear vein quartz	subangular chips up to 1.2 cm

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
UPPER DRIPPING SPRING QUARTZITE (pCdsu)				
770 - 780	234.7 - 237.7	Quartzite; reddish black [10R2.5/1]; well lithified; dark purplish-brown and dark purplish-gray fine-grained quartzite; trace grayish-green fine-grained quartzite; trace orange quartzite; reaction to acid: none to very weak	trace iron oxide staining, trace white vein quartz	subangular chips up to 1.5 cm
780 - 790	237.7 - 240.8	Quartzite; black [N2.5]; well lithified; 98% dark purplish-brown and black fine-grained quartzite and siltstone; 2% orange quartzite; reaction to acid: none to very weak	trace iron oxide staining	subangular chips up to 1.2 cm
790 - 800	240.8 - 243.8	Quartzite; red [2.5YR5/6], very dark gray [N3], and pale brown [10YR6/3]; well lithified; 40% orange-red fine-grained quartzite; 30% black fine-grained quartzite and siltstone; 30% grayish-brown fine-grained quartzite; reaction to acid: weak	common iron oxide staining, trace very small calcite crystals	subangular chips up to 1.0 cm
800 - 810	243.8 - 246.9	Quartzite; black [N2.5] and dark reddish gray [10R3/1]; well lithified; 90% purplish-black and dark purplish-brown very fine-grained silty quartzite; 10% pinkish-brown very fine-grained quartzite; reaction to acid: weak	trace iron oxide staining, very trace white vein quartz, very trace tiny calcite crystals	subangular chips up to 1.5 cm
810 - 820	246.9 - 249.9	Quartzite; dark reddish gray [10R3/1] and black [N2.5]; well lithified; purplish-black and dark purplish-brown very fine-grained silty quartzite; trace pinkish-brown very fine-grained quartzite; reaction to acid: very weak	trace iron oxide staining, trace talc? on fracture surfaces	subangular chips up to 1.1 cm
820 - 830	249.9 - 253.0	Quartzite; reddish black [10R2.5/1]; well lithified; purplish-black and dark purplish-brown very fine-grained silty quartzite; trace pinkish-brown very fine-grained quartzite; reaction to acid: none to very weak	trace iron oxide staining	subangular chips up to 1.5 cm
830 - 840	253.0 - 256.0	Quartzite; reddish brown [2.5YR5/3]; well lithified; 98% orange-pink and light pinkish-brown very sugary fine to medium-grained quartzite; 2% purplish-black silty quartzite; reaction to acid: very weak	common iron oxide staining	subangular to subrounded chips up to 0.9 cm

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UPPER DRIPPING SPRING QUARTZITE (pCdsu)				
840 - 850	256.0 - 259.1	Quartzite; reddish brown [2.5YR4/4]; well lithified; 98% orange-red fine-grained quartzite; 2% dark gray and dark green quartzite; trace purplish-black silty quartzite; reaction to acid: very weak to weak	abundant iron oxide staining, trace very small calcite crystals	subangular chips up to 2.0 cm, mostly 0.6 cm
850 - 860	259.1 - 262.1	Quartzite; dark reddish gray [10R3/1] and red [10R4/8]; well lithified; 80% purplish-brown and black very fine-grained silty quartzite; 20% orange-red and gray medium-grained quartzite; reaction to acid: weak	some iron oxide staining, trace very small calcite crystals	subangular chips up to 0.7 cm
860 - 870	262.1 - 265.2	Quartzite; dark reddish gray [10R3/1] and red [10R4/8]; well lithified; 70% purplish-brown and black with orange speckling, fine-grained quartzite; 30% orange-red fine to medium-grained quartzite; reaction to acid: very weak	some iron oxide staining, trace very small calcite crystals	subangular chips up to 1.1 cm
870 - 880	265.2 - 268.2	Quartzite; weak red [10R5/4]; well lithified; 90% orange-pink and pinkish-brown fine to medium-grained sugary quartzite; 10% purplish-black silty quartzite with orange speckling; reaction to acid: very weak	abundant iron oxide staining (hematite)	subangular to subrounded chips up to 0.9 cm
880 - 890	268.2 - 271.3	Quartzite; red [10R4/6]; well lithified; 95% red fine to medium-grained quartzite; 5% dark gray fine to medium-grained quartzite; reaction to acid: none to very weak	abundant iron oxide staining (hematite)	subangular chips up to 1.2 cm
890 - 900	271.3 - 274.3	Quartzite; red [10R5/6], dark reddish gray [10R3/1], and dark greenish gray [10Y4/1]; well lithified; 90% red fine to medium-grained quartzite; 10% dark gray fine to medium-grained quartzite; trace green diabase; reaction to acid: very weak	abundant iron oxide staining (hematite)	subangular chips up to 1.2 cm
PRECAMBRIAN DIABASE (pCdiab)				
900 - 910	274.3 - 277.4	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with plagioclase, pyroxene, some magnetite; trace orange-red quartzite; reaction to acid: moderate	trace iron oxide staining (hematite), trace calcite veins with hematite	subangular chips up to 1.1 cm
910 - 920	277.4 - 280.4	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 45% plagioclase, 55% pyroxene, some magnetite; trace orange-red quartzite; reaction to acid: weak	some iron oxide staining (hematite) especially on fracture surfaces, trace manganese oxide	subangular chips up to 1.1 cm

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PRECAMBRIAN DIABASE (pCdiab)				
920 - 930	280.4 - 283.5	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 45% plagioclase, 55% pyroxene, common magnetite; trace orange-red quartzite; reaction to acid: very weak	trace iron oxide staining (hematite), trace green serpentine	subangular chips up to 0.9 cm
930 - 940	283.5 - 286.5	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with much larger crystals of 45% plagioclase, 55% pyroxene, common magnetite; trace orange-red quartzite; reaction to acid: weak	trace iron oxide staining, trace clear calcite crystals and veins, very trace pyrite	subangular chips up to 1.0 cm
940 - 950	286.5 - 289.6	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with much larger crystals of 45% plagioclase, 55% pyroxene, common magnetite; trace orange-red quartzite; reaction to acid: weak	trace iron oxide staining, trace flat fracture surfaces, trace clear calcite crystals and veins	subangular chips up to 1.0 cm
950 - 960	289.6 - 292.6	Diabase; greenish black [5GY2.5/1] and greenish gray [5GY5/1]; well lithified; black and green diabase with some larger crystals of 45% plagioclase, 55% pyroxene, common magnetite; trace orange-red quartzite; reaction to acid: weak	trace iron oxide staining (hematite), trace green serpentine, trace calcite crystals	subangular to subrounded chips up to 1.2 cm
960 - 970	292.6 - 295.7	Diabase; greenish black [5GY2.5/1] and greenish gray [5GY5/1]; well lithified; black, white and green diabase with 60% pyroxene, 40% plagioclase, common to abundant magnetite, trace red quartzite; reaction to acid: none to very weak	trace iron oxide staining (hematite), trace green serpentine especially on fracture surfaces, very trace pyrite	subangular chips up to 1.2 cm
970 - 980	295.7 - 298.7	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 65% pyroxene, 35% plagioclase, common to abundant magnetite; reaction to acid: very weak	trace green and black serpentine, very trace pyrite	subangular chips up to 1.4 cm
980 - 990	298.7 - 301.8	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with pyroxene, plagioclase, common to abundant magnetite; reaction to acid: weak	very trace iron oxide staining, trace green and black serpentine, trace calcite on fracture surfaces	subangular chips up to 1.2 cm
990 - 1,000	301.8 - 304.8	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 50% pyroxene, 50% plagioclase, common to abundant magnetite; reaction to acid: very weak	trace iron oxide staining (limonite), trace green and black serpentine, very trace calcite, very trace pyrite	subangular chips up to 1.0 cm

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PRECAMBRIAN DIABASE (pCdiab)				
1,000 - 1,010	304.8 - 307.8	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 60% pyroxene, 40% plagioclase, common magnetite; reaction to acid: very weak	trace iron oxide staining (limonite), trace green and black serpentine, very trace calcite, very trace pyrite	subangular chips up to 1.2 cm
1,010 - 1,020	307.8 - 310.9	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 60% pyroxene, 40% plagioclase, common magnetite; reaction to acid: very weak	trace iron oxide staining (limonite), trace green and black serpentine	subangular chips up to 1.0 cm
1,020 - 1,030	310.9 - 313.9	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 60% pyroxene, 40% plagioclase, common magnetite; reaction to acid: weak	trace iron oxide staining, common green and black serpentinization, trace calcite crystals	subangular chips up to 1.5 cm
1,030 - 1,040	313.9 - 317.0	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 50% pyroxene, 50% plagioclase, common to abundant magnetite; reaction to acid: weak	very trace iron oxide staining, common green and black serpentinization, very trace tiny pyrite	subangular chips up to 1.0 cm
1,040 - 1,050	317.0 - 320.0	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with 50% pyroxene, 50% plagioclase, common to abundant magnetite; reaction to acid: very weak	very trace iron oxide staining, common greenish-black serpentinization of fractures	subangular chips up to 1.0 cm
1,050 - 1,060	320.0 - 323.1	Diabase; greenish black [5GY2.5/1]; well lithified; blackish-green diabase with 60% pyroxene, 40% plagioclase, trace biotite, common to abundant magnetite; reaction to acid: none to very weak	very trace iron oxide staining, very trace pyrite	subangular chips up to 0.9 cm
1,060 - 1,070	323.1 - 326.1	Diabase; greenish black [5GY2.5/1]; well lithified; blackish-green diabase with 50% pyroxene, 50% plagioclase, trace biotite, common to abundant magnetite; reaction to acid: very weak	very trace iron oxide staining, very trace pyrite	subangular chips up to 1.1 cm
1,070 - 1,080	326.1 - 329.2	Diabase; greenish black [5GY2.5/1]; well lithified; blackish-green diabase with 50% pyroxene, 50% plagioclase, trace biotite, common to abundant magnetite; reaction to acid: very weak	very trace iron oxide staining, very trace pyrite	subangular chips up to 1.3 cm
1,080 - 1,090	329.2 - 332.2	Diabase; greenish black [5GY2.5/1]; well lithified; black, white and green diabase with 50% plagioclase, 50% pyroxene, common to abundant magnetite, trace biotite; reaction to acid: very weak	trace iron oxide staining (hematite), common green serpentinization (trace on fracture surfaces), very trace pyrite	subangular chips up to 0.8 cm

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PRECAMBRIAN DIABASE (pCdiab)				
1,090 - 1,100	332.2 - 335.3	Diabase; greenish black [5GY2.5/1]; well lithified; black, white and green diabase with 50% plagioclase, 50% pyroxene, common to abundant magnetite, trace biotite; reaction to acid: very weak	trace iron oxide staining	subangular chips up to 0.8 cm
1,100 - 1,110	335.3 - 338.3	Diabase; greenish black [5GY2.5/1]; well lithified; greenish-black diabase with 60% pyroxene, 40% plagioclase, common to abundant magnetite; reaction to acid: weak	trace iron oxide staining, very trace pyrite	subangular chips up to 1.5 cm, chips coarser in general
1,110 - 1,120	338.3 - 341.4	Diabase; greenish black [5GY2.5/1]; well lithified; greenish-black diabase with 50% pyroxene, 50% plagioclase, common to abundant magnetite, trace biotite; reaction to acid: weak	very trace iron oxide staining, very trace pyrite	subangular chips up to 1.4 cm
1,120 - 1,130	341.4 - 344.4	Diabase; greenish black [5GY2.5/1]; well lithified; greenish-black diabase with 60% pyroxene, 40% plagioclase, common to abundant magnetite, trace biotite; reaction to acid: weak	very trace iron oxide staining, trace green serpentine on fracture surfaces, very trace pyrite	subangular chips up to 1.3 cm, chips ground fine
1,130 - 1,140	344.4 - 347.5	Diabase; greenish black [5GY2.5/1]; well lithified; greenish-black diabase with 65% pyroxene, 35% plagioclase, common magnetite, trace biotite; reaction to acid: weak	very trace iron oxide staining, very trace pyrite	subangular chips up to 1.3 cm
1,140 - 1,150	347.5 - 350.5	Diabase; greenish black [5GY2.5/1]; well lithified; greenish-black diabase with 65% pyroxene, 35% plagioclase, common magnetite, trace biotite; reaction to acid: weak	very trace iron oxide staining, trace green serpentinization (and chips up to 0.5 cm)	subangular chips up to 1.0 cm
1,150 - 1,160	350.5 - 353.6	Diabase; dark greenish gray [5G4/1]; well lithified; greenish-black diabase with 65% pyroxene, 35% plagioclase, common magnetite, trace biotite; reaction to acid: weak	very trace iron oxide staining, trace green serpentinization (and on fracture surfaces)	subangular chips up to 1.0 cm
1,160 - 1,170	353.6 - 356.6	Diabase and quartzite; dark greenish gray [5G3/1] and dusky red [10R3/3]; well lithified; 70% greenish-black diabase with 50% plagioclase, 50% pyroxene, common magnetite, 30% reddish-brown fine-grained sugary quartzite; reaction to acid: very weak	trace iron oxide staining, common green serpentinization, very trace white mineral (not calcite) vein quartz?	subangular chips up to 1.0 cm

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PRECAMBRIAN DIABASE (pCdiab)				
1,170 - 1,180	356.6 - 359.7	Diabase; greenish gray [5G4/1]; well lithified; light green and black diabase with 50% plagioclase, 50% pyroxene (highly altered); trace reddish-brown quartzite; reaction to acid: weak	trace vein quartz	subangular chips up to 0.8 cm
1,180 - 1,190	359.7 - 362.7	Diabase; greenish gray [5G4/1]; well lithified; greenish-black diabase with 50% pyroxene, 50% plagioclase, common magnetite; trace reddish-brown quartzite; reaction to acid: weak	very trace iron oxide staining, trace green serpentine on fracture surfaces, trace vein quartz	subangular chips up to 1.2 cm
1,190 - 1,200	362.7 - 365.8	Diabase; dark greenish gray [10GY3/1] and dusky red [10R3/3]; well lithified; 90% greenish-black diabase with 50% plagioclase, 50% pyroxene, common magnetite, 10% reddish-brown fine-grained quartzite; reaction to acid: weak	very trace iron oxide staining, trace green serpentine on fracture surfaces, trace vein quartz	subangular chips up to 0.8 cm
1,200 - 1,210	365.8 - 368.8	Diabase; greenish black [5GY2.5/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, common to abundant magnetite; reaction to acid: weak	trace iron oxide staining (hematite), common serpentine on fracture surfaces, trace vein quartz, very trace pyrite	subangular chips up to 1.0 cm
1,210 - 1,220	368.8 - 371.9	Diabase; grayish green [5G5/2]; well lithified; greenish-gray diabase with plagioclase, pyroxene, common magnetite, altered; reaction to acid: moderate	trace calcite on fracture surfaces, trace pyrite	subangular chips up to 1.2 cm
1,220 - 1,230	371.9 - 374.9	Diabase and Quartzite; grayish green [5G4/2] and dusky red [10R3/3]; well lithified; 70% green and black diabase with 50% plagioclase, 50% pyroxene, common magnetite, 30% red to reddish-brown fine-grained quartzite; reaction to acid: moderate	iron oxide staining on quartzite chips, trace calcite on fracture surfaces	subangular chips up to 0.8 cm
1,230 - 1,240	374.9 - 378.0	Diabase; grayish green [5G4/2] and dusky red [10R3/3]; well lithified; 90% greenish-black diabase with 60% plagioclase, 40% pyroxene, abundant magnetite, 10% reddish-brown fine-grained quartzite; reaction to acid: weak	trace iron oxide staining on quartzite chips, trace green serpentine and calcite on fracture surfaces	subangular chips up to 0.9 cm
1,240 - 1,250	378.0 - 381.0	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; trace reddish-brown fine-grained quartzite; reaction to acid: weak	trace iron oxide staining on quartzite chips, trace green serpentine on fracture surfaces, very trace pyrite	subangular chips up to 1.2 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,250 - 1,260	381.0 - 384.0	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; trace reddish-brown fine-grained quartzite; reaction to acid: weak	trace iron oxide staining on quartzite chips, trace green serpentine on fracture surfaces	subangular chips up to 1.2 cm
1,260 - 1,270	384.0 - 387.1	Diabase; grayish green [5G4/2]; well lithified; light green and black diabase with 60% plagioclase, 40% pyroxene, abundant magnetite, trace biotite; trace red fine-grained quartzite; reaction to acid: moderate	trace green serpentine and calcite on fracture surfaces, very trace pyrite	subangular chips up to 1.0 cm
1,270 - 1,280	387.1 - 390.1	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with large crystals of 60% plagioclase, 40% pyroxene, abundant magnetite, trace biotite; trace red fine-grained quartzite; reaction to acid: weak	very trace iron oxide staining, very trace pyrite	subangular chips up to 1.2 cm
1,280 - 1,290	390.1 - 393.2	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with smaller crystals of 50% plagioclase, 50% pyroxene, abundant magnetite; trace red fine-grained quartzite; reaction to acid: weak	trace iron oxide staining, very trace pyrite	subangular chips up to 0.8 cm
1,290 - 1,300	393.2 - 396.2	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-gray diabase with 45% plagioclase, 50% pyroxene, 5% biotite; trace red fine-grained quartzite; reaction to acid: moderate	trace iron oxide staining, very trace pyrite	subangular chips up to 1.4 cm
1,300 - 1,310	396.2 - 399.3	Diabase; grayish green [5G4/2]; well lithified; greenish-gray altered diabase with plagioclase, pyroxene, abundant magnetite; reaction to acid: strong	trace iron oxide staining, common calcite on fracture surfaces, very trace pyrite	subangular chips up to 2.5 cm, coarser chips
1,310 - 1,320	399.3 - 402.3	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; reaction to acid: moderate	trace iron oxide staining, common calcite on fracture surfaces, very trace pyrite	subangular chips up to 1.2 cm
1,320 - 1,330	402.3 - 405.4	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with 60% plagioclase, 40% pyroxene, trace biotite, abundant magnetite; reaction to acid: weak	very trace iron oxide staining (hematite), trace vein quartz	subangular chips up to 1.5 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,330 - 1,340	405.4 - 408.4	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with 60% plagioclase, 40% pyroxene, trace biotite, abundant magnetite; reaction to acid: weak	very trace iron oxide staining, trace vein quartz, very trace pyrite	subangular chips up to 1.0 cm
1,340 - 1,350	408.4 - 411.5	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; reaction to acid: weak	very trace iron oxide staining, trace vein quartz, very trace pyrite	subangular chips up to 1.4 cm
1,350 - 1,360	411.5 - 414.5	Diabase; very dark grayish green [5G3/2]; well lithified; greenish-black diabase with 60% plagioclase, 40% pyroxene, abundant magnetite; trace orange-red and brown quartzite; reaction to acid: very weak	very trace iron oxide staining, trace vein quartz, very trace calcite, very trace pyrite	subangular chips up to 1.0 cm
1,360 - 1,370	414.5 - 417.6	Diabase; very dark grayish green [5G3/2]; well lithified; 95% greenish-black diabase with 65% plagioclase, 35% pyroxene, abundant magnetite; 5% reddish-brown fine-grained quartzite; reaction to acid: weak	very trace iron oxide staining, trace vein quartz, trace calcite	subangular chips up to 1.5 cm
1,370 - 1,380	417.6 - 420.6	Diabase; greenish black [10GY2.5/1]; well lithified; greenish-black diabase with 65% plagioclase, 35% pyroxene, abundant magnetite; trace dark red quartzite; reaction to acid: very weak	trace serpentine on fracture surfaces, very trace vein quartz	subangular chips up to 1.0 cm
1,380 - 1,390	420.6 - 423.7	Diabase; greenish black [10GY2.5/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; reaction to acid: very weak	very trace iron oxide staining, very trace serpentine on fracture surfaces	subangular chips up to 2.0 cm
1,390 - 1,400	423.7 - 426.7	Diabase; greenish black [10GY2.5/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; reaction to acid: weak	very trace iron oxide staining, very trace serpentine, very trace calcite	subangular chips up to 0.8 cm
1,400 - 1,410	426.7 - 429.8	Diabase; dark greenish gray [5G4/1]; well lithified; light green and black diabase with 60% pyroxene, 40% plagioclase, abundant magnetite; reaction to acid: weak	very trace iron oxide staining, very trace calcite	subangular chips up to 0.8 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,410 - 1,420	429.8 - 432.8	Diabase; dark greenish gray [5G4/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite, trace biotite; reaction to acid: very weak	very trace iron oxide staining	subangular chips up to 0.6 cm
1,420 - 1,430	432.8 - 435.9	Diabase; dark greenish gray [5G4/1] and dusky red [10R3/3]; well lithified; 95% greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite, trace biotite; 5% reddish-brown quartzite; reaction to acid: weak	very trace iron oxide staining, very trace calcite	subangular chips up to 0.6 cm
1,430 - 1,440	435.9 - 438.9	Diabase; dark greenish gray [5G4/1]; well lithified; greenish-black diabase with 60% plagioclase, 40% pyroxene, abundant magnetite; trace reddish-brown quartzite; reaction to acid: very weak	very trace iron oxide staining, very trace calcite	subangular chips up to 1.8 cm
1,440 - 1,450	438.9 - 442.0	Diabase; dark greenish gray [5G4/1]; well lithified; greenish-black diabase with 60% plagioclase, 40% pyroxene, abundant magnetite; reaction to acid: weak	very trace iron oxide staining (hematite), trace green serpentine on fracture surfaces, very trace calcite, very trace pyrite	subangular chips up to 1.5 cm
1,450 - 1,460	442.0 - 445.0	Diabase; dark greenish gray [5G4/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; reaction to acid: very weak	very trace iron oxide staining	subangular chips up to 1.2 cm
1,460 - 1,470	445.0 - 448.1	Diabase; dark greenish gray [5G4/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; reaction to acid: very weak	very trace iron oxide staining	subangular chips up to 1.0 cm
1,470 - 1,480	448.1 - 451.1	Diabase; dark greenish gray [5G4/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; reaction to acid: very weak	trace vein quartz	subangular chips up to 1.5 cm
1,480 - 1,490	451.1 - 454.2	Diabase; very dark greenish gray [5GY3/1]; well lithified; greenish-black diabase with larger crystals of 60% plagioclase, 40% pyroxene, abundant magnetite, trace biotite; reaction to acid: very weak	trace green serpentine on fracture surfaces, trace vein quartz	subangular chips up to 1.0 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,490 - 1,500	454.2 - 457.2	Diabase; very dark greenish gray [5GY3/1]; well lithified; greenish-black diabase with larger crystals of 60% plagioclase, 40% pyroxene, abundant magnetite, trace biotite; reaction to acid: weak	very trace iron oxide staining, trace vein quartz, trace calcite	subangular chips up to 1.2 cm
1,500 - 1,510	457.2 - 460.2	Diabase; very dark greenish gray [5GY3/1] and dusky red [10R3/3]; well lithified; 95% greenish-black diabase with larger crystals of 60% plagioclase, 40% pyroxene, abundant magnetite, trace biotite; 5% orange-red to dark red quartzite; reaction to acid: weak	very trace iron oxide staining, trace green serpentine on fracture surfaces, trace vein quartz, trace calcite	subangular chips up to 1.5 cm, generally coarser chips
1,510 - 1,520	460.2 - 463.3	Diabase; very dark greenish gray [5GY3/1] and dusky red [10R3/3]; well lithified; 95% greenish-black diabase with larger crystals of 60% plagioclase, 40% pyroxene, abundant magnetite, trace biotite; 5% orange-red to dark red quartzite; reaction to acid: weak	very trace iron oxide staining, trace green serpentine on fracture surfaces, trace vein quartz, trace calcite	subangular chips up to 1.2 cm, coarser chips
1,520 - 1,530	463.3 - 466.3	Diabase; very dark greenish gray [5GY3/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; trace reddish-brown quartzite; reaction to acid: weak	very trace iron oxide staining, trace vein quartz, trace calcite on fracture surfaces	subangular chips up to 1.2 cm, chips finer
1,530 - 1,540	466.3 - 469.4	Diabase; very dark greenish gray [5GY3/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; trace reddish-brown quartzite; reaction to acid: weak	very trace iron oxide staining, trace vein quartz, trace calcite on fracture surfaces	subangular chips up to 1.5 cm
1,540 - 1,550	469.4 - 472.4	Diabase; very dark greenish gray [5GY3/1]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; trace reddish-brown quartzite; reaction to acid: weak	very trace iron oxide staining, trace vein quartz, trace calcite	subangular chips up to 0.8 cm
1,550 - 1,560	472.4 - 475.5	Diabase; very dark greenish gray [5GY3/1] and dusky red [10R3/3]; well lithified; 90% greenish-black diabase with 50% plagioclase, 50% pyroxene, abundant magnetite; 10% reddish-brown quartzite; reaction to acid: weak to moderate	very trace iron oxide staining, trace vein quartz, trace calcite	subangular chips up to 0.8 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,560 - 1,570	475.5 - 478.5	Diabase; very dark greenish gray [5GY3/1] and dusky red [10R3/3]; well lithified; 95% greenish-black diabase with 50% plagioclase, 50% pyroxene, common magnetite; 5% reddish-brown fine-grained quartzite; reaction to acid: weak	very trace iron oxide staining (hematite), trace green serpentine on fracture surfaces, trace calcite, very trace pyrite	subangular chips up to 1.2 cm
1,570 - 1,580	478.5 - 481.6	Diabase; very dark greenish gray [5GY3/1] and dusky red [10R3/3]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, common magnetite; reaction to acid: weak	trace vein quartz, trace calcite, very trace pyrite	subangular chips up to 1.2 cm
1,580 - 1,590	481.6 - 484.6	Diabase; very dark greenish gray [5GY3/1] and dusky red [10R3/3]; well lithified; greenish-black diabase with 50% plagioclase, 50% pyroxene, trace biotite, common magnetite; trace reddish-brown quartzite; reaction to acid: very weak	very trace iron oxide staining, trace vein quartz	subangular chips up to 1.0 cm
1,590 - 1,600	484.6 - 487.7	Diabase and Quartzite; very dark greenish gray [5GY3/1] and dusky red [10R3/3]; well lithified; 60% greenish-black diabase with 50% plagioclase, 50% pyroxene, common magnetite, trace biotite; 40% reddish-brown and dark brown fine to medium-grained quartzite (from the interval 1594 - 1596 feet); reaction to acid: very weak	iron oxide staining on quartzite chips, trace vein quartz, very trace calcite	FLOODED REVERSE CIRCULATION ROTARY; subangular chips up to 1.2 cm
1,600 - 1,610	487.7 - 490.7	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black, white and green diabase with plagioclase, pyroxene, common magnetite; trace orange-red fine-grained quartzite; reaction to acid: weak	trace iron oxide staining on quartzite chips, common black and green serpentinization especially on fracture surfaces, trace slickensides, trace calcite veins, very trace pyrite	subangular chips up to 2.7 cm, mostly <1.0 cm
1,610 - 1,620	490.7 - 493.8	Diabase; greenish black [5GY2.5/1], light greenish gray [5GY7/1], and red [10R4/6]; well lithified; 90% black, white and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; 10% dark red and orange-red fine-grained quartzite; reaction to acid: weak	some iron oxide staining on quartzite chips, common black and green serpentinization, trace subhedral calcite crystals on fracture surfaces, trace calcite veins, very trace pyrite	subangular chips up to 1.9 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,620 - 1,630	493.8 - 496.8	Diabase; greenish black [5GY2.5/1], light greenish gray [5GY7/1], and red [10R4/6]; well lithified; 90% black, white and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; 10% dark red and orange-red fine-grained quartzite; reaction to acid: weak	some iron oxide staining on quartzite chips, common black and green serpentinization, trace calcite veins, very trace pyrite	subangular chips up to 1.0 cm
1,630 - 1,640	496.8 - 499.9	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY5/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; trace orange-red fine-grained quartzite; reaction to acid: moderate	trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, some calcite veins, very trace pyrite	subangular chips up to 2.3 cm, mostly <1.3 cm
1,640 - 1,650	499.9 - 502.9	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY5/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; trace orange-red fine-grained quartzite; reaction to acid: weak	trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, trace calcite on fractures, very trace pyrite	subangular chips up to 2.4 cm, mostly large chips
1,650 - 1,660	502.9 - 506.0	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; trace orange-red fine-grained quartzite; reaction to acid: weak	trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, very trace calcite on fractures, very trace pyrite	subangular chips up to 1.0 cm
1,660 - 1,670	506.0 - 509.0	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; trace orange-red fine-grained quartzite; reaction to acid: very weak	trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, trace white vein quartz, very trace calcite on fractures, very trace pyrite	subangular chips up to 2.2 cm, mostly large chips
1,670 - 1,680	509.0 - 512.1	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: weak	very trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, very trace calcite on fractures, very trace pyrite	subangular chips up to 0.8 cm

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DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,680 - 1,690	512.1 - 515.1	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak to weak	very trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, very trace calcite on fractures	subangular chips up to 1.4 cm
1,690 - 1,700	515.1 - 518.2	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: weak	very trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, very trace calcite on fractures	subangular chips up to 2.0 cm
1,700 - 1,710	518.2 - 521.2	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, trace calcite veins	subangular chips up to 2.2 cm, almost all large chips
1,710 - 1,720	521.2 - 524.3	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak to weak	trace iron oxide staining on quartzite chips, abundant green and black serpentinization especially on fracture surfaces, trace calcite veins	subangular chips up to 0.7 cm
1,720 - 1,730	524.3 - 527.3	Diabase; greenish black [5GY2.5/1] and light greenish gray [10GY7/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite and trace biotite; trace orange-red fine-grained quartzite; reaction to acid: none to very weak	trace iron oxide staining on quartzite chips, abundant black and green serpentinization especially on fractures, very trace calcite on fractures	subangular chips up to 1.0 cm
1,730 - 1,740	527.3 - 530.4	Diabase; greenish black [5GY2.5/1] and light greenish gray [10GY7/1]; well lithified; black, white and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak to weak	very trace iron oxide staining on quartzite chips, common green and black serpentinization, trace calcite	subangular chips up to 1.5 cm

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PRECAMBRIAN DIABASE (pCdiab)				
1,740 - 1,750	530.4 - 533.4	Diabase; greenish black [5GY2.5/1] and light greenish gray [10GY7/1]; well lithified; black, white and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, common green serpentinization, very trace calcite	subangular chips up to 1.7 cm
1,750 - 1,760	533.4 - 536.4	Diabase; greenish black [5GY2.5/1] and light greenish gray [10GY7/1]; well lithified; black, white and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: weak to moderate	very trace iron oxide staining on quartzite chips, common green serpentinization, trace calcite, very trace pyrite	subangular chips up to 2.2 cm
1,760 - 1,770	536.4 - 539.5	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, very trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, very trace calcite, trace pyrite	subangular chips up to 2.1 cm, mostly 1.2 cm
1,770 - 1,780	539.5 - 542.5	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, very trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, very trace calcite, trace pyrite	subangular chips up to 2.3 cm
1,780 - 1,790	542.5 - 545.6	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, very trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, very trace calcite, very trace pyrite	subangular chips up to 2.1 cm, mostly 1.1 cm
1,790 - 1,800	545.6 - 548.6	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, very trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, very trace calcite, trace pyrite	subangular chips up to 0.6 cm

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PRECAMBRIAN DIABASE (pCdiab)				
1,800 - 1,810	548.6 - 551.7	Diabase; greenish black [5GY2.5/1] and light greenish gray [5GY7/1]; well lithified; black and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, very trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, trace large calcite vein (1 chip up to 1.5 cm), trace pyrite	subangular chips up to 2.2 cm, mostly 1.2 cm
1,810 - 1,820	551.7 - 554.7	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY5/1]; well lithified; black and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, very trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak to weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, very trace calcite, very trace pyrite	subangular chips up to 2.2 cm, mostly 1.5 cm
1,820 - 1,830	554.7 - 557.8	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY5/1]; well lithified; black and green diabase with 50% plagioclase, 50% pyroxene, common magnetite, very trace biotite; very trace orange-red fine-grained quartzite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, very trace calcite, very trace pyrite	subangular chips up to 2.7 cm, mostly 1.7 cm
1,830 - 1,840	557.8 - 560.8	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY5/1]; well lithified; 99% black and green diabase with plagioclase, pyroxene, common magnetite; 1% orange-red fine to medium-grained quartzite; reaction to acid: weak	trace iron oxide staining and slickensides on quartzite chips, abundant green serpentinization, trace calcite, very trace pyrite	subangular chips up to 2.5 cm, almost all larger chips
1,840 - 1,850	560.8 - 563.9	Diabase; greenish gray [10GY5/1]; well lithified; highly altered, green and white diabase with very finely crystalline zones of quartz replacement, very trace magnetite; reaction to acid: very weak	very trace iron oxide staining on quartzite chips, 8% of overall sample is white quartz veins (1 chip up to 1.1 cm thick), trace serpentine, very trace calcite, some pyrite	subangular chips up to 2.6 cm, almost all larger chips
1,850 - 1,860	563.9 - 566.9	Diabase; greenish black [5GY2.5/1] and greenish gray [5GY5/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; trace orange-red fine to medium-grained quartzite; reaction to acid: moderate	trace iron oxide staining on quartzite chips, abundant serpentinization, some calcite on fractures, very trace pyrite	subangular chips up to 2.2 cm, mostly 1.1 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,860 - 1,870	566.9 - 570.0	Diabase; greenish black [5GY2.5/1] and dark greenish gray [5GY4/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; reaction to acid: very weak	abundant green serpentinization, trace calcite vein with serpentine, very trace pyrite	subangular chips up to 2.5 cm, almost all larger chips
1,870 - 1,880	570.0 - 573.0	Diabase; greenish black [5GY2.5/1] and dark greenish gray [5GY4/1]; well lithified; 99% black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; 1% orange-red fine to medium-grained quartzite; reaction to acid: moderate	trace iron oxide staining on quartzite chips, abundant green serpentinization, some calcite on fractures	subangular chips up to 1.5 cm
1,880 - 1,890	573.0 - 576.1	Diabase; greenish black [5GY2.5/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; very trace orange-red fine to medium-grained quartzite; reaction to acid: weak	very trace iron oxide staining on quartzite chips, abundant green serpentinization, very trace calcite, very trace pyrite	subangular chips up to 1.9 cm
1,890 - 1,900	576.1 - 579.1	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, common magnetite, trace biotite; reaction to acid: very weak	abundant green serpentinization especially on fractures, trace calcite on fractures	subangular chips up to 2.3 cm, mostly larger chips
1,900 - 1,910	579.1 - 582.2	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, abundant magnetite; very trace orange-red fine-grained quartzite; reaction to acid: weak to moderate	very trace iron oxide staining on quartzite, abundant green serpentinization, trace calcite on fractures, very trace pyrite	subangular chips up to 2.9 cm, mostly <1.0 cm
1,910 - 1,920	582.2 - 585.2	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, abundant magnetite; trace orange-red fine-grained quartzite; reaction to acid: weak	trace iron oxide staining mostly on quartzite, abundant green serpentinization, very trace calcite veins, very trace pyrite	subangular chips up to 2.3 cm, mostly <1.0 cm
1,920 - 1,930	585.2 - 588.3	Diabase; greenish black [5GY2.5/1] and greenish gray [10GY6/1]; well lithified; black and green diabase with plagioclase, pyroxene, abundant magnetite; trace orange-red fine-grained quartzite; reaction to acid: weak to moderate	trace iron oxide staining mostly on quartzite, abundant green serpentinization, some calcite veins, very trace pyrite	subangular chips up to 1.8 cm, mostly <1.0 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
1,930 - 1,940	588.3 - 591.3	Diabase; dark greenish gray [10GY4/1], white [N8], and weak red [10R5/4]; well lithified; 75% highly altered green diabase with quartz and calcite replacement, trace magnetite; 10% orange-red fine to medium-grained quartzite; reaction to acid: moderate	15% white quartz and calcite veins, trace iron oxide staining mostly on quartzite, some green serpentinization, trace clay alteration, trace pyrite	subangular chips up to 3.1 cm, mostly 1.4 cm
1,940 - 1,950	591.3 - 594.4	Diabase; dark greenish gray [10GY4/1] and some red [10R5/6]; well lithified; 98% highly altered green and black diabase with quartz and calcite replacement, trace magnetite; 1% orange-red fine to medium-grained quartzite; reaction to acid: moderate	trace iron oxide staining, common serpentinization, 1% white quartz and calcite veins, trace pyrite, very trace bornite	subangular chips up to 1.8 cm
1,950 - 1,960	594.4 - 597.4	Diabase; very dark greenish gray [5GY3/1] and some red [10R5/6]; well lithified; 98% black and green diabase; some magnetite; 2% orange-red medium-grained quartzite; reaction to acid: moderate	trace iron oxide staining, common green serpentinization especially on fractures, trace calcite, very trace pyrite	subangular chips up to 1.9 cm, larger chips
1,960 - 1,970	597.4 - 600.5	Diabase; greenish black [5GY2.5/1] and greenish gray [5GY5/1]; well lithified; black and green diabase with common magnetite; trace highly altered diabase; trace orange-red medium-grained quartzite; reaction to acid: weak to moderate	trace iron oxide staining mostly on quartzite, common green serpentinization especially on fractures, trace calcite on fractures, very trace vein quartz, very trace pyrite	subangular chips up to 2.1 cm, mostly 1.0 cm
1,970 - 1,980	600.5 - 603.5	Diabase; greenish black [5GY2.5/1], greenish gray [5GY5/1], and some red [10R5/6]; well lithified; black and green diabase with common magnetite; trace orange-red medium-grained quartzite; reaction to acid: weak to moderate	trace iron oxide staining mostly on quartzite, common green serpentinization especially on fractures, trace calcite, very trace pyrite	subangular chips up to 2.0 cm, mostly 0.8 cm
1,980 - 1,990	603.5 - 606.6	Diabase; greenish black [5GY2.5/1] and greenish gray [5GY5/1]; well lithified; black and green diabase with common magnetite; trace orange-red and reddish-brown medium-grained quartzite; reaction to acid: moderate	trace iron oxide staining mostly on quartzite, common green serpentinization especially on fractures, trace calcite, trace slickensides	subangular chips up to 0.9 cm
1,990 - 2,000	606.6 - 609.6	Diabase; greenish black [5GY2.5/1] and greenish gray [5GY6/1]; well lithified; black and green diabase with common magnetite; trace orange-red and reddish-brown medium-grained quartzite; reaction to acid: weak	trace iron oxide staining mostly on quartzite, common green serpentinization especially on fractures, trace calcite, very trace pyrite	subangular chips up to 3.0 cm, mostly <1.3 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PRECAMBRIAN DIABASE (pCdiab)				
2,000 - 2,010	609.6 - 612.6	Diabase; very dark greenish gray [10GY3/1]; well lithified; black and green diabase with common magnetite; reaction to acid: weak	very trace iron oxide staining mostly on quartzite, common green serpentinization especially on fractures, trace calcite veins, very trace pyrite	subangular chips up to 2.4 cm, almost all large chips
2,010 - 2,020	612.6 - 615.7	Diabase; very dark greenish gray [10GY3/1]; well lithified; black and green diabase with common magnetite; trace orange-red medium-grained quartzite; reaction to acid: moderate	trace iron oxide staining mostly on quartzite, common green serpentinization especially on fractures, trace calcite on fractures, very trace pyrite	subangular chips up to 1.4 cm
2,020 - 2,030	615.7 - 618.7	Diabase; very dark greenish gray [10GY3/1]; well lithified; black and green diabase with common magnetite, trace highly altered diabase; reaction to acid: moderate	trace iron oxide staining mostly on quartzite, common green serpentinization especially on fractures, trace calcite on fractures, very trace pyrite	subangular chips up to 2.7 cm, mostly large chips
2,030 - 2,040	618.7 - 621.8	Diabase; dark greenish gray [5GY4/1]; well lithified; greenish-black diabase with some magnetite; reaction to acid: moderate	some iron oxide staining, some green serpentinization especially on fractures, trace calcite on fractures and in veins, very trace pyrite	subangular chips up to 1.9 cm
MAIN FAULT BRECCIA				
2,040 - 2,050	621.8 - 624.8	Quartzite and diabase breccia; reddish black [2.5YR2.5/1] and some greenish gray [10GY5/1]; well lithified; 80% purplish-black very fine-grained silty quartzite; 20% highly altered, light green diabase; trace black and green diabase with trace magnetite; reaction to acid: moderate	trace iron oxide staining, trace calcite, very trace pyrite	angular to subangular chips up to 1.8 cm
2,050 - 2,060	624.8 - 627.9	Quartzite and diabase breccia; reddish black [2.5YR2.5/1] and some greenish gray [10GY5/1]; well lithified; 50% purplish-black very fine-grained silty quartzite; 50% altered, dark green diabase with very small crystals; trace orange-red medium-grained quartzite; reaction to acid: moderate	trace iron oxide staining, trace calcite, very trace pyrite	angular to subangular chips up to 2.7 cm, mostly 1.0 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
MAIN FAULT BRECCIA				
2,060 - 2,070	627.9 - 630.9	Quartzite and diabase breccia; reddish black [2.5YR2.5/1] and some greenish gray [10GY5/1]; well lithified; 45% purplish-black very fine-grained silty quartzite; 45% dark green and black diabase; trace highly altered diabase; trace light brown fine-grained quartzite; trace silvery dark gray schist; reaction to acid: weak	10% white vein quartz, trace iron oxide staining, trace calcite, very trace pyrite, trace light green clay and calcite on fracture	angular to subangular chips up to 2.5 cm, mostly <1.2 cm
PINAL SCHIST (pCpi)				
2,070 - 2,080	630.9 - 634.0	Schist; very dark gray [N3]; well lithified; 90% silvery very dark gray schist; reaction to acid: none	10% white vein quartz, very trace iron oxide staining (hematite), very trace green serpentinization	subangular chips up to 2.1 cm, larger chips
2,080 - 2,090	634.0 - 637.0	Schist; very dark gray [N3]; well lithified; 85% silvery very dark gray schist; trace highly altered green and black diabase; reaction to acid: none	15% white vein quartz, very trace iron oxide staining (hematite), very trace green serpentine	subangular chips up to 2.0 cm
2,090 - 2,100	637.0 - 640.1	Schist; very dark gray [N3]; well lithified; 99% silvery very dark gray schist; reaction to acid: very weak	1% white vein quartz, very trace iron oxide staining (hematite), very trace calcite	subangular chips up to 2.5 cm
2,100 - 2,110	640.1 - 643.1	Schist; very dark gray [N3]; well lithified; silvery very dark gray schist; trace orange-red, purple and grayish-green quartzite; reaction to acid: very weak	trace iron oxide staining (hematite), trace white vein quartz, very trace calcite	subangular chips up to 1.7 cm
2,110 - 2,120	643.1 - 646.2	Schist; very dark gray [N3]; well lithified; silvery very dark gray schist; trace orange-red, purple and grayish-green quartzite; trace black and green diabase; reaction to acid: weak	trace iron oxide staining (hematite), trace white vein quartz, very trace calcite	subangular chips up to 2.0 cm
2,120 - 2,130	646.2 - 649.2	Schist; very dark gray [N3]; well lithified; silvery very dark gray schist; very trace black and green diabase; very trace orange-red and purple quartzite; reaction to acid: none	trace iron oxide staining (hematite), trace white vein quartz	subangular chips up to 2.6 cm
2,130 - 2,140	649.2 - 652.3	Schist; very dark gray [N3]; well lithified; silvery very dark gray schist; trace red quartzite; reaction to acid: very weak	some iron oxide staining (hematite), trace green, red and white vein quartz, very trace calcite	subangular chips up to 1.8 cm

LITHOLOGIC DESCRIPTION OF DRILL CUTTINGS FROM HYDROGEOLOGIC TEST WELL DHRES-09
Resolution Copper Mining
Pinal County, Arizona

DEPTH INTERVAL (feet)	DEPTH INTERVAL (meters)	GENERAL DESCRIPTION	SECONDARY FEATURES	COMMENTS
PINAL SCHIST (pCpi)				
2,140 - 2,150	652.3 - 655.3	Schist; very dark gray [N3]; well lithified; silvery very dark gray schist, trace red quartzite; reaction to acid: none to very weak	trace iron oxide staining, trace white vein quartz, very trace calcite, trace slickensides	subangular chips up to 3.0 cm, mostly large chips
2,150 - 2,160	655.3 - 658.4	Schist; very dark gray [N3]; well lithified; 99% silvery very dark gray schist; reaction to acid: none to very weak	1% white vein quartz, trace iron oxide staining (hematite), very trace orange and green vein quartz, very trace tiny calcite	subangular chips up to 2.4 cm
2,160 - 2,170	658.4 - 661.4	Schist; very dark gray [N3]; well lithified; 99% silvery very dark gray schist; very trace orange-red quartzite; reaction to acid: weak	1% white vein quartz, trace green vein quartz, very trace iron oxide staining (hematite), trace calcite on fractures	subangular chips up to 2.8 cm
2,170 - 2,175	661.4 - 662.9	Schist; very dark gray [N3]; well lithified; 82% silvery very dark gray schist; 5% red fine-grained quartzite; reaction to acid: weak	10% white vein quartz, 2% red and green vein quartz, some iron oxide staining (hematite), trace calcite	subangular chips up to 2.5 cm

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL DHRES-09

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
8-Jul	DHRES-9	J.Kent	0.00	0.00	0.00	0.00	Crew's safely mobilized the LM-140 from the #9 laydown yard to DHRES-9 located on West Plant. Currently loading semis with equipment at #9 laydown yard and moving it to site.	Mobilization	N/A	N/A
9-Jul	DHRES-9	J.Kent	0.00	0.00	0.00	0.00	Crew's continue to transfer auxiliary equipment from #9 laydown yard to DHRES-9. Mechanics continue to work on the LM-140 (drill rig).	Mobilization	N/A	N/A
10-Jul	DHRES-9	E. Jung	0.00	0.00	0.00	0.00	Maintenance and repairs continue on the LM-140. Site is clear of equipment to allow for positioning of crane truck during repairs. Auxiliary equipment is staged/organized nearby, off site. Anticipate completion of work on drill rig, and beginning of site set-up by tomorrow pm.	Mobilization	N/A	N/A
11-Jul	DHRES-9	E. Jung	0.00	0.00	0.00	0.00	Maintenance and repairs continue on the LM-140. Waiting for parts to ship. Complete site set up is delayed until repairs are completed.	Mobilization	N/A	N/A
12-Jul	DHRES-9	J.Kent	0.00	0.00	0.00	0.00	Maintenance and repairs continue on the LM-140. Site set up and repairs should be completed Wednesday/Thursday.	Mobilization	N/A	N/A
13-Jul	DHRES-9	J.Kent	0.00	0.00	0.00	0.00	Maintenance and repairs continue on the LM-140. Site set up and repairs should be completed Wednesday/Thursday.	Mobilization	N/A	N/A
14-Jul	DHRES-9	J.Kent	0.00	0.00	0.00	0.00	Maintenance and repairs continue on the LM-140. Final inspection should take place	Mobilization	N/A	N/A
15-Jul	DHRES-9	E. Jung	0.00	0.00	0.00	0.00	Maintenance and repairs continue on the LM-140 rod arm. Site set up is complete, and pre drill audit has been completed by RCM. Anticipate drilling Friday morning.	Mobilization	N/A	N/A
16-Jul	DHRES-9	J.Kent	11.28	37.00	11.28	37.00	Drilling commenced at 0400hrs with a 17" Tri-Cone bit. Anticipate installing 12" surface casing down to 12m this afternoon, cement will set for a minimum of 8hrs.	17" Tri-Cone Starter Bit - Air	N/A	Diabase

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL DHRES-09

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
17-Jul	DHRES-9	E. Jung	24.08	79.00	12.80	42.00	Installed 12" surface casing to 12m. Cemented casing at 0000hrs and let cure for 8hrs. Rigged down and removed cementing equipment, and set up BHA to drill using 10" hammer. Resumed drilling at 1330hrs (7-17). Shut down at 1500hrs to replace control valve for top head. Currently making repairs. Anticipate completion of repairs this evening.	10" RC Hammer	N/A	pЄd - Weathered Precambrian diabase: 50% plagioclase, 50% amphibole, trace magnetite.
18-Jul	DHRES-9	E. Jung	115.52	379.00	91.44	300.00	Drilling, making good progress. Took surveys at: 30.5m inc 0.25°, 60.96m inc 0.25°, 91.44m inc 0.25°. Currently drilling.	10" RC Hammer Air	N/A	pЄd - Precambrian diabase: 50% plagioclase, 50% pyroxene, common magnetite, trace iron oxide, trace calcite.
19-Jul	DHRES-9	J.Kent	197.82	649.00	82.30	270.00	Drilling making great progress. Took surveys at 121m Inc 0.75˚, 152m Inc 0.5˚, and 176m Inc 0.25˚. Tripped out of the hole to change bit at 0205hrs, tripped back in and commenced drilling at 0745hrs.	10" RC Hammer Air	Encountered water at 158m and measured water production 8-10gpm. Water production at 176-182m 25-30gpm. Water parameters of water being injected into the hole while drilling: pH=8.16 EC=583.7µS. Ground water parameters during production tests: ph=8.20 EC=830.7µS. EC was increasing down hole, but leveled out during the last water production test (830.7µS).	Diabase contact with Dripping Springs Quartzite (pЄds) and basalt (possible dikes) at 140m. Basalt from 155-158m. pЄds with thin light green laminations, common iron oxide staining from 158-167m. pЄds changed to pink fine grained quartzite without laminations from 167-195m.

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL DHRES-09

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
20-Jul	DHRES-9	J.Kent	292.30	959.00	94.49	310.00	Drilling making great progress. Took surveys at 213m Inc 1˚, 243m Inc 1˚, and 274m Inc 1.25˚. Talked to driller and foreman about holding back some weight to control the deviation. Current plan is to drill to 336m, trip for a bit, and complete geophysical logging. Anticipate reaching 336m late tonight.	10" RC Hammer Air	Water production from 182-274m 25-30gpm. Water production has decreased due to a lithology change (see geology) from 274-292m to 13-40gpm. Water parameters from 231-292m Temperature=26° C, EC=785 µS, pH=8.2, discharge=~30gpm.	Upper Dripping Springs Quartzite (pЄds) interbedded with sandy to very thick shale layers. Shale is very fine grained, black to a purple in color; possible contact with Pioneer Shale being reviewed. Contact with pЄd (diabase) @ 274.32m.
21-Jul	DHRES-9	A. Jergenson	334.98	1099.00	42.67	140.00	Drilled to 334m at 2215hrs. Set up and tripped out of hole in preparation for geophysical logging. Crew shut down for lightning this morning 0223-0323hrs. Started geophysical logging at 0400hrs. Completed standard suite of logs early this afternoon. Currently tripping back into the hole to conduct 6hr airlift test.	10" RC Hammer Air	Water production from 292-335m 15-21gpm. Water parameters held steady: Temp= 25.3-26.5˚C, EC=781-790 µS. Currently tripping dual wall drill rods to 220m to complete a 6hr airlift test.	It was determined that the Upper Dripping Springs Quartzite is present from 134.11-274.32m. Contact with the Precambrian Diabase (pЄd) occurred at 274.32m. Diabase consists of 40-50% plagioclase, common magnetite, very trace pyrite, common green and black serpentine alteration.
22-Jul	DHRES-9	J.Kent	334.98	1099.00	0.00	0.00	Tripped in 5-1/2" dual wall drill rods to 220m, and took the water level reading before starting airlift test. Started airlift test at 1730hrs. Completed airlift test at 0152hrs, and started recovery test. Completed recovery test at 1130hrs. Currently tripping out of the hole.	10" RC Hammer Air	Water level prior to start of airlift test was 72.2m below land surface (bls). During the duration of the airlift test water production held steady at 35-45gpm. Water parameters: pH=8.2 EC=820 µS Temp=27˚C. Water level was at 162.43m 15mins after air was shut off. Water level was monitored for 9hrs and recoverd to 99.9m bls.	Diabase (pЄd)

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL DHRES-09

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
23-Jul	DHRES-9	E. Jung	395.94	1299.00	60.96	200.00	Set up and tripped in BHA. Hole was tight from 304.5m - 334.98m (bottom). Resumed drilling at 1900hrs. Took survey at 365.74m Inc 2.0°. Currently drilling.	10" RC Hammer Air	Water production from 335m - 395m 15-20gpm. Water parameters to be included on following report.	Diabase (pЄd) - 40-50% plagioclase, common magnetite, very trace pyrite, common green and black serpentine alteration.
24-Jul	DHRES-9	E. Jung	469.09	1539.00	73.15	240.00	Drilling, making great progress. Took surveys at: 396.22m Inc 3.0°, 426.7m Inc 2.75°, 457.18m Inc 2.5°. Plan to trip for bit at 487.66m, and will switch to a 9 7/8" tricone, flooded reverse.	10" RC Hammer Air	Water production from 395m - 466m 15-19gpm. 466m - 469m 23-27gpm. Water parameters steady near: Temp = 26.2C, EC = 690.	Diabase (pЄd) - black and green diabase with ~55% pyroxene, 45% plagioclase, common magnetite, trace iron oxide staining (hematite), trace green serpentine, trace calcite, (much larger crystals of plagioclase and pyroxene 930-950', some in 950-960'), (very trace pyrite 940, 980, and 1000')
25-Jul	DHRES-9	E. Jung	487.68	1600.00	18.59	61.00	Tripped for bit at487.66m and switched to a 9 7/8 Tri-cone, flooded reverse. Reaming the hole from 61m. Currently reaming/tripping in.	9 7/8 Tri-cone Reverse Flooded	N/A	Diabase (pЄd) 457.18m - 485.83m; 50-60% Plagioclase 40-50% pyroxene; common magnetite, trace biotite, Fe Ox, vein qtz, serpentine, calcite. Dripping Springs Quartzite (pЄds) 485.83m - 486.44m; reddish brown to dark red, fine to medium grained quartzite, common Fe Ox staining. Diabase (pЄd) 486.44m - 487.66m; 50% plagioclase, 50% pyroxene, common magnetite, trace biotite.
26-Jul	DHRES-9	J.Kent	522.73	1715.00	35.05	115.00	Completed tripping in 9-7/8" tri-cone assembly. Set up and circulated on hole; commenced drilling at 2145hrs. Currently drilling making good progress, took two surveys at 487.66m Inc 2.75˚, and 516.63m Inc 2˚.	9 7/8 Tri-cone Reverse Flooded	Drilling reverse flood, water level is holding at ~30m bls.	Diabase (pЄd)-Logger noted trace py in the chips.
27-Jul	DHRES-9	J.Kent	580.64	1905.00	57.91	190.00	Drilling making good progress. Took survey at 548m Inc 2˚. Currently drilling.	9 7/8 Tri-cone Reverse Flooded	Drilling reverse flood, water level in the hole is holding steady. Drillers are keeping water level in hole (while drilling) at ~30m bls.	Diabase (pЄd)-Logger noted trace py is increasing the chips.

APPENDIX B. DAILY DRILLING REPORT SUMMARY FOR HYDROLOGIC TEST WELL DHRES-09

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
28-Jul	DHRES-9	J.Kent	643.13	2110.00	62.48	205.00	Drilling, making great progress. Took surveys at 579m Inc 2.5˚, and 608m Inc 2.5˚. Due to lithology change (see Geology) the current plan is to drill to 663m, and then begin to trip out in preparation for geophysical logging. Anticipate logging tomorrow at 0600hrs.	9 7/8 Tri-cone Reverse Flooded	N/A	Contact between the Diabase and Dripping Springs Quartzite at 621.79m. Contact between the Dripping Springs Quartzite and Pinal Schist at 630.74m. Possible fault (Main Fault) under review from 627.8-630.9m.
29-Jul	DHRES-9	E. Jung	662.94	2175.00	19.81	65.00	Drilled to 662.94m (TD). Cleaned the hole and tripped out for geophysical logging. Geophysical logging conducted between 0600hrs and 1400hrs. All tools were run successfully between 270m - 662.94m. Currently setting up for packer air-lift testing and completion of well. Packer unit due to arrive on site tomorrow am.	9 7/8 Tri-cone Reverse Flooded	Water level = 43.9m bls.	Pinal Schist (pЄpi)
30-Jul	DHRES-9	J.Kent	662.94	2175.00	0.00	0.00	Set up to run packer assembly; tripped in assembly at 0600hrs. Tripped in AQ pipe and commenced air-lift test at 1145hrs.	9 7/8 Tri-cone Reverse Flooded	Water level in the annulus was 44.44m bls. Water production below packer is holding at 4 GPM. Water is very muddy.	Pinal Schist (pЄpi)
31-Jul	DHRES-9	E. Jung	662.94	2175.00	0.00	0.00	Conducted 2 hour air-lift and 2 hour recovery tests beginning at 1245hrs. Tripped out packer assembly and set up to run BQ rods (for gravel pack) and 41/2" blank and slotted casing as per casing schedule. Ran BQ rods to 658.34m. Currently running 41/2" casing.	4 1/2" blank and slotted casing	Packer air-lift test produced 3 gpm for 2 hours. Water was muddy and never cleared. Parameters stabilized near: T = 31.6 C, EC = 660 µS, pH = 8.39. Water level after 2 hour recovery was 41.15m bls.	Pinal Schist (pЄpi)
1-Aug	DHRES-9	A. Jergenson	662.94	2175.00	0.00	0.00	Tripped in 4 1/2" blank and slotted casing per M & A well design. Set up and started gravel pack process, completed pouring in 5 gallon buckets before BQ rods became clogged with gravel. Currently, trouble-shooting to free up gravel in rods.	4 1/2" blank and slotted casing	N/A	Pinal Schist (pЄpi)

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2-Aug	DHRES-9	J.Kent	662.94	2175.00	0.00	0.00	The lower section containing gravel with a bentonite seal is completed 663m-649m. Currently gravel packing first perforated zone 649m-560m. Experiencing some problems with the BQ pipe plugging up while pouring gravel down into the hole, foreman is troubleshooting the problem.	4 1/2" blank and slotted casing	N/A	Pinal Schist (pЄpi)
3-Aug	DHRES-9	A. Jergenson	662.94	2175.00	0.00	0.00	Well construction continues. The second (all from bottom) gravel zone 650-562m, second sand zone 562-560m, and second bentonite zone 560-554m have been completed. The BQ rods have been plugging up less frequently and the process has been running smoother.	4 1/2" blank and slotted casing	N/A	Pinal Schist (pЄpi)
4-Aug	DHRES-9	A. Jergenson	662.94	2175.00	0.00	0.00	Well construction continues. The third perforated zone has been completed, gravel zone 469-554m, also a sand zone 469-467m, and a bentonite zone 467-460m. Currently gravel packing next zone (460-298m).	4 1/2" blank and slotted casing	N/A	Pinal Schist (pЄpi)
5-Aug	DHRES-9	A. Jergenson	662.94	2175.00	0.00	0.00	Well construction continues. The fourth perforated zone has been completed, gravel zone 460-294m, also a bentonite zone 294-291m, and a sand zone 291-289m. Crew is currently working on last, most upper, gravel zone (289-105m). Anticipate completion of the well construction by tomorrow evening.	4 1/2" blank and slotted casing	N/A	Pinal Schist (pЄpi)
6-Aug	DHRES-9	J.Kent	662.94	2175.00	0.00	0.00	Completed well construction; tripped the BQ rods out of the hole in preparation for the airlift test. Tripped in AQ pipe, and waited for the water level to stabilize. Currently running airlift test.	4 1/2" blank and slotted casing	Tripped in 335m of AQ pipe (airline) for the airlift test. Started airlift test after shift change. Initially started pumping at 70gpm, then scaled back to 40gpm.	Pinal Schist (pЄpi)

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7-Aug	DHRES-9	A. Jergenson	662.94	2175.00	0.00	0.00	Airlift and recovery tests completed at 0800hrs. AQ rods tripped out and BQ tripped in, tagged gravel at 110m. Completed well construction up to 98m; gravel zone 289-105m, 105-103.5m, hole plug 103.5-97.5m. Currently, mixing and pouriing cement for upper most portion of well. Crews have begun breaking down the site and staging equipment for mobilization to DHRES-05.	4 1/2" blank and slotted casing	Airlift and recovery tests completed.	Pinal Schist (pЄpi)
8-Aug	DHRES-9	E. Jung	662.94	2175.00	0.00	0.00	Mobilization from DHRES-9 to DHRES-5 continues. Anticipate complete set up by tomorrow afternoon. Site inspections will be set up with Peeks Performance and RCM representatives.	4 1/2" blank and slotted casing	N/A	Pinal Schist (pЄpi)