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BROOK MINING CO., LLC.
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VOLUME V

Appendix D6

Brook Mine
Permit Application
Volume V

Appendix D6

DEQ Exhibit 6

RAMACO

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APPENDIX D6 TEXT

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HYDROLOGY

Appendix D6

Prepared by:
WWC Engineering

July 2015

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D6 HYDROLOGY

Hydrologic sections for RAMACO's Brook Mine were prepared by WWC Engineering (WWC) of Sheridan, Wyoming

D6.1 Surface Water

The following sections provide the information gathered to define the surface-water baseline for the Brook Mine permit area.

D6.1.1 Regional Description

The Brook Mine is located in the upper reaches of the Tongue River drainage basin (Hydrologic Unit Code (HUC) 10090102) near its confluence with Goose Creek. The Tongue River originates in the Bighorn Mountains in north central Wyoming, flows through southeastern Montana where it empties into the Yellowstone River at Miles City. The drainage area for the Tongue River encompasses approximately 5,397 square miles (United States Geological Survey, 2013). Exhibit D6.1-1 shows the Tongue River and Goose Creek drainage basins above the Brook Mine permit area. The main tributaries to Tongue River and Goose Creek on and near the permit area are Slater Creek and Hidden Water Creek. Exhibit D6.1-2 shows the major drainage basin divides in the general area of the Brook Mine permit area.

The Brook Mine is located in the semi-arid west where evaporation exceeds annual precipitation. Climatology for the site is discussed in Appendix D4.

D6.1.2 Drainage Basin Description

Brook Mine is located in the northeastward flowing Tongue River drainage basin as shown on Exhibit D6.1-1. Slater Creek and Hidden Water Creek flow from northwest to southeast and the majority of the runoff from areas within the Brook Mine permit boundary will flow into one of these streams with the remaining runoff flowing into either Tongue River or Goose Creek via a minor tributary as shown on Exhibit D6.1-2. Drainage basin geomorphology for the Brook Mine area is presented in Table D6.1-1.

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The permit area is typical of the Tongue River Basin with rugged terrain in steep-sided, irregular gullies and washes. These types of features continue in each direction from the permit area. The permit area contains portions of valleys for the drainages of Tongue River, Goose Creek, Slater Creek and Hidden Water Creek. These valleys range in width from 200 feet for Hidden Water Creek to 3,500 feet for Tongue River.

The Tongue River drainage system cuts into the Fort Union Formation. Structural and bedrock controls on stream channel orientation are reflected in the sub-dendritic drainage pattern. Tributaries are often oriented parallel to the northwest-to-southeast structural trends, and abrupt changes in channel direction may follow major joint or fault trends. Elevations in the Tongue River drainage basin range from approximately 11,800 feet msl in the headwaters area to approximately 3,600 feet msl at the confluence with Goose Creek. Hidden Water Creek, its minor contributing tributaries and Slater Creek's minor contributing streams are all ephemeral streams. Flows in ephemeral streams are in response to precipitation and snowmelt. These flows are dependent on precipitation frequency-duration relationships and on the characteristics of the contributing drainage areas. Slater Creek is identified as an intermittent stream. Intermittent streams are streams that are below the local water table for some part of the year, but are not perennial streams. In addition to direct runoff due to precipitation, Slater Creek may also have some discharge that comes from infiltration of precipitation into high perched scoria burn above the channel areas that seep into the colluvial/alluvial areas as described in Appendix D11. The water is then stored and slowly released into the surface flow downstream. Based on upstream and downstream flows presented in Addendum D6-4, Slater Creek is likely a losing stream through the permit area. This loss of flow is likely due to the infiltration of flow into the colluvial alluvial material that comprise the channel bottom. Basin characteristics, which control precipitation-runoff characteristics are: area, relief, soil type, vegetative cover and stream length. These parameters are critical in determining the hydrologic and geomorphic characteristics of the drainage basin.

D6.1.3 Surface Runoff Estimates

D6.1.3.1 Regional USGS

There are no long-term streamflow records available for the streams inside of the permit boundary. However, two United States Geological Survey (USGS) gaging stations are located on Tongue River, one USGS gaging station on Goose Creek near the Brook Mine permit area, and one on Slater Creek near Monarch, WY. One Tongue River gaging station is approximately 2.9 miles upstream from the Goose Creek confluence. The second Tongue River gaging station is approximately 27.9 miles below the Goose Creek confluence. The Goose Creek

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gaging station is approximately 11.5 miles above the Tongue River confluence. The Slater Creek gaging station is approximately 0.2 miles above its confluence with Tongue River. Although the gaging stations are not located on the permit area, the data collected by the gaging stations is useful for observing and verifying trends that cannot be obtained with the limited records from the Brook Mine gaging stations alone. Locations of the USGS gaging stations are shown on Exhibit D6.1-1. Information for these gaging stations is presented in Table D6.1-2.

Figure D6.1-1 displays the mean monthly discharge rate at three of the USGS gaging stations. The discharge is typically lowest from August to April and highest from May to June. Table D6.1-3 presents the observed peak annual flows at the USGS gaging stations. During the period of record for the Tongue River gaging station at Monarch WY the peak flow was in June 2007 at 3,910 cfs. The peak flow for the Tongue River gaging station at State Line near Decker MT was in May 1978 at 17,500 cfs. The peak flow for the Goose Creek gaging station below Sheridan WY was in June 1963 at 5,450 cfs. The peak flow for the Slater Creek gaging station was in June 1967 at 1,700 cfs. The timing of these peak flows indicates that snow melt and spring run-off typically result in the highest flows.

D6.1.3.2 Flood Studies

Due to the relatively small drainage areas within the Brook Mine Permit, no USGS stream gages are located on any of the channels within the permit area. Therefore, flood studies were conducted to calculate the peak flow and runoff volumes for the drainage within the permit.

The rainfall-runoff computer program, HEC-HMS (U.S. Army Corps of Engineers, 2009) was used to predict peak discharge and runoff volumes for various recurrence intervals within the permit area. The program was selected due to the range of sizes of the drainage areas, the watershed routing functions available in the program, and the universal acceptance of the program within the hydrologic sciences community. The HEC-HMS model uses a form of the NRCS

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(formerly SCS) Triangular Hydrograph Method, and is a parametric method of estimating flood peaks and runoff volumes from site-specific data, in addition to providing watershed routing parameters. The NRCS method was utilized for the evaluation of individual watershed hydrology, while the Muskingum-Cunge method was used for routing procedures. Existing impoundments (such as stock reservoirs) were not considered in routing of the precipitation events. Impoundments would attenuate peak flows during runoff events. By not considering attenuation of flows through impoundments, the peak flow estimates from HEC-HMS should be conservatively high.

Procedures followed in applying these methods may be found in the HEC-HMS Users Manual (U.S. Army Corps of Engineers, August 2009), HEC-HMS Technical Reference Manual (U.S. Army Corps of Engineers, 2000) and the Design of Small Dams (U.S. Bureau of Reclamation, 1987).

The precipitation values used for surface runoff estimates were determined from the NOAA Atlas No. 2 for Wyoming (National Oceanic and Atmospheric Adminstration, 1973) and are presented in Table D6.1-4. Soil types, land condition and vegetation cover were used to develop a runoff curve number (CN) for each drainage basin. Soil types were obtained from the NRCS Web Soil Survey Program (NRCS Web Soil Survey, 2013). The hydrologic soil groups were used in conjunction with rangeland in fair condition to determine the curve number for each soil type. The curve number for each drainage was determined by area weighting the values for each soil type. Curve numbers utilized are presented in Table D6.1-1.

The HEC-HMS analyses input parameters and results are presented in Addendum D6-1. The surface runoff estimates for the 6-hour and 24-hour storm events are summarized in Table D6.1-5 and Table D6.1-6, respectively.

Runoff calculations for Hidden Water Creek and Slater Creek were also performed using regression equations developed by Miller's equations which were developed through the use of refined analytical techniques to interpret data from 364 selected continuous and partial-records streamflow gaging stations

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that were minimally affected by anthropogenic activities and had at least ten years of annual peak data (Miller, 2003). Instantaneous peak flow data through the year 2000 were also utilized in the analysis. The data were used to provide a correlation between flow characteristics and basin characteristics. The resulting information was transformed into regression equations that provide an analytical tool for estimating peak flow events where no gaging data is available. The regression calculations are provided in Addendum D6-2. A comparison of the runoff estimates using the Miller (2003) and HEC-HMS methods is shown in Table D6.1-7. The HEC-HMS runoff estimates are higher than the estimates using Miller's method due in part to existing reservoirs. The Miller method is based on empirical measurements of Wyoming streams, most of which are affected by existing reservoirs. Aforementioned, the HEC-HMS model did not consider attenuation by existing reservoirs. A report released by the U.S.G.S. examined the floods of May 1978 in southeastern Montana and northeastern Wyoming. This report stated that during the May 1978 flood event, peak flows in the Tongue River basin were measured at approximately the 1-percent-chance (100-year) flood estimates. The flow reported for Slater Creek during this event was approximately 1,100 cfs (United States Geological Survey, 1984). For the 100-year flood, this is more comparable to the Miller method as shown in Table D6.1-7. However, channel hydraulics were calculated using the higher runoff estimates from the HEC-HMS method because of its broad acceptance in the hydrologic community; the flowrates provide for conservative design; and comparable results to the postmining hydrology can be obtained through using HEC-HMS. HEC-HMS will calculate the same storm in the same area repeatedly, as opposed to measurements that only represent a specific period in time under specific drainage basin conditions. The ability to change drainage basin parameters is useful in comparing the change in the postmining hydrologic environment. Channel hydraulics based on the HEC-HMS results are provided in Addendum D6-3.

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D6.1.3.3 Channel Geometry

Premining longitudinal profiles of the streams were determined from flight topography. The topography was generated from LiDAR data collected by Fugro EarthData, Inc. on October 16, 2013. The LiDAR data accuracy meets the National Map Accuracy Standards (U.S. Bureau of the Budget, 1947) for 1"=100' scale, 2' contour interval mapping. The profiles are shown on Exhibit D6.1-3. Some of the minor tributaries exhibit more deeply incised channels and show evidence of localized headcutting. Numerous stock ponds are located along the lengths of some of these tributaries, and they may factor in the presence of headcutting along the tributaries by reducing instream sediment loads.

Hydraulic properties of the Slater Creek and Hidden Water Creek channels were determined using the U.S. Army Corps of Engineer's HEC-RAS© River Analysis System. The primary input parameters to the model were as follows: peak discharge for the 2-year, 24-hour and 100-year, 24-hour precipitation events (as determined by HEC-HMS watershed model); Manning's roughness value "n" for the channel and overbank areas; and station/elevation data for stream cross sections within the study area. The cross section interval utilized in the model is 500 feet to match that of the Reclamation Plan. The cross section information was obtained using the flight topography. Channel hydraulic values for flow depth, water surface width, flow area, manning's "n", hydraulic radius and mean channel velocity can be found in Table D6.1-8. Results of HEC-RAS modeling can be found in Addendum D6-3.

Discussion of channel vegetation, soils and sediment deposits may be found in Appendices D7, D8 and D11; respectively. Table D6.1-1 provides channel geometry information such as sinuosity and channel slope.

D6.1.4 Surface Water Use

A surface water rights search was completed within the permit area and adjacent to the permit area using the Wyoming State Engineer's Office database. The search of the database found 45 reservoir surface water rights and 47 diversion ditch water rights exist within the search area. A summary of the

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surface water features is included in Tables D6.1-9 (Stockponds and Impoundments) and D6.1-10 (Diversions) and are shown on Exhibit D6.1-2. In addition to the permitted surface water rights, 14 additional unpermitted reservoirs were identified. Unpermitted reservoirs have been included in the table and are denoted as such. Refer to Adjudication for a complete list of water rights within and adjacent to the permit area.

Surface water use within the permit area and surrounding area are primarily for livestock watering, with lesser amounts of irrigation, fishing, wetlands and industrial uses. The diversions within the permit area and surrounding area are primarily used for irrigation, with lesser amounts used for domestic, municipal and temporary uses. The number and age of surface water rights provide insight into the historical water and land use in the area. Stock reservoirs account for about 75% of the total reservoir water rights in the search area, but if stock reservoirs not listed in the Wyoming State Engineer's Office database are included, the proportion climbs to about 80% of the total reservoir water rights. Most of the stock reservoirs were constructed before 1970 with the majority still in use today. Irrigation water rights account for approximately 70% of the diversion surface water rights. Approximately 80% of the irrigation rights were permitted between 50 and 100 years ago with recent permits primarily being for diversion enlargements or domestic use.

D6.1.5 Surface Water Monitoring

D6.1.5.1 Monitoring Stations

The Brook Mine established four surface water monitoring stations, two sites on Slater Creek and two sites on Hidden Water Creek. The locations of the monitoring sites are shown on Exhibit D6.1-2. Details on the monitoring stations are summarized in Table D6.1-11. The sites were identified during a preliminary field investigation and discussions with the Wyoming Department of Environmental Quality Land Quality Division. Criteria for each station location included: 1) a straight reach of the channel, 2) the channel should be close to an elevated bank that has a fairly steep grade to ensure the instruments will not be

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flooded, 3) the distance from the center of the channel to the instruments is less than 50 feet (length of sensor cable), and 4) avoid being located in submerged channel reaches (pools).

In September 2013, continuous stage recorders were installed at all four of the sites and an integrated pump sampler at the lower Slater Creek site (SM578418-SW-1). The stage recorders are designed to continuously measure flow. During installation of each station, the cross section and profile of the stream channel at each station was surveyed. The survey data were then used to develop a rating curve, which was programmed into the continuous stage recorder to calculate flow. The pump sampler installed on lower Slater Creek was used to collect water quality samples during runoff events. The pump sampler was initiated by a specific flow stage for flows greater than one foot based on stream geomorphology. The water sample will automatically be collected in a single container located in the instrument. Following the runoff event the water was manually transferred from the container to sample bottles and submitted to the laboratory for analysis.

Surface water monitoring sites were monitored monthly during baseline sampling for structural, mechanical, and electrical integrity of equipment; during site visits by field personnel. These inspections are denoted on the field sheets included in Addendum D6-6. During these site investigations personnel also checked for signs of erosion or debris preventing the proper function of any equipment. If problems were discovered during the site visit they were corrected and denoted in the field sheets. Site visits were also conducted after 2-year, 24-hour or greater storm events. The surface water monitoring stations were removed from the site during the winter to prevent damage to the equipment. The timeframes that the monitoring stations were onsite are as follows: the monitoring stations were installed on September 17 & 30, 2013 and removed for the winter on October 31, 2013; the monitoring stations were reinstalled on April 22 & 24, 2014 and remained for the summer of 2014.

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Wyoming Department of Environmental Quality classifies the Tongue River as a 2AB stream and Earley Creek, Slater Creek, and Hidden Water Creek as 3B. Waters classified as 2AB are suitable for use as drinking water, game fish, non-game fish, fish consumption, other aquatic life, recreation, wildlife, agriculture, industry and scenic value. Waters classified 3B streams are suitable for use of other aquatic life, recreation, wildlife, agriculture, industry, and scenic value.

In addition to the monitoring performed by RAMACO, monitoring of the Tongue River watershed has been conducted by the Sheridan County Conservation District (SCCD), the Big Horn Mine, USGS, and WDEQ/WQD. The SCCD prepared a report outlining water quality of the Tongue River watershed from the confluence with Goose Creek to the Bighorn National Forest boundary (Sheridan County Conservation District, 2012). Data for this report was collected from 1996 through 2010 and included the parameters: water temperature, pH, conductivity, dissolved oxygen, discharge, turbidity and E.Coli. The water quality data obtained for the 2010 monitoring report was generally within expected ranges for several parameters including pH, dissolved oxygen and specific conductivity. Several of the sites experienced an increase in E.Coli bacteria in 2010 compared to samples collected in 2006. However, the increase may be attributed to higher run-off and streamflows experienced during May-June 2010. Generally turbidity values for the 2010 report were normal; however, during the spring and early summer runoff period values were occasionally high.

Sections of the Tongue River near the proposed mine are currently on the Wyoming Department of Environmental Quality's 303(d) list due to impaired water quality. Also Goose Creek has been on the 303(d) list in the past and a Total Maximum Daily Load (TDML) has been set. The 303(d) list is a list compiled by a state that includes impaired and threatened waters for which the effluent limits are not effective in attaining designated uses.

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D6.1.5.2 Surface Water Quantity

The general area surrounding the Brook Mine is characterized by mostly ephemeral streams. The drainage basins convert little precipitation to runoff because of generally dry soil conditions, high evapotranspiration rates, high initial abstractions, stock ponds, and reservoirs. These factors, in addition to low-frequency, low-magnitude precipitation events result in low average annual volume of runoff. A summary of discharge data for the USGS gaging stations on the Tongue River is contained in Section D6.1.3.1.

Hydrographs generated from the data collected from the monitoring stations located on Hidden Water Creek (SM578415-SW-1 and SM578409-SW-1) within the permit area are shown in Addendum D6-4. As shown on these hydrographs, no measurable flows were detected on Hidden Water Creek. Minimum measurable flow rates for these stations are listed on the rating curves included in Addendum D6-5. Flow on Hidden Water Creek is influenced by: the existing mine pits in the upper portions of the Hidden Water Creek drainage, several reservoirs existing in the drainage as shown on Exhibit D6.1-2, and the lack of a significant precipitation event during the monitoring period. The collected data indicates that Hidden Water Creek is an ephemeral stream with flow responses primarily due to large storm events. Flow data from former Big Horn Mine surface monitoring station HWC1-79 supports Hidden Water Creek being a primarily ephemeral stream with the majority of the flows occurring in late winter and early spring. The summarized flow data is in Table D6.1-14 depicted by the number of flow days at HWC1-79. The approximate location for surface monitoring station HWC1-79 appears on Exhibit D6.1-2.

Hydrographs generated from the data collected from the monitoring stations located on Slater Creek (SM578418-SW-1 and SM578512-SW-1) within the permit area are also shown in Addendum D6-4. As shown on these hydrographs, no measurable flows were collected in during baseline monitoring. Minimum measurable flow rates for these stations are listed on the rating curves included in Addendum D6-5. The Slater Creek gages were removed for winter conditions from October 31, 2013 through April 22, 2014. The gages were reinstalled on April 22 and had measureable flows every day through late June as shown in Addendum D6-4. The collected flow rates show typical event durations of three to six days. Slater Creek is above the upper zone of saturation of the adjacent unconfined overburden, which is dry

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and incapable of producing greater than 0.5 gpm of water. This data indicates that Slater Creek is an intermittent stream with flow responses due to snowmelt, rainfall/runoff events and discharge from infiltration of precipitation from high perched scoria burn areas seeping into colluvial and alluvial areas. The data also shows that the recorded peak runoff events for the baseline monitoring occurred on May 8 (SM578418-SW-1) and May 10 (SM578512-SW-1). The peak runoff dates correlates with the typical peak runoff events for Goose Creek and Tongue River as shown in Table D6.1-3.

D6.1.5.3 Surface Water Quality

Water quality data for the general area are available from the USGS gaging stations on Tongue River and Goose Creek. These data are available online from the USGS National Water Information System Web Interface (USGS, 2013). Field samples from USGS station 06299980 Tongue River at Monarch, WY near the permit area were analyzed for multiple parameters. Average water quality from the USGS station indicates a water type of calcium-bicarbonate. Water quality data for the general area can also be found in the aforementioned SCCD report for the Tongue River (Sheridan County Conservation District, 2012).

Water quality samples were collected from two surface water monitoring stations located on Slater Creek. Samples were collected during flow events via an ISCO automatic sampler. In addition, grab samples were also collected at monitoring stations on a quarterly basis if flow was occurring during the quarterly site visit. Samples were obtained in accordance with criteria established in WDEQ/LQD Guideline 8. Due to the low flow nature of the Slater and Hidden Water Creeks only two grab samples were obtained for the baseline water quality. The samples were analyzed for the constituents listed in Table D6.1-12. Table D6.1-12 also includes the analytical method used for the samples. The samples indicate a water type of magnesium-calcium sulfate. The total dissolved solid concentrations were moderately high in the two grab samples obtained. The two samples from Slater Creek indicate no exceedances of Class 3B criteria. All other parameters exhibited low to non-detect values. Summary of the water quality sampling results are listed in Table D6.1-13.

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Addendum D6-6 provides the laboratory results and field sheets for the surface water stations. In addition nine samples were collected from the former Big Horn Mine surface water station, HWC1-79, on Hidden Water Creek. The samples indicate a water type of magnesium sulfate. Some concentrations of aluminum and copper exceed WDEQ standards for aquatic life. A summary of HWC1-79 can be found in Table D6.1-15 and the location can be found on Exhibit D6.1-2.

Field parameters were measured during grab sample events and from events activating the automatic sampler including; pH, electrical conductivity (EC), temperature, turbidity, dissolved oxygen, oxygen reduction potential (ORP), and discharge or water level where appropriate. The results of the field measurements are shown in Table D6.1-13. Field observations have been recorded on the water quality sampling field forms (Addendum D6-6).

The laboratory analysis of collected grab and flow event water samples was conducted by a contracted laboratory. A quality assurance and quality control program was adhered to which included comparison of field EC to laboratory EC, comparison of field turbidity to laboratory turbidity, comparison of measured TDS to calculated TDS, ion balance analysis and holding time/preservation evaluations. The laboratory reports, field sheets, and chain of custodies (COCs) for the surface water monitoring are also included in Addendum D6-6.

D6.1.5.4 Sediment Transport

A water quality sample was taken for the downstream Slater Creek gaging station (SM578418-SW-1). This station reported a total suspended solids (TSS) of 9 mg/l. Another sample was collected in June 1967 at the USGS Station on Slater Creek. The sample reported a flow of 18 cfs, TSS of 11,600 mg/L and a suspended sediment discharge of 564 tons/day. A summary of the collected TSS data is shown in Table D6.1-13 and included in Addendum D6-6. No discharges occurred for Hidden Water Creek during the baseline monitoring period. Only a single downstream water quality sample was collected during the baseline monitoring program.

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D6.2 Groundwater

The following is a brief description of the geologic setting at the Brook Mine as it relates to groundwater hydrology. Appendix D5 contains a more detailed description of the geologic setting.

D6.2.1 Regional Hydrogeology

The Brook Mine permit area is located in the Tongue River Member of the Fort Union Formation and is underlain by the Lebo Shale Member of the Fort Union Formation as discussed in Appendix D5. The Ground-Water Resources of Sheridan County, Wyoming (USGS, 1966) identified the Fort Union formation as continental deposits of light-colored sandstone, dark-colored shale, and coal. Coal is the only regional shallow (less than 1000') aquifer that has sufficient quantities of water for domestic and stock use, and which is continuous enough to be considered a regional aquifer. The Tongue River Member and the Lebo Shale Member are interbedded sandstones and claystones and not continuous enough to be considered a regional aquifer.

The structure of the basin and local topography are the main factors controlling groundwater movement within the Powder River Basin. On a regional basis, flow moves from peripheral recharge areas (Clinker outcrops) toward the center of the basin. Locally, shallow groundwater movement is affected by topography. Infiltrating water falling on topographically high areas generally moves downward and laterally in the overburden. Depending on the local geology, this results in water in the overburden system recharging the coal or discharging to nearby valleys. The water reaching the coal through the overburden system also generally moves downward and laterally to discharge areas in nearby valleys.

D6.2.1.1 Local Hydrogeology

There are three potential hydrogeologic units at the Brook Mine: the Carney seam, the Masters seam; and the underburden. Of these three units, only the Carney seam and the Masters seam appear to be significant units. The

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overburden is comprised of sand lenses, clinker and alluvial that has the potential of being water bearing bodies. The topography in this area the valley cut and faulting through these deposits provide enough discontinuity to preclude holding large quantities of water. Addendum D5-2 contains electric logs with resistivity data that demonstrates the overburden is dry. In review of those lithologic logs it is noted that the overburden is mostly dry except for a few boreholes where the alluvium/colluvium and burn materials indicated the presence of water. These areas of saturation are generally shallow, less than 30 feet below the ground surface, and generally occur near streams within the permit area. The alluvial system is discussed in D11. Detailed cross sections of the permit area geology are shown in Appendix D5. These sections show the geologic units, geologic features and existing surface. Exhibit D6.2-1 shows the monitor well sites while Exhibits D6.2-2 and D6.2-3 show potentiometric surfaces, recharge/discharge areas and approximate coal outcrop and edge of saturation boundaries for the Masters and Carney coal seams. Appendix D11 contains an exhibit showing the potentiometric surface and recharge/discharge areas of the alluvial materials. Supporting data used in developing the geologic cross sections including geophysical logs and/or lithologic logs can be found in Appendix D5.

D6.2.2 Baseline Monitoring Plan

Groundwater monitoring began in October of 2013 and was conducted on a quarterly basis. The baseline groundwater quality samples and static water levels were obtained for four consecutive quarters and the monthly water level data was obtained from alluvial monitor wells for a duration of one year. The locations of the monitor wells used to characterize baseline are shown on Exhibit D6.2-1. Monitor well completion information is submitted in Addendum D6-7.

D6.2.2.1 Monitor Well Construction, Completion and Development

Construction of the baseline groundwater monitoring network began in the third quarter of 2013 and was completed early in the fourth quarter 2013. In accordance with SEO Policy memo dated March 12, 2013 "Permitting Requirements for Groundwater Monitoring Well" (SEO, 2013) the monitor wells were not permitted with the State Engineer's Office. The groundwater monitoring network consists of 9 Carney coal wells, 9 Masters coal wells, 3 alluvium wells, 1 underburden well and 1 well perforated in both the Masters and Carney coal seams. No monitoring wells were completed in the overburden or interburden as no water was found in these units during drilling operations. Addendum D5-2

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contains drilling logs and resistivity logs that demonstrate the overburden and interburden are dry, the locations of the drill holes can be found on Addendum D5-3 Exhibit 1. Also, one well 578409-MST-UB showed the presence of water in the underburden. An aquifer for this application is defined as a drilled hole capable of producing 0.5 gpm or greater. Locations and depths of monitoring well/piezometer installations are provided in Table D6.2-1 and the locations are depicted on Exhibit D6.2-1.

The Groundwater monitor wells/piezometers were completed using air rotary methods in accordance with WDEQ/LQD guidelines. Construction of the monitoring wells consisted of the following. A pilot hole was drilled and logged as it progresses through each stratigraphic layer. When the geologic formation was determined to be an aquifer a monitor well/piezometer was completed in that aquifer as follows: the pilot hole was reamed to the appropriate diameter, and casing and factory slotted screen was installed. Coal wells did not require filter pack, and were constructed with a cement basket at the top of the screened interval to hold the annular sealant, which consisted of hydrated bentonite chips. Centralizers were installed at the top and approximately every 20 feet within screened intervals.

In a July 15, 2013 meeting between RAMACO and WDEQ/LQD to discuss acquisition of baseline at RAMACO's Brook Mine property, it was the consensus of the group, based on recent and historical drilling, that areas of the RAMACO Brook Mine Property contain limited groundwater resources and could be dry. The group agreed that installation of 2-inch diameter piezometers in core holes following core retrieval could be used to demonstrate the absence or presence of groundwater in the various coal seams and overlying intervals. This was performed on wells 578417-MST, 578417-CRN, 578408-MST and 578408-CRN. See Table D6.2-1 for an explanation of which cores holes were utilized for this. The procedure for this was as follows.

Coring operations consisted of a pilot hole that was drilled, geophysically logged, and plugged with bentonite chips. Core intervals were selected from

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geophysical logs, and a core hole was drilled approximately 20 feet from the pilot hole. Following coring, the core hole was plugged with bentonite chips except when a coring location was selected for piezometer installation. The piezometer screened interval was selected from the geophysical log. The core hole was completed and, depending upon the interval to be screened, the lower portion of the hole was plugged. As an example, if the core hole extended to the base of the Masters coal bed, and the piezometer was to be completed in the overlying Carney coal bed, the interval from the base of the Master coal to the base of the Carney was plugged with bentonite chips to hydraulically isolate the two coal beds. During plugging operations, the volume of the hole to be plugged was measured against the volume of bentonite chips placed to ensure that the bentonite chip seal was intact and bridging had not occurred. A weighted measuring line was also used to tag the top of the bentonite plug to verify proper placement. Following plugging, two-inch diameter threaded, flush casing and screen was installed. The screened interval contained one centralizer every 20 feet, and in smaller intervals, at least one centralize was used. The screen was placed opposite the entire target interval with a screen slot size of 0.020-inch. Filter pack consisted of 8-12 silica sand across and slightly above the screened interval. The remaining portion of the piezometer was sealed with bentonite chips, hydrated in 5 foot lifts. The piezometer was completed with a lockable metal protective casing set in cement.

The monitor well inspection and maintenance program was conducted throughout baseline monitoring. Site visits were conducted quarterly and if problems were discovered during site visits they were immediately fixed and denoted on the field sheets. The monitoring program consisted of the following inspection items 1) measurement of total depth compared with original completion depth to determine whether the well has silted up or the casing has failed, 2) checking surface seal and casing integrity which includes shaking the well to check for seal integrity, inspecting the seal for cracks and animal burrows, and checking ventilation/drain holes for plugging, 3) listening for trickling, bubbling or gas venting sounds, 4) checking historic data for abnormal

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water level trends, and 5) conducting well efficiency tests on wells suspected of blocked perforations or screens.

D6.2.2.2 Aquifer Tests

Aquifer pumping tests were conducted on the section 9 cluster wells located in the SESE quarter quarter of section 9, Township 57 north, Range 84 west. Selection of this cluster of wells was primarily in response to discussion with WDEQ and analysis of historic well data surrounding the permit area. Historic data characterized the coals seam within the western portion of the permit area as being dry; therefore, an eastern cluster of wells were selected for the tests. The section 9 cluster wells consist of two wells in the Carney seam, two wells in the Masters seam and one well in the underburden. As previously discussed, no wells were completed in the overburden or interburden since water was not encountered in these strata during drilling operations. Three alluvial wells were completed in Slater Creek and water levels were monitored quarterly.

During the aquifer tests, water levels in the alluvial aquifer were not observed. This was due to no alluvial material being present in the vicinity of the aquifer tests. The nearest potentially alluvial material to the tested well cluster was Hidden Water Creek to the east; however, as noted in Appendix D11, the fill material in the Hidden Water Creek channel is more colluvial than alluvial. As displayed by the absence of alluvial pump test in the Big Horn Coal Permit No. 213, alluvial pump tests were only conducted on the Tongue River and Goose Creek. Additional reasoning for not monitoring the alluvial wells is the presence of multiple claystone intervals between the Carney coal and the surface. The top of the Carney coal is approximately 90 feet below ground surface, which makes it approximately 50 feet below the level of any colluvial/alluvial deposits in Hidden Water Creek. Similarly, the potentiometric head in the Carney coal is approximately 50 feet below the level of colluvial/alluvial deposits in Hidden Water Creek and if there were a direct hydraulic connection, there would be no water in the Hidden Water Creek colluvium/alluvium. Given the confining intervals and the significant difference in potentiometric head between the Carney coal in the Hidden Water Creek colluvium/alluvium, additional shallow monitoring above the Carney coal was not necessary. Due to the confining intervals and the difference in potentiometric heads, aquifer tests were not conducted in the alluvial wells. The confining claystone intervals provide a barrier from mining activities impacting the alluvial aquifer; therefore, the presence of the confining intervals preclude the need for aquifer tests in the alluvial aquifer. As noted in Addendum MP-3,

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coal bed natural gas (CBNG) dewatering efforts have resulted in decreased water levels in the coals. However, all CBNG dewatering efforts have occurred approximately 2 miles away from the wells utilized for aquifer testing. Given the relatively low transmissivity of the coal it is unlikely that the CBNG dewatering efforts have significantly affected water levels in the wells utilized for the aquifer tests. The water levels measured in the Carney coal during the aquifer test demonstrate that the Carney coal is confined (see Addendum D6-8). If the drawdowns from CBNG dewatering were significant it is unlikely that the coal aquifer would still be confined.

Only one underburden well was evaluated during the testing since the other wells drilled into the underburden were dry during drilling. Separate multi-well pumping tests were conducted in the wells completed in the Masters and Carney seams. A report of these tests can be found in Addendum D6-8 and a summary tabulation of the aquifer test results is included in Table D6.2-2.

The results as stated in Table D6.2-1 are comparable with measured coal aquifer properties at other mines in the vicinity. Big Horn Coal Company reported transmissivities ranging from 0.13-100 ft^2/day and a storage coefficient of $1.4x10^{-4}$ for the Monarch coal in their DEQ permit (no. 213). Similarly in the Dietz 3 seam Big Horn Coal Company reported transmissivities ranging from 0.26-93 ft^2/day and a storage coefficient of $1.4x10^{-4}$. The aquifer test results from the Youngs Creek Mine DEQ permit (no. 406) in Sheridan County indicate average transmissivity (with an outlier thrown out) of about 24 gpd/ft.

D6.2.2.3 Water Levels

Potentiometric surfaces may be found on Exhibits D6.2-2 and D6.2-3. Water level measurements made quarterly during baseline monitoring may also be found in Addendum D6-9. As is shown by the data the Masters and Carney coal seams have varying water levels (typically 20'-60' difference). This difference suggests that the claystone interburden between the coal seams can be assumed to be a confining interval.

D6.2.2.4 Premining Potentiometric Surface

Premining potentiometric surface exhibits for the Masters Coal and Carney Coal seams are shown on Exhibit D6.2-2 and Exhibit D6.2-3, respectively. These exhibits characterize computed average water levels prepared from water level measurements obtained during baseline monitoring (Fall 2013 though Fall 2014) and applicable data from nearby domestic and stock wells as provided by the Wyoming SEO website. Research was also conducted utilizing

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the Wyoming Oil and Gas Conservation Commission (WOGCC) database and other nearby coal mines; however the additional information was difficult to utilize in development of the potentiometric surfaces due to distance, completion intervals, extraneous impacts such as CBNG development, etc. Aquifer properties for the non-coal portion of the minable sequence are generally very poor. Sandstone intervals within the permit area, as desirable for development of groundwater resources, are typically thin and discontinuous. Additionally, where these strata lie stratigraphically higher than the Tongue River or Slater Creek valley floors, they generally lack any significant water content. Therefore, potentiometric surfaces were not prepared for the overburden, interburden or underburden. Refer to Appendix D11 for the discussion of alluvial valley floors.

Groundwater movement in both the Carney and Masters coal seams is generally northwest to southeast with local movement in the permit area north to south resulting from faulting. The direction of flow within the coal seams generally follows the geologic dip. Measured values of transmissivity from the Brook Mine area can be found in the aquifer testing data included in Section D6.2.2.2. Zones of high permeability are reflected by wide spacing of potentiometric surface contours, while zones of low permeability are reflected by closely spaced potentiometric surface contours. The groundwater gradient within the Masters and Carney seams ranges from approximately 0.02 ft/ft to 0.009 ft/ft and 0.02 ft/ft to 0.008 ft/ft, respectively within the Brook Mine area. Groundwater velocities are low ranging from approximately 2 – 4 ft/year in the Masters Coal and 1 to 2.5 ft/year in the Carney Coal. The Masters seam is generally confined in the permit area, although some areas of the mine are unconfined near surface outcrops, in stratigraphic highs, and near recent CBNG development. The Carney seam; however, is generally unconfined in the permit area due to substantial outcropping, faulting, limited recharge sources, and CBNG development. Available information indicates both the Carney and Masters coal seams are in a semi-confined state and are not single continuous aquifers within the permit area.

CBNG production has affected the potentiometric surface prior to baseline monitoring on the eastern edge of the permit area. CBNG development and production largely occurred from 2000 thru 2012. Based on a comparison of pre- and post-CBNG water levels from Big Horn Coal monitor wells, the potentiometric surface in the eastern portion of the permit area has been lowered by approximately 40-80 feet since CBNG development began. Since it has been several years since Big Horn Coal has been active and the CBNG development has occurred since Big Horn Coal activities ceased, any water level drawdowns that may have been induced from mining operations have been superseded by CBNG drawdowns.

D6.2.2.5 Recharge and Discharge Areas

Premining potentiometric surface exhibits for the Masters Coal and Carney Coal seams are shown on Exhibit D6.2-2 and Exhibit D6.2-3, respectively. The approximate outcrop line for the Carney coal seam is shown on Exhibit D6.2-3. Water in the Brook Mine hydrologic system generally recharges in the northwest and then flows down the geologic dip to the southeast although

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interrupted frequently from a series of normal faults perpendicular to the direction of groundwater flow. As is shown by the outcrop line in Exhibit D6.2-3, additional areas of recharge and discharge exist on the Carney coal seam on the western portion of the Brook Mine permit area. Generally, the Carney coal is dry or only has a minimal amount of water in it along the western portion of the Brook Mine permit area. Therefore, there is only a minimal amount of discharge from the Carney coal within the permit area. No other areas of discharge for either the Carney or the Masters coal exist within the permit area. Sources of recharge for the Carney seam include clinker, locally known as scoria, that is in communication with the coal seam; historic surface mine pits (where the Carney Seam was mined) north of the permit area; regions where the Carney seam subcrops into either Slater Creek or Tongue River alluvial material; and infiltration from precipitation on the Monarch burn stratigraphically higher than the Carney seam. Recharge within the permit area is described in more detail within Section 2.6.1 of Addendum MP-3. As shown on Exhibit D6.2-2 the Masters seam does not outcrop in the permit area; however, it may subcrop into Slater Creek alluvial/colluvial materials. Sources of recharge for the Masters seam can then be assumed to include infiltration from overlying strata, communication with river alluvium and seam outcrops west of the Permit area. Both the Masters and Carney coal seams trend downward in a generally southeast direction. Surface and groundwater interactions are discussed in the groundwater model in the mine plan.

While different soil types are expected to have variable infiltration rates, the only infiltration rate that is significant for the coal aquifers is the infiltration rate assigned to the strata near the outcrop of the coal seams. Throughout the permit area, the strata overlying the coal aquifer are generally dry. Therefore the primary source of recharge occurs at the outcrops. Scoria, in particular, plays a significant role in recharge of the coal seams because it usually occurs near the coal outcrop. Because of its highly permeable characteristics, most of the precipitation that falls on the scoria infiltrates into the scoria where it either infiltrates into the coal or discharges along a seep line at the base of the scoria. Ash material between the base of the scoria and the coal seams sometimes limits how much of the water in the scoria actually comes into direct contact with the coal. Nevertheless, because a large percentage of precipitation falling on the scoria infiltrates into it, the scoria does provide a consistent water source for recharge into the coal outcrops. Within the permit area, there are several locations where the coal seams outcrop as well. Since the strata overlying the coal seams to be mined are generally dry, the recharge component from the

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overburden to the coal is very low away from the outcrop areas. Because of the limited hydrologic interaction between the recharge at the surface and the coal in areas away from the outcrop, site specific changes in the recharge rates based on soil type will not impact the coal aquifers. For this reason, additional analysis of the infiltration properties of the soils within the permit area represents a level of detail that is not necessary to describe the hydrologic impacts to the coal aquifers from the proposed mining operations. Detailed descriptions of soil properties within the permit area are provided in Appendix D7.

Seeps and springs have been observed on the property, specifically in T57N R85W section 12. The springs are primarily the result of water seeping out from the contact of discontinuous saturated clinker knobs and the vuggy low permeable clay below the clinker.

D6.2.2.6 Regional Vertical Leakage and Infiltration

As indicated from the pumping test in Addendum D6-8 and as discussed earlier, the overburden and interburden are largely dry and the underburden is predominantly dry in and near the permit area where it lies stratigraphically higher than the Tongue River. Based on this information, vertical leakage through the minable sequence in the permit area is minimal. Large regions of Monarch clinker likely provide substantial infiltration zones; however, due to their perched nature, the majority of the infiltration likely escapes into the surface water system and only a small percentage is assumed to provide recharge to underlying coals.

Hydrographs of wells completed in the Carney coal seam and Masters coal seam do not show any distinct seasonal recharge-discharge effects. No general recharge or discharge trends are noticeable and all data seem to support the conclusion that the Carney coal seam and Masters coal seam are of limited extent and little hydraulic connection. Collected groundwater elevations and hydrographs of the groundwater wells are found in Addendum D6-9.

D6.2.3 Baseline Groundwater Quality

Numerous groundwater samples have been collected from wells within and adjacent to the permit area and have been analyzed for the constituents and

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methods shown in Table D6.1-12. Groundwater samples were collected on a quarterly basis as shown in Addendum D6-10. The Brook Mine adhered to the following procedures and protocols for groundwater quality and quantity monitoring:

- A water level, total depth measurement and well head inspection was completed at each monitoring event for each well monitored.
- All wells were pumped at the rate required to evacuate the casing of stagnant water and draw in at least three casing volumes of formation water.
- In low yield wells (those that produce 0.5 gpm or less during well development), it was not practical to purge three casing volumes prior to sampling. In low yielding wells, low flow sampling methods were employed.
- Field observations were recorded on the water quality sampling field forms.
- Field parameters such as pH, EC, temperature, dissolved oxygen and turbidity were measured throughout purging to determine geochemical stability. Three values with less than 10% difference indicated that the water was a stable representation of the aquifer, and samples were collected.
- Field filtered and preserved samples were collected in clean, unused plastic and or glass containers provided by the contract laboratory.
- Samples were kept on ice until arrival at the laboratory (no more than two days following sample collection). The laboratory analytical procedures used and constituents analyzed by the lab are presented in Table D6.1-12. Lab COCs are included in Addendum D6-10.
- A quality assurance and quality control program was adhered to which included comparison of field EC to laboratory EC, comparison of field turbidity to laboratory turbidity, comparison of measured TDS to calculated TDS, ion balance analysis and holding time/preservation evaluations.

The groundwater quality analyses results are tabulated and presented in Tables D6.2-3 through D6.2-7. In general, groundwater quality varies with respect to each of the geologic units and the location within any given unit in the mine permit area. Groundwater quality data recorded during the baseline monitoring period indicate that all groundwater in the permit area is suitable only for livestock watering according to WDEQ/WQD Rules and Regulations

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Chapter 8 underground water class standards and also generally meets EPA Primary maximum contaminant levels (MCLs) but not EPA secondary MCLs. This is shown in Tables D6.2-8 through D6.2-17. The constituents that most frequently exceed the standard concentration limitations are ammonia, total dissolved solids (TDS), sulfate, and manganese. Other constituents that exceed standards at one or more sites include sodium absorption ratio (SAR) and iron. A piper diagram of the groundwater wells with measured values is presented in Figure D6.2-1. As can be seen in the tabular results and the figure, the water quality in the coal aquifers is variable. This is attributed to the strike and dip of the coal, the presence of several faults, the location of coal recharge areas next to outcrops and the transitioning of the coal aquifers from confined to unconfined within the permit area.

The water quality data was also reviewed to determine if any surface water and groundwater interactions exist. During baseline monitoring, a single water quality sample was taken from surface water flows for the two gaging stations located along Slater Creek. No samples were taken for Hidden Water Creek due to a no-flow condition. Therefore only the wells in the Slater Creek drainage may be used as comparison for surface water groundwater interaction. Also, as discussed previously the Masters coal seam underlies the Carney coal seam and the interburden is dry, which indicates that if surface water groundwater interaction were to occur it would only occur in the Carney coal seam. As shown by Tables D6.2-3 through D6.2-7 all Carney coal wells in the Slater Creek drainage were dry during baseline monitoring except well 578511-CRN. The water type of this well was sodium sulfate. Comparing the water quality data for this well and the surface water quality samples for Slater Creek (magnesium-calcium sulfate water type) indicates no discernible patterns. Based on this information, a significant surface water groundwater interaction in the Permit area does not exist.

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D6.2.4 Groundwater Rights

Adjacent and on-site groundwater rights are listed in Appendix B in the Adjudication Volume in detail. Table D6.2-18 provides a summary of the number of groundwater wells within the permit boundary and the adjacent three-mile buffer. The table shows the total number of wells and splits the wells into categories according to usage. Additionally, Table D6.2-18 provides the groundwater well use by percentage. As shown in the table, the water uses of groundwater wells in the vicinity include irrigation, coal bed methane, stock watering, domestic, industrial and miscellaneous uses. The predominant water use (24%) is for domestic use. Monitoring wells were excluded from the table due to their lack of consumptive use. In addition, not all wells included in the list are actively used. Wells identified as potentially located in the target coal seams and that could be possibly impacted by mining activities are discussed further in the Mine Plan Addendum MP-3.

D6.2.5 Groundwater Models

A groundwater model was conducted in 2014 by WWC. The purpose of the model was to predict drawdown in the coal aquifer due to mining the Brook Mine Area. The groundwater flow model is included in the Mine Plan.

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D6.3 References

Miller, K. A. (2003). *Peak-Flow Characteristics of Wyoming Streams: Water-Resources Investigations Report 03-4107.* Cheyenne, Wyoming: U.S. Department of the Interior, U.S. Geological Survey

National Oceanic and Atmospheric Adminstration. (1973). *Precipitation Frequency Atlas of the Western United States* (Wyoming ed., Vol. II). U.S. Department of Commerce.

NRCS Web Soil Survey. (2013). *Custom Soil Resource Report for Area of Interest.* Retrieved from http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx

Sheridan County Conservation District. (2010). *Tongue River Watershed Interim Monitoring Project.* August 2012. Sheridan, WY.

State Engineer's Office (2013). *Policy Memo: Permitting Requirements for Groundwater Monitoring Wells* Retrieved from http://seo.wyo.gov/regulations-instructions

U.S. Army Corps of Engineers. (2000). *Hydrologic Modeling System: HEC-HMS Technical Reference Manual.* Retrieved October 2014, from Hydrologic Engineering Center: http://www.hec.usace.army.mil/software/hec-hms/documentation/HEC-HMS_Technical%20Reference%20Manual_%28CPD-74B%29.pdf

U.S. Army Corps of Engineers. (2009). *Hydrologic Modeling System (HEC-HMS).*(Version 3.4) [Computer Program]

U.S. Army Corps of Engineers. (August 2009). *Hydrologic Modeling System: HEC-HMS User's Manual (Version 3.4).* Retrieved October 2014, from Hydrologic Engineering Center: http://www.hec.usace.army.mil/software/hec-hms/documentation/HEC-HMS_Users_Manual_3.4.pdf

U.S. Army Corps of Engineers. (2010). *Hydrologic Engineering Center River Analysis System (HEC-RAS).*(Version 4.1) [Computer Program]

U.S. Bureau of Reclamation. (1987). *Design of Small Dams* Third Edition, 1987. Washington D.C.

U.S. Bureau of the Budget. (1947). United States National Map Accuracy Standards. Retrieved from http://nationalmap.gov/standards/pdf/NMAS647.PDF

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United States Geological Survey (1966). *Ground-Water Resources of Sheridan County, Wyoming* Retrieved http://pubs.er.usgs.gov/publication/wsp1807

United States Geological Survey (1984). *Floods of May 1978 in Southeastern Montana and Northeastern Wyoming.* Retrieved from http://pubs.usgs.gov/pp/1244/report.pdf

United States Geological Survey (2013). *National Water Information System: Web Interface* Retrieved from http://waterdata.usgs.gov/nwis

Water Quality Division Surface Water Standards (2001). *Wyoming Surface Water Classification List* Retrieved from http://deq.state.wy.us/wqd/watershed/surfacestandards/

Wyoming Department of Environmental Quality/Land Quality Division (WDEQ/LQD). (2014, January). *Guideline Number 8: Hydrology.* Retrieved 2014, from http://deq.state.wy.us/lqd/downloads/Guidelines/Guideline_8_(1_2014).pdf

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APPENDIX D6 TABLES

Table D6.1-1. Drainage Basin Characteristics

Drainage Basin Designation[2]	Watershed Area (ac)	Basin Length (mi)	Valley Length (mi)	Channel Length (mi)	Basin Relief (ft)	Valley Relief (ft)	Channel Relief (ft)	Total Stream Length (mi)	Basin Relief Ratio (ft/ft)	Valley Slope (ft/mi)	Channel Slope (ft/mi)	Channel Sinuosity	Drainage Density (mi/mi^2)	Curve No.
TR1	154.6	0.76	0.71	0.73	300	160	160	0.73	0.07	226	221	1.02	3.00	74
TR2	334.5	1.41	1.48	1.59	460	270	270	1.59	0.06	183	169	1.08	3.05	72
TRD1	25.1	0.38	0.31	0.31	260	210	210	0.31	0.13	675	672	1.01	7.97	72
TRD2	328.2	1.50	1.34	1.44	435	275	275	1.44	0.05	206	191	1.08	2.81	73
TRD3	378.6	1.61	1.65	1.77	445	375	375	2.27	0.05	227	212	1.07	3.84	71
TRD4	172.8	0.91	0.46	0.50	230	80	80	0.50	0.05	173	160	1.08	1.85	83
TRD5	593.1	1.73	1.56	1.64	300	200	200	2.86	0.03	128	122	1.05	3.08	84
SLATER CREEK	10532.6	10.60	10.63	14.20	1600	1100	1100	54.72	0.03	103	77	1.34	3.30	79
SCSUB1	270.6	1.20	1.20	1.23	375	265	265	1.74	0.06	222	215	1.03	4.11	77
SCSUB2	259.2	0.95	0.83	0.86	405	185	185	1.35	0.08	223	215	1.04	3.34	75
SCSUB3	198.8	0.98	0.91	0.95	300	230	230	0.95	0.06	252	242	1.04	3.06	76
SCSUB4	219.5	0.85	0.86	0.92	205	115	115	1.60	0.05	134	125	1.07	4.65	84
SCSUB5	81.3	0.62	0.62	0.62	290	180	180	0.62	0.09	289	289	1.00	4.91	75
EFEC	1178.1	3.63	3.40	3.82	520	310	310	4.81	0.03	91	81	1.12	2.61	87
HIDDEN WATER CREEK	5113.2	6.27	7.04	7.82	885	805	805	25.05	0.03	114	103	1.11	3.14	76
HWCSUB1	120.6	0.68	0.51	0.52	220	130	130	0.52	0.06	257	251	1.02	2.75	76
HWCSUB2	91	0.58	0.31	0.33	190	115	115	0.33	0.06	368	352	1.04	2.30	77
HWCSUB3	46.4	0.71	0.54	0.56	260	200	200	0.56	0.07	373	360	1.03	7.66	76
HWCSUB4	112	0.95	0.71	0.72	380	250	250	0.72	0.08	353	345	1.02	4.14	75
HWCSUB5	76.2	0.62	0.59	0.60	340	230	230	0.60	0.10	391	382	1.02	5.06	76
GC1	219.3	1.17	0.83	1.07	220	120	120	1.07	0.04	144	112	1.28	3.12	81

Notes: [1]Drainage basin characteristics are based on USGS Quads except for drainage GC1. Drainage GC1 is based on flight topography.

[2]Refer to Exhibit D6.1-2 for drainage basin designation.

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Table D6.1-2. USGS Gaging Station Data

Parameter	USGS Gaging Station			
	06299980	06306300	06305500	06299900
	Tongue River at Monarch WY	Tongue River at State Line nr Decker MT	Goose Creek Below Sheridan, WY	Slater Creek Near Monarch, WY
Drainage Area (mi^2)	478	1,453	392	18
Mean Annual Discharge (cfs)	249	441	184	NA
Mean Annual Flow (ac-ft)	180,300	319,300	133,200	NA
Period of Record	2004-2013	1960-2013	1941-1984	1967-1981
Latitude	44.90028	45.00914	44.82250	44.90889
Longitude	107.02028	106.83594	106.96194	107.04694

Source: USGS National Water Information System: Web Interface

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DEQ 6-039

Table D6.1-3. Annual Peak Streamflows

Water Year	Tongue River at Monarch WY		Tongue River at State Line near Decker		Goose Creek Below Sheridan, WY		Slater Creek near Monarch, WY	
	Date	Stream flow (cfs)	Date	Stream flow (cfs)	Date	Streamf low (cfs)	Date	Streamf low (cfs)
1942	ND	ND	ND	ND	27-May-42	1,650	ND	ND
1943	ND	ND	ND	ND	13-Jun-43	1,380	ND	ND
1944	ND	ND	ND	ND	4-Jun-44	4,040	ND	ND
1945	ND	ND	ND	ND	24-Jun-45	2,270	ND	ND
1946	ND	ND	ND	ND	25-Jun-46	2,780	ND	ND
1947	ND	ND	ND	ND	22-Jun-47	1,440	ND	ND
1948	ND	ND	ND	ND	23-Jun-48	2,340	ND	ND
1949	ND	ND	ND	ND	8-Jun-49	1,680	ND	ND
1950	ND	ND	ND	ND	15-Jun-50	1,120	ND	ND
1951	ND	ND	ND	ND	11-Jun-51	1,120	ND	ND
1952	ND	ND	ND	ND	7-Jun-52	1,690	ND	ND
1953	ND	ND	ND	ND	15-Jun-53	2,370	ND	ND
1954	ND	ND	ND	ND	23-May-54	591	ND	ND
1955	ND	ND	ND	ND	26-Jun-55	1,300	ND	ND
1956	ND	ND	ND	ND	29-May-56	3,360	ND	ND
1957	ND	ND	ND	ND	17-Jun-57	1,830	ND	ND
1958	ND	ND	ND	ND	24-May-58	1,080	ND	ND
1959	ND	ND	ND	ND	8-Jun-59	1,130	ND	ND
1960	ND	ND	ND	ND	19-Mar-60	600[e]	ND	ND
1961	ND	ND	30-May-61	1,720	30-May-61	939	ND	ND
1962	ND	ND	17-Jun-62	4,560	16-Jun-62	2,960	ND	ND
1963	ND	ND	16-Jun-63	6,080	16-Jun-63	5,450	ND	ND
1964	ND	ND	10-Jun-64	5,990	9-Jun-64	3,630[ud]	ND	ND
1965	ND	ND	14-Jun-65	3,510	14-Jun-65	1,450[ud]	ND	ND
1966	ND	ND	8-May-66	1,920	8-May-66	436[ud]	ND	ND
1967	ND	ND	15-Jun-67	7,480	14-Jun-67	4,050[ud]	15-Jun-67	1,700
1968	ND	ND	10-Jun-68	5,710	9-Jun-68	2,300[d]	2-Sep-68	1,140
1969	ND	ND	19-Mar-69	4,500[e]	27-May-69	886[d]	27-Apr-69	180
1970	ND	ND	14-Jun-70	4,190	15-Jun-70	1,670[d]	8-May-70	910
1971	ND	ND	31-May-71	3,110	14-Jun-71	1,460[d]	24-Apr-71	399
1972	ND	ND	22-May-72	2,590	10-Jun-72	1,070[d]	Mar-72	245
1973	ND	ND	21-May-73	3,810	10-Jun-73	2,180[d]	Apr-73	62
1974	ND	ND	29-May-74	2,900	17-Jun-74	1,330[d]	Mar-74	122
1975	ND	ND	22-Jun-75	5,350	21-Jun-75	2,560[d]	21-Jun-75	370
1976	ND	ND	6-Jun-76	2,140	7-Jun-76	986[d]	2-Aug-76	90
1977	ND	ND	11-May-77	3,230	5-Jun-77	806[d]	9-Apr-77	180
1978	ND	ND	19-May-78	17,500	18-May-78	5,430[d]	18-May-78	1,100

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Table D6.1-3. Annual Peak Streamflows (Continued)

Water Year	Tongue River at Monarch WY		Tongue River at State Line near Decker		Goose Creek Below Sheridan, WY		Slater Creek near Monarch, WY	
	Date	Stream flow (cfs)	Date	Stream flow (cfs)	Date	Streamf low (cfs)	Date	Streamf low (cfs)
1979	ND	ND	29-May-79	2,050	30-May-79	880[(d)]	4-May-79	117
1980	ND	ND	25-May-80	2,290	25-May-80	1,280[(d)]	25-May-80	50
1981	ND	ND	23-May-81	4,400	22-May-81	2,390[(d)]	13-Jun-87	300
1982	ND	ND	18-Jun-82	2,570	23-Jun-82	1,090[(d)]	ND	ND
1983	ND	ND	13-Jun-83	3,880	25-Jun-83	1,510[(d)]	ND	ND
1984	ND	ND	16-Jun-84	4,460	17-Jun-84	1,880[(d)]	ND	ND
1985	ND	ND	4-May-85	932	ND	ND	ND	ND
1986	ND	ND	5-Jun-86	3,670	ND	ND	ND	ND
1987	ND	ND	28-Apr-87	1,190	ND	ND	ND	ND
1988	ND	ND	18-May-88	3,130	ND	ND	ND	ND
1989	ND	ND	11-May-89	714	ND	ND	ND	ND
1990	ND	ND	11-Jun-90	2,710	ND	ND	ND	ND
1991	ND	ND	22-May-91	3,930	ND	ND	ND	ND
1992	ND	ND	16-Jun-92	3,160	ND	ND	ND	ND
1993	ND	ND	8-Jun-93	3,210	ND	ND	ND	ND
1994	ND	ND	13-May-94	2,340	ND	ND	ND	ND
1995	ND	ND	18-Jun-95	5,470	ND	ND	ND	ND
1996	ND	ND	11-Jun-96	2,720	ND	ND	ND	ND
1997	ND	ND	16-Jun-97	3,910	ND	ND	ND	ND
1998	ND	ND	15-Jun-98	1,360	ND	ND	ND	ND
1999	ND	ND	7-Jun-99	3,350	ND	ND	ND	ND
2000	ND	ND	18-May-00	3,890	ND	ND	ND	ND
2001	ND	ND	15-May-01	645	ND	ND	ND	ND
2002	ND	ND	2-Jun-02	1,050	ND	ND	ND	ND
2003	ND	ND	31-May-03	2,820	ND	ND	ND	ND
2004	7-May-04	293	6-Jun-04	326	ND	ND	ND	ND
2005	11-May-05	3,350	12-May-05	5,440	ND	ND	ND	ND
2006	24-May-06	1,170	24-May-06	1,840	ND	ND	ND	ND
2007	7-Jun-07	3,910	8-Jun-07	6,450	ND	ND	ND	ND
2008	23-May-08	2,460	25-May-08	4,310	ND	ND	ND	ND
2009	31-May-09	1,280	8-Jun-09	2,200	ND	ND	ND	ND
2010	29-May-10	1,930	12-Jun-10	3,550	ND	ND	ND	ND
2011	22-May-11	3,880	22-May-11	6,220	ND	ND	ND	ND
2012	6-Jun-12	886	6-Jun-12	1,890	ND	ND	ND	ND

Source: USGS National Water Information System: Web Interface

[(d)] Discharge affected by Regulation or Diversion

[(e)] Discharge is an estimate

[(ud)] Discharge affected to unknown degree by Regulation or Diversion

ND No Data

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DEQ 6-041

Table D6.1-4. Precipitation-Frequency Values

DURATION		RETURN PERIOD						
		2-YR	5-YR	10-YR	25-YR	50-YR	100-YR	500-YR
HOURS	MIN.	PRECIPITATION IN INCHES						
0.08	5	0.19	0.28	0.34	0.41	0.47	0.53	0.67
0.17	10	0.30	0.43	0.52	0.64	0.74	0.83	1.05
0.25	15	0.37	0.55	0.66	0.81	0.93	1.05	1.33
0.5	30	0.52	0.76	0.91	1.13	1.29	1.46	1.84
1	60	0.66	0.96	1.16	1.43	1.64	1.84	2.33
2	120	0.75	1.06	1.27	1.56	1.78	2.00	2.51
3	180	0.83	1.16	1.37	1.67	1.91	2.14	2.67
6	360	1.03	1.38	1.62	1.95	2.21	2.47	3.06
12	720	1.26	1.69	1.98	2.39	2.71	3.02	3.74
24	1440	1.50	2.00	2.35	2.83	3.20	3.57	4.42

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Table D6.1-5. HEC-HMS Peak Flow and Runoff Volume for the 6-Hour Events

Stream Designation[2]	Storm Event Recurrence Interval (yr)[1]											
	2		5		10		25		50		100	
	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)
GC1	21.1	4.6	39.2	8.7	52.9	11.8	71.1	16.0	85.4	19.4	100.1	22.9
Hidden Water Creek (HWC Out)	229.5	85.2	442.3	165.0	606.2	227.7	830.3	313.8	1010.2	383.6	1197.9	457.1
HWCSUB1	15.1	2.0	28.9	4.0	40.2	5.5	54.8	7.5	66.5	9.2	78.6	11.0
HWCSUB2	13.4	1.6	25.4	3.0	34.9	4.2	47.4	5.7	57.4	7.0	67.8	8.3
HWCSUB3	5.7	0.8	11.0	1.5	15.0	2.0	20.4	2.8	24.8	3.4	29.3	4.0
HWCSUB4	11.8	1.9	22.6	3.6	31.0	5.0	42.4	6.9	51.6	8.5	61.1	10.1
HWCSUB5	11.5	1.3	21.9	2.5	30.0	3.5	40.8	4.8	49.5	5.8	58.6	6.9
TR1	31.5	5.1	60.7	10.0	83.4	13.9	114.4	19.3	139.3	23.6	165.4	28.2
TR2	8.7	2.2	17.0	4.3	23.5	6.0	32.4	8.3	39.6	10.2	47.2	12.3
Slater Creek (SC Out)	497.6	197.7	947.4	378.5	1296.4	521.8	1761.4	713.8	2131.6	868.1	2516.3	1029.7
SCSUB1	23.8	4.5	45.6	8.8	65.8	12.5	89.5	17.2	108.5	21.0	128.1	25.0
SCSUB2	29.0	4.2	55.6	8.2	75.9	11.4	103.9	15.7	126.3	19.2	149.6	23.0
SCSUB3	19.3	3.3	36.9	6.5	50.5	8.9	68.8	12.3	83.5	15.0	98.8	17.9
SCSUB4	29.7	5.3	54.2	9.8	72.2	13.3	95.8	17.9	114.2	21.5	132.9	25.3
SCSUB5	10.4	1.4	20.0	2.8	25.5	3.6	34.9	5.0	42.4	6.1	50.3	7.3
EFEC	95.7	33.3	171.0	60.7	225.6	80.9	296.5	107.6	351.3	128.6	407.1	150.1
TRD1	2.8	0.3	5.4	0.5	10.1	1.0	13.9	1.4	17.0	1.7	20.2	2.0
TRD2	20.3	5.0	39.2	9.8	51.6	13.2	71.0	18.3	86.7	22.4	103.2	26.8
TRD3	19.9	5.2	38.9	10.2	54.2	14.2	75.0	19.8	91.8	24.4	109.6	29.2
TRD4	24.5	4.0	45.1	7.5	60.3	10.1	80.4	13.7	96.0	16.5	112.1	19.4
TRD5	58.8	13.7	108.0	25.7	153.3	36.2	203.5	48.8	242.7	58.7	282.8	68.9

Note: [1] Storm events are SCS Type II, 6-hr General Storms.

[2] See Exhibit D6.1-2 for Drainage Basin Locations.

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Table D6.1-6. HEC-HMS Peak Flow and Runoff Volume for the 24-Hour Events

Stream Designation[2]	Storm Event Recurrence Interval (yr)[1]											
	2		5		10		25		50		100	
	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)	Peak (cfs)	Vol. (Ac-ft)
GC1	48	11	77	17	99	21	131	28	157	34	184	39
Hidden Water Creek (HWC Out)	474	206	772	331	1005	427	1351	570	1635	686	1930	807
HWCSUB1	37	5	60	8	78	10	105	14	127	16	151	19
HWCSUB2	33	4	53	6	69	8	93	10	112	12	132	15
HWCSUB3	14	2	23	3	29	4	39	5	48	6	56	7
HWCSUB4	28	5	46	7	60	9	80	13	98	15	115	18
HWCSUB5	28	3	46	5	60	6	80	9	97	10	115	12
TR1	75	12	123	20	161	26	217	35	264	42	312	50
TR2	20	5	33	9	43	11	58	15	71	19	84	22
Slater Creek (SC Out)	1022	473	1638	751	2115	965	2813	1277	3382	1530	3970	1791
SCSUB1	60	11	96	18	125	23	168	31	203	37	239	44
SCSUB2	69	10	113	16	148	21	199	28	241	34	285	40
SCSUB3	46	8	74	13	97	17	130	22	157	27	186	31
SCSUB4	69	12	108	19	138	24	181	31	215	36	250	42
SCSUB5	23	3	38	5	50	7	67	9	81	11	96	13
EFEC	194	74	298	112	376	141	486	182	574	214	663	247
TRD1	10	1	16	1	21	2	28	3	34	3	40	4
TRD2	44	12	72	19	94	25	128	33	155	40	184	48
TRD3	46	13	75	21	99	27	134	36	163	44	194	52
TRD4	58	9	91	14	116	18	152	24	182	28	212	33
TRD5	143	33	224	51	286	64	374	84	445	100	517	116

Note: [1] Storm events are SCS Type II, 24-hr General Storms.

[2] See Exhibit D6.1-2 for Drainage Basin Locations.

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Table D6.1-7. Peak Flow Estimates Comparison

Basin	Method	Parameter (unit)	Recurrence Interval (yr)					
			2	5	10	25	50	100
Hidden Water Creek	HEC-HMS	Peak Flow (cfs)	474	772	1005	1351	1635	1930
	Miller (2003)	Peak Flow (cfs)	80	208	339	560	766	1014
Slater Creek	HEC-HMS	Peak Flow (cfs)	1022	1638	2115	2813	3382	3970
	Miller (2003)	Peak Flow (cfs)	113	289	469	769	1049	1384

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Table D6.1-8. HEC-RAS Modeling Results

Channel	Storm Event	Average Channel Hydraulic Properties					
		Flow Depth (ft)	Channel Top Width (ft)	Flow Area (ft^2)	Manning's "n"	Hydraulic Radius (ft)	Channel Velocity (ft/s)
Hidden Water Creek	2-Year, 24-Hour	2.15	92.6	132.8	0.027	1.22	5.48
	100-Year, 24-Hour	3.82	144.7	335.4	0.026	2.15	7.86
Slater Creek	2-Year, 24-Hour	2.19	191.6	206.4	0.027	1.21	5.44
	100-Year, 24-Hour	3.83	297.6	562.2	0.026	2.13	8.04

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Table D6.1-9. Surface Features within 1 Mile of Project Area (Stockponds and Impoundments)

Facility Name	Stream Source	Permit #	Location (Tns-Rng-Sec-¼ ¼)	Priority Date	Applicant	Size of Reservoir (acre-ft)	Uses
Baldwin Reservoir	Tongue River	P1392.0S	NENE- Sec. 01- T57- R85	03/05/1956	PADLOCK RANCH CO	1.1	STO
DeLapp No. 3 Stock Reservoir	Riverside Mine Draw	P6321.0R	NESW- Sec. 03- T57- R84	04/17/1956	WILLIAM & OLGA LONG	15.45	IRR_SW
Hart Bros Reservoir	Jensik Dry Draw	P19072.0S	NENW- Sec. 03- T57- R85	12/24/2008	NORTH SHERIDAN LAND CO., LCC	4.4	STO
DAN SCOTT NO. 3 STOCK RESERVOIR	Tongue River	P7838.0S	NESW- Sec. 04- T57- R85	09/16/1974	Flying V Cattle Co.	3.96	STO
Perre Reservoir	Tongue River	P447.0R	NESE- Sec. 06- T57- R84	11/09/1903	Rosa Masters	3.9	IRR_SW
MOCK-SMITH #1 STOCK RESERVOIR	North Fork North Dry Creek	P3695.0S	SWNE- Sec. 08- T57- R84	03/13/1961	GLENN MOCK	5.41	STO
Soltis State No. 1 Stock Reservoir	Tongue River	P6960.0S	SENE- Sec. 09- T57- R85	04/22/1971	Chevron USA, Inc.	2.47	STO
TSCHIRGI #2 STOCK RESERVOIR	Riverside Mine Draw	P2350.0S	NENE- Sec. 09- T57- R85	08/11/1958	WY STATE LANDS & INVESTMENTS	10.84	STO
SCOTT #1 STOCK RESERVOIR	Slater Creek	P7249.0S	NWNE- Sec. 10- T57- R85	05/18/1972	Avon Barney	3.19	STO
Upper 10 Stock Reservoir	Small Draw	P8206.0S	NWSE- Sec. 10- T57- R85	09/03/1976	WILLIAM F. WELCH	16.85	STO
Hall Reservoir	Draw	P18569.0S	NWSE- Sec. 11- T57- R85	08/28/2007	NORTH SHERIDAN LAND CO LLC	8.55	STO
Legerski Bros #1 Stock Reservoir	Neil's Draw	P2419.0S	SENE- Sec. 12- T57- R85	10/02/1958	MARK AND SUSAN PORDEN	3.6	STO
Enl of the PIT 3 Reservoir	Tongue River	P684.0R	NENW- Sec. 14- T57- R84	05/15/1905	IRA M. HECHT	8	IRR_SW
LEGERSKI #1 STOCK RESERVOIR	Sediment Draw	P6850.0S	SENE- Sec. 14- T57- R85	11/04/1970	NEIL DELAPP	3.85	STO
Welch #4 Stock Reservoir	Ike Draw	P8133.0S	NWNW- Sec. 14- T57- R85	07/06/1976	WILLIAM WELCH	9.52	STO
Black Mountain No. 1 Stock Reservoir	Metzger Gulch	P10306.0S	SENW- Sec. 14- T57- R85	09/16/1987	WYOMING FUEL COMPANY	6.15	STO
BIG HORN NO. 14 RESERVOIR	Short Draw	P8158.0R	SESE- Sec. 15- T57- R84	10/01/1979	BIG HORN COAL CO.	6.77	IND_SW

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Table D6.1-9. Surface Features within 1 Mile of Project Area (Stockponds and Impoundments) (Continued)

Facility Name	Stream Source	Permit #	Location (Tns-Rng-Sec-¼ ¼)	Priority Date	Applicant	Size of Reservoir (acre-ft)	Uses
BIG HORN NO. 2 RESERVOIR	Avon's Draw	P8676.0R	SESE- Sec. 15- T57- R84	10/27/1983	BIG HORN COAL CO.	0.17	IND_SW
FIRST ENL OF BIG HORN NO 14 RESERVOIR	Tongue River	P363.0R	SESE- Sec. 15- T57- R84	11/28/1902	John R. Bocek	42	IRR_SW
SANITARY TRATMENT FACILITIES NO. 1	Big Goose Creek	P60.0R	NESE- Sec. 15- T57- R84	06/15/1896	MALCOLM G. SWAN	26.1	IRR_SW
PERMANENT IMPOUNDMENT #1 RESERVOIR	SEAN CREEK	P9528.0S	NWSW- Sec. 18- T57- R84	10/01/1984	Legerski Ranch	13.3	STO
Monarch Slough Reservoir	Sean Creek	P12855.0S	SWNE- Sec. 19- T57- R84	03/19/1997	Sean Carroll	4.4	STO
LONG'S STOCK RESERVOIR	Sheep Draw	P7157.0S	NESE- Sec. 19- T57- R84	10/28/1971	Walter Belish	1.94	STO
BIG HORN NO. 8 RESERVOIR	North Fork Hidden Water Creek	P8677.0R	NENE- Sec. 21- T57- R84	10/27/1983	BIG HORN COAL CO.	1.31	IND_SW
BIG HORN NO. 9-1 RESERVOIR	Ike Draw	P8477.0R	NENW- Sec. 21- T57- R84	07/06/1982	BIG HORN COAL CO.	0.97	IND_SW
BIG HORN SCALE HOUSE RESERVOIR	Baby Draw	P12986.0R	NENW- Sec. 21- T57- R84	07/06/2007	TAYLOR INVESTMENTS, LLC	0.32	IND_SW
Sediment Stock Reservoir	East Fork Earley Creek	P7236.0S	SENW- Sec. 22- T57- R85	05/15/1972	WILLIAM F. WELCH	1.04	STO
13-2374 (POND #10) RESERVOIR	NEILS DRAW	P10952.0R	NWSW- Sec. 23- T57- R84	12/20/1999	BIG HORN COAL CO.	19.3	STO
14-2374 (POND #11) STOCK RESERVOIR	Dry Draw	P2349.0S	SWSW- Sec. 23- T57- R84	08/11/1958	C.R. TSCHIRGI	2.28	STO
KOOI POND RESERVOIR	Schilling Draw (57-85-21)	P2322.0S	NENW- Sec. 23- T57- R85	07/18/1958	JOHN JENSIK	7.6	STO
DeLapp No. 2 Stock Reservoir	Roman Draw	P19844.0S	SENE- Sec. 23- T57- R84	04/29/2013	TAYLOR INVESTMENTS LLC	5.5	STO
DELAPP NO. 4	P. D. Draw	P2290.0S	NWSE- Sec. 23- T57- R84	05/15/1958	TAYLOR INVESTMENTS, LLC	3.8	STO
SEAN CARROL NO. 2 STOCK RESERVOIR	BH 12 Draw	P13317.0R	NWSE- Sec. 24- T57- R85	10/09/2008	FIDELITY EXPLORATION & PRODUCTION COMPANY	44.38	CNG_SW; IND_SW; STO; WL

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Table D6.1-9. Surface Features within 1 Mile of Project Area (Stockponds and Impoundments) (Continued)

Facility Name	Stream Source	Permit #	Location (Tns-Rng-Sec-¼ ¼)	Priority Date	Applicant	Size of Reservoir (acre-ft)	Uses
Sean Carrol No. 3 Stock Reservoir	Heart Draw	P2671.0R	NESE- Sec. 24- T57- R85	05/29/1914	CARMALLA PERRE	15	DOM_SW; FIS; IRR_SW; STO; COMBBU
Sean Carrol No. 1 Stock Reservoir	Dan Draw	P7371.0S	SWSE- Sec. 24- T57- R85	09/15/1972	GENE LEE	0.37	STO
ENLARGEMENT OF DELAPP NO. 1 STOCK RESERVOIR	East Fork Earley Creek	P2418.0S	SWNW- Sec. 26- T57- R84	10/02/1958	BARNEY BROS LAND & LIVESTOCK, INC	18.72	STO
DeLapp No. 1 Stock Reservoir	Big Goose Creek	P2083.0S	SWNW- Sec. 26- T57- R84	09/20/1957	SEAN P AND KELLIE A CARROLL	1.29	STO
14-2674 STOCK RESERVOIR	White Shale Draw	P10957.0S	SWSW- Sec. 26- T57- R84	06/18/1990	WALTER BELISH	4.22	STO
23-2674 STOCK RESERVOIR	Monarch Slough	P1350.0S	NESW- Sec. 26- T57- R84	01/04/1956	WILLIAM AND OLGA LONG	0.29	STO
34-2674 STOCK RESERVOIR	Gulch	P12856.0S		03/19/1997	Sean Carroll	3.6	STO
44-2674 STOCK RESERVOIR	Hidden Water Creek	P12857.0S	SESE- Sec. 26- T57- R84	03/19/1997	Sean Carroll	5.5	STO
Last Prospect Reservoir	Tongue River	P2250.0S	SESW- Sec. 27- T57- R84	01/24/1958	JORGENSON LAND CO	2	STO
Strip Mine Stock Reservoir	Contact Draw	P11595.0R	SWSE- Sec. 28- T57- R84	02/26/2001	Big Horn Coal Co.	548.5	FIS; STO; WET; WIL; COMBBU
Jensik #2 Stock Reservoir	Smokey Draw	P18796.0S	SWNW- Sec. 28- T57- R84	01/03/2008	FIDELITY EXPLORATION & PROD. CO.	6.92	STO
JOHN JENSIK #1 STOCK RESERVOIR	Tongue River	P7536.0S	SENW- Sec. 28- T57- R84	03/12/1973	NEIL DELAPP	6.72	STO
57-84-19-SWSW	Trib to Tongue River	Unpermitted	SWSW - Sec. 19 - T57 - R84	N/A	N/A	N/A	N/A
57-85-22-NWSW	Trib to North Dry Creek	Unpermitted	NWSW - Sec. 22 - T57 - R85	N/A	N/A	N/A	N/A
57-85-23-NWSW	Trib to Tongue River	Unpermitted	NWSW - Sec. 23 - T57 - R85	N/A	N/A	N/A	N/A

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Table D6.1-9. Surface Features within 1 Mile of Project Area (Stockponds and Impoundments) (Continued)

Facility Name	Stream Source	Permit #	Location (Tns-Rng-Sec-¼ ¼)	Priority Date	Applicant	Size of Reservoir (acre-ft)	Uses
57-84-20-SWSW	Trib to Tongue River	Unpermitted	SWSW - Sec. 20 - T57 - R84	N/A	N/A	N/A	N/A
57-84-28-NESW	Trib to Goose Creek	Unpermitted	NESW - Sec. 28 - T57 - R84	N/A	N/A	N/A	N/A
57-84-22-SESW	Trib to Goose Creek	Unpermitted	SESW - Sec. 28 - T57 - R84	N/A	N/A	N/A	N/A
57-85-14-NESE	Sediment Draw	Unpermitted	NESE - Sec. 14 - T57 - R85	N/A	N/A	N/A	N/A
57-85-15-NWNE	Trib to East Fork Early Creek	Unpermitted	NWNE - Sec. 15 - T57 - R85	N/A	N/A	N/A	N/A
57-85-2-SWSW	Trib to Slater Creek	Unpermitted	SWSW - Sec. 2 - T57 - R85	N/A	N/A	N/A	N/A
57-85-11-NWNE	Trib to Slater Creek	Unpermitted	NWNE - Sec. 11 - T57 - R85	N/A	N/A	N/A	N/A
57-85-1-SESE	Hidden Water Creek	Unpermitted	SESE - Sec. 1 - T57 - R85	N/A	N/A	N/A	N/A
57-84-7-NWNW	Hidden Water Creek	Unpermitted	NWNW - Sec. 7 - T57 - R84	N/A	N/A	N/A	N/A
57-84-7-NENE	Hidden Water Creek	Unpermitted	NENE - Sec. 7 - T57 - R84	N/A	N/A	N/A	N/A
57-84-5-SWNE	Trib to Hidden Water Creek	Unpermitted	SWNE - Sec. 5 - T57 - R84	N/A	N/A	N/A	N/A

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Table D6.1-10. Surface Features within 1 Mile of Project Area (Diversions)

Facility Name	Stream Source	Permit #	Location (Tns-Rng-Sec-¼ ¼)	Priority Date	Applicant	Appropriation (cfs)	Uses
Baldwin Ditch	North Fork Hidden Water Creek	P14570.0D	NENE - Sec. 1 - T57 - R85	08/08/1916	Mooty Baldwin	0.64	IRR_SW
East Side Ditch No. 2	Slater Creek	P4077.0D	NENW - Sec. 3 - T57 - R85	07/31/1902	ELIAS A. HART	0.1	IRR_SW
Hart Brothers Ditches (CHANGEDIN PART TO WILLIAMS	Slater Creek	P1317.0D	NWNE - Sec. 3 - T57 - R85	06/15/1896	HART BROTHERS	1.87	IRR_SW
Perre Ditch	Fork of Hidden Water Creek	P12438.0D	NESE - Sec. 6 - T57 - R84	05/29/1914	CARMALLA PERRE		DOM_SW; IRR_SW; STO
Earley Creek Ditch No. 1	East Fork Earley Creek	P3456.0D	NWSW - Sec. 10 - T57 - R85	10/07/1901	LUELLA MORROW	1.2	IRR_SW
Badger Ditch	Badger Draw	P5864.0D	SWNW - Sec. 11 - T57 - R84	03/02/1904	ANNA SCHRIEBEIS	0.23	IRR_SW
Hall Ditch	Draw	P5195.0D	NWSE - Sec. 11 - T57 - R85	11/28/1902	John R. Bocek		IRR_SW
Landen Ditch	Slater Creek	P11695.0D	NENW - Sec. 11 - T57 - R85	01/29/1913	JAMES LANDEN	0.57	IRR_SW
Power Ditch	Tongue River	P8321.0D	NESW - Sec. 11 - T57 - R84	04/20/1908	W.E. Wagner		POW
Wagner No. 3 Ditch	Tongue River	P7820.0D	NESW - Sec. 11 - T57 - R84	04/25/1907	W.E. Wagner	1	IRR_SW
Earley Cr. Ditch No. 2	East Fork Earley Creek	P3459.0D	NWSW - Sec. 15 - T57 - R85	09/27/1901	LUELLA MORROW	0.54	IRR_SW
Monroe & Williams	Tongue River	P1107.0D	NWSW - Sec. 15 - T57 - R84	12/26/1895	JAMES MONROE	2	IRR_SW
Padlock Sprinkler System #5-G	Big Goose Creek	P22447.0D	SWSW - Sec. 15 - T57 - R84	05/14/1962	Big Horn Coal Co.	0.11	IRR_SW
Padlock Sprinkler System #9-T	Tongue River	P22445.0D	NWSE - Sec. 15 - T57 - R84	05/11/1962	Big Horn Coal Co.	0.15	IRR_SW
Sheridan County Electric Company Tunnel	Tongue River	P11181.0D	NWSW - Sec. 15 - T57 - R84	03/23/1912	Lee A. Bartel	5	POW

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Table D6.1-10. Surface Features within 1 Mile of Project Area (Diversions) (Continued)

Facility Name	Stream Source	Permit #	Location (Tns-Rng-Sec-¼ ¼)	Priority Date	Applicant	Appropriation (cfs)	Uses
Sheridan County Electric Tunnel,, 1st Enl.	Tongue River	P5059.0E	NWSW - Sec. 15 - T57 - R84	03/10/1937	Sheridan County Electric Co.		MAN
McKinley Ditch	Tongue River	P1335.0D	SWSE - Sec. 16 - T57 - R84	09/28/1896	MINNIE STONER	1.64	IRR_SW
Padlock Sprinkler System #6-T, #7-T and #8-T	Tongue River	P22443.0D	SESW - Sec. 16 - T57 - R84	10/17/1961	Big Horn Coal Co.	1.98	IRR_SW
Addleman Sprinkler	Tongue River	P30385.0D	SWNW - Sec. 19 - T57 - R84	08/24/1989	Larry E. & Anna Lee Pilch	0.24	IRR_SW
Buyok Irrigation System	Tongue River	P28382.0D	SENW - Sec. 19 - T57 - R84	06/11/1982	Buyok Ranch	0.34	IRR_SW
JANE BUYOK DOMESTIC PUMP	Tongue River	P34669.0D	SENW - Sec. 19 - T57 - R84	01/31/2011	JANE BUYOK	0.06	DOM_SW
Long's Ditch #1	Tongue River	P21719.0D	SWNE - Sec. 19 - T57 - R84	01/04/1956	WILLIAM & OLGA LONG	0.34	IRR_SW; STO
Long's Ditch #2	Monarch Slough	P21720.0D	SWNE - Sec. 19 - T57 - R84	01/04/1956	WILLIAM & OLGA LONG	0	IRR_SW; STO
Longs Ditch No. 1,, Enlargement	--	P5856.0E	SWNE - Sec. 19 - T57 - R84	04/17/1956	William Long	0	RES
VANESSA DOMESTIC PUMP	Tongue River	P34570.0D	SWNE - Sec. 19 - T57 - R84	03/14/2011	JOHN AND VANESSA BUYOK	0.06	DOM_SW
Birchby Ditch	Tongue River	P1585.0D	NESW - Sec. 20 - T57 - R84	09/21/1897	James Birchby	1.71	IRR_SW
Birchly Ditch {Enl. of}	Tongue River	P1073.0E	NWNE - Sec. 20 - T57 - R84	06/11/1903	James Birchly	0	DOM_SW; IRR_SW
DR41299 WATER HAUL	Tongue River	P34741.0D	NWSE - Sec. 20 - T57 - R84	07/18/2012	WYDOT	1	TEM
Monarch Pipe Line	Tongue River	P18765.0D	SWNW - Sec. 20 - T57 - R84	09/03/1935	SHERIDAN WY COAL CO.	0.26	IRR_SW
Padlock Sprinkler System #1-T and #2-T	Tongue River	P22444.0D	NWNW - Sec. 20 - T57 - R84	05/11/1962	Big Horn Coal Co.	0.21	IRR_SW
Wyoming Coal Mining Co.s Water Supply Ditch	Tongue River	P8297.0D	SWNW - Sec. 20 - T57 - R84	03/16/1908	Wyoming Coal Mining Co.	2.5	MIN; MUN_SW; POW

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Table D6.1-10. Surface Features within 1 Mile of Project Area (Diversions) (Continued)

Facility Name	Stream Source	Permit #	Location (Tns-Rng-Sec-¼ ¼)	Priority Date	Applicant	Appropriation (cfs)	Uses
Howd Ditch	Big Goose Creek	P945.0D	SWSW - Sec. 22 - T57 - R84	02/11/1895	THOMAS T. HOWD	1.07	DOM_SW; IRR_SW
Padlock Sprinkler System #3-G and #4-G	Big Goose Creek	P22446.0D	SWSW - Sec. 22 - T57 - R84	05/14/1962	Big Horn Coal Co.	0.47	IRR_SW
York Ditch {Enl. of}	Tongue River	P1128.0E	SWNE - Sec. 22 - T57 - R85	11/09/1903	Rosa Masters	0.79	IRR_SW
BLEVINS DOMESTIC PUMP DIVERSION	Tongue River	P33816.0D	NENE - Sec. 23 - T57 - R85	08/17/2007	STEPHANIE BLEVINS AND CLINTON KRUMM	0.056	DSP
JOHNSON DOMESTIC PUMP	Tongue River	P33569.0D	NENE - Sec. 23 - T57 - R85	08/11/2006	JOHN AND GAYLENE JOHNSON	0.056	DOM_SW
Kooi Coal Mining Co.s Water Supply Ditch	Tongue River	P8298.0D	NWNE - Sec. 23 - T57 - R85	03/16/1908	KOOI COAL MINING CO.		MIN; MUN_SW
McPhillamey Ditch	Tongue River	P5016.0D	NWNW - Sec. 23 - T57 - R85	08/25/1902	SARAH E. MCPHILLAMEY	0.74	IRR_SW
McPhilloney (McPhillonay) Ditch {Enl. of}	Tongue River	P1133.0E	NWNW - Sec. 23 - T57 - R85	11/02/1903	Jesse McPhillamey		IRR_SW
Smith Domestic Pump	Tongue River	P33570.0D	NENE - Sec. 23 - T57 - R85	08/14/2006	Earl & Robin Smith		DOM_SW
Vannoy Pipeline	Riverside Mine Draw	P24730.0D	NENE - Sec. 23 - T57 - R85	03/31/1975	LANAINE VANNOY	0.08	IRR_SW
B134035 & B134036 CB WATER HAUL	Big Goose Creek	P34862.0D	NWSW - Sec. 27 - T57 - R84	01/04/2013	WYDOT	1	TEM
Kuzara Sprinkler System No. 5	Big Goose Creek	P25555.0D	SWSW - Sec. 27 - T57 - R84	10/29/1974	BETTY KUZARA	0.04	IRR_SW
Last Prospect Ditch	Big Goose Creek	P6746.0D	SWSW - Sec. 27 - T57 - R84	05/15/1905	IDA M. HECHT		IRR_SW
Kuzara Sprinkler System No. 3	Big Goose Creek	P25553.0D	SESE - Sec. 28 - T57 - R84	10/29/1974	BETTY KUZARA	0.34	IRR_SW
Kuzara Sprinkler System No. 4	Big Goose Creek	P25554.0D	SESE - Sec. 28 - T57 - R84	10/29/1974	BETTY KUZARA	0.05	IRR_SW
Padlock Sprinkler System #1-G and #2-G	Big Goose Creek	P22442.0D	NESE - Sec. 28 - T57 - R84	10/17/1961	Big Horn Coal Co.	0.31	IRR_SW

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Table D6.1-11. Surface Water Monitoring Locations

Site ID	Stream	Location						Monitoring Device[1,2]	Type and Frequency of Measurement[3]
		Qtr-Qtr	SEC	T(N)	R(W)	Northing (WY83ECF)	Easting (WY83ECF)		
SM578512-SW-1	Slater Creek	SE-SW	12	57	85	1,940,409	1,381,960	Flowmeter	Continuous Recorder
SM578418-SW-1	Slater Creek	SE-SW	18	57	84	1,935,703	1,386,326	Flowmeter and Pump Sampler	Continuous Recorder, Pump sampler water quality sampler based on precipitation event, Monthly grab sample is water is present
SM578409-SW-1	Hidden Water Creek	SW-NW	9	57	84	1,942,831	1,395,621	Flowmeter	Continuous Recorder
SM578415-SW-1	Hidden Water Creek	SE-NW	15	57	84	1,938,209	1,402,426	Flowmeter	Continuous Recorder

Notes: [1]Flow meter is a Teledyne Isco Signature Flow Meter with integral bubbler level sensor (330 Bubbler Module).

[2]Pump sampler is a Teledyne Isco 6712 Full-Size Portable Sampler.

[3]Flow meters and pump samplers were inactive during the winter to avoid damage to the equipment.

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Table D6.1-12. Water Quality Constituents

Constituent	Source[1,2]	Holding Time	Analytical Method
pH	GW,SW	At time of Sample	SM 4500 H B
Electrical Conductivity	GW, SW	28 Days	SM 2510B
Total Dissolved Solids (180)	GW, SW	7 Days	SM 2540
Sodium Adsorption Ratio (SAR)	GW, SW	NA	Calculation
Alkalinity, Total (as $CACO_3$)	GW, SW	14 Days	SM 2320B
Alkalinity, carbonate (as CO_3)	GW, SW	14 Days	SM 2320B
Alkalinity, Hydroxide (as OH)	GW, SW	14 Days	SM 2320B
Ammonia Nitrogen (as N)	GW, SW	28 Days	EPA 350.1
Total Suspended Solids	SW	7 Days	SM 2540
Turbidity	SW	48 Hours	SM 2130
Nitrate+Nitrite as N	GW, SW	28 Days	EPA 353.2
Alkalinity, bicarbonate as HCO_3	GW, SW	14 Days	SM 2320B
Boron	GW, SW	180 Days	EPA 200.7
Barium	GW, SW	180 Days	EPA 200.8
Copper	GW, SW	180 Days	EPA 200.8
Fluoride	GW, SW	28 Days	SM 4500FC
Sulfate	GW, SW	28 Days	EPA 300.0
Aluminum	GW, SW	180 Days	EPA 200.7
Arsenic	GW, SW	180 Days	EPA 200.8
Cadmium	GW, SW	180 Days	EPA 200.8
Calcium	GW, SW	180 Days	EPA 200.7
Chloride	GW, SW	28 Days	EPA 300.0
Chromium	GW, SW	180 Days	EPA 200.7
Iron	GW, SW	180 Days	EPA 200.7
Total Iron	GW, SW	180 Days	EPA 200.7
Lead	GW, SW	180 Days	EPA 200.8
Magnesium	GW, SW	180 Days	EPA 200.7
Manganese	GW, SW	180 Days	EPA 200.7
Total Manganese	GW, SW	180 Days	EPA 200.7
Molybdenum	GW, SW	180 Days	EPA 200.8
Nickel	GW, SW	180 Days	EPA 200.7
Potassium	GW, SW	180 Days	EPA 200.7
Selenium	GW, SW	180 Days	EPA 200.8
Sodium	GW, SW	180 Days	EPA 200.7
Mercury	GW, SW	28 Days	EPA 245.1
Total Mercury	GW, SW	28 Days	EPA 245.1
Zinc	GW, SW	180 Days	EPA 200.7

Notes: [1]SW = Surface Water Monitoring, GW = Groundwater Monitoring

[2]Surface and groundwater monitoring was conducted in accordance with WDEQ/LQD Guideline 8

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Table D6.1-13. Surface Water Quality Monitoring Results

Parameter	Units	578409-SW						578415-SW					
		Sep-13	Oct-13	Apr-14	May-14	Jul-14	Sep-14	Sep-13	Oct-13	Apr-14	May-14	Jul-14	Sep-14
Sample Type		DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Field													
Field Conductivity	µmhos/cm												
Field pH	s.u.												
Field turbidity	NTUs												
Temperature	Deg C												
General													
Alkalinity (as CaCO3)	mg/L												
Ammonia	mg/L												
Fluoride	mg/L												
Hardness (as CaCO3)	mg/L												
Hydroxide	mg/L												
Laboratory conductivity	µmhos/cm												
Dissolved oxygen	mg/L												
Laboratory pH	s.u.												
Laboratory turbidity	NTUs												
Nitrate/Nitrite	mg/L												
Total Dissolved Solids	mg/L												
Total Suspended Solids	mg/L												
Sodium Adsorption Ratio (SAR)	unitless												
Major Ions													
Calcium	mg/L												
Magnesium	mg/L												
Potassium	mg/L												
Sodium	mg/L												
Bicarbonate	mg/L												
Carbonate	mg/L												
Chloride	mg/L												
Sulfate	mg/L												
Metals													
Aluminum, dissolved	mg/L												
Arsenic, dissolved	mg/L												
Barium, dissolved	mg/L												
Boron, dissolved	mg/L												
Cadmium, dissolved	mg/L												
Chromium, dissolved	mg/L												
Copper, dissolved	mg/L												
Iron, dissolved	mg/L												
Iron, total	mg/L												
Lead, dissolved	mg/L												
Manganese, dissolved	mg/L												
Manganese, total	mg/L												
Mercury, dissolved	mg/L												
Molybdenum, dissolved	mg/L												
Nickel, dissolved	mg/L												
Selenium, dissolved	mg/L												
Zinc, dissolved	mg/L												
QA/QC													
Anion Sum	meq/L												
Cation Sum	meq/L												
Total Anion/Cation Balance	%												
Total Dissolved Solids (calc)	mg/L												

Note: GS = Grab Sample Collected
LF = Low flow recorded by sampler. Flow level wasn't enough to sample.

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Table D6.1-13. Surface Water Quality Monitoring Results (Continued)

Parameter	Units	578418-SW						578512-SW					
		Sep-13	Oct-13	Apr-14	May-14	Jul-14	Sep-14	Sep-13	Oct-13	Apr-14	May-14	Jul-14	Sep-14
Sample Type		DRY	DRY	GS	DRY	LF	LF	DRY	DRY	GS	DRY	DRY	LF
Field													
Field Conductivity	µmhos/cm			1851						1504			
Field pH	s.u.			8.48						8.58			
Field turbidity	NTUs			16.92						17.84			
Temperature	Deg C			12.1						13.8			
General													
Alkalinity (as CaCO3)	mg/L			340						303			
Ammonia	mg/L			<0.1						<0.1			
Fluoride	mg/L			0.6						0.5			
Hardness (as CaCO3)	mg/L			816						653			
Hydroxide	mg/L			<5						<5			
Laboratory conductivity	µmhos/cm			1890						1540			
Dissolved oxygen	mg/L			10						10			
Laboratory pH	s.u.			8.4						8.4			
Laboratory turbidity	NTUs			13.9						13.4			
Nitrate/Nitrite	mg/L			<0.1						<0.1			
Total Dissolved Solids	mg/L			1560						1220			
Total Suspended Solids	mg/L			9						8			
Sodium Adsorption Ratio (SAR)	unitless			2.2						1.9			
Major Ions													
Calcium	mg/L			104						87			
Magnesium	mg/L			136						106			
Potassium	mg/L			16						11			
Sodium	mg/L			147						112			
Bicarbonate	mg/L			395						347			
Carbonate	mg/L			10						11			
Chloride	mg/L			8						5			
Sulfate	mg/L			732						550			
Metals													
Aluminum, dissolved	mg/L			0.6						<0.1			
Arsenic, dissolved	mg/L			<0.005						<0.005			
Barium, dissolved	mg/L			<0.1						<0.1			
Boron, dissolved	mg/L			0.2						0.1			
Cadmium, dissolved	mg/L			<0.001						<0.001			
Chromium, dissolved	mg/L			<0.01						<0.01			
Copper, dissolved	mg/L			<0.01						<0.01			
Iron, dissolved	mg/L			0.35						<0.05			
Iron, total	mg/L			0.39						0.35			
Lead, dissolved	mg/L			<0.02						<0.02			
Manganese, dissolved	mg/L			0.12						0.08			
Manganese, total	mg/L			0.13						0.09			
Mercury, dissolved	mg/L			<0.001						<0.001			
Molybdenum, dissolved	mg/L			<0.02						<0.02			
Nickel, dissolved	mg/L			<0.01						<0.01			
Selenium, dissolved	mg/L			<0.005						<0.005			
Zinc, dissolved	mg/L			<0.01						<0.01			
QA/QC													
Anion Sum	meq/L			22.27						17.68			
Cation Sum	meq/L			23.11						18.23			
Total Anion/Cation Balance	%			1.84						1.53			
Total Dissolved Solids (calc)	mg/L			1350						1050			

Note: GS = Grab Sample Collected
LF = Low flow recorded by sampler. Flow level wasn't enough to sample.

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Table D6.2-1. Summary of Groundwater Monitoring Wells[1]

Well Number	Location					Ground Surface Elevation (ft)	Measuring Point Elevation (ft)	Height (ft)	Depths (ft)			Geologic Formation	Casing Diameter (in)	Drill Bit Diameter (in)	Date Completed
	SEC	T(N)	R(W)	Ground Coordinates					Total[2]	Casing	Perforation Interval				
				Northing	Easting										
578409-CRN	9	57	84	1,940,097	1,399,549	3,710.1	3,712.7	2.6	109	88	88-108	Carney Coal	5	9.875	1-Oct-13
578409-CRN-OB	9	57	84	1,940,108	1,399,538	3,710.3	3,713.0	2.7	110	89	89-109	Carney Coal Observ	5	9.875	1-Oct-13
578409-MST	9	57	84	1,940,088	1,399,559	3,709.8	3,712.4	2.6	122	115	115-120	Masters Coal	5	9.875	1-Oct-13
578409-MST-OB	9	57	84	1,940,085	1,399,547	3,710.3	3,713.3	3	122	116	116-121	Masters Coal Observ	5	9.875	2-Oct-13
578409-UBN	9	57	84	1,940,077	1,399,568	3,709.7	3,712.1	2.4	142	130	130-140	Masters Coal Underburden	5	9.875	1-Oct-13
578415-CRN-MST	15	57	84	1,936,078	1,404,292	3,611.4	3,614.3	2.9	182	121	121-141	Carney and Masters Coal	5	9.875	9-Oct-13
578418-AL	18	57	84	1,935,962	1,386,058	3,687.5	3,690.2	2.7	27	5	5-25	Alluvium	5	9.875	30-Sep-13
578418-CRN	18	57	84	1,936,928	1,387,102	3,882.4	3,884.5	2.1	153	132	132-152	Carney Coal	5	9.875	19-Sep-13
578418-MST	18	57	84	1,936,923	1,387,131	3,883.6	3,885.8	2.2	183	176	176-182	Masters Coal	5	9.875	16-Sep-13
578510-CRN	10	57	85	1,941,542	1,371,807	3,962.4	3,965.4	3	91	78	78-90	Carney Coal	5	9.875	24-Sep-13
578510-MST	10	57	85	1,941,558	1,371,823	3,962.4	3,964.4	2	146	141	141-146	Masters Coal	5	9.875	24-Sep-13
578511-CRN	11	57	85	1,940,246	1,377,926	3,893.8	3,896.1	2.3	128	119	119-127	Carney Coal	5	9.875	23-Sep-13
578511-MST	11	57	85	1,940,244	1,377,945	3,894.0	3,896.4	2.4	157	152	152-157	Masters Coal	5	9.875	23-Sep-13
578512-AL	12	57	85	1,940,880	1,381,530	3,758.0	3,760.5	2.5	22	5	5-20	Alluvium	5	9.875	25-Sep-13
578512-CRN	12	57	85	1,943,160	1,382,758	3,931.0	3,932.5	1.5	62	35	35-55	Carney Burn	5	9.875	20-Sep-13
578512-MST	12	57	85	1,943,172	1,382,743	3,930.9	3,932.7	1.8	114	109	109-114	Masters Coal	5	9.875	20-Sep-13
578513-AL	13	57	85	1,938,634	1,383,970	3,721.9	3,724.0	2.1	22	5	5-20	Alluvium	5	9.875	30-Sep-13
578513-CRN	13	57	85	1,938,329	1,381,665	3,847.7	3,850.0	2.3	116	107	107-115	Carney Coal	5	9.875	25-Sep-13
578513-MST	13	57	85	1,938,341	1,381,680	3,848.4	3,850.6	2.2	142	137	137-142	Masters Coal	5	9.875	25-Sep-13
578417-MST[4]	17	57	84	1,939,175	1,391,382	3,925.9	3,928.7	2.8	163	156	156-161	Masters Coal	2	5.125	21-Aug-13
578417-CRN[4]	17	57	84	1,939,152	1,391,364	3,926.4	3,929.1	2.7	140	118	118-140	Carney Coal	2	5.625	21-Aug-13
578408-MST[5]	8	57	84	1,941,802	1,394,423	3,887.9	3,890.5	2.6	118	113	113-118	Masters Coal	2	5.125	3-Sep-13
578408-CRN[5]	8	57	84	1,941,810	1,394,416	3,887.7	3,890.0	2.3	124	86	86-96	Carney Coal	2	5.125	3-Sep-13

Notes: [1]Exhibit D6.2-1 presents the location of the monitor wells.

[2]Reflects field measured depth from drilling log.

[3]Formation packer was not installed in any of the groundwater wells.

[4]2-inch diameter piezometers installed in core hole cluster R13-012.

[5]2-inch diameter piezometers installed in core hole cluster R13-018.

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Table D6.2-2. Summary of Aquifer Test Data

Test Well Number	Geologic Formation	Date of Test	Type of Analysis	Observation Well Number	Observation Well Distance (ft)	Length of Test (min)	Production Rate (gpm)	Aquifer Parameters				
								Spec. Cap. (gpm/ft)	Trans. (ft^2/day)	Aquif Thick (ft)	Hyd Cond (ft/day)	Storage Coefficient
578409 MST-1	Masters Coal	11/12/2013	Theis Drawdown, Cooper Jacob Straight Line Drawdown, Theis Recovery	578409 MST-OB	12.8	644	0.33	0.030	3.2	5	0.54	0.000249
578409 CRN-1	Carney Coal	11/14/2013	Theis Drawdown, Cooper Jacob Straight Line Drawdown, Theis Recovery	578409 CRN-OB	15.4	646	0.33	0.046	5.6	18	0.31	0.000364

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Table D6.2-3. Groundwater Quality Monitoring Results For Alluvium

Parameter	Units	578418-AL				578512-AL				578513-AL			
		3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14
Field													
Field Conductivity	µmhos/cm	1179	3050			5180	5460	5370	5530	4870	5130	4900	4686
Field pH	s.u.	8.72	7.67			8.02	7.22	7.59	7.33	7.95	7.18	7.57	7.26
Field turbidity	NTUs	257	38.2			3.51	20	173	21.6	2.05	0.57	0.93	0.17
Depth to Water	ft	20.65	20.78	Dry	Dry	4.03	3.81	3.67	3.61	9.51	9.36	7.66	6.18
Temperature	Deg C	12.3	9.6			13.4	10.5	9.6	16.3	12.3	10.2	9.9	17.5
General													
Alkalinity (as CaCO3)	mg/L	205	411			638	662	652	655	636	674	651	661
Ammonia	mg/L	<0.1	<0.1			<0.1	<0.1	0.2	0.2	<0.1	<0.1	<0.1	<0.1
Fluoride	mg/L	1.1	1.2			1	1	0.9	0.8	0.9	0.8	0.8	0.7
Hardness (as CaCO3)	mg/L	254	909			2840	2560	2920	2640	2340	2240	2350	2030
Hydroxide	mg/L	<5	<5			<5	<5	<5	<5	<5	<5	<5	<5
Laboratory conductivity	µmhos/cm	1160	2800			5650	5370	5340	5190	4800	4980	4670	4380
Laboratory pH	s.u.	8.4	8.3			8	8	7.9	8.1	8	8	7.9	8.1
Nitrate/Nitrite	mg/L	1.4	0.2			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Dissolved Solids	mg/L	760	2220			5210	5150	4590	5300	4530	4790	4610	3730
Sodium Adsorption Ratio (SAR)	unitless	4.3	4.8			4	4	3.9	3.6	4.3	4.1	3.9	4.1
Major Ions													
Calcium	mg/L	26	114			369	322	360	324	275	267	272	235
Magnesium	mg/L	46	152			466	427	490	444	401	383	406	352
Potassium	mg/L	13	22			26	23	23	20	33	26	25	29
Sodium	mg/L	159	332			490	465	488	431	474	448	435	426
Bicarbonate	mg/L	242	501			778	807	795	799	776	823	794	806
Carbonate	mg/L	<5	<5			<5	<5	<5	<5	<5	<5	<5	<5
Chloride	mg/L	9	14			17	17	22	16	22	22	24	17
Sulfate	mg/L	393	1200			2990	3130	2990	3050	2910	2740	2790	2460
Metals													
Aluminum, dissolved	mg/L	<0.1	<0.1			<0.1	<0.1	0.1	<0.1	<0.1	<0.1	0.1	<0.1
Arsenic, dissolved	mg/L	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Barium, dissolved	mg/L	<0.1	<0.1			<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron, dissolved	mg/L	0.2	0.3			0.4	0.4	0.3	0.4	0.4	0.4	0.5	0.3
Cadmium, dissolved	mg/L	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chromium, dissolved	mg/L	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Copper, dissolved	mg/L	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Iron, dissolved	mg/L	<0.05	<0.05			0.91	0.92	1.04	0.86	<0.05	<0.05	0.09	<0.05
Iron, total	mg/L	2.24	0.8			0.96	5.29	25.4	5.17	0.1	0.08	0.11	0.06
Lead, dissolved	mg/L	<0.02	<0.02			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Manganese, dissolved	mg/L	<0.02	0.03			2.28	1.92	2.13	1.72	0.37	0.35	0.31	0.23
Manganese, total	mg/L	0.16	0.07			2.2	2.69	2.71	2.34	0.62	0.47	0.39	0.29
Mercury, dissolved	mg/L	<0.001	<0.001			<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Molybdenum, dissolved	mg/L	<0.02	<0.02			<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Nickel, dissolved	mg/L	<0.01	<0.01			<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Selenium, dissolved	mg/L	0.006	<0.005			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Zinc, dissolved	mg/L	<0.01	<0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
QA/QC													
Anion Sum	meq/L	12.67	33.73			75.49	78.95	75.89	77.06	73.93	71.21	71.79	64.97
Cation Sum	meq/L	12.32	33.2			78.72	71.99	80.14	71.97	68.24	65.04	66.52	59.95
Total Anion/Cation Balance	%	1.43	0.79			2.09	4.6	2.72	3.41	4	4.52	3.8	4.02
Total Dissolved Solids (calc)	mg/L	780	2080			4740	4780	4760	4680	4500	4290	4340	3920

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Table D6.2-4. Groundwater Quality Monitoring Results For Carney

Parameter	Units	578408-CRN				578409-CRN				578409-CRN-OB			
		3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14
Field													
Field Conductivity	µmhos/cm	2440	2650	2600	2700					1977	2390	1960	1944
Field pH	s.u.	7.79	6.88	7.22	6.91					8.04	7.25	7.62	7.38
Field turbidity	NTUs	370	355	65.9	64.7					91.9	15.13	4.36	3.9
Depth to Water	ft	87.66	87.7	87.7	87.71	Well 578409-CRN-OB Sampled				85.99	90.76	90.78	89.87
Temperature	Deg C	13.3	10.4	9.1	13.7					10.3	10.2	11.9	14.6
General													
Alkalinity (as CaCO3)	mg/L	577	584	605	613					421	509	473	510
Ammonia	mg/L	<0.1	0.2	0.4	0.6					1.5	4.2	5.1	5.2
Fluoride	mg/L	0.7	0.7	0.7	0.7					0.5	0.6	0.6	0.6
Hardness (as CaCO3)	mg/L	1300	1380	1430	1420					879	730	665	588
Hydroxide	mg/L	<5	<5	<5	<5					<5	<5	<5	<5
Laboratory conductivity	µmhos/cm	2290	2470	2480	2440					2020	2200	2100	1950
Laboratory pH	s.u.	7.9	7.9	7.9	7.6					8.1	8.2	8.1	7.9
Nitrate/Nitrite	mg/L	<0.1	<0.1	<0.1	<0.1					<0.1	<0.1	<0.1	<0.1
Total Dissolved Solids	mg/L	1870	2000	2040	2190					1510	1560	1450	1410
Sodium Adsorption Ratio (SAR)	unitless	1	0.9	0.9	0.9					2.3	3.6	4.3	4.2
Major Ions													
Calcium	mg/L	165	173	177	175					127	110	101	91
Magnesium	mg/L	214	232	240	238					136	111	100	88
Potassium	mg/L	27	30	29	29					18	22	21	20
Sodium	mg/L	82	79	82	79					156	226	253	235
Bicarbonate	mg/L	705	712	738	748					513	621	577	622
Carbonate	mg/L	<5	<5	<5	<5					<5	<5	<5	<5
Chloride	mg/L	8	9	8	9					12	11	12	10
Sulfate	mg/L	918	963	973	969					778	753	655	637
Metals													
Aluminum, dissolved	mg/L	<0.1	<0.1	0.2	<0.1					<0.1	<0.1	<0.1	<0.1
Arsenic, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005					<0.005	<0.005	<0.005	<0.005
Barium, dissolved	mg/L	<0.1	<0.1	<0.1	<0.1					<0.1	<0.1	<0.1	<0.1
Boron, dissolved	mg/L	0.5	0.5	0.5	0.5					0.2	0.2	0.2	0.2
Cadmium, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001					<0.001	<0.001	<0.001	<0.001
Chromium, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01					<0.01	<0.01	<0.01	<0.01
Copper, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01					<0.01	<0.01	<0.01	<0.01
Iron, dissolved	mg/L	<0.05	0.05	0.14	0.13					<0.05	<0.05	<0.05	<0.05
Iron, total	mg/L	4.57	2.85	1.05	0.96					1.36	0.19	0.12	0.33
Lead, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02					<0.02	<0.02	<0.02	<0.02
Manganese, dissolved	mg/L	0.44	0.64	0.51	0.4					0.09	0.19	0.14	0.11
Manganese, total	mg/L	0.54	0.81	0.5	0.43					0.17	0.23	0.15	0.12
Mercury, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001					<0.001	<0.001	<0.001	<0.001
Molybdenum, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02					<0.02	<0.02	<0.02	<0.02
Nickel, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01					<0.01	<0.01	<0.01	<0.01
Selenium, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005					<0.005	<0.005	<0.005	<0.005
Zinc, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01					<0.01	0.01	<0.01	<0.01
QA/QC													
Anion Sum	meq/L	30.94	31.99	32.63	32.71					24.97	26.19	23.47	23.75
Cation Sum	meq/L	30.16	31.87	32.9	32.52					24.94	24.97	25.19	22.83
Total Anion/Cation Balance	%	1.27	0.19	0.4	0.28					0.05	2.38	3.53	1.98
Total Dissolved Solids (calc)	mg/L	1760	1830	1870	1870					1480	1540	1430	1390

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Table D6.2-4. Groundwater Quality Monitoring Results For Carney (Continued)

Parameter	Units	578417-CRN				578418-CRN				578510-CRN			
		3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14
Field													
Field Conductivity	µmhos/cm	1421	1483	1347	1375								
Field pH	s.u.	8.16	7.39	7.76	7.56								
Field turbidity	NTUs	302	615	971	998								
Depth to Water	ft	133.05	133.31	133.13	133.55	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Temperature	Deg C	14.6	9.9	9.5	18								
General													
Alkalinity (as CaCO3)	mg/L	465	508	449	430								
Ammonia	mg/L	2.7	3.6	1.7	0.5								
Fluoride	mg/L	1.9	1.9	1.9	1.8								
Hardness (as CaCO3)	mg/L	147	150	151	143								
Hydroxide	mg/L	<5	<5	<5	<5								
Laboratory conductivity	µmhos/cm	1420	1450	1400	1370								
Laboratory pH	s.u.	8.3	8.3	8.2	8.3								
Nitrate/Nitrite	mg/L	<0.1	<0.1	2.3	4.6								
Total Dissolved Solids	mg/L	880	880	890	870								
Sodium Adsorption Ratio (SAR)	unitless	9.8	9.2	10	8.9								
Major Ions													
Calcium	mg/L	19	19	18	17								
Magnesium	mg/L	24	25	26	24								
Potassium	mg/L	15	17	16	15								
Sodium	mg/L	272	258	282	245								
Bicarbonate	mg/L	563	607	548	513								
Carbonate	mg/L	<5	6	<5	6								
Chloride	mg/L	7	8	8	7								
Sulfate	mg/L	242	255	250	258								
Metals													
Aluminum, dissolved	mg/L	0.9	0.4	0.3	<0.1								
Arsenic, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005								
Barium, dissolved	mg/L	<0.1	<0.1	<0.1	<0.1								
Boron, dissolved	mg/L	0.1	0.1	0.1	<0.1								
Cadmium, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001								
Chromium, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01								
Copper, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01								
Iron, dissolved	mg/L	0.21	0.22	0.08	<0.05								
Iron, total	mg/L	3.56	12.7	11.3	12.9								
Lead, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02								
Manganese, dissolved	mg/L	0.07	0.06	0.02	<0.02								
Manganese, total	mg/L	0.19	0.18	0.11	0.1								
Mercury, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001								
Molybdenum, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02								
Nickel, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01								
Selenium, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005								
Zinc, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01								
QA/QC													
Anion Sum	meq/L	14.64	15.76	14.67	14.61								
Cation Sum	meq/L	15.37	14.66	15.81	13.95								
Total Anion/Cation Balance	%	2.42	3.6	3.74	2.29								
Total Dissolved Solids (calc)	mg/L	860	890	880	850								

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Table D6.2-4. Groundwater Quality Monitoring Results For Carney (Continued)

Parameter	Units	578511-CRN				578512-CRN				578513-CRN			
		3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14
Field													
Field Conductivity	µmhos/cm	3280	3800	3690	4050								
Field pH	s.u.	8.33	7.41	7.66	7.42								
Field turbidity	NTUs	86.7	72.6	28.3	88.5								
Depth to Water	ft	119.53	119.63	119.59	119.58	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Temperature	Deg C	16.8	10	12.3	18.2								
General													
Alkalinity (as CaCO3)	mg/L	525	678	737	823								
Ammonia	mg/L	6.8	6.7	7.6	6.4								
Fluoride	mg/L	1.1	1.1	1	0.9								
Hardness (as CaCO3)	mg/L	565	552	542	581								
Hydroxide	mg/L	<5	<5	<5	<5								
Laboratory conductivity	µmhos/cm	3400	3570	3660	3810								
Laboratory pH	s.u.	8.2	8.2	8	8.2								
Nitrate/Nitrite	mg/L	7.9	1.7	<0.1	<0.1								
Total Dissolved Solids	mg/L	2400	2910	3150	2650								
Sodium Adsorption Ratio (SAR)	unitless	9.8	11.6	12.6	12.4								
Major Ions													
Calcium	mg/L	85	79	76	78								
Magnesium	mg/L	86	86	86	94								
Potassium	mg/L	26	28	24	25								
Sodium	mg/L	535	625	675	690								
Bicarbonate	mg/L	641	827	899	1000								
Carbonate	mg/L	<5	<5	<5	<5								
Chloride	mg/L	24	26	27	27								
Sulfate	mg/L	1110	1270	1230	1340								
Metals													
Aluminum, dissolved	mg/L	<0.1	<0.1	<0.1	<0.1								
Arsenic, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005								
Barium, dissolved	mg/L	<0.1	<0.1	<0.1	<0.1								
Boron, dissolved	mg/L	0.3	0.2	0.2	0.2								
Cadmium, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001								
Chromium, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01								
Copper, dissolved	mg/L	<0.01	<0.01	0.02	<0.01								
Iron, dissolved	mg/L	<0.05	<0.05	0.07	0.18								
Iron, total	mg/L	0.18	1.03	0.38	1.63								
Lead, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02								
Manganese, dissolved	mg/L	0.19	0.48	0.53	0.47								
Manganese, total	mg/L	0.24	0.66	0.7	0.51								
Mercury, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001								
Molybdenum, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02								
Nickel, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01								
Selenium, dissolved	mg/L	0.005	<0.005	<0.005	<0.005								
Zinc, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01								
QA/QC													
Anion Sum	meq/L	34.94	40.99	41.22	45.05								
Cation Sum	meq/L	35.74	38.92	41.37	42.72								
Total Anion/Cation Balance	%	1.12	2.58	0.18	2.65								
Total Dissolved Solids (calc)	mg/L	2220	2530	2560	2740								

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Table D6.2-5. Groundwater Quality Monitoring Results For Masters

Parameter	Units	578408-MST				578409-MST				578409-MST-OB			
		3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14
Field													
Field Conductivity	µmhos/cm	2380	2430	1984	1982	2450	2470	2310	2390				
Field pH	s.u.	7.38	6.53	6.87	6.62	8.49	7.7	8.05	7.82				
Field turbidity	NTUs	552	518	53.7	20.3	78.1	1.45	1.86	0.36				
Depth to Water	ft	104.49	105.89	102.93	99.82	101.18	101.1	101.21	100.95	Well 578409-MST Sampled			
Temperature	Deg C	13.7	10.3	9.4	14.5	13.9	10.7	12.8	17.2				
General													
Alkalinity (as CaCO3)	mg/L	464	472	496	462	577	655	658	655				
Ammonia	mg/L	3.1	4.2	5.4	5	2	4	3.3	3.1				
Fluoride	mg/L	0.5	0.5	0.5	0.5	1.4	1.5	1.5	1.4				
Hardness (as CaCO3)	mg/L	1040	1040	1020	950	171	91	89	86				
Hydroxide	mg/L	<5	<5	<5	<5	<5	<5	<5	<5				
Laboratory conductivity	µmhos/cm	2230	2230	2120	1980	2300	2260	2230	2150				
Laboratory pH	s.u.	7.6	7.8	7.6	7.8	8.4	8.4	8.4	8.2				
Nitrate/Nitrite	mg/L	<0.1	<0.1	<0.1	<0.1	0.4	<0.1	<0.1	0.5				
Total Dissolved Solids	mg/L	1720	1690	1650	1570	1500	1510	1430	1520				
Sodium Adsorption Ratio (SAR)	unitless	1.9	1.7	1.6	1.4	16.1	22	24.2	24.2				
Major Ions													
Calcium	mg/L	129	124	120	112	29	16	16	15				
Magnesium	mg/L	174	177	175	163	24	12	12	12				
Potassium	mg/L	29	30	28	27	15	16	15	14				
Sodium	mg/L	140	129	114	101	484	484	525	516				
Bicarbonate	mg/L	566	576	605	563	685	773	775	799				
Carbonate	mg/L	<5	<5	<5	<5	9	12	13	<5				
Chloride	mg/L	8	7	7	7	10	9	9	9				
Sulfate	mg/L	891	858	767	742	560	497	449	477				
Metals													
Aluminum, dissolved	mg/L	0.8	<0.1	<0.1	<0.1	0.3	<0.1	<0.1	<0.1				
Arsenic, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				
Barium, dissolved	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1				
Boron, dissolved	mg/L	0.4	0.4	0.4	0.4	0.2	0.1	0.1	0.1				
Cadmium, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
Chromium, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				
Copper, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				
Iron, dissolved	mg/L	0.68	0.61	0.59	0.37	0.12	<0.05	<0.05	<0.05				
Iron, total	mg/L	5.95	3.53	1.41	0.77	1.13	0.06	<0.05	<0.05				
Lead, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				
Manganese, dissolved	mg/L	0.92	0.29	0.15	0.07	0.08	0.21	0.23	0.2				
Manganese, total	mg/L	0.94	0.36	0.16	0.07	0.11	0.22	0.24	0.23				
Mercury, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001				
Molybdenum, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02				
Nickel, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				
Selenium, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005				
Zinc, dissolved	mg/L	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01				
QA/QC													
Anion Sum	meq/L	28.07	27.54	26.09	24.9	23.58	23.78	22.83	23.37				
Cation Sum	meq/L	27.86	27.07	26.43	24.45	25.01	23.29	25.21	24.74				
Total Anion/Cation Balance	%	0.36	0.85	0.64	0.91	2.94	1.04	4.94	2.83				
Total Dissolved Solids (calc)	mg/L	1650	1610	1510	1430	1470	1430	1420	1440				

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Table D6.2-5. Groundwater Quality Monitoring Results For Masters (Continued)

Parameter	Units	578417-MST				578418-MST				578510-MST			
		3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14
Field													
Field Conductivity	µmhos/cm												
Field pH	s.u.												
Field turbidity	NTUs												
Depth to Water	ft	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY	DRY
Temperature	Deg C												
General													
Alkalinity (as CaCO3)	mg/L												
Ammonia	mg/L												
Fluoride	mg/L												
Hardness (as CaCO3)	mg/L												
Hydroxide	mg/L												
Laboratory conductivity	µmhos/cm												
Laboratory pH	s.u.												
Nitrate/Nitrite	mg/L												
Total Dissolved Solids	mg/L												
Sodium Adsorption Ratio (SAR)	unitless												
Major Ions													
Calcium	mg/L												
Magnesium	mg/L												
Potassium	mg/L												
Sodium	mg/L												
Bicarbonate	mg/L												
Carbonate	mg/L												
Chloride	mg/L												
Sulfate	mg/L												
Metals													
Aluminum, dissolved	mg/L												
Arsenic, dissolved	mg/L												
Barium, dissolved	mg/L												
Boron, dissolved	mg/L												
Cadmium, dissolved	mg/L												
Chromium, dissolved	mg/L												
Copper, dissolved	mg/L												
Iron, dissolved	mg/L												
Iron, total	mg/L												
Lead, dissolved	mg/L												
Manganese, dissolved	mg/L												
Manganese, total	mg/L												
Mercury, dissolved	mg/L												
Molybdenum, dissolved	mg/L												
Nickel, dissolved	mg/L												
Selenium, dissolved	mg/L												
Zinc, dissolved	mg/L												
QA/QC													
Anion Sum	meq/L												
Cation Sum	meq/L												
Total Anion/Cation Balance	%												
Total Dissolved Solids (calc)	mg/L												

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Table D6.2-5. Groundwater Quality Monitoring Results For Masters (Continued)

Parameter	Units	578511-MST				578512-MST				578513-MST			
		3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14	3Q13	4Q13	1Q14	2Q14
Field													
Field Conductivity	µmhos/cm	2300	4180							4110	4230	3920	4130
Field pH	s.u.	8.57	7.52							7.51	6.77	7.12	6.87
Field turbidity	NTUs	35	171							9.82	2.96	2.06	2.22
Depth to Water	ft	150.1	150.12	DRY	DRY	DRY	DRY	DRY	DRY	108.2	108.54	108.82	107.94
Temperature	Deg C	17.6	9.9							14.6	10.6	10.7	17.2
General													
Alkalinity (as CaCO3)	mg/L	443	1230							604	611	605	607
Ammonia	mg/L	4.5	6.9							10.6	9.1	10.4	9.4
Fluoride	mg/L	0.9	1.1							0.6	0.7	0.6	0.6
Hardness (as CaCO3)	mg/L	382	506							1040	1030	1080	974
Hydroxide	mg/L	<5	<5							<5	<5	<5	<5
Laboratory conductivity	µmhos/cm	2280	3970							4290	4010	3900	3820
Laboratory pH	s.u.	8.3	8.3							7.8	7.8	7.6	8
Nitrate/Nitrite	mg/L	8	<0.1							<0.1	<0.1	<0.1	0.3
Total Dissolved Solids	mg/L	1500	2740							3370	3120	3090	2970
Sodium Adsorption Ratio (SAR)	unitless	7.9	15.3							8.3	7.9	8.2	7.4
Major Ions													
Calcium	mg/L	59	74							128	124	129	117
Magnesium	mg/L	57	78							175	175	184	166
Potassium	mg/L	19	29							32	34	32	30
Sodium	mg/L	353	793							613	586	622	533
Bicarbonate	mg/L	540	1470							736	745	738	740
Carbonate	mg/L	<5	11							<5	<5	<5	<5
Chloride	mg/L	16	30							15	16	18	15
Sulfate	mg/L	624	1050							1740	1780	1700	1690
Metals													
Aluminum, dissolved	mg/L	<0.1	<0.1							<0.1	<0.1	<0.1	<0.1
Arsenic, dissolved	mg/L	<0.005	<0.005							<0.005	<0.005	<0.005	<0.005
Barium, dissolved	mg/L	<0.1	<0.1							<0.1	<0.1	<0.1	<0.1
Boron, dissolved	mg/L	0.3	0.2							0.3	0.3	0.3	0.3
Cadmium, dissolved	mg/L	<0.001	<0.001							<0.001	<0.001	<0.001	<0.001
Chromium, dissolved	mg/L	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01
Copper, dissolved	mg/L	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01
Iron, dissolved	mg/L	<0.05	0.47							0.19	0.4	0.55	0.05
Iron, total	mg/L	0.29	25.6							0.34	0.51	0.74	0.18
Lead, dissolved	mg/L	<0.02	<0.02							<0.02	<0.02	<0.02	<0.02
Manganese, dissolved	mg/L	0.09	0.23							0.09	0.08	0.07	0.05
Manganese, total	mg/L	0.11	0.68							0.13	0.09	0.08	0.05
Mercury, dissolved	mg/L	<0.001	<0.001							<0.001	<0.001	<0.001	<0.001
Molybdenum, dissolved	mg/L	<0.02	<0.02							<0.02	<0.02	<0.02	<0.02
Nickel, dissolved	mg/L	<0.01	<0.01							<0.01	<0.01	<0.01	<0.01
Selenium, dissolved	mg/L	<0.005	<0.005							<0.005	<0.005	<0.005	<0.005
Zinc, dissolved	mg/L	<0.01	<0.01							0.01	<0.01	<0.01	<0.01
QA/QC													
Anion Sum	meq/L	22.91	47.25							48.85	49.79	47.95	47.84
Cation Sum	meq/L	23.8	45.33							48.99	46.96	50.18	44.11
Total Anion/Cation Balance	%	1.9	2.06							0.15	2.92	2.27	4.05
Total Dissolved Solids (calc)	mg/L	1430	2790							3070	3080	3040	2920

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Table D6.2-6. Groundwater Quality Monitoring Results For Masters/Carney Commingled Coal

Parameter	Units	578415-MST/CRN			
		3Q13	4Q13	1Q14	2Q14
Field					
Field Conductivity	µmhos/cm	2590	1952	1930	1778
Field pH	s.u.	8.56	7.68	8.11	7.91
Field turbidity	NTUs	330	225	8.38	3.55
Depth to Water	ft	122.85	122.68	122.01	121.23
Temperature	Deg C	12.8	10.5	10.5	15.1
General					
Alkalinity (as CaCO3)	mg/L	958	707	679	710
Ammonia	mg/L	1	1.6	2.1	2.3
Fluoride	mg/L	1.7	1.9	2	2
Hardness (as CaCO3)	mg/L	72	56	48	43
Hydroxide	mg/L	<5	<5	<5	<5
Laboratory conductivity	µmhos/cm	2720	1950	1850	1750
Laboratory pH	s.u.	8.4	8.4	8.4	8.3
Nitrate/Nitrite	mg/L	1.2	<0.1	<0.1	<0.1
Total Dissolved Solids	mg/L	1640	1180	1140	1210
Sodium Adsorption Ratio (SAR)	unitless	29	25.1	28.1	29
Major Ions					
Calcium	mg/L	15	12	10	9
Magnesium	mg/L	8	6	6	5
Potassium	mg/L	9	10	9	9
Sodium	mg/L	567	431	449	434
Bicarbonate	mg/L	1110	831	805	859
Carbonate	mg/L	27	16	12	<5
Chloride	mg/L	24	13	14	11
Sulfate	mg/L	374	280	249	263
Metals					
Aluminum, dissolved	mg/L	<0.1	0.7	<0.1	<0.1
Arsenic, dissolved	mg/L	0.007	<0.005	<0.005	<0.005
Barium, dissolved	mg/L	<0.1	<0.1	<0.1	<0.1
Boron, dissolved	mg/L	0.1	0.1	<0.1	<0.1
Cadmium, dissolved	mg/L	0.001	<0.001	<0.001	<0.001
Chromium, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
Copper, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
Iron, dissolved	mg/L	<0.05	0.21	0.06	0.15
Iron, total	mg/L	3.67	0.95	0.29	0.35
Lead, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02
Manganese, dissolved	mg/L	0.05	0.1	0.09	0.07
Manganese, total	mg/L	0.14	0.17	0.1	0.08
Mercury, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, dissolved	mg/L	0.03	<0.02	<0.02	<0.02
Nickel, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
Selenium, dissolved	mg/L	0.005	<0.005	<0.005	0.005
Zinc, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
QA/QC					
Anion Sum	meq/L	27.78	20.43	19.27	20.1
Cation Sum	meq/L	26.41	20.12	20.86	20.13
Total Anion/Cation Balance	%	2.52	0.77	3.97	0.07
Total Dissolved Solids (calc)	mg/L	1580	1180	1140	1160

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Table D6.2-7. Groundwater Quality Monitoring Results For Masters Coal Underburden

Parameter	Units	578409-UBN			
		3Q13	4Q13	1Q14	2Q14
Field					
Field Conductivity	µmhos/cm	4110	4220	3920	3990
Field pH	s.u.	8.74	7.76	8.04	7.79
Field turbidity	NTUs	4.61	3.62	59.7	1.01
Depth to Water	ft	108.44	110.2	110.25	110.4
Temperature	Deg C	10.9	11.4	12.9	14.5
General					
Alkalinity (as CaCO3)	mg/L	435	459	460	466
Ammonia	mg/L	<0.1	0.7	1.7	2.2
Fluoride	mg/L	1	1	1.1	1
Hardness (as CaCO3)	mg/L	373	395	479	522
Hydroxide	mg/L	<5	<5	<5	<5
Laboratory conductivity	µmhos/cm	3880	4010	3840	3620
Laboratory pH	s.u.	8.5	8.3	8.2	8.1
Nitrate/Nitrite	mg/L	13.6	7.5	4.9	3.2
Total Dissolved Solids	mg/L	2860	2820	2760	2830
Sodium Adsorption Ratio (SAR)	unitless	18	16.9	15.6	13.5
Major Ions					
Calcium	mg/L	67	70	80	85
Magnesium	mg/L	50	53	68	75
Potassium	mg/L	12	14	15	35
Sodium	mg/L	801	771	784	707
Bicarbonate	mg/L	505	553	561	569
Carbonate	mg/L	13	<5	<5	<5
Chloride	mg/L	34	32	30	28
Sulfate	mg/L	1620	1600	1530	1560
Metals					
Aluminum, dissolved	mg/L	<0.1	<0.1	0.2	<0.1
Arsenic, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005
Barium, dissolved	mg/L	<0.1	<0.1	<0.1	<0.1
Boron, dissolved	mg/L	0.2	0.3	0.3	0.5
Cadmium, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Chromium, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
Copper, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
Iron, dissolved	mg/L	<0.05	<0.05	0.3	<0.05
Iron, total	mg/L	0.09	<0.05	1.88	<0.05
Lead, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02
Manganese, dissolved	mg/L	0.04	0.16	0.41	0.36
Manganese, total	mg/L	0.05	0.19	1	0.58
Mercury, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001
Molybdenum, dissolved	mg/L	0.03	0.03	0.04	0.03
Nickel, dissolved	mg/L	<0.01	<0.01	0.01	0.03
Selenium, dissolved	mg/L	0.012	0.01	0.006	0.005
Zinc, dissolved	mg/L	<0.01	<0.01	<0.01	<0.01
QA/QC					
Anion Sum	meq/L	44.37	44.01	42.33	42.92
Cation Sum	meq/L	42.6	41.79	44.17	42.24
Total Anion/Cation Balance	%	2.03	2.58	2.12	0.79
Total Dissolved Solids (calc)	mg/L	2900	2850	2810	2790

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Table D6.2-8. Groundwater Quality Comparison of Alluvial Wells for WDEQ Standards

Parameter	Units	WDEQ Class I				WDEQ Class II				WDEQ Class III			
		Standard	578418-AL	578512-AL	578513-AL	Standard	578418-AL	578512-AL	578513-AL	Standard	578418-AL	578512-AL	578513-AL
General													
Alkalinity (as CaCO3)	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Ammonia	mg/L	0.5	0	0	0	—	0	0	0	—	0	0	0
Fluoride	mg/L	4	0	0	0	—	0	0	0	—	0	0	0
Hardness (as CaCO3)	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Hydroxide	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Laboratory conductivity	µmhos/cm	—	0	0	0	—	0	0	0	—	0	0	0
Laboratory pH	s.u.	8.5	0	0	0	9	0	0	0	8.5	0	0	0
Nitrate/Nitrite	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Total Dissolved Solids	mg/L	500	2	4	4	2000	1	4	4	5000	0	3	0
Sodium Adsorption Ration (SAR)	unitless	—	0	0	0	8	0	0	0	—	0	0	0
Major Ions													
Calcium	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Magnesium	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Potassium	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Sodium	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Bicarbonate	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Carbonate	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Chloride	mg/L	250	0	0	0	100	0	0	0	2000	0	0	0
Sulfate	mg/L	250	2	4	4	200	2	4	4	3000	0	2	0
Metals													
Aluminum, dissolved	mg/L	—	0	0	0	5	0	0	0	5	0	0	0
Arsenic, dissolved	mg/L	0.05	0	0	0	0.1	0	0	0	0.2	0	0	0
Barium, dissolved	mg/L	2	0	0	0	—	0	0	0	—	0	0	0
Boron, dissolved	mg/L	0.75	0	0	0	0.75	0	0	0	5	0	0	0
Cadmium, dissolved	mg/L	0.005	0	0	0	0.01	0	0	0	0.05	0	0	0
Chromium, dissolved	mg/L	0.1	0	0	0	0.1	0	0	0	0.05	0	0	0
Copper, dissolved	mg/L	1	0	0	0	0.2	0	0	0	0.5	0	0	0
Iron, dissolved	mg/L	0.3	0	4	0	5	0	0	0	—	0	0	0
Iron, total	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Lead, dissolved	mg/L	—	0	0	0	5	0	0	0	0.1	0	0	0
Manganese, dissolved	mg/L	0.05	0	4	4	0.2	0	4	4	—	0	0	0
Manganese, total	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Mercury, dissolved	mg/L	0.002	0	0	0	—	0	0	0	0.00005	0	0	0
Molybdenum, dissolved	mg/L	—	0	0	0	—	0	0	0	—	0	0	0
Nickel, dissolved	mg/L	—	0	0	0	0.2	0	0	0	—	0	0	0
Selenium, dissolved	mg/L	0.05	0	0	0	0.02	0	0	0	0.05	0	0	0
Zinc, dissolved	mg/L	5	0	0	0	2	0	0	0	25	0	0	0

Pink Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

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Table D6.2-9. Groundwater Quality Comparison of Alluvial Wells for EPA Standards

Parameter	Units	EPA Primary				EPA Secondary			
		Standard	578418-AL	578512-AL	578513-AL	Standard	578418-AL	578512-AL	578513-AL
General									
Alkalinity (as CaCO3)	mg/L	—	0	0	0	—	0	0	0
Ammonia	mg/L	—	0	0	0	—	0	0	0
Fluoride	mg/L	4	0	0	0	2	0	0	0
Hardness (as CaCO3)	mg/L	—	0	0	0	—	0	0	0
Hydroxide	mg/L	—	0	0	0	—	0	0	0
Laboratory conductivity	µmhos/cm	—	0	0	0	—	0	0	0
Laboratory pH	s.u.	—	0	0	0	8.5	0	0	0
Nitrate/Nitrite	mg/L	—	0	0	0	—	0	0	0
Total Dissolved Solids	mg/L	—	0	0	0	500	2	4	4
Sodium Adsorption Ration (SAR)	unitless	—	0	0	0	—	0	0	0
Major Ions									
Calcium	mg/L	—	0	0	0	—	0	0	0
Magnesium	mg/L	—	0	0	0	—	0	0	0
Potassium	mg/L	—	0	0	0	—	0	0	0
Sodium	mg/L	—	0	0	0	—	0	0	0
Bicarbonate	mg/L	—	0	0	0	—	0	0	0
Carbonate	mg/L	—	0	0	0	—	0	0	0
Chloride	mg/L	—	0	0	0	250	0	0	0
Sulfate	mg/L	—	0	0	0	250	2	4	4
Metals									
Aluminum, dissolved	mg/L	—	0	0	0	—	0	0	0
Arsenic, dissolved	mg/L	0.01	0	0	0	—	0	0	0
Barium, dissolved	mg/L	2	0	0	0	—	0	0	0
Boron, dissolved	mg/L	—	0	0	0	—	0	0	0
Cadmium, dissolved	mg/L	0.005	0	0	0	—	0	0	0
Chromium, dissolved	mg/L	—	0	0	0	—	0	0	0
Copper, dissolved	mg/L	1.3	0	0	0	1	0	0	0
Iron, dissolved	mg/L	—	0	0	0	0.3	0	4	0
Iron, total	mg/L	—	0	0	0	—	0	0	0
Lead, dissolved	mg/L	0.015	0	0	0	—	0	0	0
Manganese, dissolved	mg/L	—	0	0	0	0.05	0	4	4
Manganese, total	mg/L	—	0	0	0	—	0	0	0
Mercury, dissolved	mg/L	0.002	0	0	0	—	0	0	0
Molybdenum, dissolved	mg/L	—	0	0	0	—	0	0	0
Nickel, dissolved	mg/L	—	0	0	0	—	0	0	0
Selenium, dissolved	mg/L	0.05	0	0	0	—	0	0	0
Zinc, dissolved	mg/L	—	0	0	0	5	0	0	0

Pink Indicates the number of baseline samples whose results exceed the EPA Primary or Secondary MCLs

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Table D6.2-10. Groundwater Quality Comparison of Underburden Wells for WDEQ Standards

Parameter	Units	WDEQ Class I		WDEQ Class II		WDEQ Class III	
		Standard	578409-UBN	Standard	578409-UBN	Standard	578409-UBN
General							
Alkalinity (as CaCO3)	mg/L	—	0	—	0	—	0
Ammonia	mg/L	0.5	3	—	0	—	0
Fluoride	mg/L	4	0	—	0	—	0
Hardness (as CaCO3)	mg/L	—	0	—	0	—	0
Hydroxide	mg/L	—	0	—	0	—	0
Laboratory conductivity	µmhos/cm	—	0	—	0	—	0
Laboratory pH	s.u.	8.5	0	9	0	8.5	0
Nitrate/Nitrite	mg/L	—	0	—	0	—	0
Total Dissolved Solids	mg/L	500	4	2000	4	5000	0
Sodium Adsorption Ratio (SAR)	unitless	—	0	8	4	—	0
Major Ions							
Calcium	mg/L	—	0	—	0	—	0
Magnesium	mg/L	—	0	—	0	—	0
Potassium	mg/L	—	0	—	0	—	0
Sodium	mg/L	—	0	—	0	—	0
Bicarbonate	mg/L	—	0	—	0	—	0
Carbonate	mg/L	—	0	—	0	—	0
Chloride	mg/L	250	0	100	0	2000	0
Sulfate	mg/L	250	4	200	4	3000	0
Metals							
Aluminum, dissolved	mg/L	—	0	5	0	5	0
Arsenic, dissolved	mg/L	0.05	0	0.1	0	0.2	0
Barium, dissolved	mg/L	2	0	—	0	—	0
Boron, dissolved	mg/L	0.75	0	0.75	0	5	0
Cadmium, dissolved	mg/L	0.005	0	0.01	0	0.05	0
Chromium, dissolved	mg/L	0.1	0	0.1	0	0.05	0
Copper, dissolved	mg/L	1	0	0.2	0	0.5	0
Iron, dissolved	mg/L	0.3	0	5	0	—	0
Iron, total	mg/L	—	0	—	0	—	0
Lead, dissolved	mg/L	—	0	5	0	0.1	0
Manganese, dissolved	mg/L	0.05	3	0.2	2	—	0
Manganese, total	mg/L	—	0	—	0	—	0
Mercury, dissolved	mg/L	0.002	0	—	0	0.00005	0
Molybdenum, dissolved	mg/L	—	0	—	0	—	0
Nickel, dissolved	mg/L	—	0	0.2	0	—	0
Selenium, dissolved	mg/L	0.05	0	0.02	0	0.05	0
Zinc, dissolved	mg/L	5	0	2	0	25	0

Pink — Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1.

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Table D6.2-11. Groundwater Quality Comparison of Underburden Wells for EPA Standards

Parameter	Units	EPA Primary		EPA Secondary	
		Standard	578409-UBN	Standard	578409-UBN
General					
Alkalinity (as CaCO3)	mg/L	—	0	—	0
Ammonia	mg/L	—	0	—	0
Fluoride	mg/L	4	0	2	0
Hardness (as CaCO3)	mg/L	—	0	—	0
Hydroxide	mg/L	—	0	—	0
Laboratory conductivity	µmhos/cm	—	0	—	0
Laboratory pH	s.u.	—	0	8.5	0
Nitrate/Nitrite	mg/L	—	0	—	0
Total Dissolved Solids	mg/L	—	0	500	4
Sodium Adsorption Ratio (SAR)	unitless	—	0	—	0
Major Ions					
Calcium	mg/L	—	0	—	0
Magnesium	mg/L	—	0	—	0
Potassium	mg/L	—	0	—	0
Sodium	mg/L	—	0	—	0
Bicarbonate	mg/L	—	0	—	0
Carbonate	mg/L	—	0	—	0
Chloride	mg/L	—	0	250	0
Sulfate	mg/L	—	0	250	4
Metals					
Aluminum, dissolved	mg/L	—	0	—	0
Arsenic, dissolved	mg/L	0.01	0	—	0
Barium, dissolved	mg/L	2	0	—	0
Boron, dissolved	mg/L	—	0	—	0
Cadmium, dissolved	mg/L	0.005	0	—	0
Chromium, dissolved	mg/L	—	0	—	0
Copper, dissolved	mg/L	1.3	0	1	0
Iron, dissolved	mg/L	—	0	0.3	0
Iron, total	mg/L	—	0	—	0
Lead, dissolved	mg/L	0.015	0	—	0
Manganese, dissolved	mg/L	—	0	0.05	3
Manganese, total	mg/L	—	0	—	0
Mercury, dissolved	mg/L	0.002	0	—	0
Molybdenum, dissolved	mg/L	—	0	—	0
Nickel, dissolved	mg/L	—	0	—	0
Selenium, dissolved	mg/L	0.05	0	—	0
Zinc, dissolved	mg/L	—	0	5	0

Pink Indicates the number of baseline samples whose results exceed the EPA Primary or Secondary MCLs

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RECD NOV 14, 2014

Table D6.2-12. Groundwater Quality Comparison of Masters Coal Seam Wells for WDEQ Standards

Parameter	Units	WDEQ Class I									
		Standard	578408-MST	578409-MST	578409-MST-OB	578417-MST	578418-MST	578510-MST	578511-MST	578512-MST	578513-MST
General					Not Sampled	DRY	DRY	DRY		DRY	
Alkalinity (as CaCO3)	mg/L	---	0	0					0		0
Ammonia	mg/L	0.5	4	4					2		3
Fluoride	mg/L	4	0	0					0		0
Hardness (as CaCO3)	mg/L	---	0	0					0		0
Hydroxide	mg/L	---	0	0					0		0
Laboratory conductivity	µmhos/cm	---	0	0					0		0
Laboratory pH	s.u.	8.5	0	0					0		0
Nitrate/Nitrite	mg/L	---	0	0					0		0
Total Dissolved Solids	mg/L	500	4	4					2		3
Sodium Adsorption Ratio (SAR)	unitless	---	0	0					0		0
Major Ions											
Calcium	mg/L	---	0	0					0		0
Magnesium	mg/L	---	0	0					0		0
Potassium	mg/L	---	0	0					0		0
Sodium	mg/L	---	0	0					0		0
Bicarbonate	mg/L	---	0	0					0		0
Carbonate	mg/L	---	0	0					0		0
Chloride	mg/L	250	0	0					0		0
Sulfate	mg/L	250	4	4					2		3
Metals											
Aluminum, dissolved	mg/L	---	0	0					0		0
Arsenic, dissolved	mg/L	0.05	0	0					0		0
Barium, dissolved	mg/L	2	0	0					0		0
Boron, dissolved	mg/L	0.75	0	0					0		0
Cadmium, dissolved	mg/L	0.005	0	0					0		0
Chromium, dissolved	mg/L	0.1	0	0					0		0
Copper, dissolved	mg/L	1	0	0					0		0
Iron, dissolved	mg/L	0.3	4	0					1		2
Iron, total	mg/L	---	0	0					0		0
Lead, dissolved	mg/L	---	0	0					0		0
Manganese, dissolved	mg/L	0.05	4	4					2		3
Manganese, total	mg/L	---	0	0					0		0
Mercury, dissolved	mg/L	0.002	0	0					0		0
Molybdenum, dissolved	mg/L	---	0	0					0		0
Nickel, dissolved	mg/L	---	0	0					0		0
Selenium, dissolved	mg/L	0.05	0	0					0		0
Zinc, dissolved	mg/L	5	0	0					0		0

Pink Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

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Table D6.2-12. Groundwater Quality Comparison of Masters Coal Seam Wells for WDEQ Standards (Continued)

Parameter	Units	WDEQ Class II									
		Standard	578408-MST	578409-MST	578409-MST-OB	578417-MST	578418-MST	578510-MST	578511-MST	578512-MST	578513-MST
General					Not Sampled	DRY	DRY	DRY		DRY	
Alkalinity (as CaCO3)	mg/L	---	0	0					0		0
Ammonia	mg/L	---	0	0					0		0
Fluoride	mg/L	---	0	0					0		0
Hardness (as CaCO3)	mg/L	---	0	0					0		0
Hydroxide	mg/L	---	0	0					0		0
Laboratory conductivity	µmhos/cm	---	0	0					0		0
Laboratory pH	s.u.	9	0	0					0		0
Nitrate/Nitrite	mg/L	---	0	0					0		0
Total Dissolved Solids	mg/L	2000	0	0					1		3
Sodium Adsorption Ratio (SAR)	unitless	8	0	4					1		2
Major Ions											
Calcium	mg/L	---	0	0					0		0
Magnesium	mg/L	---	0	0					0		0
Potassium	mg/L	---	0	0					0		0
Sodium	mg/L	---	0	0					0		0
Bicarbonate	mg/L	---	0	0					0		0
Carbonate	mg/L	---	0	0					0		0
Chloride	mg/L	100	0	0					0		0
Sulfate	mg/L	200	4	4					2		3
Metals											
Aluminum, dissolved	mg/L	5	0	0					0		0
Arsenic, dissolved	mg/L	0.1	0	0					0		0
Barium, dissolved	mg/L	---	0	0					0		0
Boron, dissolved	mg/L	0.75	0	0					0		0
Cadmium, dissolved	mg/L	0.01	0	0					0		0
Chromium, dissolved	mg/L	0.1	0	0					0		0
Copper, dissolved	mg/L	0.2	0	0					0		0
Iron, dissolved	mg/L	5	0	0					0		0
Iron, total	mg/L	---	0	0					0		0
Lead, dissolved	mg/L	5	0	0					0		0
Manganese, dissolved	mg/L	0.2	2	2					1		0
Manganese, total	mg/L	---	0	0					0		0
Mercury, dissolved	mg/L	---	0	0					0		0
Molybdenum, dissolved	mg/L	---	0	0					0		0
Nickel, dissolved	mg/L	0.2	0	0					0		0
Selenium, dissolved	mg/L	0.02	0	0					0		0
Zinc, dissolved	mg/L	2	0	0					0		0

Pink Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

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Table D6.2-12. Groundwater Quality Comparison of Masters Coal Seam Wells for WDEQ Standards (Continued)

Parameter	Units	WDEQ Class III									
		Standard	578408-MST	578409-MST	578409-MST-OB	578417-MST	578418-MST	578510-MST	578511-MST	578512-MST	578513-MST
General					Not Sampled	DRY	DRY	DRY		DRY	
Alkalinity (as CaCO3)	mg/L	---	0	0					0		0
Ammonia	mg/L	---	0	0					0		0
Fluoride	mg/L	---	0	0					0		0
Hardness (as CaCO3)	mg/L	---	0	0					0		0
Hydroxide	mg/L	---	0	0					0		0
Laboratory conductivity	µmhos/cm	---	0	0					0		0
Laboratory pH	s.u.	8.5	0	0					0		0
Nitrate/Nitrite	mg/L	---	0	0					0		0
Total Dissolved Solids	mg/L	5000	0	0					0		0
Sodium Adsorption Ratio (SAR)	unitless	---	0	0					0		0
Major Ions											
Calcium	mg/L	---	0	0					0		0
Magnesium	mg/L	---	0	0					0		0
Potassium	mg/L	---	0	0					0		0
Sodium	mg/L	---	0	0					0		0
Bicarbonate	mg/L	---	0	0					0		0
Carbonate	mg/L	---	0	0					0		0
Chloride	mg/L	2000	0	0					0		0
Sulfate	mg/L	3000	0	0					0		0
Metals											
Aluminum, dissolved	mg/L	5	0	0					0		0
Arsenic, dissolved	mg/L	0.2	0	0					0		0
Barium, dissolved	mg/L	---	0	0					0		0
Boron, dissolved	mg/L	5	0	0					0		0
Cadmium, dissolved	mg/L	0.05	0	0					0		0
Chromium, dissolved	mg/L	0.05	0	0					0		0
Copper, dissolved	mg/L	0.5	0	0					0		0
Iron, dissolved	mg/L	---	0	0					0		0
Iron, total	mg/L	---	0	0					0		0
Lead, dissolved	mg/L	0.1	0	0					0		0
Manganese, dissolved	mg/L	---	0	0					0		0
Manganese, total	mg/L	---	0	0					0		0
Mercury, dissolved	mg/L	0.00005	0	0					0		0
Molybdenum, dissolved	mg/L	---	0	0					0		0
Nickel, dissolved	mg/L	---	0	0					0		0
Selenium, dissolved	mg/L	0.05	0	0					0		0
Zinc, dissolved	mg/L	25	0	0					0		0

Pink — Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

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Table D6.2-13. Groundwater Quality Comparison of Masters Coal Seam Wells for EPA Standards

Parameter	Units	EPA Primary									
		Standard	578408-MST	578409-MST	578409-MST-OB	578417-MST	578418-MST	578510-MST	578511-MST	578512-MST	578513-MST
General					Not Sampled	DRY	DRY	DRY		DRY	
Alkalinity (as CaCO3)	mg/L	---	0	0					0		0
Ammonia	mg/L	---	0	0					0		0
Fluoride	mg/L	4	0	0					0		0
Hardness (as CaCO3)	mg/L	---	0	0					0		0
Hydroxide	mg/L	---	0	0					0		0
Laboratory conductivity	µmhos/cm	---	0	0					0		0
Laboratory pH	s.u.	---	0	0					0		0
Nitrate/Nitrite	mg/L	---	0	0					0		0
Total Dissolved Solids	mg/L	---	0	0					0		0
Sodium Adsorption Ratio (SAR)	unitless	---	0	0					0		0
Major Ions											
Calcium	mg/L	---	0	0					0		0
Magnesium	mg/L	---	0	0					0		0
Potassium	mg/L	---	0	0					0		0
Sodium	mg/L	---	0	0					0		0
Bicarbonate	mg/L	---	0	0					0		0
Carbonate	mg/L	---	0	0					0		0
Chloride	mg/L	---	0	0					0		0
Sulfate	mg/L	---	0	0					0		0
Metals											
Aluminum, dissolved	mg/L	---	0	0					0		0
Arsenic, dissolved	mg/L	0.01	0	0					0		0
Barium, dissolved	mg/L	2	0	0					0		0
Boron, dissolved	mg/L	---	0	0					0		0
Cadmium, dissolved	mg/L	0.005	0	0					0		0
Chromium, dissolved	mg/L	---	0	0					0		0
Copper, dissolved	mg/L	1.3	0	0					0		0
Iron, dissolved	mg/L	---	0	0					0		0
Iron, total	mg/L	---	0	0					0		0
Lead, dissolved	mg/L	0.015	0	0					0		0
Manganese, dissolved	mg/L	---	0	0					0		0
Manganese, total	mg/L	---	0	0					0		0
Mercury, dissolved	mg/L	0.002	0	0					0		0
Molybdenum, dissolved	mg/L	---	0	0					0		0
Nickel, dissolved	mg/L	---	0	0					0		0
Selenium, dissolved	mg/L	0.05	0	0					0		0
Zinc, dissolved	mg/L	---	0	0					0		0

Pink Indicates the number of baseline samples whose results exceed the EPA Primary or Secondary MCLs

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RECD OCT 23, 2015

Table D6.2-13. Groundwater Quality Comparison of Masters Coal Seam Wells for EPA Standards (Continued)

Parameter	Units	EPA Secondary									
		Standard	578408-MST	578409-MST	578409-MST-OB	578417-MST	578418-MST	578510-MST	578511-MST	578512-MST	578513-MST
General					Not Sampled	DRY	DRY	DRY		DRY	
Alkalinity (as CaCO3)	mg/L	---	0	0					0		0
Ammonia	mg/L	---	0	0					0		0
Fluoride	mg/L	2	0	0					0		0
Hardness (as CaCO3)	mg/L	---	0	0					0		0
Hydroxide	mg/L	---	0	0					0		0
Laboratory conductivity	µmhos/cm	---	0	0					0		0
Laboratory pH	s.u.	8.5	0	0					0		0
Nitrate/Nitrite	mg/L	---	0	0					0		0
Total Dissolved Solids	mg/L	500	4	4					2		3
Sodium Adsorption Ratio (SAR)	unitless	---	0	0					0		0
Major Ions											
Calcium	mg/L	---	0	0					0		0
Magnesium	mg/L	---	0	0					0		0
Potassium	mg/L	---	0	0					0		0
Sodium	mg/L	---	0	0					0		0
Bicarbonate	mg/L	---	0	0					0		0
Carbonate	mg/L	---	0	0					0		0
Chloride	mg/L	250	0	0					0		0
Sulfate	mg/L	250	4	4					2		3
Metals											
Aluminum, dissolved	mg/L	---	0	0					0		0
Arsenic, dissolved	mg/L	---	0	0					0		0
Barium, dissolved	mg/L	---	0	0					0		0
Boron, dissolved	mg/L	---	0	0					0		0
Cadmium, dissolved	mg/L	---	0	0					0		0
Chromium, dissolved	mg/L	---	0	0					0		0
Copper, dissolved	mg/L	1	0	0					0		0
Iron, dissolved	mg/L	0.3	4	0					1		2
Iron, total	mg/L	---	0	0					0		0
Lead, dissolved	mg/L	---	0	0					0		0
Manganese, dissolved	mg/L	0.05	4	4					2		3
Manganese, total	mg/L	---	0	0					0		0
Mercury, dissolved	mg/L	---	0	0					0		0
Molybdenum, dissolved	mg/L	---	0	0					0		0
Nickel, dissolved	mg/L	---	0	0					0		0
Selenium, dissolved	mg/L	---	0	0					0		0
Zinc, dissolved	mg/L	5	0	0					0		0

Pink — Indicates the number of baseline samples whose results exceed the EPA Primary or Secondary MCLs

TFN 6 2/025
RECD OCT 23, 2015

Table D6.2-14. Groundwater Quality Comparison of Masters/Carney Commingled Coal Seam Wells for WDEQ Standards

Parameter	Units	WDEQ Class I		WDEQ Class II		WDEQ Class III	
		Standard	578415-MST/CRN	Standard	578415-MST/CRN	Standard	578415-MST/CRN
General							
Alkalinity (as CaCO3)	mg/L	—	0	—	0	—	0
Ammonia	mg/L	0.5	4	—	0	—	0
Fluoride	mg/L	4	0	—	0	—	0
Hardness (as CaCO3)	mg/L	—	0	—	0	—	0
Hydroxide	mg/L	—	0	—	0	—	0
Laboratory conductivity	µmhos/cm	—	0	—	0	—	0
Laboratory pH	s.u.	8.5	0	9	0	8.5	0
Nitrate/Nitrite	mg/L	—	0	—	0	—	0
Total Dissolved Solids	mg/L	500	4	2000	0	5000	0
Sodium Adsorption Ratio (SAR)	unitless	—	0	8	4	—	0
Major Ions							
Calcium	mg/L	—	0	—	0	—	0
Magnesium	mg/L	—	0	—	0	—	0
Potassium	mg/L	—	0	—	0	—	0
Sodium	mg/L	—	0	—	0	—	0
Bicarbonate	mg/L	—	0	—	0	—	0
Carbonate	mg/L	—	0	—	0	—	0
Chloride	mg/L	250	0	100	0	2000	0
Sulfate	mg/L	250	3	200	4	3000	0
Metals							
Aluminum, dissolved	mg/L	—	0	5	0	5	0
Arsenic, dissolved	mg/L	0.05	0	0.1	0	0.2	0
Barium, dissolved	mg/L	2	0	—	0	—	0
Boron, dissolved	mg/L	0.75	0	0.75	0	5	0
Cadmium, dissolved	mg/L	0.005	0	0.01	0	0.05	0
Chromium, dissolved	mg/L	0.1	0	0.1	0	0.05	0
Copper, dissolved	mg/L	1	0	0.2	0	0.5	0
Iron, dissolved	mg/L	0.3	0	5	0	—	0
Iron, total	mg/L	—	0	—	0	—	0
Lead, dissolved	mg/L	—	0	5	0	0.1	0
Manganese, dissolved	mg/L	0.05	3	0.2	0	—	0
Manganese, total	mg/L	—	0	—	0	—	0
Mercury, dissolved	mg/L	0.002	0	—	0	0.00005	0
Molybdenum, dissolved	mg/L	—	0	—	0	—	0
Nickel, dissolved	mg/L	—	0	0.2	0	—	0
Selenium, dissolved	mg/L	0.05	0	0.02	0	0.05	0
Zinc, dissolved	mg/L	5	0	2	0	25	0

Pink — Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

TFN 6 2/025
RECD NOV 14, 2014

Table D6.2-15. Groundwater Quality Comparison of Masters/Carney Commingled Coal Seam Wells for EPA Standards

Parameter	Units	EPA Primary		EPA Secondary	
		Standard	578415-MST/CRN	Standard	578415-MST/CRN
General					
Alkalinity (as CaCO3)	mg/L	—	0	—	0
Ammonia	mg/L	—	0	—	0
Fluoride	mg/L	4	0	2	0
Hardness (as CaCO3)	mg/L	—	0	—	0
Hydroxide	mg/L	—	0	—	0
Laboratory conductivity	µmhos/cm	—	0	—	0
Laboratory pH	s.u.	—	0	8.5	0
Nitrate/Nitrite	mg/L	—	0	—	0
Total Dissolved Solids	mg/L	—	0	500	4
Sodium Adsorption Ratio (SAR)	unitless	—	0	—	0
Major Ions					
Calcium	mg/L	—	0	—	0
Magnesium	mg/L	—	0	—	0
Potassium	mg/L	—	0	—	0
Sodium	mg/L	—	0	—	0
Bicarbonate	mg/L	—	0	—	0
Carbonate	mg/L	—	0	—	0
Chloride	mg/L	—	0	250	0
Sulfate	mg/L	—	0	250	3
Metals					
Aluminum, dissolved	mg/L	—	0	—	0
Arsenic, dissolved	mg/L	0.01	0	—	0
Barium, dissolved	mg/L	2	0	—	0
Boron, dissolved	mg/L	—	0	—	0
Cadmium, dissolved	mg/L	0.005	0	—	0
Chromium, dissolved	mg/L	—	0	—	0
Copper, dissolved	mg/L	1.3	0	1	0
Iron, dissolved	mg/L	—	0	0.3	0
Iron, total	mg/L	—	0	—	0
Lead, dissolved	mg/L	0.015	0	—	0
Manganese, dissolved	mg/L	—	0	0.05	3
Manganese, total	mg/L	—	0	—	0
Mercury, dissolved	mg/L	0.002	0	—	0
Molybdenum, dissolved	mg/L	—	0	—	0
Nickel, dissolved	mg/L	—	0	—	0
Selenium, dissolved	mg/L	0.05	0	—	0
Zinc, dissolved	mg/L	—	0	5	0

Pink — Indicates the number of baseline samples whose results exceed the EPA Primary or Secondary MCLs

TFN 6 2/025
RECD NOV 14, 2014

Table D6.2-16. Groundwater Quality Comparison of Carney Coal Seam Wells for WDEQ Standards

Parameter	Units	WDEQ Class I									
		Standard	578408-CRN	578409-CRN	578409-CRN-OB	578417-CRN	578418-CRN	578510-CRN	578511-CRN	578512-CRN	578513-CRN
General				Not Sampled			DRY	DRY		DRY	DRY
Alkalinity (as CaCO3)	mg/L	—	0		0	0			0		
Ammonia	mg/L	0.5	0		0	0			0		
Fluoride	mg/L	4	0		0	0			0		
Hardness (as CaCO3)	mg/L	—	0		0	0			0		
Hydroxide	mg/L	—	0		0	0			0		
Laboratory conductivity	µmhos/cm	—	0		0	0			0		
Laboratory pH	s.u.	8.5	0		0	0			0		
Nitrate/Nitrite	mg/L	—	0		0	0			0		
Total Dissolved Solids	mg/L	500	0		0	0			0		
Sodium Adsorption Ratio (SAR)	unitless	—	0		0	0			0		
Major Ions											
Calcium	mg/L	—	0		0	0			0		
Magnesium	mg/L	—	0		0	0			0		
Potassium	mg/L	—	0		0	0			0		
Sodium	mg/L	—	0		0	0			0		
Bicarbonate	mg/L	—	0		0	0			0		
Carbonate	mg/L	—	0		0	0			0		
Chloride	mg/L	250	0		0	0			0		
Sulfate	mg/L	250	0		0	0			0		
Metals											
Aluminum, dissolved	mg/L	—	0		0	0			0		
Arsenic, dissolved	mg/L	0.05	0		0	0			0		
Barium, dissolved	mg/L	2	0		0	0			0		
Boron, dissolved	mg/L	0.75	0		0	0			0		
Cadmium, dissolved	mg/L	0.005	0		0	0			0		
Chromium, dissolved	mg/L	0.1	0		0	0			0		
Copper, dissolved	mg/L	1	0		0	0			0		
Iron, dissolved	mg/L	0.3	0		0	0			0		
Iron, total	mg/L	—	0		0	0			0		
Lead, dissolved	mg/L	—	0		0	0			0		
Manganese, dissolved	mg/L	0.05	0		0	0			0		
Manganese, total	mg/L	—	0		0	0			0		
Mercury, dissolved	mg/L	0.002	0		0	0			0		
Molybdenum, dissolved	mg/L	—	0		0	0			0		
Nickel, dissolved	mg/L	—	0		0	0			0		
Selenium, dissolved	mg/L	0.05	0		0	0			0		
Zinc, dissolved	mg/L	5	0		0	0			0		

Pink — Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

TFN 6 2/025
RECD NOV 14, 2014

Table D6.2-16. Groundwater Quality Comparison of Carney Coal Seam Wells for WDEQ Standards (Continued)

Parameter	Units	WDEQ Class II									
		Standard	578408-CRN	578409-CRN	578409-CRN-OB	578417-CRN	578418-CRN	578510-CRN	578511-CRN	578512-CRN	578513-CRN
General				Not Sampled			DRY	DRY		DRY	DRY
Alkalinity (as CaCO3)	mg/L	—	0		0	0			0		
Ammonia	mg/L	—	0		0	0			0		
Fluoride	mg/L	—	0		0	0			0		
Hardness (as CaCO3)	mg/L	—	0		0	0			0		
Hydroxide	mg/L	—	0		0	0			0		
Laboratory conductivity	µmhos/cm	—	0		0	0			0		
Laboratory pH	s.u.	9	0		0	0			0		
Nitrate/Nitrite	mg/L	—	0		0	0			0		
Total Dissolved Solids	mg/L	2000	0		0	0			0		
Sodium Adsorption Ratio (SAR)	unitless	8	0		0	0			0		
Major Ions											
Calcium	mg/L	—	0		0	0			0		
Magnesium	mg/L	—	0		0	0			0		
Potassium	mg/L	—	0		0	0			0		
Sodium	mg/L	—	0		0	0			0		
Bicarbonate	mg/L	—	0		0	0			0		
Carbonate	mg/L	—	0		0	0			0		
Chloride	mg/L	100	0		0	0			0		
Sulfate	mg/L	200	0		0	0			0		
Metals											
Aluminum, dissolved	mg/L	5	0		0	0			0		
Arsenic, dissolved	mg/L	0.1	0		0	0			0		
Barium, dissolved	mg/L	—	0		0	0			0		
Boron, dissolved	mg/L	0.75	0		0	0			0		
Cadmium, dissolved	mg/L	0.01	0		0	0			0		
Chromium, dissolved	mg/L	0.1	0		0	0			0		
Copper, dissolved	mg/L	0.2	0		0	0			0		
Iron, dissolved	mg/L	5	0		0	0			0		
Iron, total	mg/L	—	0		0	0			0		
Lead, dissolved	mg/L	5	0		0	0			0		
Manganese, dissolved	mg/L	0.2	0		0	0			0		
Manganese, total	mg/L	—	0		0	0			0		
Mercury, dissolved	mg/L	—	0		0	0			0		
Molybdenum, dissolved	mg/L	—	0		0	0			0		
Nickel, dissolved	mg/L	0.2	0		0	0			0		
Selenium, dissolved	mg/L	0.02	0		0	0			0		
Zinc, dissolved	mg/L	2	0		0	0			0		

Pink — Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

TFN 6 2/025
RECD NOV 14, 2014

Table D6.2-16. Groundwater Quality Comparison of Carney Coal Seam Wells for WDEQ Standards (Continued)

Parameter	Units	WDEQ Class III									
		Standard	578408-CRN	578409-CRN	578409-CRN-OB	578417-CRN	578418-CRN	578510-CRN	578511-CRN	578512-CRN	578513-CRN
General				Not Sampled			DRY	DRY		DRY	DRY
Alkalinity (as CaCO3)	mg/L	—	0		0	0			0		
Ammonia	mg/L	—	0		0	0			0		
Fluoride	mg/L	—	0		0	0			0		
Hardness (as CaCO3)	mg/L	—	0		0	0			0		
Hydroxide	mg/L	—	0		0	0			0		
Laboratory conductivity	µmhos/cm	—	0		0	0			0		
Laboratory pH	s.u.	**8.5**	0		0	0			0		
Nitrate/Nitrite	mg/L	—	0		0	0			0		
Total Dissolved Solids	mg/L	**5000**	0		0	0			0		
Sodium Adsorption Ratio (SAR)	unitless	—	0		0	0			0		
Major Ions											
Calcium	mg/L	—	0		0	0			0		
Magnesium	mg/L	—	0		0	0			0		
Potassium	mg/L	—	0		0	0			0		
Sodium	mg/L	—	0		0	0			0		
Bicarbonate	mg/L	—	0		0	0			0		
Carbonate	mg/L	—	0		0	0			0		
Chloride	mg/L	**2000**	0		0	0			0		
Sulfate	mg/L	**3000**	0		0	0			0		
Metals											
Aluminum, dissolved	mg/L	**5**	0		0	0			0		
Arsenic, dissolved	mg/L	**0.2**	0		0	0			0		
Barium, dissolved	mg/L	—	0		0	0			0		
Boron, dissolved	mg/L	**5**	0		0	0			0		
Cadmium, dissolved	mg/L	**0.05**	0		0	0			0		
Chromium, dissolved	mg/L	**0.05**	0		0	0			0		
Copper, dissolved	mg/L	**0.5**	0		0	0			0		
Iron, dissolved	mg/L	—	0		0	0			0		
Iron, total	mg/L	—	0		0	0			0		
Lead, dissolved	mg/L	**0.1**	0		0	0			0		
Manganese, dissolved	mg/L	—	0		0	0			0		
Manganese, total	mg/L	—	0		0	0			0		
Mercury, dissolved	mg/L	**0.00005**	0		0	0			0		
Molybdenum, dissolved	mg/L	—	0		0	0			0		
Nickel, dissolved	mg/L	—	0		0	0			0		
Selenium, dissolved	mg/L	**0.05**	0		0	0			0		
Zinc, dissolved	mg/L	**25**	0		0	0			0		

Pink — Indicates the number of baseline samples whose results exceed the underground water class use suitability as defined by WQD, Chapter 8, Table 1

TFN 6 2/025
RECD NOV 14, 2014

Table D6.2-17. Groundwater Quality Comparison of Carney Coal Seam Wells for EPA Standards

Parameter	Units	EPA Primary									
		Standard	578408-CRN	578409-CRN	578409-CRN-OB	578417-CRN	578418-CRN	578510-CRN	578511-CRN	578512-CRN	578513-CRN
General				Not Sampled			DRY	DRY		DRY	DRY
Alkalinity (as CaCO3)	mg/L	—	0		0	0			0		
Ammonia	mg/L	—	0		0	0			0		
Fluoride	mg/L	4	0		0	0			0		
Hardness (as CaCO3)	mg/L	—	0		0	0			0		
Hydroxide	mg/L	—	0		0	0			0		
Laboratory conductivity	µmhos/cm	—	0		0	0			0		
Laboratory pH	s.u.	—	0		0	0			0		
Nitrate/Nitrite	mg/L	—	0		0	0			0		
Total Dissolved Solids	mg/L	—	0		0	0			0		
Sodium Adsorption Ratio (SAR)	unitless	—	0		0	0			0		
Major Ions											
Calcium	mg/L	—	0		0	0			0		
Magnesium	mg/L	—	0		0	0			0		
Potassium	mg/L	—	0		0	0			0		
Sodium	mg/L	—	0		0	0			0		
Bicarbonate	mg/L	—	0		0	0			0		
Carbonate	mg/L	—	0		0	0			0		
Chloride	mg/L	—	0		0	0			0		
Sulfate	mg/L	—	0		0	0			0		
Metals											
Aluminum, dissolved	mg/L	—	0		0	0			0		
Arsenic, dissolved	mg/L	0.01	0		0	0			0		
Barium, dissolved	mg/L	2	0		0	0			0		
Boron, dissolved	mg/L	—	0		0	0			0		
Cadmium, dissolved	mg/L	0.005	0		0	0			0		
Chromium, dissolved	mg/L	—	0		0	0			0		
Copper, dissolved	mg/L	1.3	0		0	0			0		
Iron, dissolved	mg/L	—	0		0	0			0		
Iron, total	mg/L	—	0		0	0			0		
Lead, dissolved	mg/L	0.015	0		0	0			0		
Manganese, dissolved	mg/L	—	0		0	0			0		
Manganese, total	mg/L	—	0		0	0			0		
Mercury, dissolved	mg/L	0.002	0		0	0			0		
Molybdenum, dissolved	mg/L	—	0		0	0			0		
Nickel, dissolved	mg/L	—	0		0	0			0		
Selenium, dissolved	mg/L	0.05	0		0	0			0		
Zinc, dissolved	mg/L	—	0		0	0			0		

Pink Indicates the number of baseline samples whose results exceed the EPA Primary or Secondary MCLs

TFN 6 2/025
RECD NOV 14, 2014

Table D6.2-17. Groundwater Quality Comparison of Carney Coal Seam Wells for EPA Standards (Continued)

Parameter	Units	EPA Secondary									
		Standard	578408-CRN	578409-CRN	578409-CRN-OB	578417-CRN	578418-CRN	578510-CRN	578511-CRN	578512-CRN	578513-CRN
General				Not Sampled			DRY	DRY		DRY	DRY
Alkalinity (as CaCO3)	mg/L	---	0		0	0			0		
Ammonia	mg/L	---	0		0	0			0		
Fluoride	mg/L	2	0		0	0			0		
Hardness (as CaCO3)	mg/L	---	0		0	0			0		
Hydroxide	mg/L	---	0		0	0			0		
Laboratory conductivity	µmhos/cm	---	0		0	0			0		
Laboratory pH	s.u.	8.5	0		0	0			0		
Nitrate/Nitrite	mg/L	---	0		0	0			0		
Total Dissolved Solids	mg/L	500	0		0	0			0		
Sodium Adsorption Ratio (SAR)	unitless	---	0		0	0			0		
Major Ions											
Calcium	mg/L	---	0		0	0			0		
Magnesium	mg/L	---	0		0	0			0		
Potassium	mg/L	---	0		0	0			0		
Sodium	mg/L	---	0		0	0			0		
Bicarbonate	mg/L	---	0		0	0			0		
Carbonate	mg/L	---	0		0	0			0		
Chloride	mg/L	250	0		0	0			0		
Sulfate	mg/L	250	0		0	0			0		
Metals											
Aluminum, dissolved	mg/L	---	0		0	0			0		
Arsenic, dissolved	mg/L	---	0		0	0			0		
Barium, dissolved	mg/L	---	0		0	0			0		
Boron, dissolved	mg/L	---	0		0	0			0		
Cadmium, dissolved	mg/L	---	0		0	0			0		
Chromium, dissolved	mg/L	---	0		0	0			0		
Copper, dissolved	mg/L	1	0		0	0			0		
Iron, dissolved	mg/L	0.3	0		0	0			0		
Iron, total	mg/L	---	0		0	0			0		
Lead, dissolved	mg/L	---	0		0	0			0		
Manganese, dissolved	mg/L	0.05	0		0	0			0		
Manganese, total	mg/L	---	0		0	0			0		
Mercury, dissolved	mg/L	---	0		0	0			0		
Molybdenum, dissolved	mg/L	---	0		0	0			0		
Nickel, dissolved	mg/L	---	0		0	0			0		
Selenium, dissolved	mg/L	---	0		0	0			0		
Zinc, dissolved	mg/L	5	0		0	0			0		

Pink — Indicates the number of baseline samples whose results exceed the EPA Primary or Secondary MCLs

TFN 6 2/025
RECD JUL 30, 2015

Table D6.2-18. Summary of Groundwater Rights Within the Permit Area and the Adjacent 3 Miles [1,2]

Permitted Water Use [3]	Number of Wells	Percent of Total (%)
Coal Bed Methane	86	17.92
Coal Bed Methane and Irrigation	8	1.67
Coal Bed Methane and Miscellaneous	2	0.42
Coal Bed Methane and Stock Watering	101	21.04
Domestic	116	24.17
Domestic and Irrigation	2	0.42
Domestic, Irrigation, and Stock Watering	1	0.21
Domestic and Stock Watering	52	10.83
Industrial and Miscellaneous	1	0.21
Irrigation	1	0.21
Irrigation, Miscellaneous, and Stock Watering	1	0.21
Irrigation and Stock Watering	2	0.42
Miscellaneous	20	4.17
Stock Watering	85	17.71
Other	2	0.42
Total	**480**	**100.00**

Notes: [1]Summary does not include cancelled, expired, abandoned, or suspended water rights. Refer to Adjudication Appendix B for a full summary of groundwater rights.

[2]Wells may not be currently active.

[3]Summary excludes monitoring wells.

TFN 6 2/025
RECD OCT 23, 2015

Table D6.1-14. Big Horn Mine Hidden Water Creek Flow Days

Year	HWC1-79											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1982										0	0	0
1983	2 (5.88)	0	0	0	0	0	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	0	0	0
1985	0	2 (0.56)	1 (0.01)	0	0	0	0	0	0	0	0	0
1986	0	2 (4.3)	0	0	1 (1.17)	0	0	0	0	0	0	0
1987	0	0	0	0	0	0	0	0	0	0	0	0
1988	0	4 (0.53)	0	0	0	0	0	0	0	0	0	0
1989	0	0	1(0.02)	0	0	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	0	0	0
1992	0	0	0	0	0	0	0	0	0	0	0	0
1993	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	0	0	3 (0.77)	0	0	0	0	0	0	0	0
1997	0	6 (1.79)	0	0								

Notes: 1. "( )" Maximum average daily flow (cfs) in given month.
2. Monitoring location depicted on Exhibit D6.1-2.

TFN 6 2/025
RECD OCT 23, 2015

Table D6.1-15. Big Horn Mine Surface Water Quality Monitoring Results

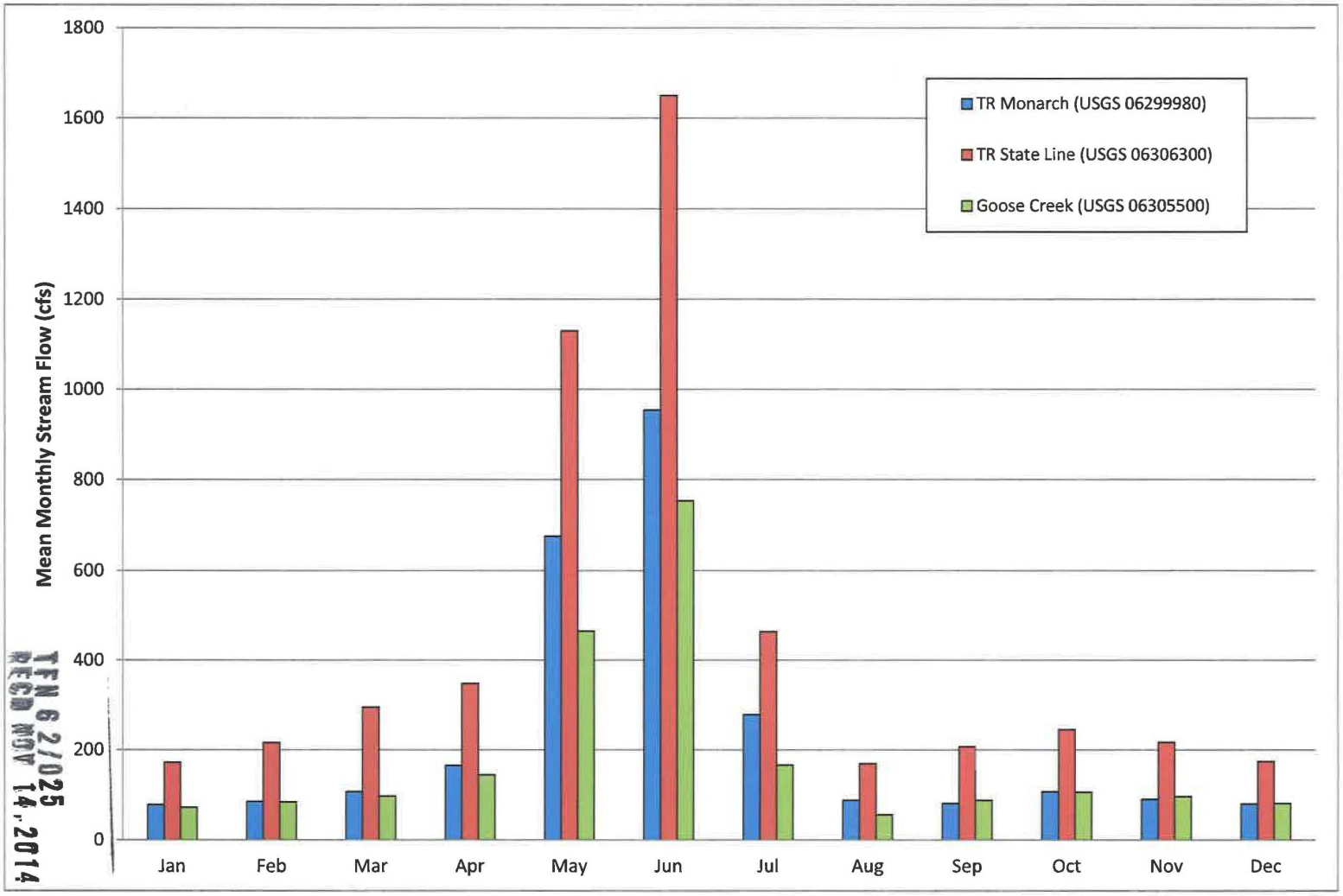
Parameter	Units	HWC1-79								
		3/22/79	4/9/79	4/16/79	3/11/80	2/24/86	2/25/86	6/5/86	3/2/88	3/13/89
Field										
Field Conductivity	µmhos/cm	4000	3500	3283	1390					
Field pH	s.u.	8.6	7.6		6.62					
Field turbidity	NTUs									
Temperature	Deg C	8.5	20	17.2	5					
General										
Alkalinity (as CaCO3)	mg/L	228	328	330	160	20	45	45	32.5	47.5
Ammonia	mg/L	<0.01	1.43	0.63	0.09	<0.01	0.01	<0.01	0.17	0.73
Fluoride	mg/L	0.85	0.63	0.61	0.28	0.11	0.13	0.14	<0.1	<0.1
Hardness (as CaCO3)	mg/L	1867	1950	1930	637	42	118	91.5	47	56
Hydroxide	mg/L									
Laboratory conductivity	µmhos/cm	3340	3400	3220	1290	57	217	126	123	136
Dissolved oxygen	mg/L									
Laboratory pH	s.u.	8.2	8.4	8.5	8.1	7.51	7.55	7.13	6.57	7.36
Laboratory turbidity	NTUs	2.3	2.9	3.2	50	180	88	1000	48	170
Nitrate/Nitrite	mg/L	0.15	0.01	<0.01	0.11	3.1	2.83	0.62	4.47	1.77
Total Dissolved Solids	mg/L	3190	3300	3220	1130	96	117	156	154	166
Total Suspended Solids	mg/L	5	11	9	72	488	234	3630	67	234
Sodium Adsorption Ratio (SAR)	unitless					0.12	0.6	0.15	0.11	0.12
Total Phosphorus	mg/L	0.02	0.03	0.02	0.35	0.19	0.3			0.64
Major Ions										
Calcium	mg/L	242	260	251	89	8.6	21.2	19.6	6.6	10.6
Magnesium	mg/L	307	316	317	101	2.7	13.7	6.7	3.8	4.1
Potassium	mg/L	2	26	25	16	7.2	9.6	2.1	15.2	14.8
Sodium	mg/L	186	191	188	70	1.6	14.5	3	1.4	1.8
Bicarbonate	mg/L	278	379	373	195	24.4	54.9	54.9	39.7	58
Carbonate	mg/L		10	15						
Chloride	mg/L	28	28	29	11	5	8	14	11	4
Sulfate	mg/L	1922	1970	1940	609	16.1	94	12.5	<1	12.5
Metals										
Aluminum, dissolved	mg/L	0.9	0.2	0.2	0.1	0.47	<0.1	2		
Arsenic, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002	<0.002		
Barium, dissolved	mg/L	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		
Boron, dissolved	mg/L	0.6	0.4	0.5	0.1	0.03	0.72	0.26	1.63	0.17
Cadmium, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002	<0.002		
Chromium, dissolved	mg/L	<0.02	<0.02	0.02	<0.02	<0.02	<0.02	<0.02		
Copper, dissolved	mg/L	0.02	0.03	0.02	<0.01	<0.01	0.01	0.02		
Iron, dissolved	mg/L	0.13	0.06	<0.05	0.1	0.32	0.06	0.62		
Iron, total	mg/L	0.17	0.1	0.12	1.77	1.64	0.42	0.73		
Lead, dissolved	mg/L	<0.02	<0.02	<0.02	<0.02	<0.01	<0.01	<0.01		
Manganese, dissolved	mg/L	0.03	0.02	0.02	0.09	<0.01	<0.01	<0.01		
Manganese, total	mg/L									
Mercury, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
Molybdenum, dissolved	mg/L					<0.02	<0.02	<0.02		
Nickel, dissolved	mg/L	0.02	0.05	0.04	0.01	0.01	0.01	0.02		
Selenium, dissolved	mg/L	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002	<0.002		
Zinc, dissolved	mg/L	0.03	0.05	0.05	0.01	0.01	0.01	<0.01		

Note: Monitoring location depicted on Exhibit D6.1-2.

TFN 6 2/025
RECD OCT 23, 2015

DEQ 6-088

APPENDIX D6 FIGURES



TFN 6 2/025
RECD NOV 14, 2014

Figure D6.1-1. Tongue River and Goose Creek Mean Monthly Flow

Source: USGS National Water Information System: Web Interface

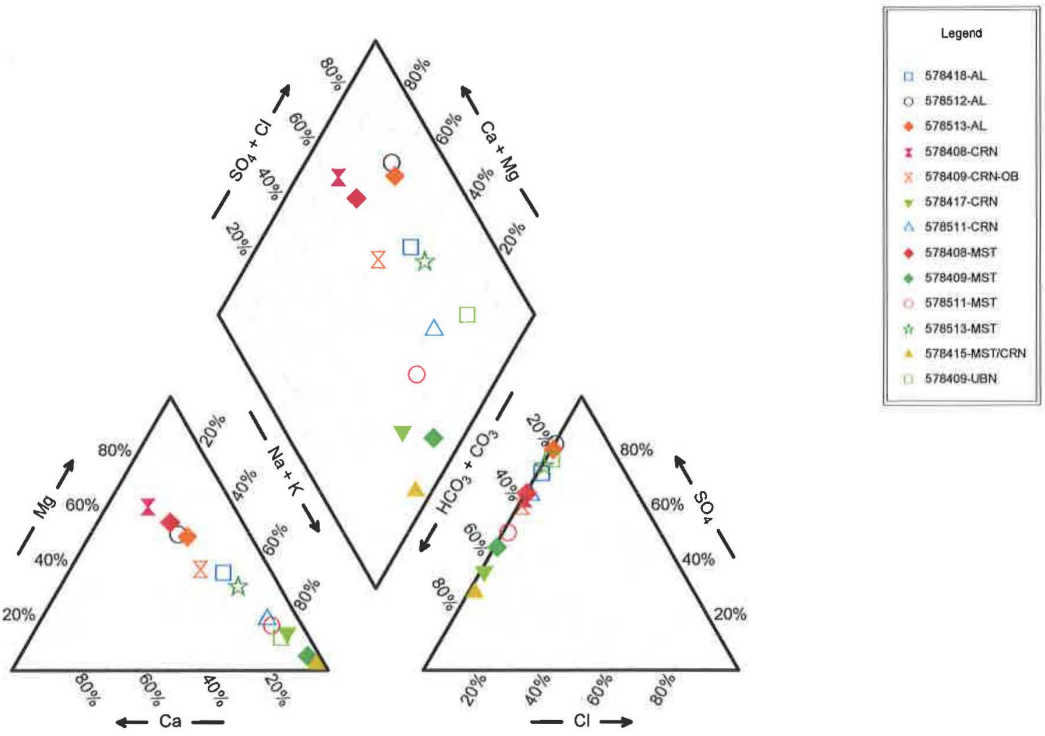
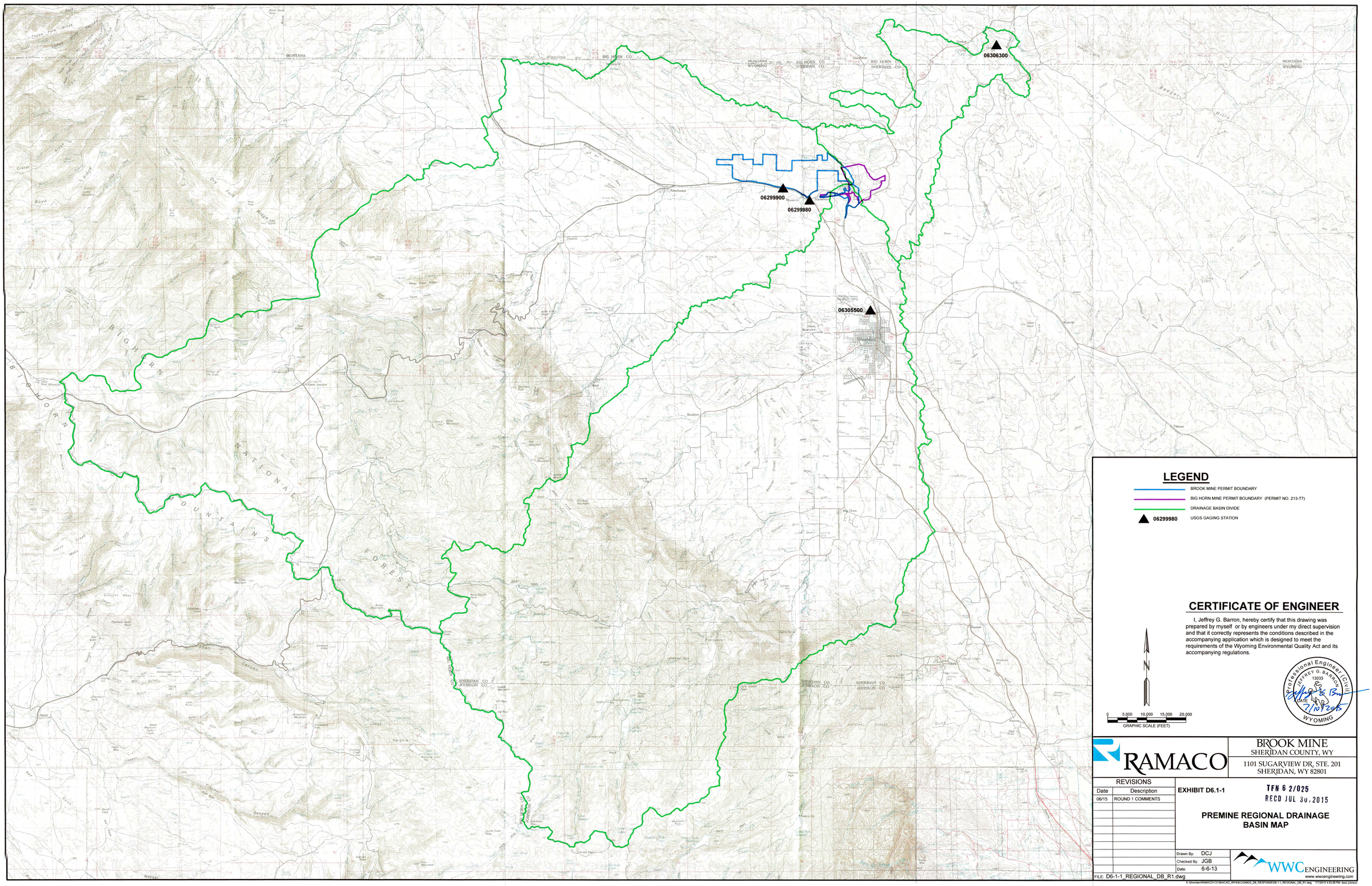


Figure D6.2-1. Groundwater Monitoring Well Results Piper Diagram

TFN 6 2/025
RECD NOV 14, 2014

DEQ 6-090

APPENDIX D6 EXHIBITS



LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN MINE PERMIT BOUNDARY (PERMIT NO. 213-T7)
- DRAINAGE BASIN DIVIDE
- ▲ 06299980 USGS GAGING STATION

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 WYOMING

DATE 7/10/2015

N

0 5,000 10,000 15,000 20,000
GRAPHIC SCALE (FEET)

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS

EXHIBIT D6.1-1

TFN 6 2/025
RECD JUL 30, 2015

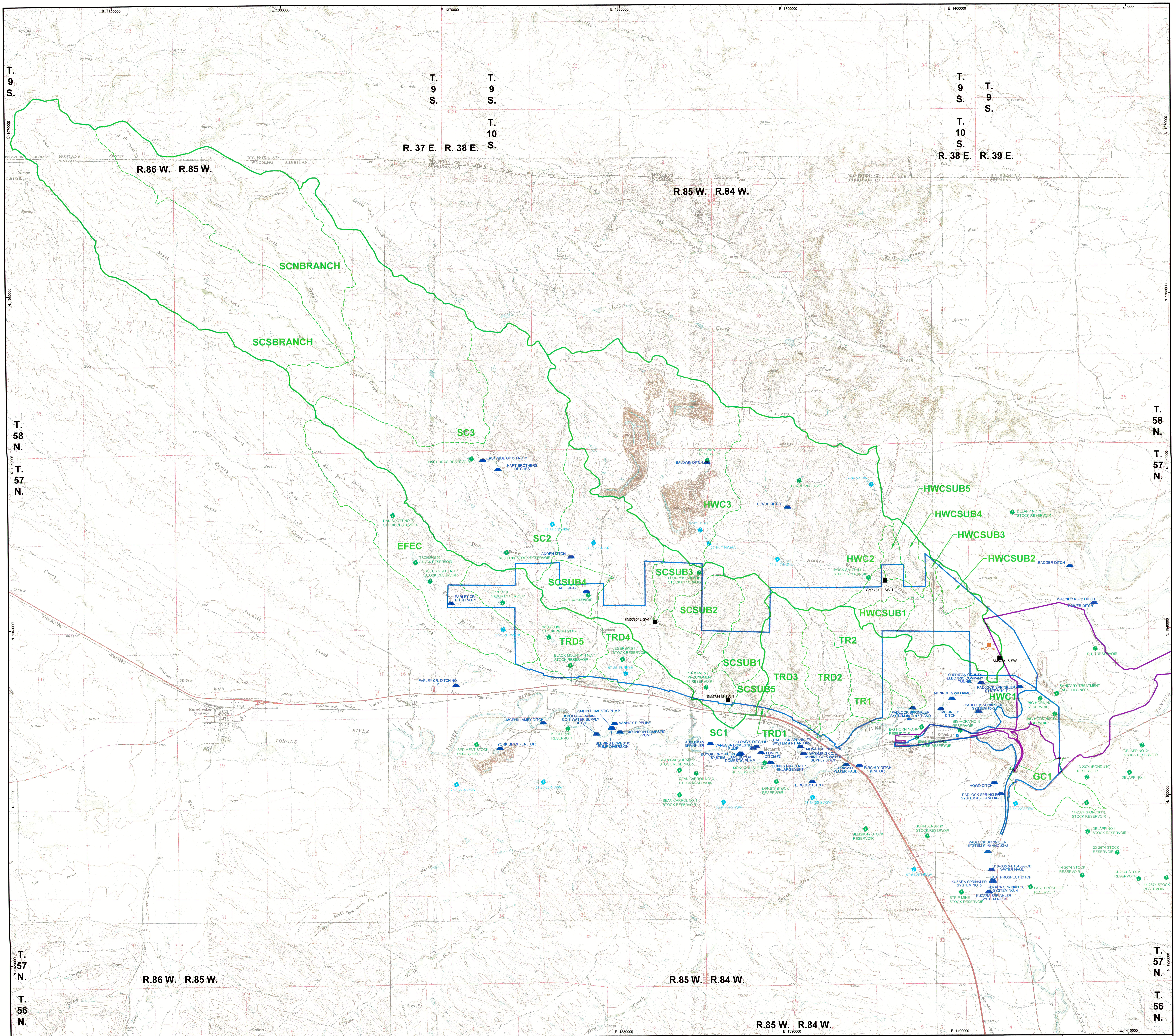
PREMINE REGIONAL DRAINAGE BASIN MAP

Drawn By: DCJ
Checked By: JGB
Date: 6-6-13

WWC ENGINEERING
www.wwcengineering.com

FILE: D6-1-1_REGIONAL_DB_R1.dwg

K:\Sheridan\RAMACO\13139\ACAD_WYSE\DWGS_D6_RESPONSE\D6-1-1_REGIONAL_DB_R1.dwg 7/7/2015 4:03:26 PM dave johnson



LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- MAJOR DRAINAGE DIVIDE
- MINOR DRAINAGE DIVIDE
- TRD4 — DRAINAGE BASIN ID
- DELAPP NO. 4 — RESERVOIR WITH SURFACE WATER RIGHT
- SM578522-SW-1 — SURFACE WATER MONITORING STATION
- 57-84-28-NESW — UNPERMITTED RESERVOIR
- PADLOCK SPRINKLER SYSTEM #1-G AND #2-G — POINT OF DIVERSION WITH SURFACE WATER RIGHT
- HWC1-79 — BIG HORN MINE FORMER SURFACE WATER MONITORING STATION

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 DATE 12/?/2015 WYOMING

GRAPHIC SCALE (FEET) 0 1,000 2,000 3,000 4,000
C.I. = VARIES

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
10/15	ROUND 2 COMMENTS
12/15	ROUND 3 COMMENTS

EXHIBIT D6.1-2

TFN 6 2/025
RECD DEC 18, 2015

PREMINE DRAINAGE BASINS

Drawn By: DCJ
Checked By: JGB
Date: 6-6-13

WWC ENGINEERING
www.wwcengineering.com

FILE: D6-1-2_PRE_DB_R3.dwg

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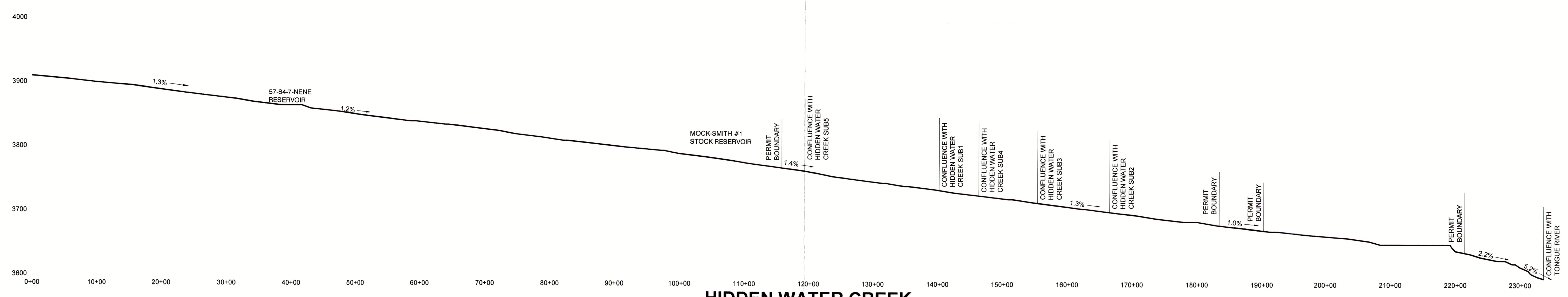
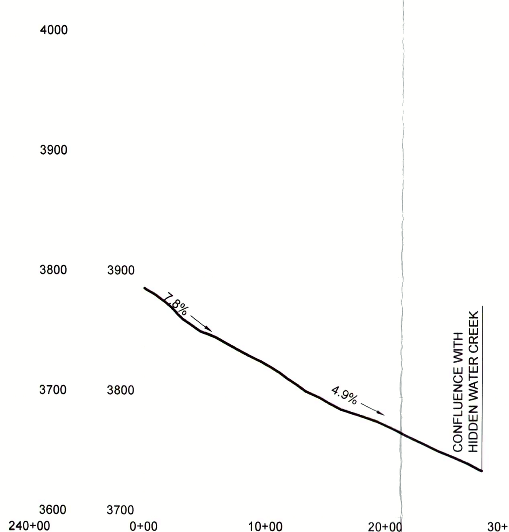


HIDDEN WATER CREEK LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'



HIDDEN WATER CREEK SUB1 LONGITUDINAL CHANNEL PROFILE

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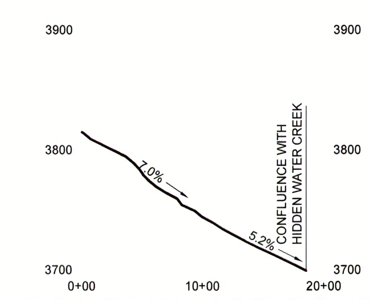

HIDDEN WATER CREEK SUB2 LONGITUDINAL CHANNEL PROFILE

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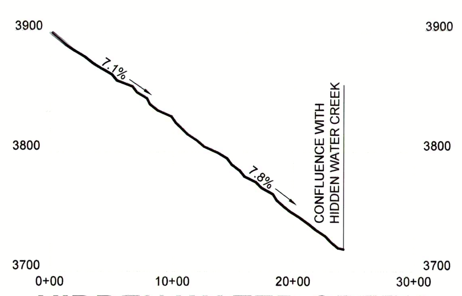

HIDDEN WATER CREEK SUB3 LONGITUDINAL CHANNEL PROFILE

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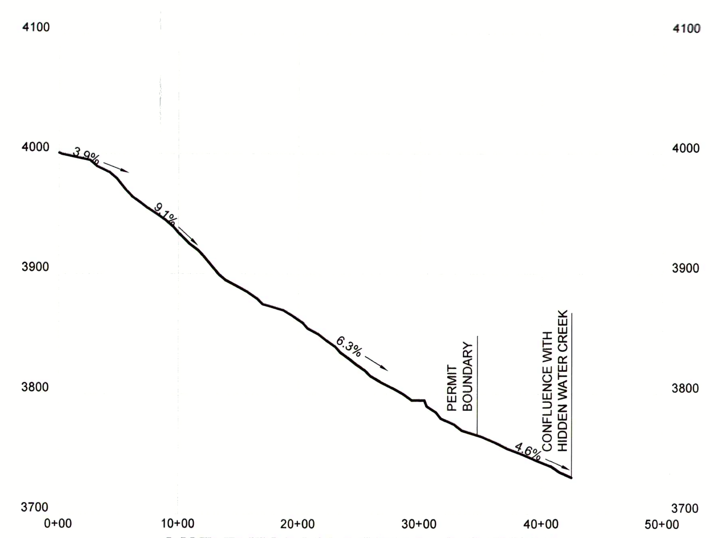

HIDDEN WATER CREEK SUB4 LONGITUDINAL CHANNEL PROFILE

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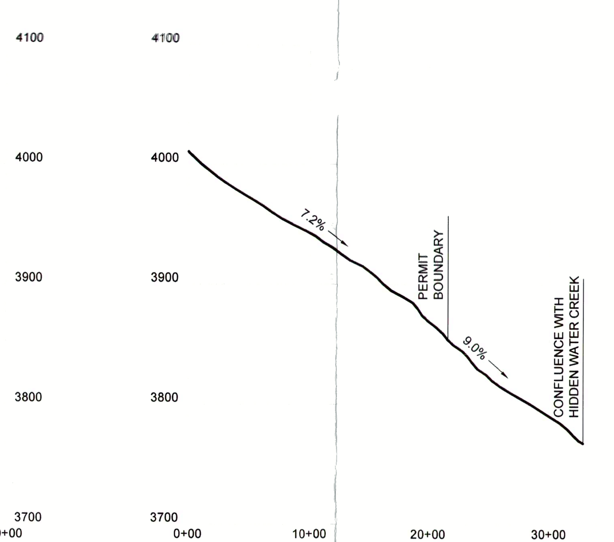

HIDDEN WATER CREEK SUB5 LONGITUDINAL CHANNEL PROFILE

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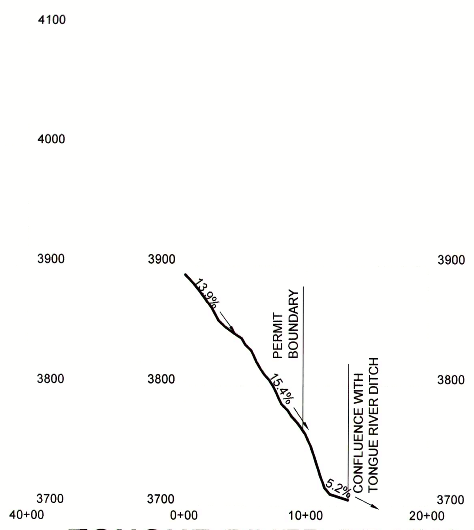
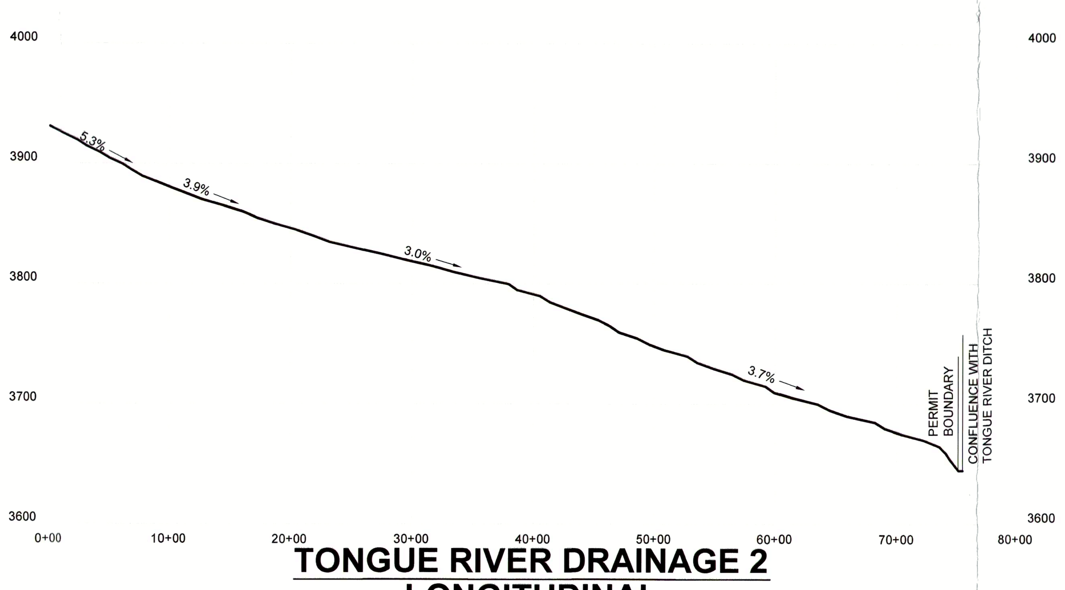


TONGUE RIVER DRAINAGE 1 LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'



TONGUE RIVER DRAINAGE 2 LONGITUDINAL CHANNEL PROFILE

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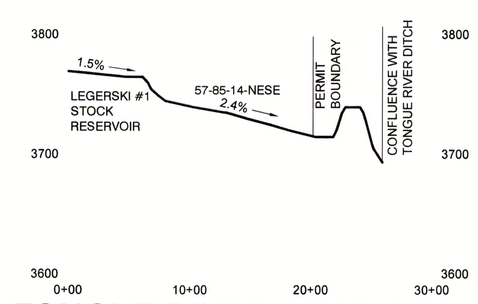

TONGUE RIVER DRAINAGE 4 LONGITUDINAL CHANNEL PROFILE

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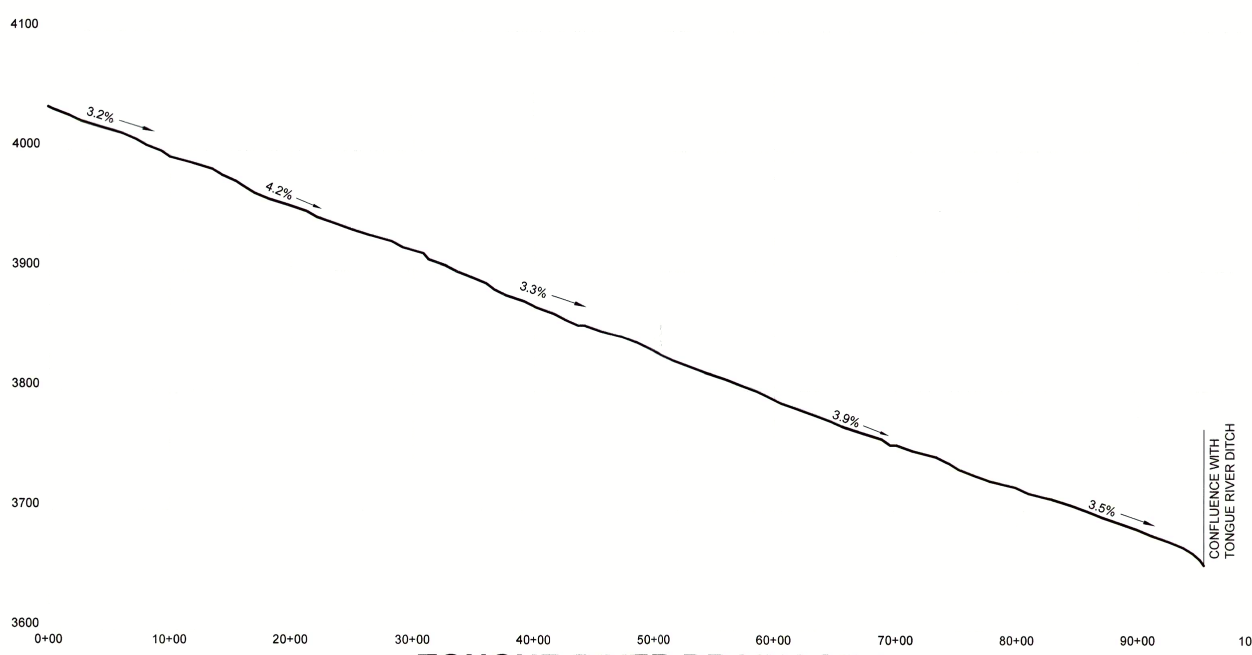

TONGUE RIVER DRAINAGE 3 LONGITUDINAL CHANNEL PROFILE

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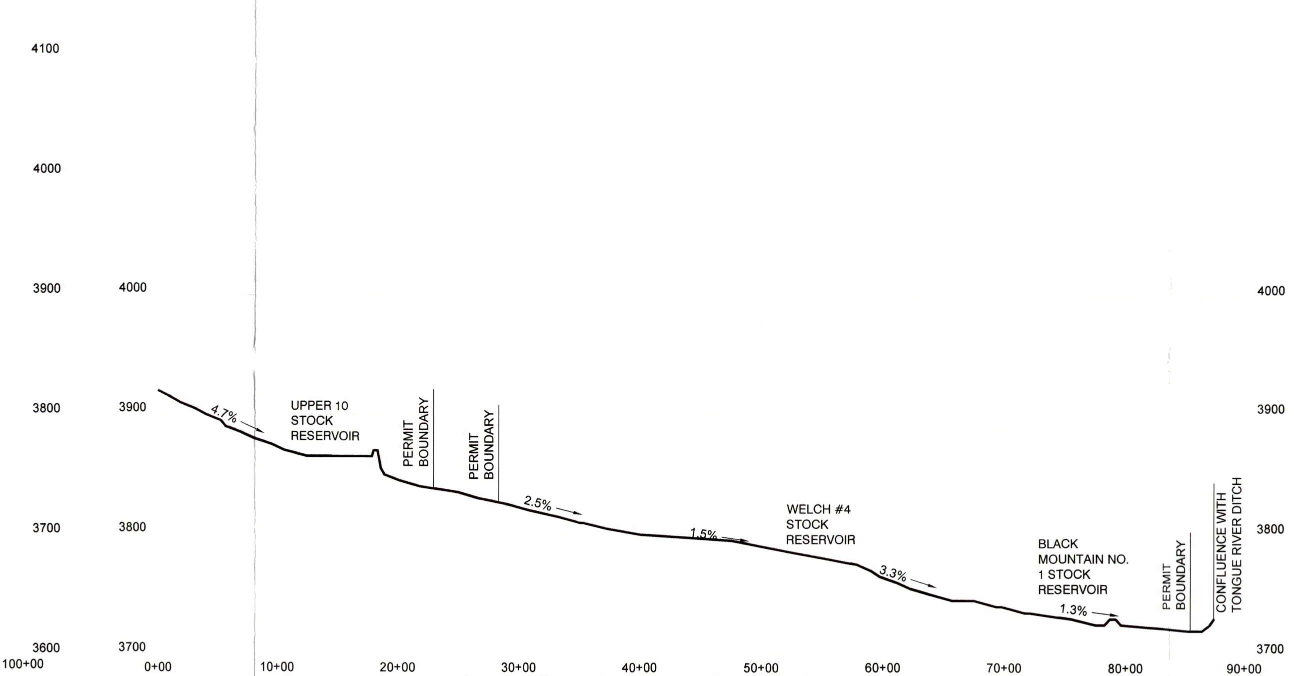

TONGUE RIVER DRAINAGE 5 LONGITUDINAL CHANNEL PROFILE

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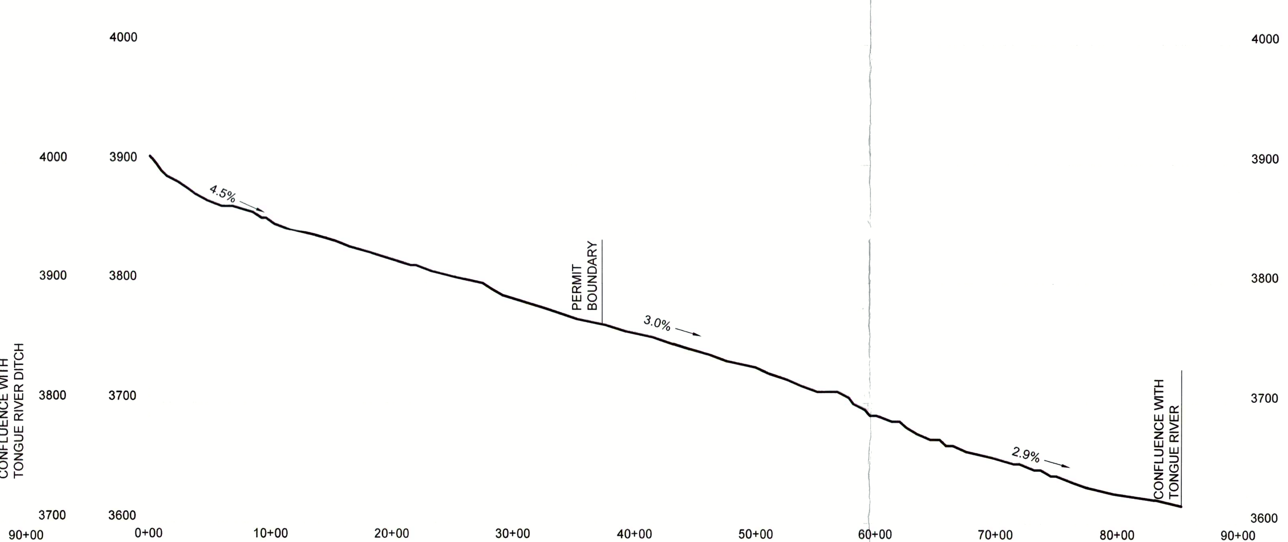

TONGUE RIVER 2 LONGITUDINAL CHANNEL PROFILE

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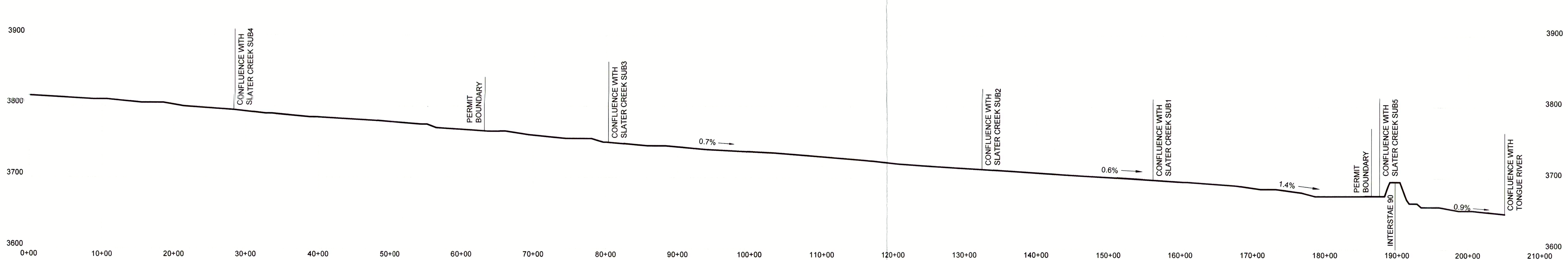
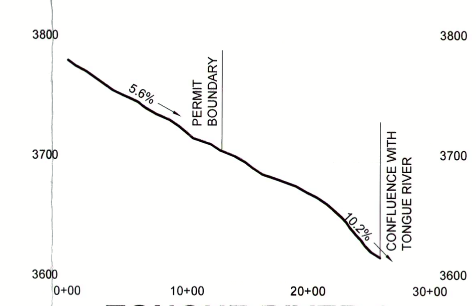


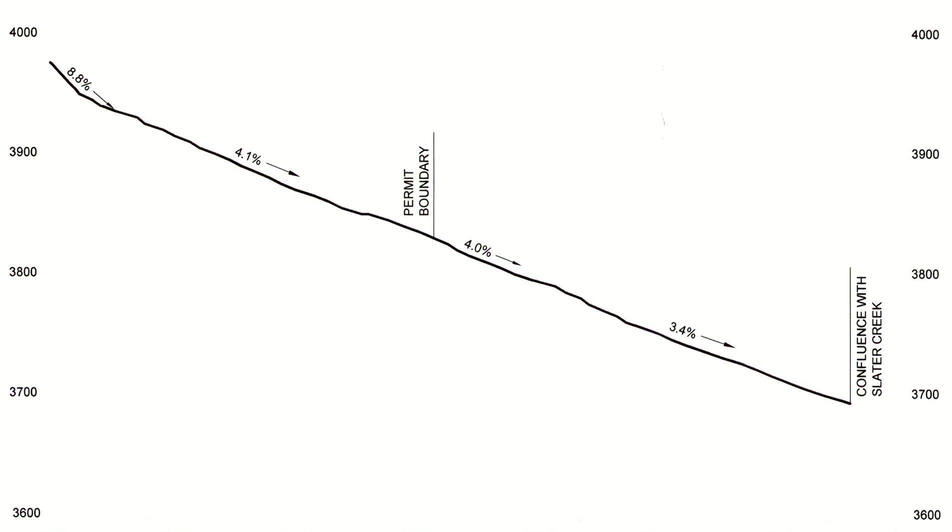
SLATER CREEK LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'



TONGUE RIVER 1 LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'



SLATER CREEK SUB1 LONGITUDINAL CHANNEL PROFILE

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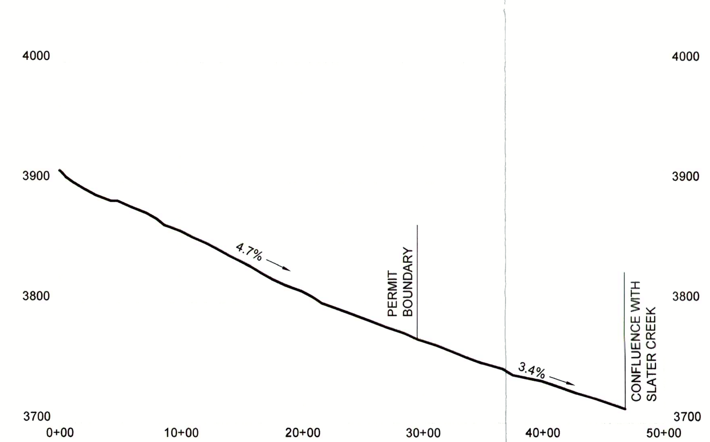

SLATER CREEK SUB2 LONGITUDINAL CHANNEL PROFILE

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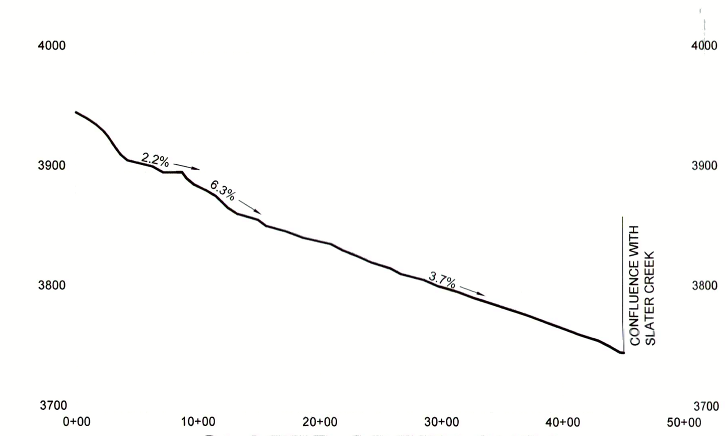

SLATER CREEK SUB3 LONGITUDINAL CHANNEL PROFILE

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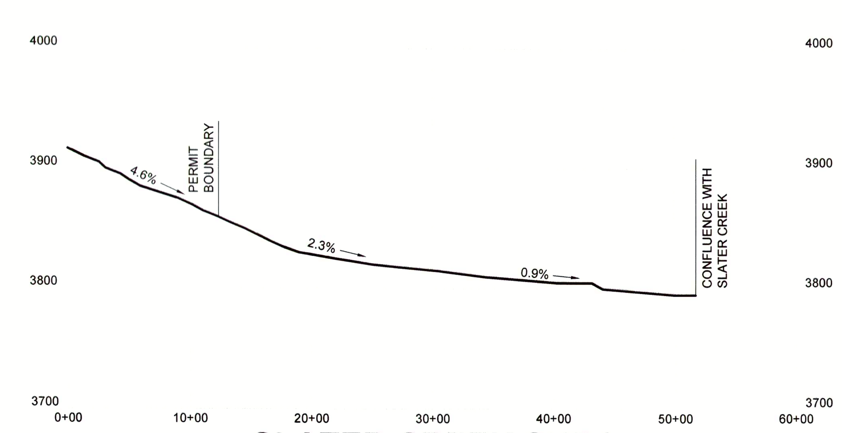
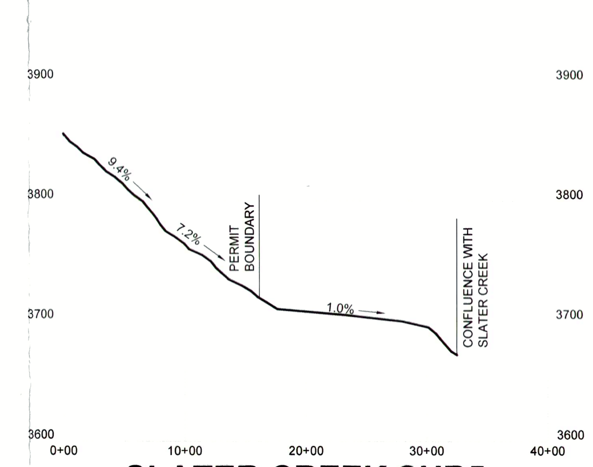


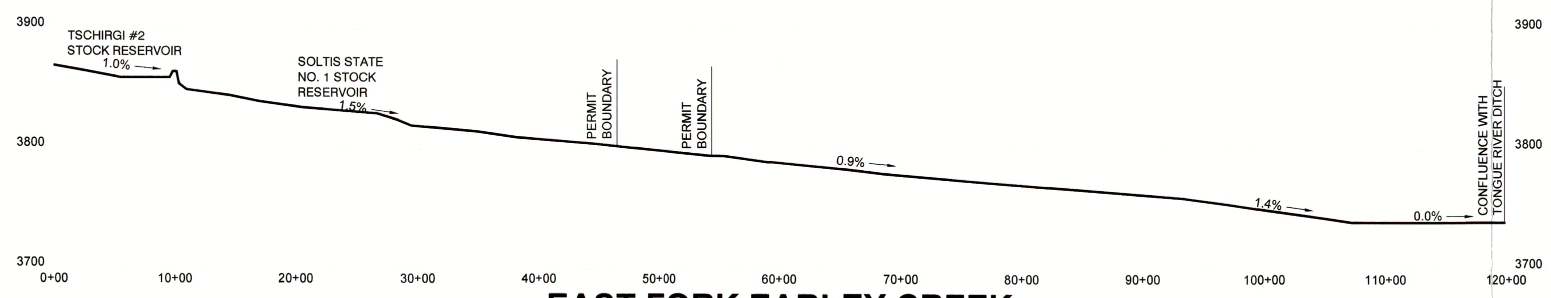
SLATER CREEK SUB4 LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'



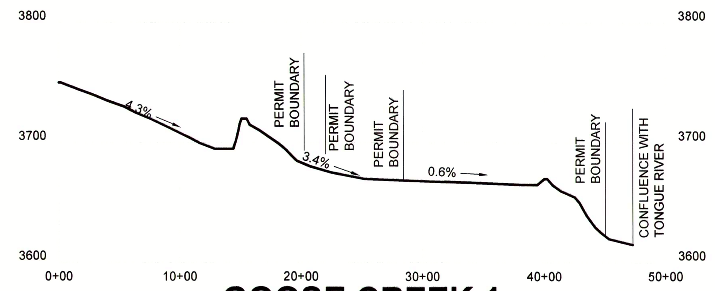
SLATER CREEK SUB5 LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'



EAST FORK EARLEY CREEK LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'



GOOSE CREEK 1 LONGITUDINAL CHANNEL PROFILE

SCALE: HORZ. 1" = 1000', VERT. 1" = 100'

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 WYOMING

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS

Date	Description

EXHIBIT D6.1-3

TFN 6 2/025
RECD NOV 14, 2014

PREMINE STREAM PROFILES

Drawn By: DCJ
Checked By: JGB
Date: 6-6-13

WWC ENGINEERING
www.wwcengineering.com

FILE: D6-1-3_CHANNELPROF.dwg

T. 58 N.

T. 57 N.

R.85 W. R.84 W.

T. 58 N.

T. 57 N.

WELL CLUSTER
578510-CRN
578510-MST

WELL CLUSTER
578511-CRN
578511-MST

WELL CLUSTER
578512-CRN
578512-MST

578512-AL

WELL CLUSTER
578513-CRN
578513-MST

578513-AL

WELL CLUSTER
578408-MST
578408-CRN

WELL CLUSTER
578409-MST
578409-MST-OB
578409-CRN
578409-CRN-OB
578409-MST-UB

WELL CLUSTER
578417-MST
578417-CRN

WELL CLUSTER
578418-CRN
578418-MST

578418-AL

578415-CRN-MST

Dan Draw

East Fork Earley Creek

Earley Creek

Stob Mine

Drift Hole

Hidden Water Creek

Gravel Pit

Kleenburn

Acme

Radio Tower

Monarch

Monarch Cem

Rest Area

Stop Mine

TONGUE RIVER DITCH

BURLINGTON NORTHERN

TONGUE RIVER

GREEN MOUNTAIN

GOOSE CREEK

Dry Fork North Dry Creek

South Dry Creek

BM 3707

BM 3703

BM 3676

BM 3670

BM 3641

BM 3634

BM 3620

BM 3644

BM 3651

BR 3686

LEGEND

BROOK MINE PERMIT BOUNDARY	
BIG HORN MINE PERMIT BOUNDARY (PERMIT NO. 213-T7)	
578409-MST-UB ☒	UNDERBURDEN MONITOR WELL
578415-CRN-MST ⊕	COAL MONITOR WELL
578418-AL ▲	ALLUVIAL MONITOR WELL

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) Jeffrey G. Barron 13033 WYOMING DATE 10/15/2014

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 20'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description

EXHIBIT D6.2-1

TFN 6 2/025
RECD NOV 14, 2014

PREMINE MONITOR WELL LOCATIONS

Drawn By: DCJ
Checked By: JGB
Date: 6-6-13

WWC ENGINEERING
www.wwcengineering.com

FILE: D6-2-1_MON_LOC.dwg

K:\Sheridan\RAMACO\1101SKVAD_WY\EIS\DWGS\D6\D6-2-1_MON_LOC.dwg - 10/8/2014 1:45:37 PM - cindy.grissom

R.85 W. R.84 W.

T. 58 N.

T. 57 N.

578510-MST
3821

578511-MST
3746.28

578512-MST
3820.78

578513-MST
3742.06

578418-MST
3701.35

578408-MST
3784.36

578417-MST
3768.43

578409-MST
3611.3

578415-CRN-MST
3491.62

3840
3820
3800
3780
3760
3740
3720
3700
3680
3660
3640
3620
3600
3580
3560
3540
3520
3500
3480
3460
3440

R.85 W. R.84 W.

LEGEND

- BROOK MINE PERMIT BOUNDARY
- POTENTIOMETRIC CONTOUR
- POTENTIOMETRIC CONTOUR (INFERRED)
- D / U — FAULT LOCATION - APPROXIMATE
- FAULT LOCATION - INFERRED
- FAULT LOCATION - CONCEALED
- 578408-MST 3784.36 — MASTERS SEAM MONITOR WELL WITH OBSERVED WATER LEVEL
- EDGE OF SATURATION ZONE OF COAL SEAM

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 WYOMING

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 20'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR. STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS

EXHIBIT D6.2-2

TFN 6 2/025
RECD JUL 30, 2015

MASTERS SEAM
PREMINE POTENTIOMETRY

Drawn By:	DCJ
Checked By:	JGB
Date:	6-6-13

WWC ENGINEERING
www.wwcengineering.com

FILE: D6-2-2_MASTERS_POT_R1.dwg

DEQ 6-096

R.85 W. R.84 W.

T. 58 N.

T. 57 N.

578610-CRN 3872.23

578511-CRN 3776.47

578513-CRN 3732.95

578417-CRN 3795.59

578418-CRN 3737.95

578408-CRN 3802.55

578409-CRN 3621.98

578415-CRN-MST 3491.62

P62333.OW 3727

P100680.OW 3610

P63975.OW 3640

3860 3840 3820 3800 3780 3760 3740 3720 3700 3680 3660 3640 3620 3600 3580 3560 3540 3520 3500 3480 3460 3440

LEGEND

- BROOK MINE PERMIT BOUNDARY
- POTENTIOMETRIC CONTOUR
- POTENTIOMETRIC CONTOUR (INFERRED)
- D / U — FAULT LOCATION - APPROXIMATE
- FAULT LOCATION - INFERRED
- FAULT LOCATION - CONCEALED
- APPROXIMATE OUTCROP LINE
- 578417-CRN 3795.59 — CARNEY SEAM MONITOR WELL WITH OBSERVED WATER LEVEL
- EDGE OF SATURATION ZONE OF COAL SEAM
- APPROXIMATE LOCATION OF CARNEY SPLIT

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) — Jeffrey G. Barron — 13030 — Date: 10/15/2015 — WYOMING

GRAPHIC SCALE (FEET) 0 500 1,000 1,500 2,000 — 1" = 20'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY
1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS

EXHIBIT D6.2-3

TFN 6 2/025
RECD OCT 23, 2015

CARNEY SEAM
PREMINE POTENTIOMETRY

Drawn By: DCJ
Checked By: JGB
Date: 10-15-14

WWC ENGINEERING
www.wwcengineering.com

FILE: D6-2-3_CARNEY_POT_R2.dwg

ADDENDUM D6-1

ADDENDUM D6-1

HEC-HMS Model

TFN 6 2/025
RECD NOV 14, 2014

DEQ 6-099

HEC-HMS INPUTS

TFN 6 2/025
RECD NOV 14, 2014

```
Basin: Sheridan_Mine
     Last Modified Date: 2 May 2014
     Last Modified Time: 15:15:00
     Version: 3.5
     Filepath Separator: \
     Unit System: English
     Missing Flow To Zero: No
     Enable Flow Ratio: No
     Allow Blending: No
     Compute Local Flow At Junctions: No

     Enable Sediment Routing: No

     Enable Quality Routing: No
End:

Subbasin: SCSBranch
     Canvas X: -7504.761904761905
     Canvas Y: 3895.2380952380954
     Label X: -19.0
     Label Y: 20.0
     Area: 3.71
     Downstream: SCBRANCH_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79
     Initial Abstraction: 0

     Transform: SCS
     Lag: 153.7
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: SCNBranch
     Canvas X: -5409.523809523809
     Canvas Y: 4504.761904761905
     Area: 2.40
     Downstream: SCBRANCH_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79
     Initial Abstraction: 0
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Transform: SCS
     Lag: 108.8
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SCBRANCH_R
     Canvas X: -5504.761904761905
     Canvas Y: 1952.3809523809523
     From Canvas X: -6304.761904761905
     From Canvas Y: 3552.3809523809523
     Downstream: SC3_R

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 12676
     Energy Slope: 0.011
     Width: 30
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: SC3
     Canvas X: -6742.857142857143
     Canvas Y: 2047.6190476190477
     Label X: -1.0
     Label Y: -2.0
     Area: 2.95
     Downstream: SC3_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79
     Initial Abstraction: 0

     Transform: SCS
     Lag: 117.8
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SC3_R
     Canvas X: -4438.095238095238
     Canvas Y: 1019.0476190476184
     From Canvas X: -5504.761904761905
```

TFN 6 2/025
RECD NOV 14, 2014

```
     From Canvas Y: 1952.3809523809523
     Downstream: SC2_R

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 10310
     Energy Slope: 0.0097
     Width: 30
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: SC2
     Canvas X: -6190.476190476191
     Canvas Y: 657.1428571428569
     Area: 3.81
     Downstream: SC2_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79
     Initial Abstraction: 0

     Transform: SCS
     Lag: 119.5
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SC2_R
     Canvas X: -1980.9523809523807
     Canvas Y: -1285.7142857142862
     From Canvas X: -4438.095238095238
     From Canvas Y: 1019.0476190476184
     Downstream: SC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 23923
     Energy Slope: 0.0071
     Width: 50
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:
```

TFN 6 2/025
RECD NOV 14, 2014

```
Subbasin: SC1
     Canvas X: -3161.9047619047615
     Canvas Y: -1800.0
     Area: 1.98
     Downstream: SC_Out

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 79
     Initial Abstraction: 0

     Transform: SCS
     Lag: 214.3
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: SCSub1
     Canvas X: -247.6190476190477
     Canvas Y: 2428.5714285714284
     Area: 0.42
     Downstream: SCS1_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 77
     Initial Abstraction: 0

     Transform: SCS
     Lag: 44.6
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SCS1_R
     Canvas X: -1980.9523809523807
     Canvas Y: -1285.7142857142862
     From Canvas X: -571.4285714285716
     From Canvas Y: 1704.7619047619046
     Label X: 1.0
     Label Y: 38.0
     Downstream: SC_Out

     Route: Muskingum Cunge
```

TFN 6 2/025
RECD NOV 14,2014

```
     Channel: Trapezoid
     Length: 4555
     Energy Slope: 0.0110
     Width: 50
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: SCSub2
     Canvas X: -1600.0
     Canvas Y: 2657.142857142857
     Area: 0.41
     Downstream: SCS2_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 75
     Initial Abstraction: 0

     Transform: SCS
     Lag: 30.9
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SCS2_R
     Canvas X: -1980.9523809523807
     Canvas Y: -1285.7142857142862
     From Canvas X: -1771.4285714285716
     From Canvas Y: 1857.1428571428569
     Label X: -26.0
     Label Y: 23.0
     Downstream: SC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 7487
     Energy Slope: 0.0087
     Width: 50
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: SCSub4
     Canvas X: -6171.428571428572
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Canvas Y: -504.7619047619046
     Label X: -2.0
     Label Y: 0.0
     Area: 0.34
     Downstream: SCS4_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 84
     Initial Abstraction: 0

     Transform: SCS
     Lag: 40.6
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SCS4_R
     Canvas X: -1980.9523809523807
     Canvas Y: -1285.7142857142862
     From Canvas X: -4971.428571428572
     From Canvas Y: -314.2857142857147
     Label X: -42.0
     Label Y: -14.0
     Downstream: SC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 18990
     Energy Slope: 0.0076
     Width: 50
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: SCSub3
     Canvas X: -3276.190476190476
     Canvas Y: 2619.047619047619
     Area: 0.31
     Downstream: SCS3_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Curve Number: 76
     Initial Abstraction: 0

     Transform: SCS
     Lag: 39.9
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SCS3_R
     Canvas X: -1980.9523809523807
     Canvas Y: -1285.7142857142862
     From Canvas X: -2990.476190476191
     From Canvas Y: 1914.2857142857142
     Label X: -35.0
     Label Y: 1.0
     Downstream: SC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 13461
     Energy Slope: 0.0074
     Width: 50
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: SCSub5
     Canvas X: 476.19047619047706
     Canvas Y: 1323.8095238095239
     Area: 0.13
     Downstream: SCS5_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 75
     Initial Abstraction: 0

     Transform: SCS
     Lag: 28.3
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: SCS5_R
     Canvas X: -1980.9523809523807
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Canvas Y: -1285.7142857142862
     From Canvas X: -228.57142857142844
     From Canvas Y: 542.8571428571431
     Label X: -12.0
     Label Y: 5.0
     Downstream: SC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 1166
     Energy Slope: 0.0214
     Width: 50
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: SC_Out
     Canvas X: -1980.9523809523807
     Canvas Y: -1285.7142857142862
     Label X: 0.0
     Label Y: 1.0
     Downstream: TONGUE_RIVER
End:

Subbasin: EF EC
     Canvas X: -7662.60162601626
     Canvas Y: -2947.1544715447153
     Label X: 13.0
     Label Y: -5.0
     Area: 1.84
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 87
     Initial Abstraction: 0

     Transform: SCS
     Lag: 119.6
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: TRD5
     Canvas X: -6585.365853658536
     Canvas Y: -2398.373983739837
     Area: 0.93
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 84
     Initial Abstraction: 0

     Transform: SCS
     Lag: 59.9
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: TRD3
     Canvas X: 345.5284552845533
     Canvas Y: -1260.162601626016
     Area: 0.59
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 71
     Initial Abstraction: 0

     Transform: SCS
     Lag: 75.2
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: TR_Sub1
     Canvas X: 1599.496221662469
     Canvas Y: -1020.1511335012592
     Label X: 2.0
     Label Y: -5.0
     Area: 0.52
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Curve Number: 74
     Initial Abstraction: 0

     Transform: SCS
     Lag: 36.7
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: TRD2
     Canvas X: 1422.7642276422757
     Canvas Y: -731.707317073171
     Area: 0.51
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 73
     Initial Abstraction: 0

     Transform: SCS
     Lag: 71.6
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: TRD4
     Canvas X: -5284.552845528455
     Canvas Y: -1849.5934959349588
     Area: 0.27
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 83
     Initial Abstraction: 0

     Transform: SCS
     Lag: 35.6
     Unitgraph Type: STANDARD

     Baseflow: None
End:
```

TFN 6 2/025
RECD NOV 14, 2014

```
Subbasin: TR_Sub2
     Canvas X: 2662.6016260162596
     Canvas Y: -792.6829268292686
     Label X: 3.0
     Label Y: 1.0
     Area: 0.24
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 72
     Initial Abstraction: 0

     Transform: SCS
     Lag: 71.9
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: TRD1
     Canvas X: -447.1544715447153
     Canvas Y: -650.4065040650403
     Label X: 4.0
     Label Y: 1.0
     Area: 0.04
     Downstream: TONGUE_RIVER

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 72
     Initial Abstraction: 0

     Transform: SCS
     Lag: 14.6
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: TONGUE_RIVER
     Canvas X: -894.3089430894306
     Canvas Y: -4146.341463414634
End:

Subbasin: HWC3
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Canvas X: 438.0952380952385
     Canvas Y: 4200.0
     Area: 3.29
     Downstream: HWCUpper

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 76
     Initial Abstraction: 0

     Transform: SCS
     Lag: 126.0
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: HWCUpper
     Canvas X: 2012.1951219512193
     Canvas Y: 2399.6515679442505
     From Canvas X: 457.1428571428569
     From Canvas Y: 3761.904761904762
     Label X: -22.0
     Label Y: 18.0
     Downstream: HWCLower

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 12103
     Energy Slope: 0.0112
     Width: 20
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: HWC2
     Canvas X: 2628.5714285714294
     Canvas Y: 3076.190476190476
     Area: 3.19
     Downstream: HWCLower

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 76
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Initial Abstraction: 0

     Transform: SCS
     Lag: 124.1
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: HWCLower
     Canvas X: 5295.238095238095
     Canvas Y: -904.7619047619046
     From Canvas X: 2012.1951219512193
     From Canvas Y: 2399.6515679442505
     Downstream: HWC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 12103
     Energy Slope: 0.0148
     Width: 25
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: HWC1
     Canvas X: 4152.380952380952
     Canvas Y: -1476.1904761904761
     Label X: 3.0
     Label Y: -2.0
     Area: 0.81
     Downstream: HWC_Out

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 76
     Initial Abstraction: 0

     Transform: SCS
     Lag: 106.7
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Subbasin: HWCSub1
     Canvas X: 1142.8571428571431
     Canvas Y: 238.09523809523762
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Area: 0.19
     Downstream: HWCS1_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 76
     Initial Abstraction: 0

     Transform: SCS
     Lag: 26.4
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: HWCS1_R
     Canvas X: 5295.238095238095
     Canvas Y: -904.7619047619046
     From Canvas X: 2247.6190476190477
     From Canvas Y: 180.95238095238074
     Downstream: HWC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 9170
     Energy Slope: 0.0147
     Width: 25
     Side Slope: 4
     Mannings n: 0.03
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: HWCSub4
     Canvas X: 5752.380952380952
     Canvas Y: 3819.0476190476193
     Area: 0.18
     Downstream: HWCS4_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 75
     Initial Abstraction: 0

     Transform: SCS
     Lag: 34.8
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: HWCS4_R
     Canvas X: 5295.238095238095
     Canvas Y: -904.7619047619046
     From Canvas X: 5447.619047619048
     From Canvas Y: 3057.142857142857
     Downstream: HWC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 8604
     Energy Slope: 0.0145
     Width: 25
     Side Slope: 4
     Mannings n: 0.030
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: HWCSub2
     Canvas X: 6971.4285714285725
     Canvas Y: 657.1428571428569
     Area: 0.14
     Downstream: HWCS2_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 77
     Initial Abstraction: 0

     Transform: SCS
     Lag: 20.9
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: HWCS2_R
     Canvas X: 5295.238095238095
     Canvas Y: -904.7619047619046
     From Canvas X: 6380.952380952382
     From Canvas Y: 180.95238095238074
     Downstream: HWC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
```

TEN 6 2/025
ECD NOV 14, 2014

```
     Length: 6582
     Energy Slope: 0.0152
     Width: 25
     Side Slope: 4
     Mannings n: 0.030
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: HWCSub5
     Canvas X: 3695.2380952380954
     Canvas Y: 4428.571428571428
     Area: 0.12
     Downstream: HWCS5_R

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 76
     Initial Abstraction: 0

     Transform: SCS
     Lag: 19.7
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: HWCS5_R
     Canvas X: 5295.238095238095
     Canvas Y: -904.7619047619046
     From Canvas X: 4209.523809523809
     From Canvas Y: 3838.095238095238
     Downstream: HWC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 11153
     Energy Slope: 0.0148
     Width: 25
     Side Slope: 4
     Mannings n: 0.030
     Use Variable Time Step: No
     Channel Loss: None
End:

Subbasin: HWCSub3
     Canvas X: 6476.190476190477
     Canvas Y: 2752.3809523809523
     Area: 0.07
     Downstream: HWCS3_R
```

TFN 6 2/025
RECD NOV 14, 2014

```
     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 76
     Initial Abstraction: 0

     Transform: SCS
     Lag: 25.9
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Reach: HWCS3_R
     Canvas X: 5295.238095238095
     Canvas Y: -904.7619047619046
     From Canvas X: 5980.952380952382
     From Canvas Y: 2009.5238095238096
     Downstream: HWC_Out

     Route: Muskingum Cunge
     Channel: Trapezoid
     Length: 7721
     Energy Slope: 0.0149
     Width: 25
     Side Slope: 4
     Mannings n: 0.030
     Use Variable Time Step: No
     Channel Loss: None
End:

Junction: HWC_Out
     Canvas X: 5295.238095238095
     Canvas Y: -904.7619047619046
End:

Subbasin: GC1
     Canvas X: 6422.764227642276
     Canvas Y: -3821.1382113821146
     Area: 0.34
     Downstream: GOOSE_CREEK

     Canopy: None

     Surface: None

     LossRate: SCS
     Percent Impervious Area: 0.0
     Curve Number: 81
     Initial Abstraction: 0
```

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```
     Transform: SCS
     Lag: 55.8
     Unitgraph Type: STANDARD

     Baseflow: None
End:

Junction: GOOSE_CREEK
     Canvas X: 4796.747967479674
     Canvas Y: -3211.382113821139
End:

Basin Schematic Properties:
     Last View N: 5000.0
     Last View S: -5000.0
     Last View W: -5000.0
     Last View E: 5000.0
     Maximum View N: 5000.0
     Maximum View S: -5000.0
     Maximum View W: -5000.0
     Maximum View E: 5000.0
     Extent Method: Elements
     Buffer: 0
     Draw Icons: Yes
     Draw Icon Labels: Yes
     Draw Map Objects: No
     Draw Gridlines: No
     Draw Flow Direction: No
     Fix Element Locations: No
     Fix Hydrologic Order: No
End:
```

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HEC-HMS RESULTS

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2-year, 6-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	95.7	01Jun2014, 14:27	33.3
GC1	0.34	21.1	01Jun2014, 13:18	4.6
GOOSE_CREEK	0.34	21.1	01Jun2014, 13:18	4.6
HWCLower	6.48	193.9	01Jun2014, 15:12	68.9
HWCSub1	0.19	15.1	01Jun2014, 12:48	2.0
HWCSub2	0.14	13.4	01Jun2014, 12:45	1.6
HWCSub3	0.07	5.7	01Jun2014, 12:48	0.8
HWCSub4	0.18	11.8	01Jun2014, 12:57	1.9
HWCSub5	0.12	11.5	01Jun2014, 12:42	1.3
HWCS1_R	0.19	15.1	01Jun2014, 13:30	2.1
HWCS2_R	0.14	13.3	01Jun2014, 13:15	1.6
HWCS3_R	0.07	5.7	01Jun2014, 13:42	0.8
HWCS4_R	0.18	11.7	01Jun2014, 13:42	1.9
HWCS5_R	0.12	14.2	01Jun2014, 13:39	1.3
HWCUpper	3.29	99.8	01Jun2014, 15:03	35.0
HWC_Out	7.99	229.5	01Jun2014, 15:00	85.2
HWC1	0.81	27.0	01Jun2014, 14:18	8.7
HWC2	3.19	97.8	01Jun2014, 14:33	33.9
HWC3	3.29	99.9	01Jun2014, 14:33	35.0
SCBRANCH_R	6.11	197.4	01Jun2014, 15:03	74.1
SCNBranch	2.40	90.5	01Jun2014, 14:18	29.2
SCSBranch	3.71	113.0	01Jun2014, 15:00	44.9
SCSub1	0.42	23.8	01Jun2014, 13:09	4.5
SCSub2	0.41	29.0	01Jun2014, 12:54	4.2
SCSub3	0.31	19.3	01Jun2014, 13:03	3.3
SCSub4	0.34	29.7	01Jun2014, 13:03	5.3
SCSub5	0.14	10.4	01Jun2014, 12:51	1.4
SCS1_R	0.42	23.8	01Jun2014, 13:33	4.5
SCS2_R	0.41	28.8	01Jun2014, 13:33	4.2
SCS3_R	0.31	19.9	01Jun2014, 14:15	3.4
SCS4_R	0.34	32.3	01Jun2014, 14:36	5.3
SCS5_R	0.14	10.4	01Jun2014, 12:57	1.4
SC_Out	16.45	497.6	01Jun2014, 15:36	197.7
SC1	1.96	47.1	01Jun2014, 15:42	22.8
SC2	3.81	135.1	01Jun2014, 14:27	46.1
SC2_R	12.87	419.7	01Jun2014, 15:45	156.0
SC3	2.95	105.9	01Jun2014, 14:27	35.8
SC3_R	9.06	296.7	01Jun2014, 15:09	109.9
TONGUE_RIVER	21.38	595.6	01Jun2014, 15:18	266.6
TRD1	0.03	2.8	01Jun2014, 12:39	0.3
TRD2	0.51	20.3	01Jun2014, 13:36	5.0
TRD3	0.59	19.9	01Jun2014, 13:42	5.2
TRD4	0.27	24.5	01Jun2014, 12:57	4.0
TRD5	0.93	58.8	01Jun2014, 13:27	13.7
TR_Sub1	0.52	31.5	01Jun2014, 13:00	5.1
TR_Sub2	0.24	8.7	01Jun2014, 13:39	2.2

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2-year, 24-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	194.2	01Jun2014, 22:00	73.7
GC1	0.34	48.4	01Jun2014, 20:51	10.6
GOOSE_CREEK	0.34	48.4	01Jun2014, 20:51	10.6
HWCLower	6.48	407.5	01Jun2014, 22:39	167.0
HWCSub1	0.19	37.0	01Jun2014, 20:18	4.9
HWCSub2	0.14	33.0	01Jun2014, 20:15	3.7
HWCSub3	0.07	13.8	01Jun2014, 20:18	1.8
HWCSub4	0.18	28.0	01Jun2014, 20:27	4.5
HWCSub5	0.12	28.2	01Jun2014, 20:12	3.1
HWCS1_R	0.19	36.9	01Jun2014, 20:48	4.9
HWCS2_R	0.14	32.9	01Jun2014, 20:36	3.7
HWCS3_R	0.07	13.8	01Jun2014, 20:54	1.8
HWCS4_R	0.18	28.0	01Jun2014, 21:00	4.5
HWCS5_R	0.12	28.7	01Jun2014, 20:51	3.1
HWCUpper	3.29	209.1	01Jun2014, 22:33	84.8
HWC_Out	7.99	474.2	01Jun2014, 22:30	205.9
HWC1	0.81	58.3	01Jun2014, 21:48	20.9
HWC2	3.19	205.1	01Jun2014, 22:06	82.2
HWC3	3.29	209.2	01Jun2014, 22:09	84.8
SCBRANCH_R	6.11	400.7	01Jun2014, 22:33	176.3
SCNBranch	2.40	191.9	01Jun2014, 21:51	69.3
SCSBranch	3.71	228.8	01Jun2014, 22:39	107.1
SCSub1	0.42	59.6	01Jun2014, 20:39	11.2
SCSub2	0.41	69.4	01Jun2014, 20:24	10.2
SCSub3	0.31	45.7	01Jun2014, 20:33	8.0
SCSub4	0.34	69.1	01Jun2014, 20:33	12.0
SCSub5	0.13	23.4	01Jun2014, 20:21	3.2
SCS1_R	0.42	59.4	01Jun2014, 20:57	11.2
SCS2_R	0.41	68.8	01Jun2014, 20:51	10.2
SCS3_R	0.31	45.4	01Jun2014, 21:36	8.0
SCS4_R	0.34	73.4	01Jun2014, 21:45	12.0
SCS5_R	0.13	23.3	01Jun2014, 20:27	3.2
SC_Out	16.46	1022.4	01Jun2014, 23:06	473.2
SC1	1.98	95.0	01Jun2014, 23:48	57.1
SC2	3.81	284.0	01Jun2014, 22:03	110.0
SC2_R	12.87	870.6	01Jun2014, 23:09	371.4
SC3	2.95	222.3	01Jun2014, 22:00	85.1
SC3_R	9.06	608.8	01Jun2014, 22:39	261.5
TONGUE_RIVER	21.40	1253.9	01Jun2014, 22:54	632.0
TRD1	0.04	9.5	01Jun2014, 20:09	0.9
TRD2	0.51	43.9	01Jun2014, 21:09	11.8
TRD3	0.59	45.5	01Jun2014, 21:12	12.7
TRD4	0.27	57.6	01Jun2014, 20:30	9.1
TRD5	0.93	143.0	01Jun2014, 20:54	32.8
TR_Sub1	0.52	75.2	01Jun2014, 20:30	12.4
TR_Sub2	0.24	19.9	01Jun2014, 21:09	5.3

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5-year, 6-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	171.0	01Jun2014, 14:24	60.7
GC1	0.34	39.2	01Jun2014, 13:18	8.7
GOOSE_CREEK	0.34	39.2	01Jun2014, 13:18	8.7
HWCLower	6.48	373.9	01Jun2014, 15:03	133.5
HWCSub1	0.19	28.9	01Jun2014, 12:48	4.0
HWCSub2	0.14	25.4	01Jun2014, 12:45	3.0
HWCSub3	0.07	11.0	01Jun2014, 12:48	1.5
HWCSub4	0.18	22.6	01Jun2014, 12:57	3.6
HWCSub5	0.12	21.9	01Jun2014, 12:42	2.5
HWCS1_R	0.19	28.8	01Jun2014, 13:24	4.0
HWCS2_R	0.14	25.4	01Jun2014, 13:09	3.0
HWCS3_R	0.07	10.9	01Jun2014, 13:30	1.5
HWCS4_R	0.18	22.5	01Jun2014, 13:33	3.6
HWCS5_R	0.12	22.3	01Jun2014, 13:24	2.5
HWCUpper	3.29	191.3	01Jun2014, 14:57	67.8
HWC_Out	7.99	442.3	01Jun2014, 14:54	165.0
HWC1	0.81	51.7	01Jun2014, 14:18	16.9
HWC2	3.19	187.3	01Jun2014, 14:33	65.7
HWC3	3.29	191.4	01Jun2014, 14:33	67.7
SCBRANCH_R	6.11	373.6	01Jun2014, 14:54	141.7
SCNBranch	2.40	170.7	01Jun2014, 14:15	55.8
SCSBranch	3.71	213.7	01Jun2014, 15:00	85.9
SCSub1	0.42	45.6	01Jun2014, 13:09	8.8
SCSub2	0.41	55.6	01Jun2014, 12:54	8.2
SCSub3	0.31	36.9	01Jun2014, 13:03	6.5
SCSub4	0.34	54.2	01Jun2014, 13:03	9.8
SCSub5	0.14	20.0	01Jun2014, 12:51	2.8
SCS1_R	0.42	45.5	01Jun2014, 13:27	8.8
SCS2_R	0.41	55.3	01Jun2014, 13:24	8.2
SCS3_R	0.31	36.7	01Jun2014, 14:03	6.5
SCS4_R	0.34	53.7	01Jun2014, 14:18	9.9
SCS5_R	0.14	19.9	01Jun2014, 12:57	2.8
SC_Out	16.45	947.4	01Jun2014, 15:21	378.5
SC1	1.96	89.8	01Jun2014, 15:39	43.9
SC2	3.81	255.2	01Jun2014, 14:27	88.1
SC2_R	12.87	803.0	01Jun2014, 15:30	298.4
SC3	2.95	200.0	01Jun2014, 14:24	68.5
SC3_R	9.06	564.1	01Jun2014, 15:00	210.2
TONGUE_RIVER	21.38	1159.6	01Jun2014, 15:03	507.2
TRD1	0.03	5.4	01Jun2014, 12:39	0.5
TRD2	0.51	39.2	01Jun2014, 13:36	9.8
TRD3	0.59	38.9	01Jun2014, 13:42	10.2
TRD4	0.27	45.1	01Jun2014, 12:57	7.5
TRD5	0.93	108.0	01Jun2014, 13:24	25.7
TR_Sub1	0.52	60.7	01Jun2014, 13:00	10.0
TR_Sub2	0.24	17.0	01Jun2014, 13:36	4.3

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5-year, 24-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	298.3	01Jun2014, 22:00	112.3
GC1	0.34	77.0	01Jun2014, 20:51	16.7
GOOSE_CREEK	0.34	77.0	01Jun2014, 20:51	16.7
HWCLower	6.48	663.0	01Jun2014, 22:33	268.0
HWCSub1	0.19	60.2	01Jun2014, 20:18	7.9
HWCSub2	0.14	53.3	01Jun2014, 20:15	6.0
HWCSub3	0.07	22.5	01Jun2014, 20:18	2.9
HWCSub4	0.18	45.7	01Jun2014, 20:27	7.2
HWCSub5	0.12	45.9	01Jun2014, 20:12	5.0
HWCS1_R	0.19	60.0	01Jun2014, 20:45	7.9
HWCS2_R	0.14	53.1	01Jun2014, 20:33	6.0
HWCS3_R	0.07	22.4	01Jun2014, 20:48	2.9
HWCS4_R	0.18	45.6	01Jun2014, 20:54	7.2
HWCS5_R	0.12	45.1	01Jun2014, 20:45	5.0
HWCUpper	3.29	339.0	01Jun2014, 22:30	136.1
HWC_Out	7.99	771.6	01Jun2014, 22:27	330.5
HWC1	0.81	94.6	01Jun2014, 21:48	33.5
HWC2	3.19	332.7	01Jun2014, 22:06	131.9
HWC3	3.29	339.2	01Jun2014, 22:09	136.1
SCBRANCH_R	6.11	642.4	01Jun2014, 22:30	279.8
SCNBranch	2.40	307.7	01Jun2014, 21:48	109.9
SCSBranch	3.71	366.7	01Jun2014, 22:39	169.9
SCSub1	0.42	96.4	01Jun2014, 20:39	18.0
SCSub2	0.41	113.1	01Jun2014, 20:24	16.4
SCSub3	0.31	74.3	01Jun2014, 20:33	12.8
SCSub4	0.34	108.4	01Jun2014, 20:33	18.6
SCSub5	0.13	38.1	01Jun2014, 20:21	5.2
SCS1_R	0.42	96.2	01Jun2014, 20:54	18.0
SCS2_R	0.41	112.5	01Jun2014, 20:48	16.4
SCS3_R	0.31	73.6	01Jun2014, 21:27	12.8
SCS4_R	0.34	107.4	01Jun2014, 21:36	18.6
SCS5_R	0.13	37.9	01Jun2014, 20:24	5.2
SC_Out	16.46	1637.9	01Jun2014, 22:57	751.1
SC1	1.98	152.0	01Jun2014, 23:48	90.7
SC2	3.81	455.3	01Jun2014, 22:00	174.5
SC2_R	12.87	1405.3	01Jun2014, 23:00	589.4
SC3	2.95	356.3	01Jun2014, 22:00	135.1
SC3_R	9.06	979.5	01Jun2014, 22:33	414.9
TONGUE_RIVER	21.40	2024.2	01Jun2014, 22:45	998.6
TRD1	0.04	15.7	01Jun2014, 20:09	1.4
TRD2	0.51	72.1	01Jun2014, 21:09	19.1
TRD3	0.59	75.0	01Jun2014, 21:12	20.7
TRD4	0.27	90.7	01Jun2014, 20:30	14.2
TRD5	0.93	224.2	01Jun2014, 20:54	50.8
TR_Sub1	0.52	123.0	01Jun2014, 20:30	20.1
TR_Sub2	0.24	32.7	01Jun2014, 21:09	8.7

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10-year, 6-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	225.6	01Jun2014, 14:24	80.9
GC1	0.34	52.9	01Jun2014, 13:18	11.8
GOOSE_CREEK	0.34	52.9	01Jun2014, 13:18	11.8
HWCLower	6.48	513.6	01Jun2014, 15:00	184.2
HWCSub1	0.19	40.2	01Jun2014, 12:48	5.5
HWCSub2	0.14	34.9	01Jun2014, 12:42	4.2
HWCSub3	0.07	15.0	01Jun2014, 12:48	2.0
HWCSub4	0.18	31.0	01Jun2014, 12:57	5.0
HWCSub5	0.12	30.0	01Jun2014, 12:42	3.5
HWCS1_R	0.19	40.0	01Jun2014, 13:18	5.5
HWCS2_R	0.14	34.7	01Jun2014, 13:06	4.2
HWCS3_R	0.07	14.8	01Jun2014, 13:24	2.0
IIWCS4_R	0.18	30.9	01Jun2014, 13:27	5.0
HWCS5_R	0.12	29.7	01Jun2014, 13:21	3.5
HWCUpper	3.29	262.3	01Jun2014, 14:54	93.5
HWC_Out	7.99	606.2	01Jun2014, 14:48	227.7
HWC1	0.81	71.9	01Jun2014, 14:15	23.3
HWC2	3.19	256.8	01Jun2014, 14:30	90.7
HWC3	3.29	262.4	01Jun2014, 14:33	93.5
SCBRANCH_R	6.11	508.4	01Jun2014, 14:54	194.2
SCNBranch	2.40	231.9	01Jun2014, 14:15	76.5
SCSBranch	3.71	290.9	01Jun2014, 14:57	117.6
SCSub1	0.42	65.8	01Jun2014, 13:06	12.5
SCSub2	0.41	75.9	01Jun2014, 12:54	11.4
SCSub3	0.31	50.5	01Jun2014, 13:03	8.9
SCSub4	0.34	72.2	01Jun2014, 13:03	13.3
SCSub5	0.13	25.5	01Jun2014, 12:51	3.6
SCS1_R	0.42	65.7	01Jun2014, 13:24	12.5
SCS2_R	0.41	75.5	01Jun2014, 13:21	11.4
SCS3_R	0.31	50.1	01Jun2014, 14:03	8.9
SCS4_R	0.34	71.6	01Jun2014, 14:15	13.3
SCS5_R	0.13	25.4	01Jun2014, 12:54	3.6
SC_Out	16.46	1296.4	01Jun2014, 15:18	521.8
SC1	1.98	126.8	01Jun2014, 15:42	63.2
SC2	3.81	346.9	01Jun2014, 14:27	120.8
SC2_R	12.87	1096.7	01Jun2014, 15:27	408.8
SC3	2.95	271.8	01Jun2014, 14:24	93.8
SC3_R	9.06	769.0	01Jun2014, 14:57	288.0
TONGUE_RIVER	21.40	1587.5	01Jun2014, 15:00	697.4
TRD1	0.04	10.1	01Jun2014, 12:39	1.0
TRD2	0.51	51.6	01Jun2014, 13:36	13.2
TRD3	0.59	54.2	01Jun2014, 13:42	14.2
TRD4	0.27	60.3	01Jun2014, 12:57	10.1
TRD5	0.93	153.3	01Jun2014, 13:24	36.2
TR_Sub1	0.52	83.4	01Jun2014, 13:00	13.9
TR_Sub2	0.24	23.5	01Jun2014, 13:36	6.0

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10-year, 24-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	375.8	01Jun2014, 22:00	141.0
GC1	0.34	99.0	01Jun2014, 20:51	21.3
GOOSE_CREEK	0.34	99.0	01Jun2014, 20:51	21.3
HWCLower	6.48	863.3	01Jun2014, 22:30	346.5
HWCSub1	0.19	78.3	01Jun2014, 20:18	10.2
HWCSub2	0.14	69.2	01Jun2014, 20:15	7.7
HWCSub3	0.07	29.3	01Jun2014, 20:18	3.7
HWCSub4	0.18	59.7	01Jun2014, 20:27	9.3
HWCSub5	0.12	59.7	01Jun2014, 20:12	6.4
HWCS1_R	0.19	78.1	01Jun2014, 20:42	10.2
HWCS2_R	0.14	68.9	01Jun2014, 20:30	7.7
HWCS3_R	0.07	29.1	01Jun2014, 20:45	3.7
HWCS4_R	0.18	59.5	01Jun2014, 20:51	9.3
HWCS5_R	0.12	58.8	01Jun2014, 20:42	6.4
HWCUpper	3.29	440.7	01Jun2014, 22:27	175.9
HWC_Out	7.99	1004.9	01Jun2014, 22:24	427.3
HWC1	0.81	123.0	01Jun2014, 21:48	43.3
HWC2	3.19	432.5	01Jun2014, 22:06	170.6
HWC3	3.29	441.0	01Jun2014, 22:09	175.9
SCBRANCH_R	6.11	829.6	01Jun2014, 22:27	359.3
SCNBranch	2.40	397.4	01Jun2014, 21:48	141.1
SCSBranch	3.71	473.3	01Jun2014, 22:39	218.2
SCSub1	0.42	125.2	01Jun2014, 20:39	23.2
SCSub2	0.41	147.6	01Jun2014, 20:24	21.2
SCSub3	0.31	96.7	01Jun2014, 20:33	16.6
SCSub4	0.34	138.1	01Jun2014, 20:33	23.5
SCSub5	0.13	49.7	01Jun2014, 20:21	6.7
SCS1_R	0.42	125.0	01Jun2014, 20:51	23.2
SCS2_R	0.41	146.7	01Jun2014, 20:45	21.3
SCS3_R	0.31	96.0	01Jun2014, 21:21	16.6
SCS4_R	0.34	136.8	01Jun2014, 21:33	23.5
SCS5_R	0.13	49.5	01Jun2014, 20:24	6.7
SC_Out	16.46	2114.5	01Jun2014, 22:51	964.6
SC1	1.98	196.1	01Jun2014, 23:45	116.4
SC2	3.81	588.0	01Jun2014, 22:00	224.1
SC2_R	12.87	1820.7	01Jun2014, 22:54	756.9
SC3	2.95	460.1	01Jun2014, 22:00	173.5
SC3_R	9.06	1266.9	01Jun2014, 22:30	532.8
TONGUE_RIVER	21.40	2619.5	01Jun2014, 22:39	1279.3
TRD1	0.04	20.5	01Jun2014, 20:09	1.9
TRD2	0.51	94.3	01Jun2014, 21:09	24.8
TRD3	0.59	98.5	01Jun2014, 21:12	27.0
TRD4	0.27	115.8	01Jun2014, 20:27	18.1
TRD5	0.93	285.6	01Jun2014, 20:54	64.4
TR_Sub1	0.52	160.8	01Jun2014, 20:30	26.1
TR_Sub2	0.24	42.8	01Jun2014, 21:09	11.3

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25-year, 6-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	296.5	01Jun2014, 14:24	107.6
GC1	0.34	71.1	01Jun2014, 13:18	16.0
GOOSE_CREEK	0.34	71.1	01Jun2014, 13:18	16.0
HWCLower	6.48	703.7	01Jun2014, 14:57	254.0
HWCSub1	0.19	54.8	01Jun2014, 12:48	7.5
HWCSub2	0.14	47.4	01Jun2014, 12:42	5.7
HWCSub3	0.07	20.4	01Jun2014, 12:48	2.8
HWCSub4	0.18	42.4	01Jun2014, 12:57	6.9
HWCSub5	0.12	40.8	01Jun2014, 12:42	4.8
HWCS1_R	0.19	54.5	01Jun2014, 13:15	7.6
HWCS2_R	0.14	47.3	01Jun2014, 13:03	5.8
HWCS3_R	0.07	20.3	01Jun2014, 13:18	2.8
HWCS4_R	0.18	42.3	01Jun2014, 13:24	6.9
HWCS5_R	0.12	40.4	01Jun2014, 13:18	4.8
HWCUpper	3.29	358.7	01Jun2014, 14:54	128.9
HWC_Out	7.99	830.3	01Jun2014, 14:45	313.8
HWC1	0.81	98.2	01Jun2014, 14:15	32.1
HWC2	3.19	351.2	01Jun2014, 14:30	125.0
HWC3	3.29	358.9	01Jun2014, 14:33	128.9
SCBRANCH_R	6.11	690.1	01Jun2014, 14:51	265.6
SCNBranch	2.40	314.2	01Jun2014, 14:15	104.6
SCSBranch	3.71	394.9	01Jun2014, 14:57	160.9
SCSub1	0.42	89.5	01Jun2014, 13:06	17.2
SCSub2	0.41	103.9	01Jun2014, 12:54	15.7
SCSub3	0.31	68.8	01Jun2014, 13:03	12.3
SCSub4	0.34	95.8	01Jun2014, 13:03	17.9
SCSub5	0.13	34.9	01Jun2014, 12:51	5.0
SCS1_R	0.42	89.4	01Jun2014, 13:21	17.2
SCS2_R	0.41	103.3	01Jun2014, 13:18	15.7
SCS3_R	0.31	68.4	01Jun2014, 13:54	12.3
SCS4_R	0.34	95.0	01Jun2014, 14:09	17.9
SCS5_R	0.13	34.8	01Jun2014, 12:54	5.0
SC_Out	16.46	1761.4	01Jun2014, 15:12	713.8
SC1	1.98	172.7	01Jun2014, 15:39	86.5
SC2	3.81	470.2	01Jun2014, 14:24	165.2
SC2_R	12.87	1492.8	01Jun2014, 15:21	559.1
SC3	2.95	368.4	01Jun2014, 14:24	128.3
SC3_R	9.06	1045.2	01Jun2014, 14:54	393.9
TONGUE_RIVER	21.40	2171.3	01Jun2014, 14:54	950.9
TRD1	0.04	13.9	01Jun2014, 12:39	1.4
TRD2	0.51	71.0	01Jun2014, 13:36	18.3
TRD3	0.59	75.0	01Jun2014, 13:39	19.8
TRD4	0.27	80.4	01Jun2014, 12:57	13.7
TRD5	0.93	203.5	01Jun2014, 13:21	48.8
TR_Sub1	0.52	114.4	01Jun2014, 13:00	19.3
TR_Sub2	0.24	32.4	01Jun2014, 13:36	8.3

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25-year, 24-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	486.2	01Jun2014, 21:57	181.8
GC1	0.34	131.0	01Jun2014, 20:51	28.1
GOOSE_CREEK	0.34	131.0	01Jun2014, 20:51	28.1
HWCLower	6.48	1160.6	01Jun2014, 22:27	462.3
HWCSub1	0.19	105.3	01Jun2014, 20:18	13.6
HWCSub2	0.14	92.6	01Jun2014, 20:12	10.3
HWCSub3	0.07	39.4	01Jun2014, 20:18	5.0
HWCSub4	0.18	80.4	01Jun2014, 20:27	12.5
HWCSub5	0.12	80.2	01Jun2014, 20:12	8.6
HWCS1_R	0.19	104.8	01Jun2014, 20:39	13.6
HWCS2_R	0.14	92.3	01Jun2014, 20:30	10.3
HWCS3_R	0.07	39.1	01Jun2014, 20:42	5.0
HWCS4_R	0.18	80.0	01Jun2014, 20:48	12.5
HWCS5_R	0.12	79.0	01Jun2014, 20:39	8.6
HWCUpper	3.29	591.6	01Jun2014, 22:27	234.7
HWC_Out	7.99	1350.9	01Jun2014, 22:21	570.0
HWC1	0.81	165.1	01Jun2014, 21:45	57.8
HWC2	3.19	580.7	01Jun2014, 22:06	227.6
HWC3	3.29	591.9	01Jun2014, 22:09	234.7
SCBRANCH_R	6.11	1104.8	01Jun2014, 22:27	475.5
SCNBranch	2.40	529.2	01Jun2014, 21:48	186.8
SCSBranch	3.71	629.9	01Jun2014, 22:39	288.7
SCSub1	0.42	167.8	01Jun2014, 20:39	30.8
SCSub2	0.41	198.8	01Jun2014, 20:24	28.4
SCSub3	0.31	129.9	01Jun2014, 20:33	22.1
SCSub4	0.34	180.9	01Jun2014, 20:33	30.7
SCSub5	0.13	67.0	01Jun2014, 20:21	9.0
SCS1_R	0.42	167.4	01Jun2014, 20:51	30.8
SCS2_R	0.41	197.2	01Jun2014, 20:42	28.4
SCS3_R	0.31	129.0	01Jun2014, 21:15	22.1
SCS4_R	0.34	179.3	01Jun2014, 21:27	30.7
SCS5_R	0.13	66.7	01Jun2014, 20:24	9.0
SC_Out	16.46	2813.4	01Jun2014, 22:48	1276.9
SC1	1.98	260.8	01Jun2014, 23:45	154.1
SC2	3.81	782.8	01Jun2014, 22:00	296.5
SC2_R	12.87	2431.3	01Jun2014, 22:51	1001.6
SC3	2.95	612.6	01Jun2014, 21:57	229.6
SC3_R	9.06	1689.5	01Jun2014, 22:27	705.1
TONGUE_RIVER	21.40	3493.2	01Jun2014, 22:36	1688.8
TRD1	0.04	27.8	01Jun2014, 20:09	2.5
TRD2	0.51	127.6	01Jun2014, 21:09	33.4
TRD3	0.59	134.0	01Jun2014, 21:12	36.4
TRD4	0.27	152.4	01Jun2014, 20:27	23.6
TRD5	0.93	374.1	01Jun2014, 20:54	83.9
TR_Sub1	0.52	217.2	01Jun2014, 20:30	35.0
TR_Sub2	0.24	58.1	01Jun2014, 21:09	15.3

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50-year, 6-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	351.3	01Jun2014, 14:21	128.6
GC1	0.34	85.4	01Jun2014, 13:18	19.4
GOOSE_CREEK	0.34	85.4	01Jun2014, 13:18	19.4
HWCLower	6.48	856.0	01Jun2014, 14:54	310.5
HWCSub1	0.19	66.5	01Jun2014, 12:48	9.2
HWCSub2	0.14	57.4	01Jun2014, 12:42	7.0
HWCSub3	0.07	24.8	01Jun2014, 12:48	3.4
HWCSub4	0.18	51.6	01Jun2014, 12:57	8.5
HWCSub5	0.12	49.5	01Jun2014, 12:42	5.8
HWCS1_R	0.19	66.1	01Jun2014, 13:12	9.2
HWCS2_R	0.14	57.0	01Jun2014, 13:03	7.0
HWCS3_R	0.07	24.6	01Jun2014, 13:18	3.4
HWCS4_R	0.18	51.4	01Jun2014, 13:21	8.5
HWCS5_R	0.12	49.1	01Jun2014, 13:15	5.8
HWCUpper	3.29	436.1	01Jun2014, 14:51	157.6
HWC_Out	7.99	1010.2	01Jun2014, 14:45	383.6
HWC1	0.81	119.3	01Jun2014, 14:12	39.2
HWC2	3.19	426.9	01Jun2014, 14:30	152.9
HWC3	3.29	436.2	01Jun2014, 14:33	157.6
SCBRANCH_R	6.11	834.8	01Jun2014, 14:48	322.9
SCNBranch	2.40	379.5	01Jun2014, 14:15	127.2
SCSBranch	3.71	477.7	01Jun2014, 14:57	195.7
SCSub1	0.42	108.5	01Jun2014, 13:06	21.0
SCSub2	0.41	126.3	01Jun2014, 12:54	19.2
SCSub3	0.31	83.5	01Jun2014, 13:03	15.0
SCSub4	0.34	114.2	01Jun2014, 13:03	21.5
SCSub5	0.13	42.4	01Jun2014, 12:51	6.1
SCS1_R	0.42	108.3	01Jun2014, 13:21	21.0
SCS2_R	0.41	125.7	01Jun2014, 13:15	19.3
SCS3_R	0.31	83.1	01Jun2014, 13:51	15.1
SCS4_R	0.34	113.1	01Jun2014, 14:03	21.5
SCS5_R	0.13	42.4	01Jun2014, 12:54	6.1
SC_Out	16.46	2131.6	01Jun2014, 15:09	868.1
SC1	1.98	209.4	01Jun2014, 15:39	105.1
SC2	3.81	568.3	01Jun2014, 14:24	200.9
SC2_R	12.87	1808.4	01Jun2014, 15:18	680.0
SC3	2.95	445.1	01Jun2014, 14:24	156.1
SC3_R	9.06	1264.9	01Jun2014, 14:54	479.0
TONGUE_RIVER	21.40	2637.1	01Jun2014, 14:51	1154.2
TRD1	0.04	17.0	01Jun2014, 12:39	1.7
TRD2	0.51	86.7	01Jun2014, 13:36	22.4
TRD3	0.59	91.8	01Jun2014, 13:39	24.4
TRD4	0.27	96.0	01Jun2014, 12:57	16.5
TRD5	0.93	242.7	01Jun2014, 13:21	58.7
TR_Sub1	0.52	139.3	01Jun2014, 13:00	23.6
TR_Sub2	0.24	39.6	01Jun2014, 13:36	10.2

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50-year, 24-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	573.7	01Jun2014, 21:57	214.1
GC1	0.34	156.9	01Jun2014, 20:51	33.5
GOOSE_CREEK	0.34	156.9	01Jun2014, 20:51	33.5
HWCLower	6.48	1404.7	01Jun2014, 22:27	556.6
HWCSub1	0.19	127.4	01Jun2014, 20:18	16.3
HWCSub2	0.14	111.8	01Jun2014, 20:12	12.4
HWCSub3	0.07	47.6	01Jun2014, 20:18	6.0
HWCSub4	0.18	97.5	01Jun2014, 20:27	15.0
HWCSub5	0.12	97.0	01Jun2014, 20:12	10.3
HWCS1_R	0.19	126.9	01Jun2014, 20:39	16.3
HWCS2_R	0.14	111.5	01Jun2014, 20:27	12.4
HWCS3_R	0.07	47.3	01Jun2014, 20:42	6.0
HWCS4_R	0.18	97.2	01Jun2014, 20:48	15.1
HWCS5_R	0.12	96.0	01Jun2014, 20:39	10.3
HWCUpper	3.29	715.4	01Jun2014, 22:24	282.6
HWC_Out	7.99	1634.5	01Jun2014, 22:21	686.3
HWC1	0.81	199.7	01Jun2014, 21:45	69.6
HWC2	3.19	702.0	01Jun2014, 22:06	274.0
HWC3	3.29	715.6	01Jun2014, 22:06	282.6
SCBRANCH_R	6.11	1328.4	01Jun2014, 22:24	569.6
SCNBranch	2.40	636.3	01Jun2014, 21:48	223.7
SCSBranch	3.71	757.1	01Jun2014, 22:39	345.9
SCSub1	0.42	202.6	01Jun2014, 20:39	37.1
SCSub2	0.41	240.9	01Jun2014, 20:24	34.3
SCSub3	0.31	157.2	01Jun2014, 20:33	26.6
SCSub4	0.34	215.1	01Jun2014, 20:33	36.4
SCSub5	0.13	81.1	01Jun2014, 20:21	10.9
SCS1_R	0.42	202.2	01Jun2014, 20:48	37.1
SCS2_R	0.41	239.4	01Jun2014, 20:42	34.3
SCS3_R	0.31	156.0	01Jun2014, 21:12	26.6
SCS4_R	0.34	213.3	01Jun2014, 21:24	36.4
SCS5_R	0.13	80.9	01Jun2014, 20:24	10.9
SC_Out	16.46	3381.9	01Jun2014, 22:45	1529.6
SC1	1.98	313.4	01Jun2014, 23:45	184.6
SC2	3.81	941.1	01Jun2014, 22:00	355.2
SC2_R	12.87	2928.6	01Jun2014, 22:48	1199.8
SC3	2.95	736.6	01Jun2014, 21:57	275.0
SC3_R	9.06	2033.1	01Jun2014, 22:27	844.6
TONGUE_RIVER	21.40	4202.5	01Jun2014, 22:33	2019.8
TRD1	0.04	33.8	01Jun2014, 20:09	3.1
TRD2	0.51	155.1	01Jun2014, 21:09	40.4
TRD3	0.59	163.3	01Jun2014, 21:12	44.2
TRD4	0.27	181.7	01Jun2014, 20:27	28.1
TRD5	0.93	444.9	01Jun2014, 20:54	99.5
TR_Sub1	0.52	263.7	01Jun2014, 20:30	42.3
TR_Sub2	0.24	70.7	01Jun2014, 21:09	18.5

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100-year, 6-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	407.1	01Jun2014, 14:21	150.1
GC1	0.34	100.1	01Jun2014, 13:18	22.9
GOOSE_CREEK	0.34	100.1	01Jun2014, 13:18	22.9
HWCLower	6.48	1015.6	01Jun2014, 14:54	370.0
HWCSub1	0.19	78.6	01Jun2014, 12:48	11.0
HWCSub2	0.14	67.8	01Jun2014, 12:42	8.3
HWCSub3	0.07	29.3	01Jun2014, 12:48	4.0
HWCSub4	0.18	61.1	01Jun2014, 12:57	10.1
HWCSub5	0.12	58.6	01Jun2014, 12:42	6.9
HWCS1_R	0.19	78.2	01Jun2014, 13:12	11.0
HWCS2_R	0.14	67.6	01Jun2014, 13:00	8.4
HWCS3_R	0.07	29.2	01Jun2014, 13:15	4.1
HWCS4_R	0.18	60.9	01Jun2014, 13:21	10.1
HWCS5_R	0.12	57.7	01Jun2014, 13:12	7.0
HWCUpper	3.29	516.9	01Jun2014, 14:51	187.8
HWC_Out	7.99	1197.9	01Jun2014, 14:42	457.1
HWC1	0.81	141.3	01Jun2014, 14:12	46.7
HWC2	3.19	506.0	01Jun2014, 14:30	182.1
HWC3	3.29	517.1	01Jun2014, 14:30	187.8
SCBRANCH_R	6.11	985.1	01Jun2014, 14:48	383.0
SCNBranch	2.40	447.3	01Jun2014, 14:15	150.9
SCSBranch	3.71	563.8	01Jun2014, 14:54	232.1
SCSub1	0.42	128.1	01Jun2014, 13:06	25.0
SCSub2	0.41	149.6	01Jun2014, 12:54	23.0
SCSub3	0.31	98.8	01Jun2014, 13:03	17.9
SCSub4	0.34	132.9	01Jun2014, 13:03	25.3
SCSub5	0.13	50.3	01Jun2014, 12:51	7.3
SCS1_R	0.42	127.8	01Jun2014, 13:18	25.0
SCS2_R	0.41	148.8	01Jun2014, 13:15	23.0
SCS3_R	0.31	98.3	01Jun2014, 13:48	17.9
SCS4_R	0.34	131.8	01Jun2014, 14:00	25.3
SCS5_R	0.13	50.1	01Jun2014, 12:54	7.3
SC_Out	16.46	2516.3	01Jun2014, 15:06	1029.7
SC1	1.98	247.6	01Jun2014, 15:39	124.7
SC2	3.81	670.1	01Jun2014, 14:24	238.3
SC2_R	12.87	2136.4	01Jun2014, 15:15	806.5
SC3	2.95	524.7	01Jun2014, 14:24	185.1
SC3_R	9.06	1493.6	01Jun2014, 14:51	568.1
TONGUE_RIVER	21.40	3122.0	01Jun2014, 14:48	1366.7
TRD1	0.04	20.2	01Jun2014, 12:39	2.0
TRD2	0.51	103.2	01Jun2014, 13:36	26.8
TRD3	0.59	109.6	01Jun2014, 13:39	29.2
TRD4	0.27	112.1	01Jun2014, 12:57	19.4
TRD5	0.93	282.8	01Jun2014, 13:21	68.9
TR_Sub1	0.52	165.4	01Jun2014, 13:00	28.2
TR_Sub2	0.24	47.2	01Jun2014, 13:36	12.3

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100-year, 24-hour Type II Storm Event

Hydrologic Element	Drainage Area (mi^2)	Peak Discharge (cfs)	Time of Peak	Volume (Ac-ft)
EF EC	1.84	662.6	01Jun2014, 21:57	247.0
GC1	0.34	183.5	01Jun2014, 20:51	39.1
GOOSE_CREEK	0.34	183.5	01Jun2014, 20:51	39.1
HWCLower	6.48	1658.6	01Jun2014, 22:27	654.7
HWCSub1	0.19	150.5	01Jun2014, 20:18	19.2
HWCSub2	0.14	131.9	01Jun2014, 20:12	14.5
HWCSub3	0.07	56.2	01Jun2014, 20:18	7.1
HWCSub4	0.18	115.3	01Jun2014, 20:27	17.7
HWCSub5	0.12	114.5	01Jun2014, 20:12	12.1
HWCS1_R	0.19	149.5	01Jun2014, 20:39	19.2
HWCS2_R	0.14	131.5	01Jun2014, 20:27	14.5
HWCS3_R	0.07	55.9	01Jun2014, 20:39	7.1
HWCS4_R	0.18	114.9	01Jun2014, 20:48	17.7
HWCS5_R	0.12	112.9	01Jun2014, 20:36	12.1
HWCUpper	3.29	844.2	01Jun2014, 22:24	332.4
HWC_Out	7.99	1929.8	01Jun2014, 22:18	807.2
HWC1	0.81	235.7	01Jun2014, 21:45	81.8
HWC2	3.19	828.4	01Jun2014, 22:06	322.3
HWC3	3.29	844.6	01Jun2014, 22:06	332.4
SCBRANCH_R	6.11	1560.1	01Jun2014, 22:24	666.8
SCNBranch	2.40	747.2	01Jun2014, 21:48	261.9
SCSBranch	3.71	888.9	01Jun2014, 22:36	404.9
SCSub1	0.42	238.8	01Jun2014, 20:39	43.5
SCSub2	0.41	284.9	01Jun2014, 20:24	40.4
SCSub3	0.31	185.6	01Jun2014, 20:33	31.3
SCSub4	0.34	250.2	01Jun2014, 20:33	42.2
SCSub5	0.13	96.0	01Jun2014, 20:21	12.8
SCS1_R	0.42	238.4	01Jun2014, 20:48	43.5
SCS2_R	0.41	282.7	01Jun2014, 20:42	40.4
SCS3_R	0.31	184.0	01Jun2014, 21:12	31.3
SCS4_R	0.34	248.1	01Jun2014, 21:21	42.2
SCS5_R	0.13	95.7	01Jun2014, 20:24	12.8
SC_Out	16.46	3970.4	01Jun2014, 22:42	1790.9
SC1	1.98	367.9	01Jun2014, 23:45	216.1
SC2	3.81	1105.1	01Jun2014, 22:00	415.8
SC2_R	12.87	3444.4	01Jun2014, 22:45	1404.5
SC3	2.95	865.0	01Jun2014, 21:57	322.0
SC3_R	9.06	2389.7	01Jun2014, 22:24	988.8
TONGUE_RIVER	21.40	4936.3	01Jun2014, 22:30	2361.5
TRD1	0.04	40.2	01Jun2014, 20:09	3.6
TRD2	0.51	183.9	01Jun2014, 21:09	47.7
TRD3	0.59	194.3	01Jun2014, 21:12	52.4
TRD4	0.27	211.8	01Jun2014, 20:27	32.7
TRD5	0.93	517.3	01Jun2014, 20:54	115.5
TR_Sub1	0.52	312.3	01Jun2014, 20:30	49.9
TR_Sub2	0.24	84.0	01Jun2014, 21:09	21.9

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ADDENDUM D6-2

ADDENDUM D6-2

Miller Regression Analysis

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Peak Flow Estimates using Methods Presented by Miller, 2003

Drainage: **Hidden Water Creek**

Input Parameters:

Drainage Area (square miles) =	7.99
Region (See WRI Report 03-4107 Plate 1) =	2

Output Parameters:

2-Year Annual Peak Flow — **80 cfs**

$$Q_2 = 29.9(AREA^{0.475})$$

5-Year Annual Peak Flow — **208 cfs**

$$Q_5 = 80.9(AREA^{0.455})$$

10-Year Annual Peak Flow — **339 cfs**

$$Q_{10} = 134(AREA^{0.447})$$

25-Year Annual Peak Flow — **560 cfs**

$$Q_{25} = 225(AREA^{0.439})$$

50-Year Annual Peak Flow — **766 cfs**

$$Q_{50} = 311(AREA^{0.434})$$

100-Year Annual Peak Flow — **1,014 cfs**

$$Q_{100} = 415(AREA^{0.430})$$

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Peak Flow Estimates using Methods Presented by Miller, 2003

Drainage: **Slater Creek**

Input Parameters:

Drainage Area (square miles) =	**16.46**
Region (See WRI Report 03-4107 Plate 1) =	**2**

Output Parameters:

2-Year Annual Peak Flow **113 cfs**

$$Q_2 = 29.9(AREA^{0.475})$$

5-Year Annual Peak Flow **289 cfs**

$$Q_5 = 80.9(AREA^{0.455})$$

10-Year Annual Peak Flow **469 cfs**

$$Q_{10} = 134(AREA^{0.447})$$

25-Year Annual Peak Flow **769 cfs**

$$Q_{25} = 225(AREA^{0.439})$$

50-Year Annual Peak Flow **1,049 cfs**

$$Q_{50} = 311(AREA^{0.434})$$

100-Year Annual Peak Flow **1,384 cfs**

$$Q_{100} = 415(AREA^{0.430})$$

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ADDENDUM D6-3

ADDENDUM D6-3

HEC-RAS Model

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HEC-RAS RESULTS

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HEC-RAS Results: Hidden Water Creek Premine

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Mann Wtd Total	Hydr Radius (ft)
1	16164.28	2-YEAR	474.2	3854.2	3856.1	3856.1	3856.6	0.0119	5.72	82.89	84.47	1.02	0.028	0.98
1	16164.28	100-YEAR	1929.8	3854.2	3857.7	3857.7	3858.7	0.0080	8.24	242.37	124.4	0.96	0.026	1.95
1	16000	2-YEAR	474.2	3852.0	3853.1	3853.1	3853.5	0.0122	5.36	88.53	101.29	1.01	0.028	0.87
1	16000	100-YEAR	1929.8	3852.0	3854.4	3854.4	3855.3	0.0092	7.75	250.65	142.52	1	0.027	1.76
1	15500	2-YEAR	474.2	3845.1	3846.8	3846.7	3847.2	0.0092	5.02	94.42	96.02	0.89	0.028	0.98
1	15500	100-YEAR	1929.8	3845.1	3848.1	3848.1	3849.0	0.0094	7.55	255.94	149.48	1	0.027	1.71
1	15000	2-YEAR	474.2	3840.0	3841.4	3841.4	3841.8	0.0127	5.03	94.36	122.43	1.01	0.028	0.77
1	15000	100-YEAR	1929.8	3840.0	3842.6	3842.6	3843.4	0.0096	7.14	273.38	183.38	0.99	0.027	1.49
1	14500	2-YEAR	474.2	3831.8	3833.1	3833.1	3833.5	0.0120	5.34	88.8	101.12	1	0.028	0.88
1	14500	100-YEAR	1929.8	3831.8	3834.4	3834.4	3835.3	0.0094	7.46	260.75	162.16	0.99	0.027	1.61
1	14000	2-YEAR	474.2	3821.5	3823.6	3823.6	3824.1	0.0113	6.06	78.24	69.93	1.01	0.028	1.12
1	14000	100-YEAR	1929.8	3821.5	3825.3	3825.3	3826.4	0.0073	8.7	236.01	113.32	0.94	0.025	2.08
1	13500	2-YEAR	474.2	3813.9	3815.5	3815.4	3816.0	0.0086	5.41	87.72	76.23	0.89	0.028	1.15
1	13500	100-YEAR	1929.8	3813.9	3817.1	3817.1	3818.2	0.0078	8.59	233.11	112.19	0.96	0.026	2.07
1	13000	2-YEAR	474.2	3808.4	3810.5	3810.5	3811.1	0.0114	5.99	79.11	72.58	1.01	0.028	1.09
1	13000	100-YEAR	1929.8	3808.4	3812.1	3812.1	3813.2	0.0092	8.11	238.46	127.49	1.01	0.027	1.87
1	12500	2-YEAR	474.2	3801.5	3803.4	3803.4	3803.9	0.0118	5.64	84.1	86.77	1.01	0.028	0.97
1	12500	100-YEAR	1929.8	3801.5	3804.9	3804.9	3805.7	0.0075	7.63	269.3	170.76	0.92	0.024	1.57
1	12000	2-YEAR	474.2	3793.1	3794.5	3794.5	3794.9	0.0102	5.26	96.57	129.19	0.94	0.025	0.75
1	12000	100-YEAR	1929.8	3793.1	3795.8	3795.8	3796.5	0.0070	7.54	316.42	227.2	0.89	0.025	1.39
1	11500	2-YEAR	474.2	3782.9	3784.9	3784.9	3785.5	0.0114	6.01	78.97	72.15	1.01	0.028	1.09
1	11500	100-YEAR	1929.8	3782.9	3786.6	3786.6	3787.6	0.0082	8.25	239.48	128.74	0.97	0.025	1.86
1	11000	2-YEAR	474.2	3776.0	3778.0	3778.0	3778.6	0.0113	6.07	78.12	69.62	1.01	0.028	1.12

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HEC-RAS Results: Hidden Water Creek Premine

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Mann Wtd Total	Hydr Radius (ft)
1	11000	100-YEAR	1929.8	3776.0	3779.7	3779.7	3780.7	0.0092	8.14	237.02	116.52	1.01	0.028	2.02
1	10500	2-YEAR	474.2	3767.9	3769.2	3769.2	3769.7	0.0117	5.6	84.61	87.43	1	0.028	0.97
1	10500	100-YEAR	1929.8	3767.9	3770.7	3770.7	3771.7	0.0082	8.13	244.82	130.73	0.97	0.026	1.87
1	10000	2-YEAR	474.2	3759.2	3761.6	3761.6	3762.2	0.0115	6.04	78.46	71.18	1.01	0.028	1.1
1	10000	100-YEAR	1929.8	3759.2	3763.3	3763.3	3764.4	0.0074	8.55	240.2	119.82	0.94	0.025	2
1	9500	2-YEAR	474.2	3751.5	3753.7	3753.7	3754.3	0.0107	6.53	72.65	55.83	1.01	0.028	1.3
1	9500	100-YEAR	1929.8	3751.5	3755.7	3755.7	3757.0	0.0067	9.33	222.86	93.2	0.92	0.025	2.38
1	9000	2-YEAR	474.2	3744.0	3746.2	3746.2	3746.8	0.0112	6.25	75.91	64.35	1.01	0.028	1.18
1	9000	100-YEAR	1929.8	3744.0	3748.1	3748.1	3749.3	0.0084	8.93	216.57	89.06	1	0.028	2.42
1	8500	2-YEAR	474.2	3736.9	3739.0	3739.0	3739.6	0.0088	6.67	78.07	64.68	0.94	0.026	1.2
1	8500	100-YEAR	1929.8	3736.9	3740.9	3740.9	3742.1	0.0066	9.87	236.4	98.87	0.93	0.026	2.38
1	8000	2-YEAR	474.2	3730.7	3732.4	3732.4	3732.9	0.0117	5.66	83.78	85.68	1.01	0.028	0.98
1	8000	100-YEAR	1929.8	3730.7	3734.0	3734.0	3735.0	0.0075	8.33	247.65	128.43	0.94	0.025	1.93
1	7500	2-YEAR	474.2	3722.3	3724.2	3724.2	3724.7	0.0119	5.73	82.85	85.96	1.02	0.028	0.96
1	7500	100-YEAR	1929.8	3722.3	3725.7	3725.7	3726.8	0.0074	8.51	243.6	119.76	0.94	0.026	2.03
1	7000	2-YEAR	474.2	3714.7	3716.6	3716.6	3717.2	0.0095	6.11	82.07	80.27	0.95	0.025	1.02
1	7000	100-YEAR	1929.8	3714.7	3718.3	3718.3	3719.4	0.0065	8.87	271.34	156.79	0.9	0.024	1.73
1	6500	2-YEAR	474.2	3707.9	3709.4	3709.4	3710.0	0.0114	5.83	81.36	77.87	1	0.028	1.04
1	6500	100-YEAR	1929.8	3707.9	3711.0	3711.0	3712.1	0.0081	8.45	234.29	114.1	0.97	0.026	2.05
1	6000	2-YEAR	474.2	3700.7	3702.3	3702.3	3702.8	0.0114	5.55	86.68	98.46	0.99	0.027	0.88
1	6000	100-YEAR	1929.8	3700.7	3703.8	3703.8	3704.7	0.0073	8.17	265.04	149.53	0.93	0.026	1.77
1	5500	2-YEAR	474.2	3692.0	3693.4	3693.4	3693.9	0.0096	5.47	86.7	80	0.93	0.028	1.08
1	5500	100-YEAR	1929.8	3692.0	3694.9	3694.9	3696.0	0.0081	8.47	233.81	113.81	0.97	0.026	2.05

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HEC-RAS Results: Hidden Water Creek Premine

Reach	River Sta	Profile	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	Crit W.S. (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Top Width (ft)	Froude # Chl	Mann Wtd Total	Hydr Radius (ft)
1	5000	2-YEAR	474.2	3686.3	3688.1	3688.1	3688.5	0.0122	5.57	85.12	92.72	1.02	0.028	0.92
1	5000	100-YEAR	1929.8	3686.3	3689.5	3689.5	3690.6	0.0076	8.33	246.47	125.36	0.95	0.026	1.96
1	4500	2-YEAR	474.2	3679.7	3681.2	3681.0	3681.5	0.0078	4.71	100.75	100.35	0.83	0.028	1
1	4500	100-YEAR	1929.8	3679.7	3682.4	3682.4	3683.3	0.0092	7.81	248.45	139.1	1	0.027	1.78
1	4000	2-YEAR	474.2	3674.3	3676.5	3676.5	3677.1	0.0099	6.27	77.53	69.84	0.97	0.026	1.11
1	4000	100-YEAR	1929.8	3674.3	3678.3	3678.3	3679.4	0.0065	9.11	248.11	119.17	0.91	0.025	2.08
1	3500	2-YEAR	474.2	3669.4	3671.2	3671.1	3671.6	0.0080	5.02	94.41	87.19	0.85	0.028	1.08
1	3500	100-YEAR	1929.8	3669.4	3672.6	3672.6	3673.6	0.0074	8.3	249.92	132.67	0.93	0.025	1.88
1	3000	2-YEAR	474.2	3665.3	3666.5	3666.5	3666.9	0.0109	5.12	97.24	130.05	0.96	0.026	0.75
1	3000	100-YEAR	1929.8	3665.3	3667.8	3667.8	3668.5	0.0077	7.62	293.24	195.98	0.93	0.026	1.5
1	2500	2-YEAR	474.2	3653.6	3661.8		3661.8	0.0000	0.67	941.29	202.44	0.04	0.028	4.63
1	2500	100-YEAR	1929.8	3653.6	3664.2		3664.2	0.0001	1.82	1622.95	322.74	0.1	0.028	5.01
1	2000	2-YEAR	474.2	3656.0	3661.8		3661.8	0.0000	0.66	896.44	277.47	0.05	0.027	3.23
1	2000	100-YEAR	1929.8	3656.0	3664.1		3664.2	0.0001	1.53	1580.52	317.87	0.1	0.028	4.96
1	1500	2-YEAR	474.2	3658.0	3661.0	3661.0	3661.7	0.0105	6.91	68.67	47.6	1.01	0.028	1.43
1	1500	100-YEAR	1929.8	3658.0	3663.1	3663.1	3664.0	0.0056	8.2	283.24	153.66	0.83	0.024	1.83
1	1000	2-YEAR	474.2	3636.6	3639.5	3639.5	3640.3	0.0104	6.96	68.1	46.36	1.01	0.028	1.46
1	1000	100-YEAR	1929.8	3636.6	3641.7	3641.7	3643.2	0.0083	9.76	197.73	68.31	1.01	0.028	2.86
1	500	2-YEAR	474.2	3624.0	3626.5	3626.5	3627.3	0.0102	6.99	67.84	45.19	1.01	0.028	1.49
1	500	100-YEAR	1929.8	3624.0	3628.7	3628.7	3630.2	0.0084	9.64	200.25	70.85	1.01	0.028	2.79
1	250	2-YEAR	474.2	3608.9	3610.3	3610.3	3610.7	0.0118	5.22	91.92	115.27	0.99	0.027	0.8
1	250	100-YEAR	1929.8	3608.9	3613.0	3611.6	3613.3	0.0012	4.25	523.81	202.09	0.4	0.026	2.59

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HEC-RAS Results: Slater Creek Premine

Reach	River Sta	Profile												
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)			(ft)
1	13500	2-YEAR	1022.4	3806.0	3807.7		3808.2	0.0068	5.47	186.79	132.98	0.81	0.028	1.4
1	13500	100-YEAR	3970.4	3806.0	3809.4	3809.4	3810.1	0.0058	7.34	672.87	488.16	0.82	0.024	1.38
1	13000	2-YEAR	1022.4	3800.5	3802.7	3802.7	3803.3	0.0114	5.91	173.03	167.2	1.01	0.027	1.03
1	13000	100-YEAR	3970.4	3800.5	3804.5	3804.5	3805.2	0.0051	7.27	675.97	489.6	0.79	0.022	1.38
1	12500	2-YEAR	1022.4	3796.0	3797.2	3797.1	3797.4	0.0070	4.09	254.7	318.44	0.77	0.027	0.8
1	12500	100-YEAR	3970.4	3796.0	3798.1	3798.1	3798.9	0.0085	7.07	601.61	422.72	0.94	0.026	1.42
1	12000	2-YEAR	1022.4	3789.5	3791.3	3791.3	3791.8	0.0091	5.89	198.02	215.44	0.93	0.026	0.92
1	12000	100-YEAR	3970.4	3789.5	3792.7	3792.7	3793.5	0.0074	8.24	619.06	418.6	0.93	0.026	1.48
1	11500	2-YEAR	1022.4	3784.7	3786.4	3786.4	3786.6	0.0077	4.7	301.4	575.28	0.82	0.025	0.52
1	11500	100-YEAR	3970.4	3784.7	3787.1	3787.1	3787.6	0.0092	7.04	727.7	650.07	0.97	0.028	1.12
1	11000	2-YEAR	1022.4	3778.0	3779.7		3780.0	0.0044	4.13	247.53	194	0.64	0.028	1.28
1	11000	100-YEAR	3970.4	3778.0	3781.2	3780.9	3781.9	0.0044	6.73	653.9	377.22	0.73	0.023	1.73
1	10500	2-YEAR	1022.4	3771.5	3774.7	3774.6	3775.1	0.0066	5.41	220.77	233.2	0.8	0.025	0.95
1	10500	100-YEAR	3970.4	3771.5	3775.9	3775.9	3776.6	0.0090	7.49	605.64	404.77	0.98	0.028	1.49
1	10000	2-YEAR	1022.4	3764.6	3766.9	3766.9	3767.4	0.0121	5.57	183.72	197.44	1.02	0.028	0.93
1	10000	100-YEAR	3970.4	3764.6	3768.2	3768.2	3769.0	0.0093	7.01	573.78	400.25	0.98	0.026	1.43
1	9500	2-YEAR	1022.4	3757.3	3759.3		3759.5	0.0050	4.24	241.12	200.01	0.68	0.028	1.21
1	9500	100-YEAR	3970.4	3757.3	3760.9		3761.5	0.0041	6.29	652.97	318.32	0.7	0.025	2.05
1	9000	2-YEAR	1022.4	3752.0	3754.4	3754.4	3755.1	0.0105	6.78	150.8	108.25	1.01	0.028	1.39
1	9000	100-YEAR	3970.4	3752.0	3756.4	3756.4	3757.8	0.0083	9.5	418.09	151.95	1.01	0.028	2.74
1	8500	2-YEAR	1022.4	3746.0	3748.1		3748.2	0.0019	3.18	322.08	198.54	0.44	0.028	1.62
1	8500	100-YEAR	3970.4	3746.0	3749.8		3750.2	0.0024	5.55	759.08	314.27	0.55	0.025	2.41
1	8000	2-YEAR	1022.4	3744.0	3745.6	3745.5	3746.0	0.0081	4.9	214.06	241.13	0.85	0.026	0.89
1	8000	100-YEAR	3970.4	3744.0	3746.8	3746.8	3747.6	0.0077	7.8	564.07	330.58	0.93	0.026	1.71

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HEC-RAS Results: Slater Creek Premine

Reach	River Sta	Profile												
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)			(ft)
1	7500	2-YEAR	1022.4	3738.5	3740.9	3740.9	3741.5	0.0073	6.37	183.54	169.71	0.87	0.024	1.08
1	7500	100-YEAR	3970.4	3738.5	3742.6	3742.6	3743.5	0.0059	9.01	571.25	283.33	0.87	0.026	2.01
1	7227.464	2-YEAR	1022.4	3737.0	3738.7	3738.6	3739.0	0.0076	5.19	226.22	261.23	0.84	0.026	0.87
1	7227.464	100-YEAR	3970.4	3737.0	3739.9	3739.8	3740.7	0.0075	8.16	594.47	364.6	0.94	0.027	1.63
1	7000	2-YEAR	1022.4	3733.3	3735.7	3735.4	3735.9	0.0059	4.22	242.26	230.75	0.73	0.028	1.05
1	7000	100-YEAR	3970.4	3733.3	3736.9	3736.7	3737.6	0.0063	6.92	586.13	313.26	0.84	0.027	1.87
1	6500	2-YEAR	1022.4	3728.4	3730.6	3730.6	3731.1	0.0085	5.88	198.17	209.98	0.9	0.026	0.94
1	6500	100-YEAR	3970.4	3728.4	3732.0	3732.0	3732.9	0.0079	8.52	549.23	299.11	0.96	0.027	1.84
1	6000	2-YEAR	1022.4	3720.1	3721.8	3721.8	3722.3	0.0123	5.31	192.71	230.49	1.01	0.028	0.84
1	6000	100-YEAR	3970.4	3720.1	3723.1	3723.1	3724.0	0.0083	7.75	542.32	323.13	0.96	0.026	1.68
1	5500	2-YEAR	1022.4	3713.1	3714.9	3714.5	3715.1	0.0038	3.58	285.91	248.06	0.59	0.028	1.15
1	5500	100-YEAR	3970.4	3713.1	3716.6	3715.8	3717.0	0.0026	4.99	801.14	343.74	0.56	0.027	2.33
1	5000	2-YEAR	1022.4	3709.2	3711.1		3711.5	0.0064	5.05	202.43	155.06	0.78	0.028	1.3
1	5000	100-YEAR	3970.4	3709.2	3712.5	3712.5	3713.7	0.0080	8.82	457.89	197.99	0.98	0.027	2.31
1	4877.632	2-YEAR	1022.4	3708.4	3710.3		3710.7	0.0063	5.34	225.8	215.84	0.79	0.027	1.05
1	4877.632	100-YEAR	3970.4	3708.4	3711.5	3711.5	3712.6	0.0081	9.15	505.49	244.25	0.99	0.028	2.07
1	4196.757	2-YEAR	1022.4	3698.4	3700.7		3701.1	0.0060	5.29	200.91	165.6	0.77	0.026	1.21
1	4196.757	100-YEAR	3970.4	3698.4	3702.7		3703.4	0.0034	7.12	648.72	259.91	0.67	0.026	2.49
1	4000	2-YEAR	1022.4	3696.4	3699.2	3698.9	3699.7	0.0056	5.36	190.84	121.5	0.75	0.028	1.57
1	4000	100-YEAR	3970.4	3696.4	3701.0	3700.9	3702.2	0.0063	8.93	456.65	170.26	0.89	0.026	2.68
1	3500	2-YEAR	1022.4	3689.7	3691.9	3691.9	3692.7	0.0101	6.95	147.12	99.09	1.01	0.028	1.48
1	3500	100-YEAR	3970.4	3689.7	3694.1	3694.1	3695.5	0.0084	9.43	420.94	157.61	1.01	0.028	2.66
1	3000	2-YEAR	1022.4	3682.9	3685.3	3684.9	3685.7	0.0041	4.83	211.87	124.95	0.65	0.028	1.69
1	3000	100-YEAR	3970.4	3682.9	3687.7		3688.5	0.0037	7.36	539.34	154.55	0.69	0.028	3.47

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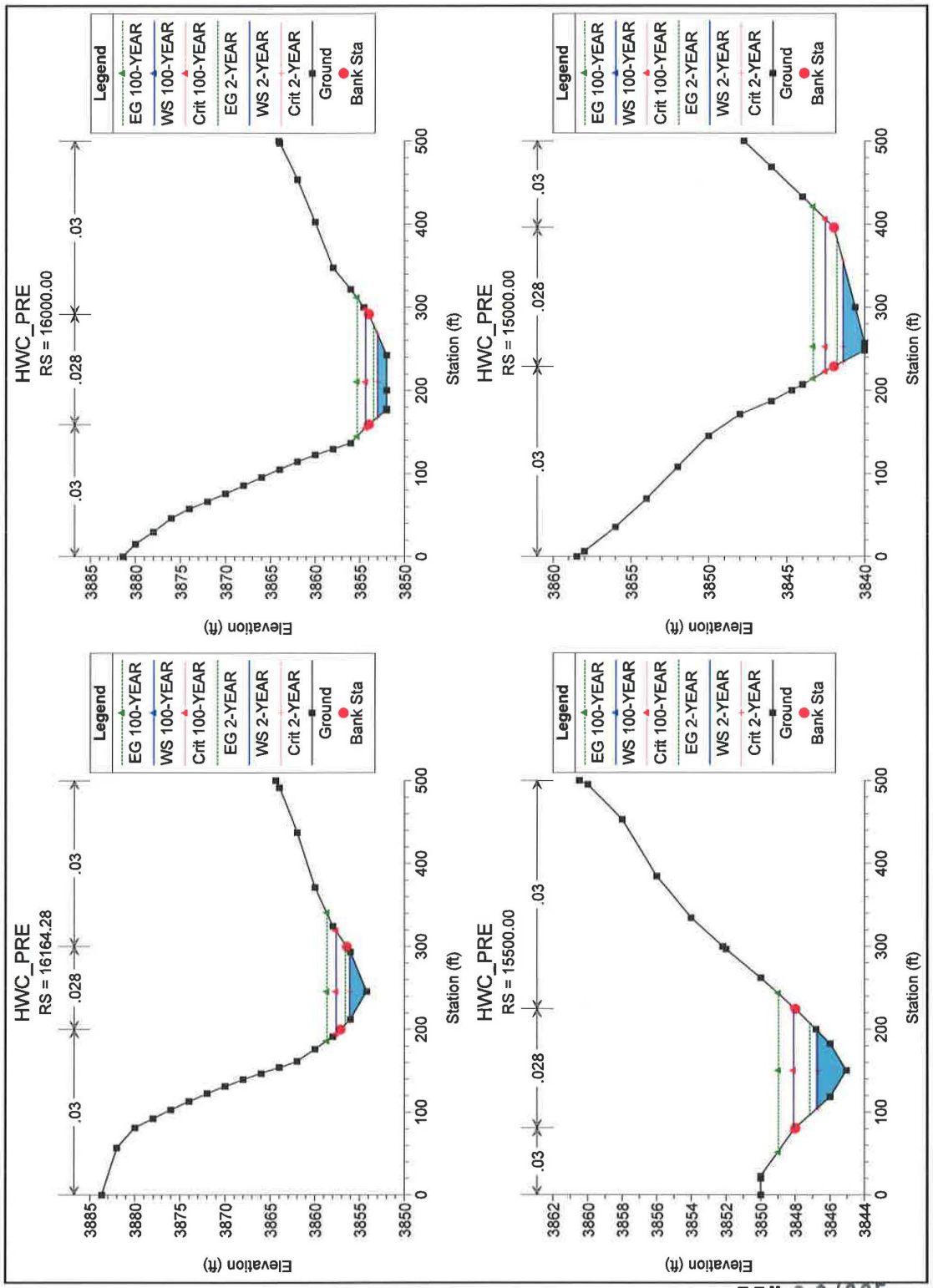
HEC-RAS Results: Slater Creek Premine

Reach	River Sta	Profile											
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)			(ft)
1	2500	2-YEAR	1022.4	3677.2	3681.1	3681.1	3682.0	0.0097	7.56	135.32	77.04	1	0.028	1.74
1	2500	100-YEAR	3970.4	3677.2	3683.6	3683.6	3685.2	0.0079	10.28	386.4	119.86	1.01	0.028	3.2
1	2000	2-YEAR	1022.4	3672.0	3675.1	3675.1	3676.0	0.0095	7.81	130.9	70.37	1.01	0.028	1.85
1	2000	100-YEAR	3970.4	3672.0	3677.8	3677.8	3679.5	0.0073	10.62	380.01	113.5	0.98	0.027	3.33
1	1275.216	2-YEAR	1022.4	3660.0	3663.2	3663.2	3664.2	0.0093	8.06	126.89	63.94	1.01	0.028	1.97
1	1275.216	100-YEAR	3970.4	3660.0	3666.1	3666.1	3667.9	0.0060	10.97	385.57	117.5	0.92	0.025	3.26
1	1000	2-YEAR	1022.4	3656.0	3657.7	3657.7	3658.2	0.0109	6.1	168.28	154.5	1	0.027	1.09
1	1000	100-YEAR	3970.4	3656.0	3659.3	3659.3	3660.5	0.0075	9.02	470.04	204.58	0.96	0.026	2.29
1	500	2-YEAR	1022.4	3650.7	3653.0	3652.5	3653.3	0.0031	4.16	252.9	167.94	0.57	0.027	1.5
1	500	100-YEAR	3970.4	3650.7	3655.5	3654.2	3656.0	0.0018	5.86	742.78	222.17	0.51	0.026	3.34

TFN 6 2/025
RECD NOV 14, 2014

HEC-RAS SECTIONS

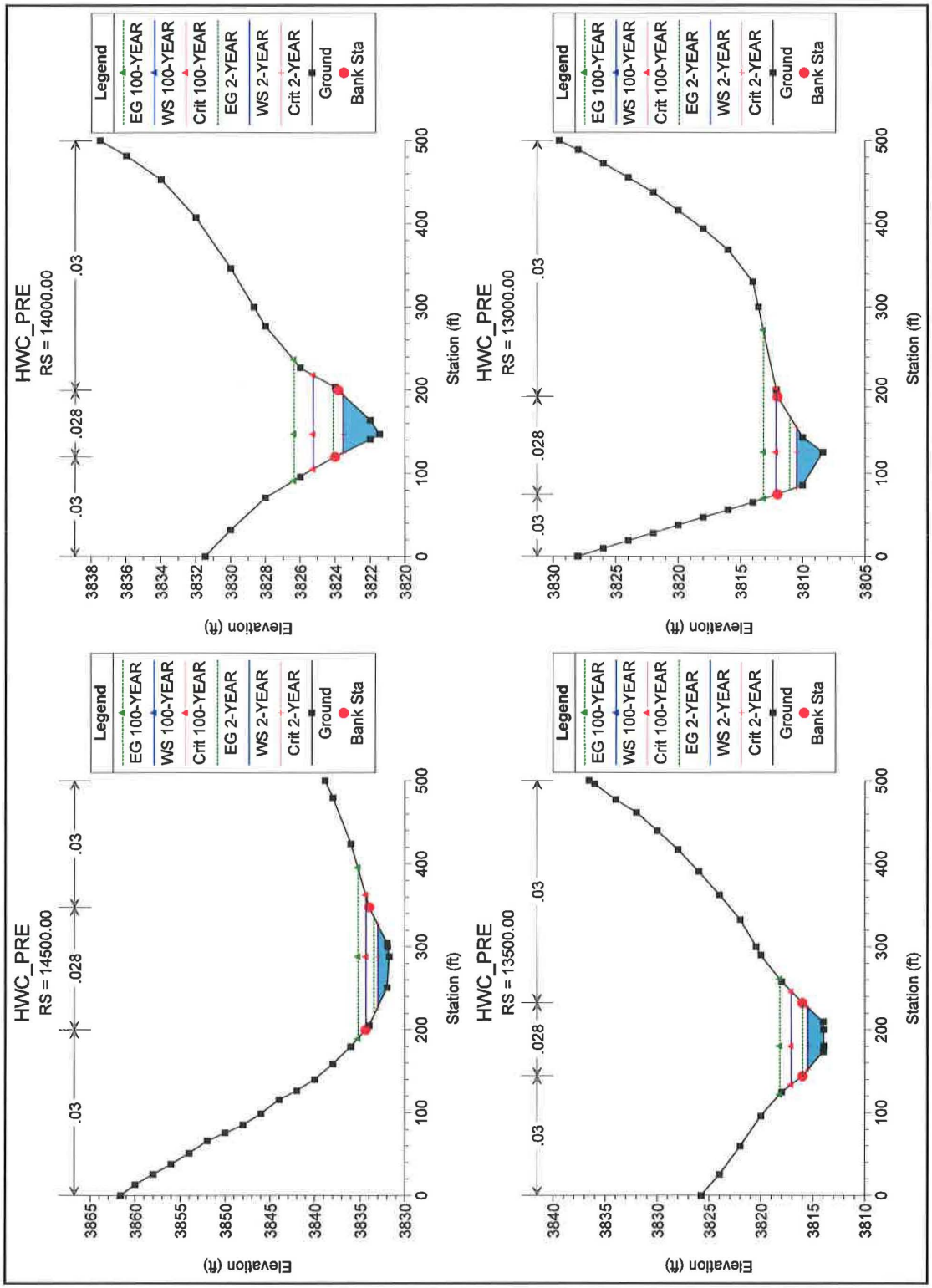
TFN 6 2/025
RECD NOV 14, 2014



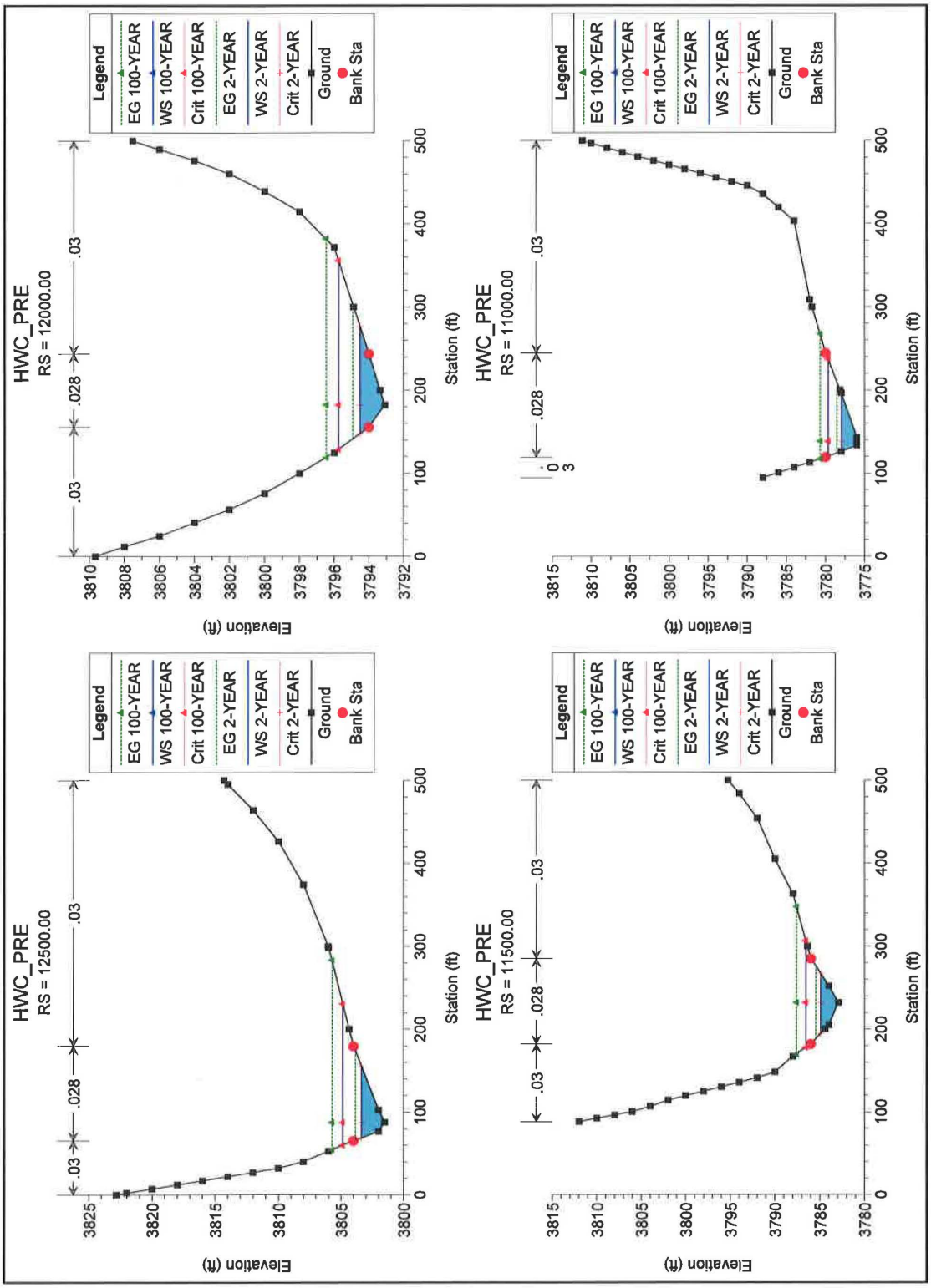
TFN 6 2/025
RECD NOV 14, 2014

DEQ 6-146

DEQ 6-147



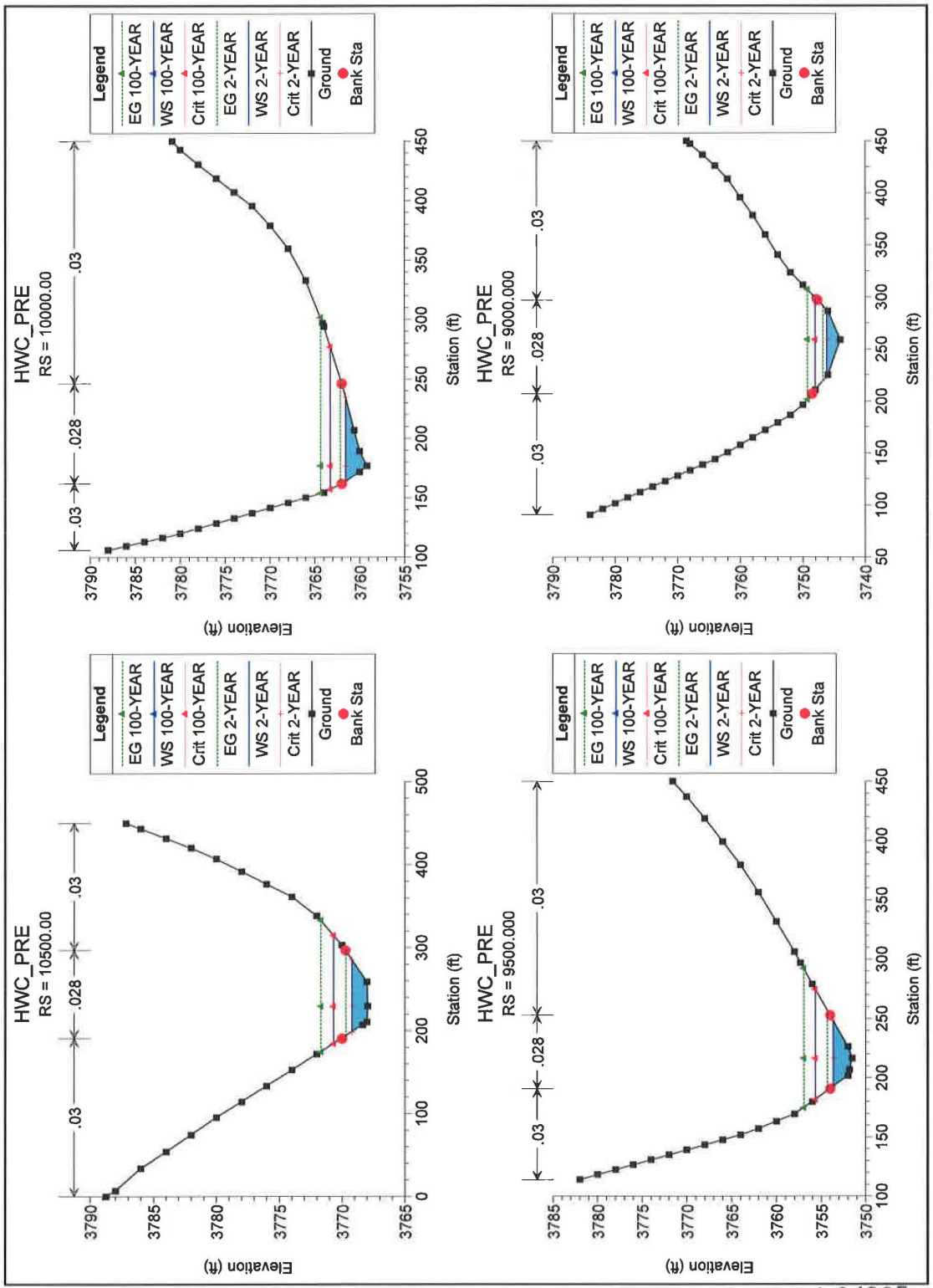
TFN 6 2/025
RECD NOV 14, 2014



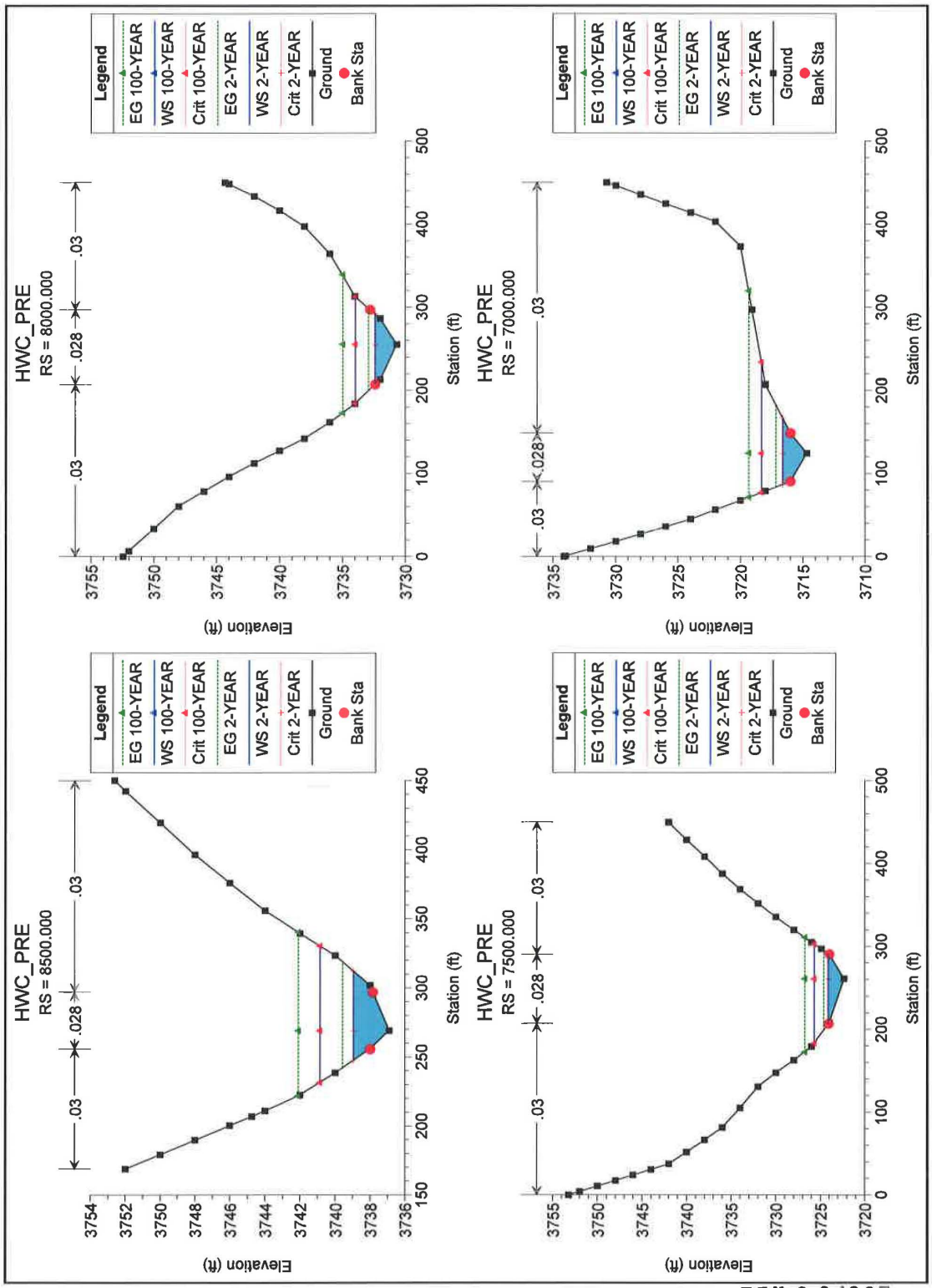
DEQ 6-148

TFN 6 2/025
RECD NOV 14, 2014

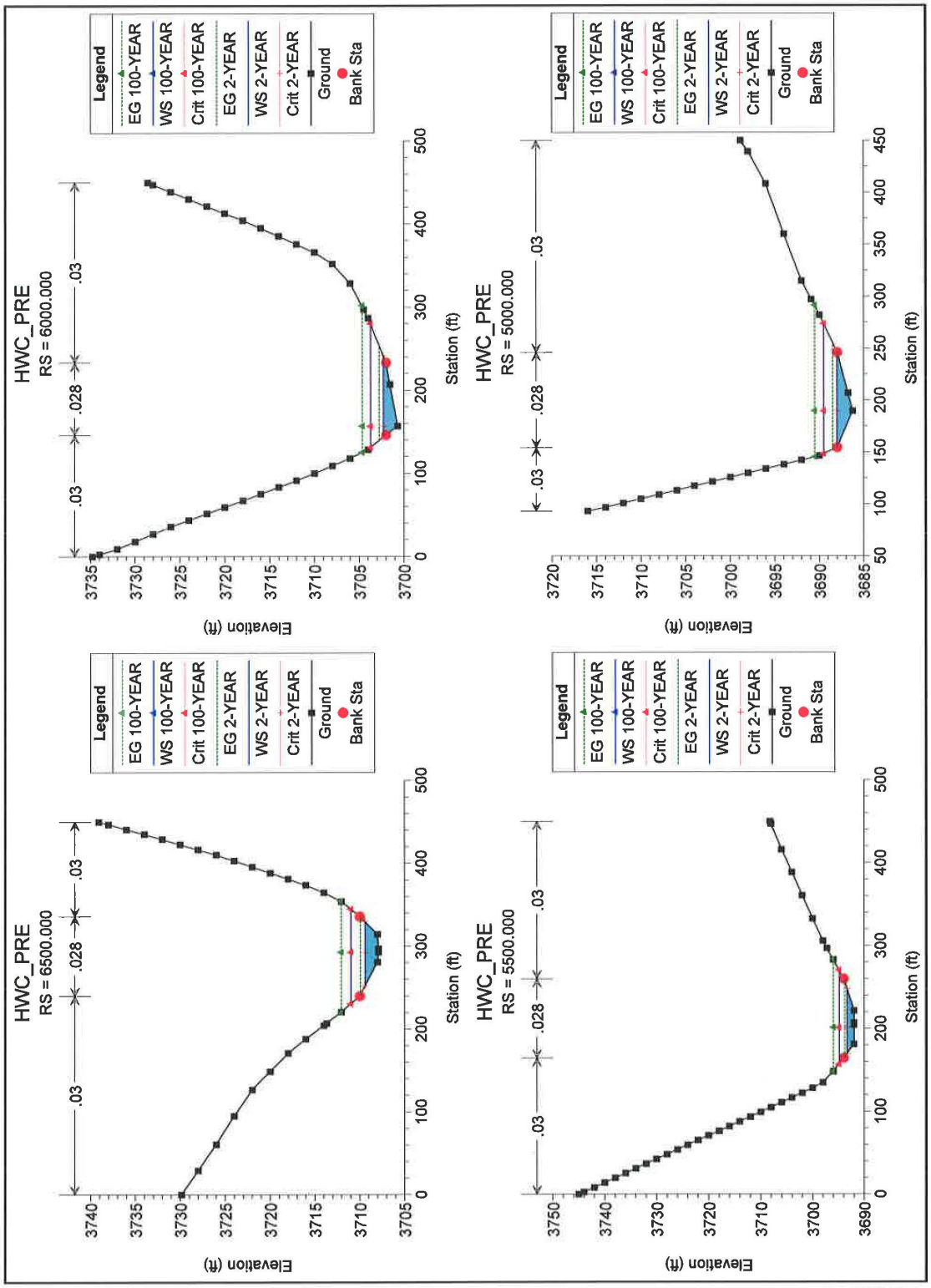
DEQ 6-149



TFN 6 2/025
RECD NOV 14, 2014



DEQ 6-150
TFN 6 2/025
RECD NOV 14, 2014



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TFN 6 2/025
RECD NOV 14, 2014

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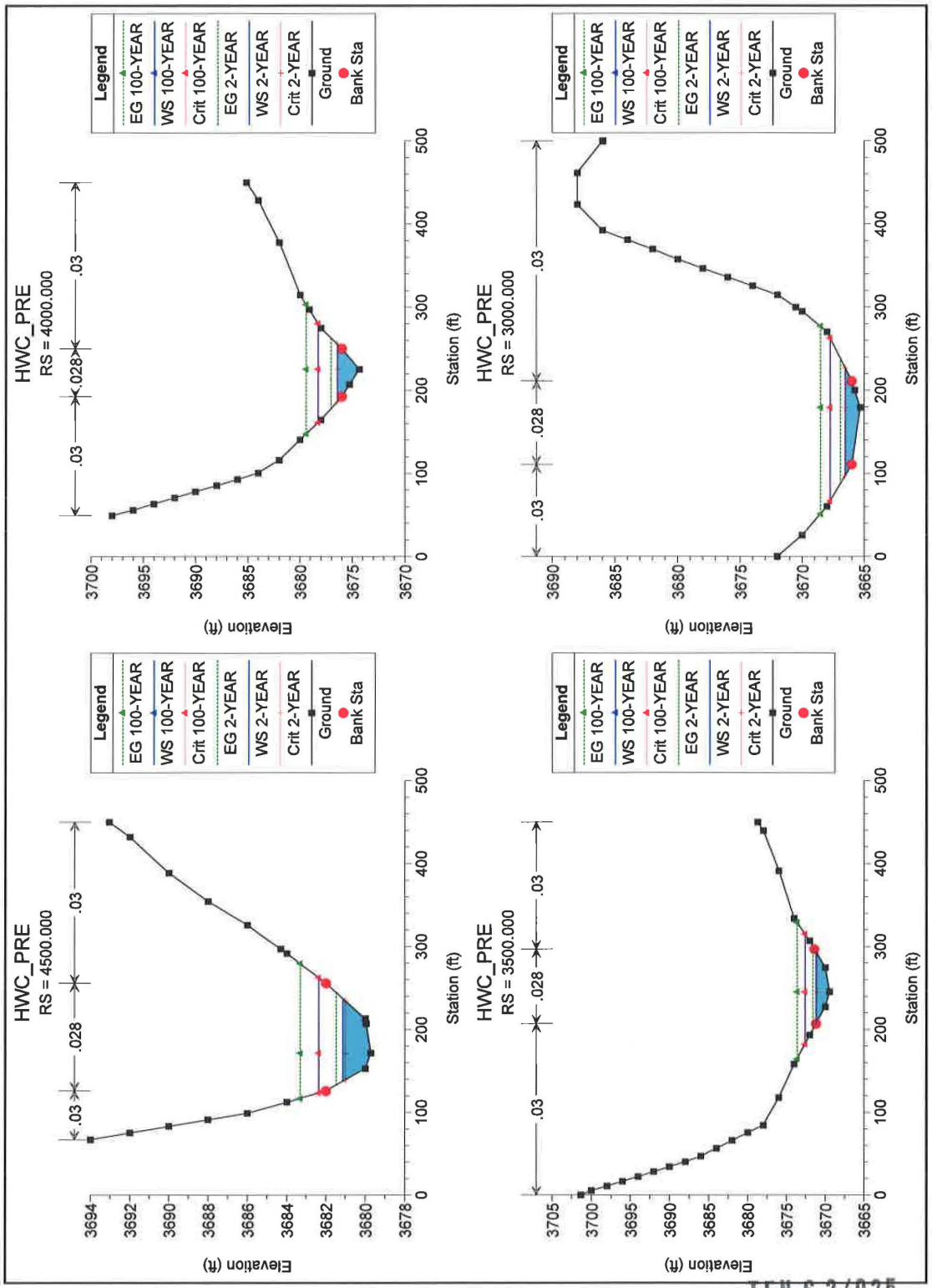

TFN 6 2/025
RECD NOV 14, 2014

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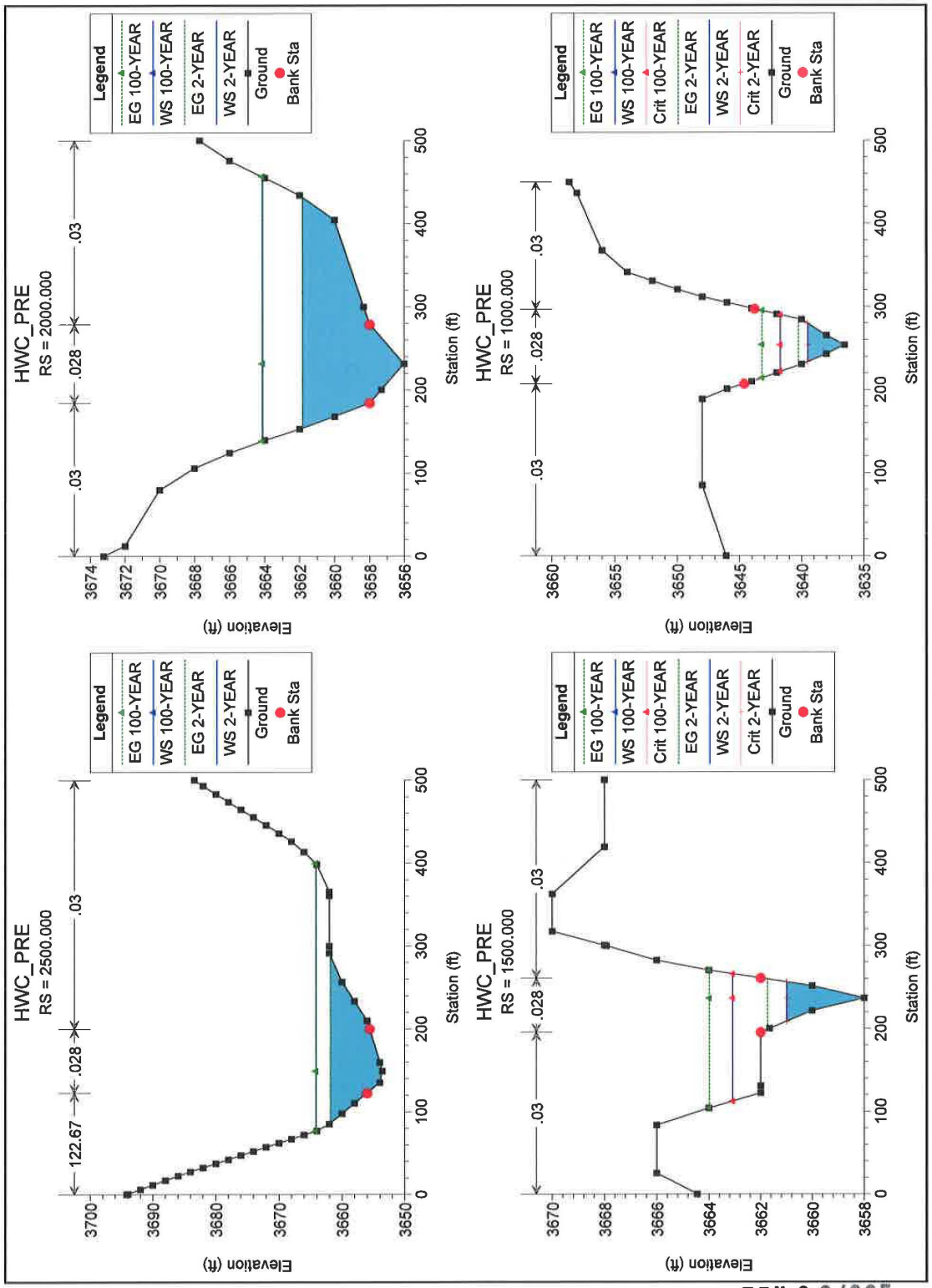

TFN 6 2/025
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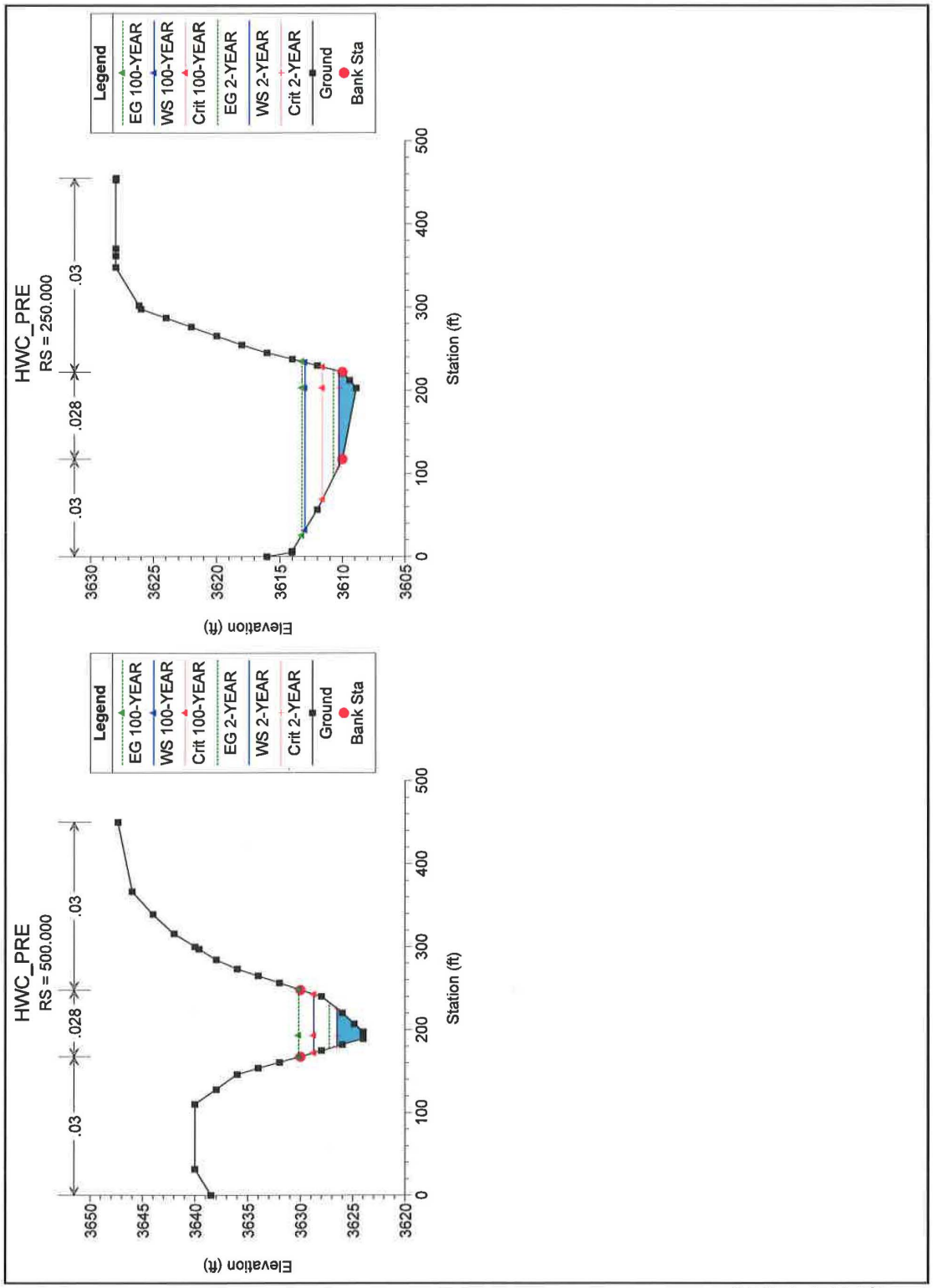
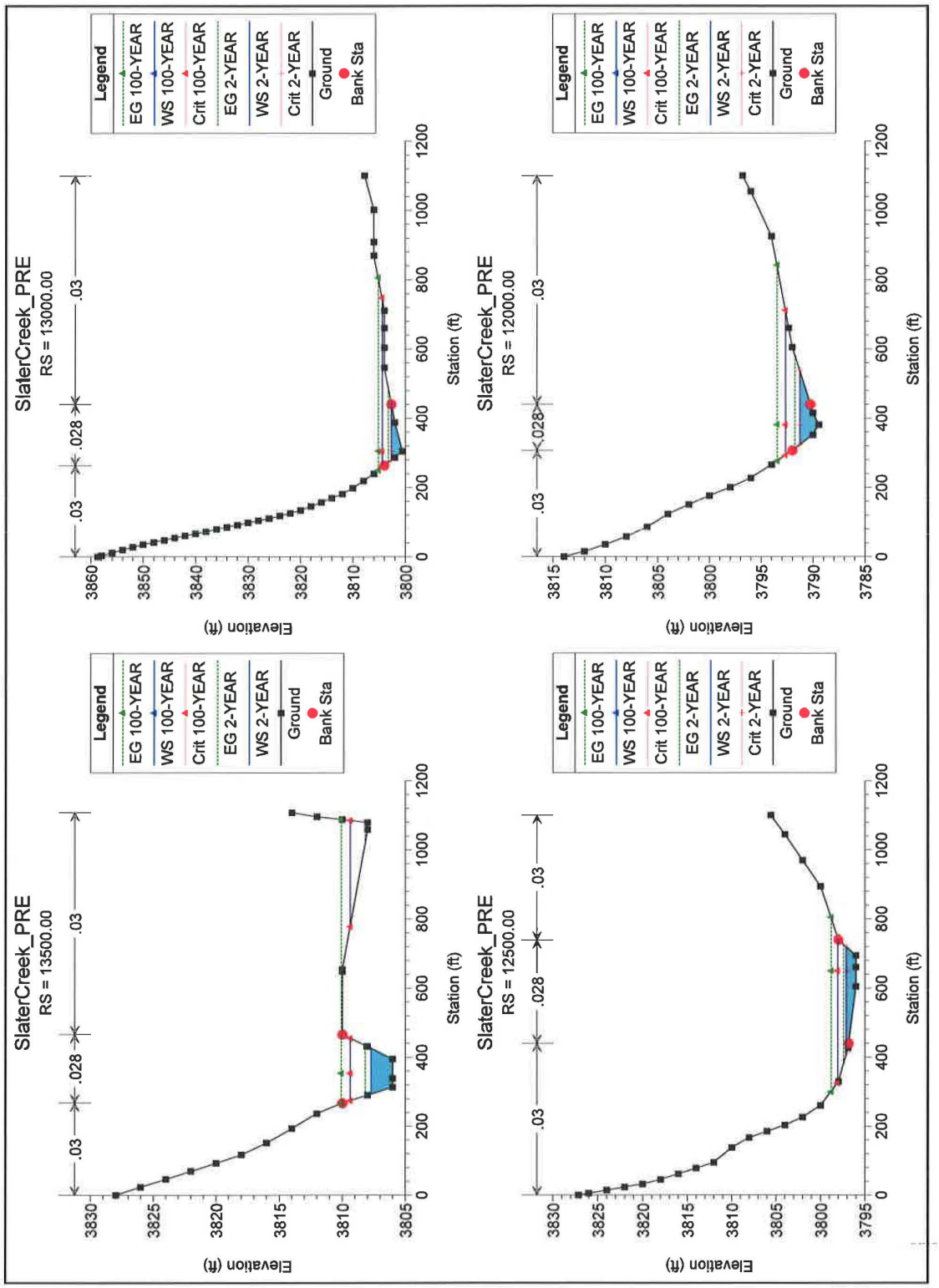


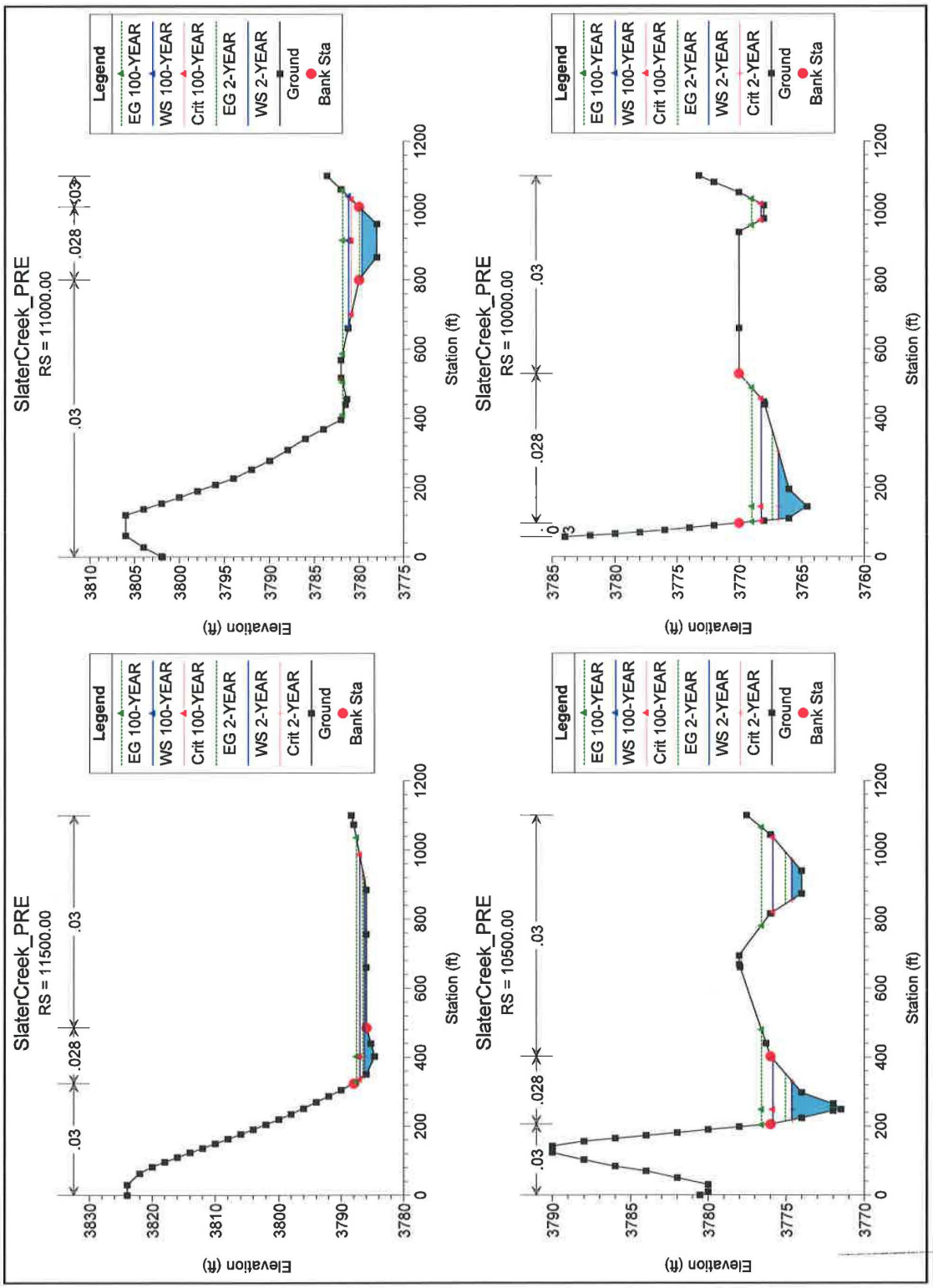
TFN 6 2/025
RECD NOV 14, 2014

DEQ 6-154

DEQ 6-155

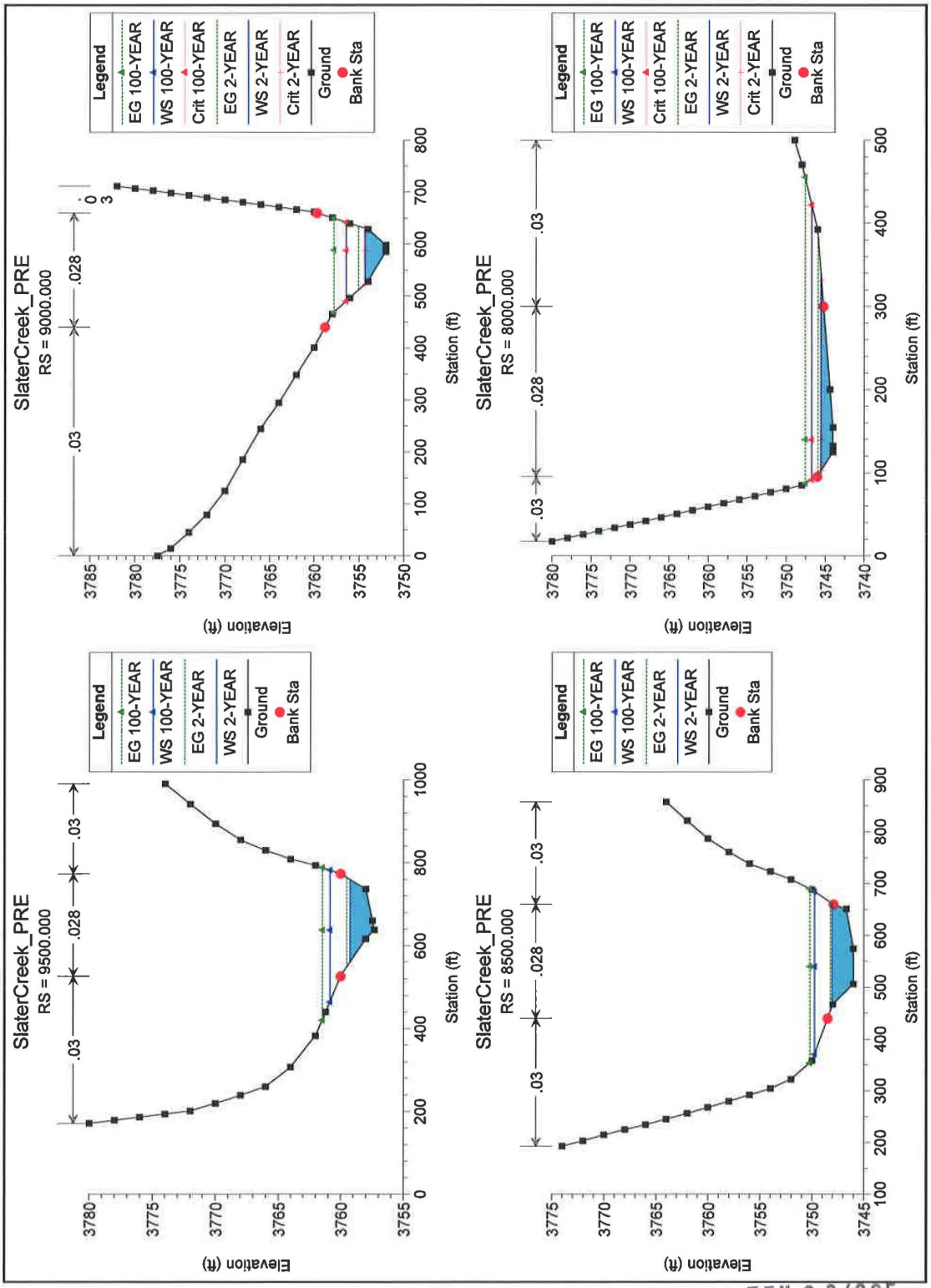


TFN 6 2/025
RECD NOV 14,2014

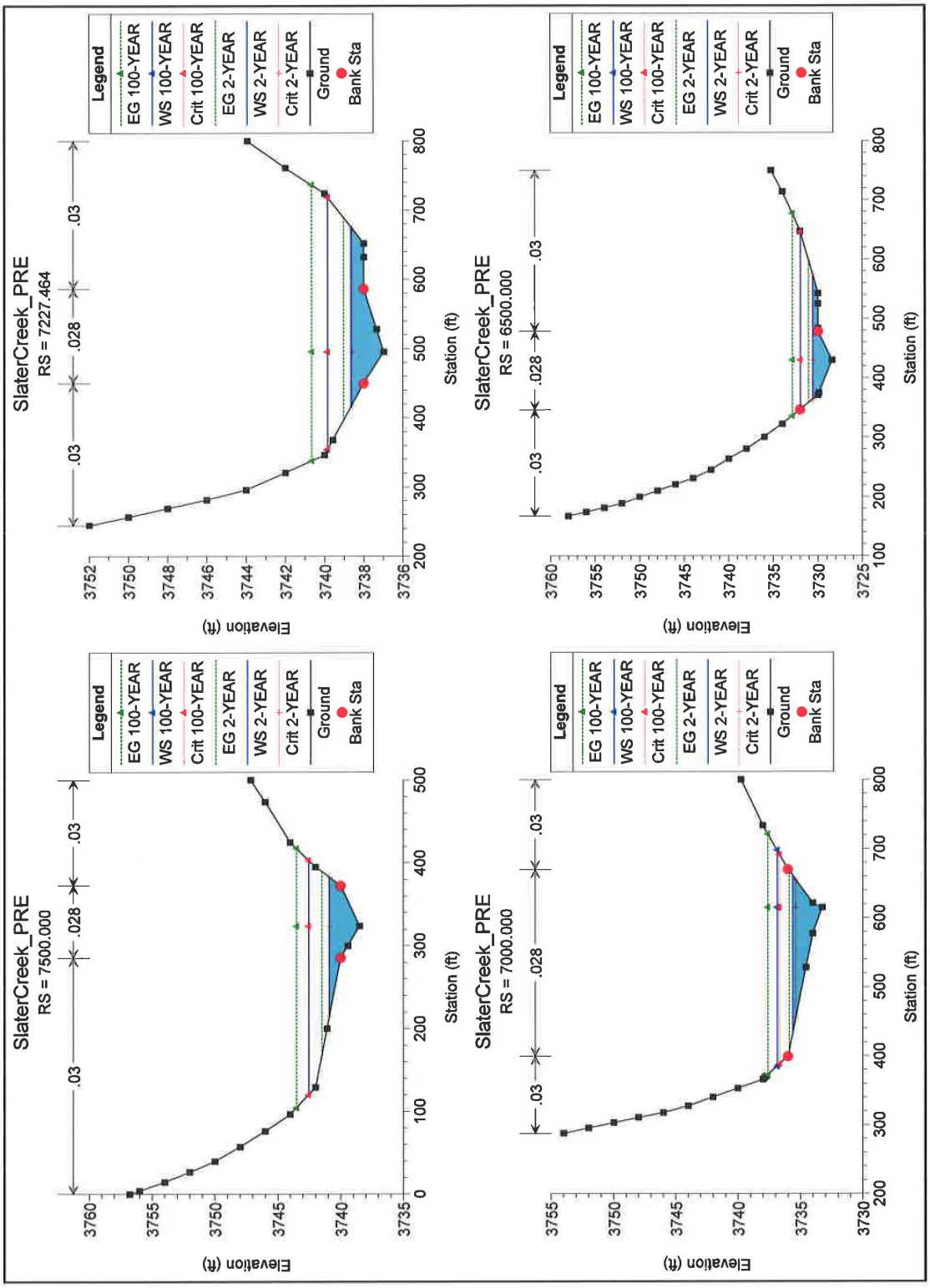


TFN 6 2/025
RECD NOV 14, 2014

DEQ 6-156



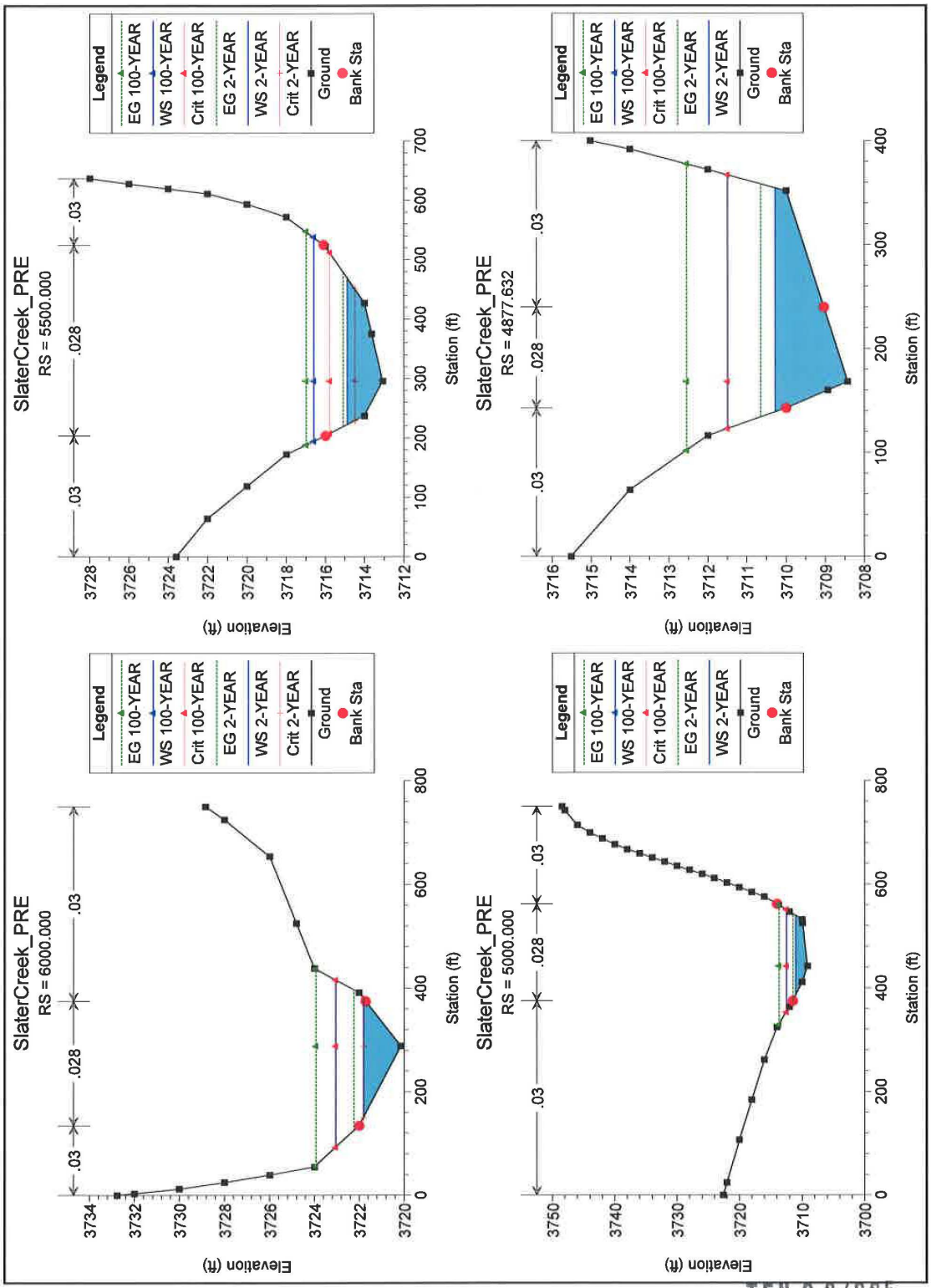
DEQ 6-157
TFN 6 2/025
RECD NOV 14, 2014



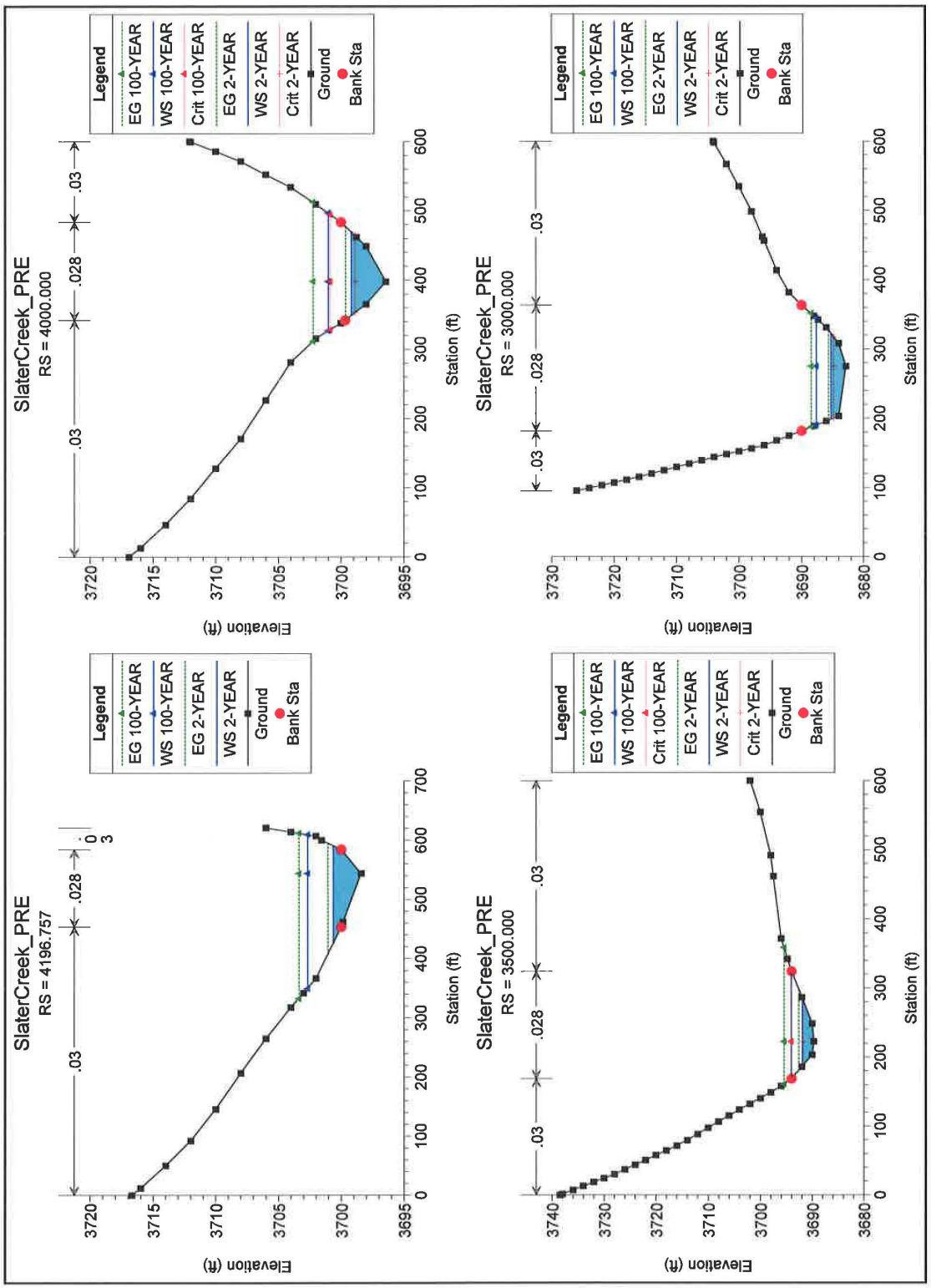
TFN 6 2/025
RECD NOV 14, 2014

DEQ 6-158

DEQ 6-159

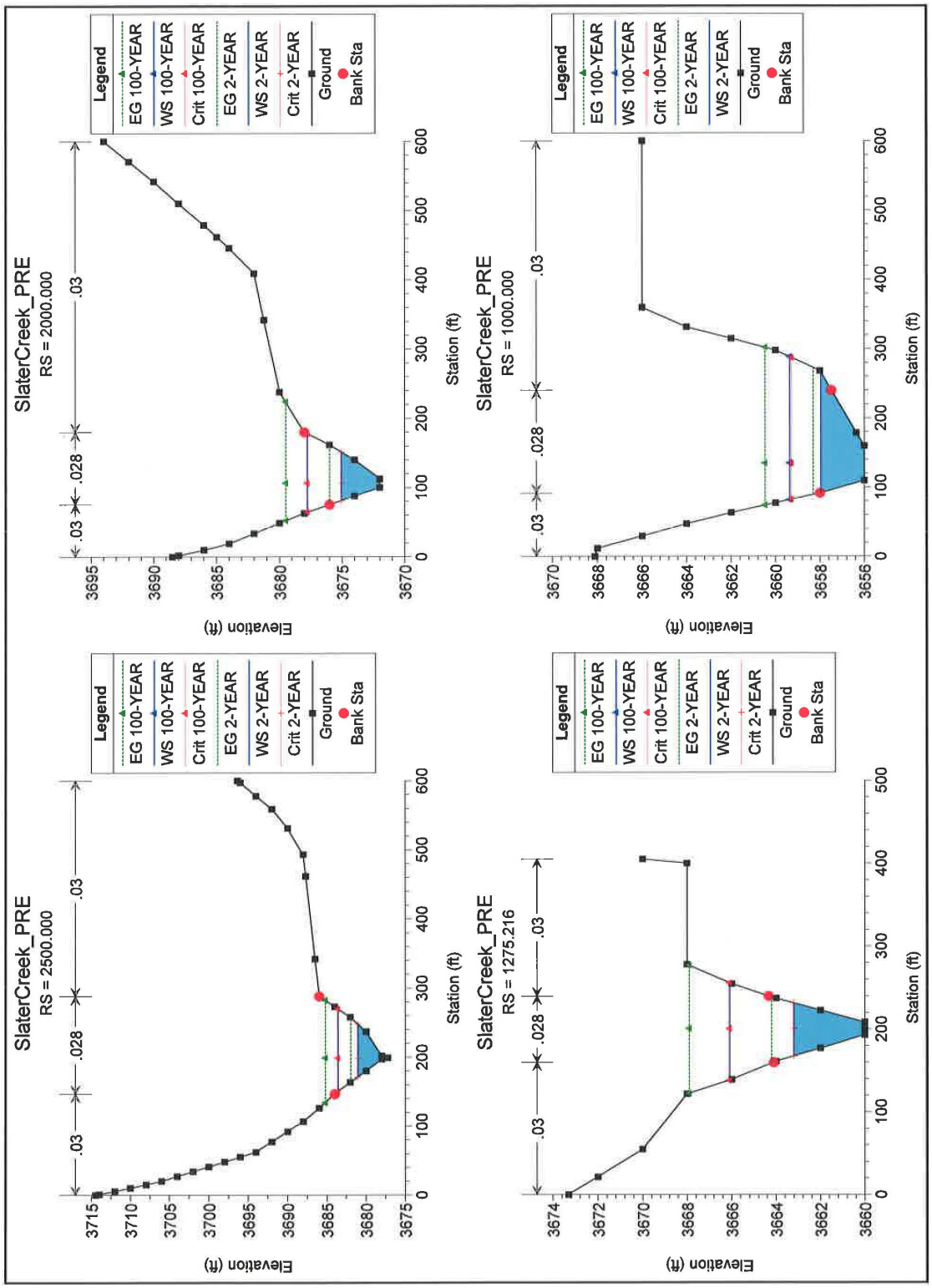


TFN 6 2/025
RECD NOV 14, 2014



DEQ 6-160

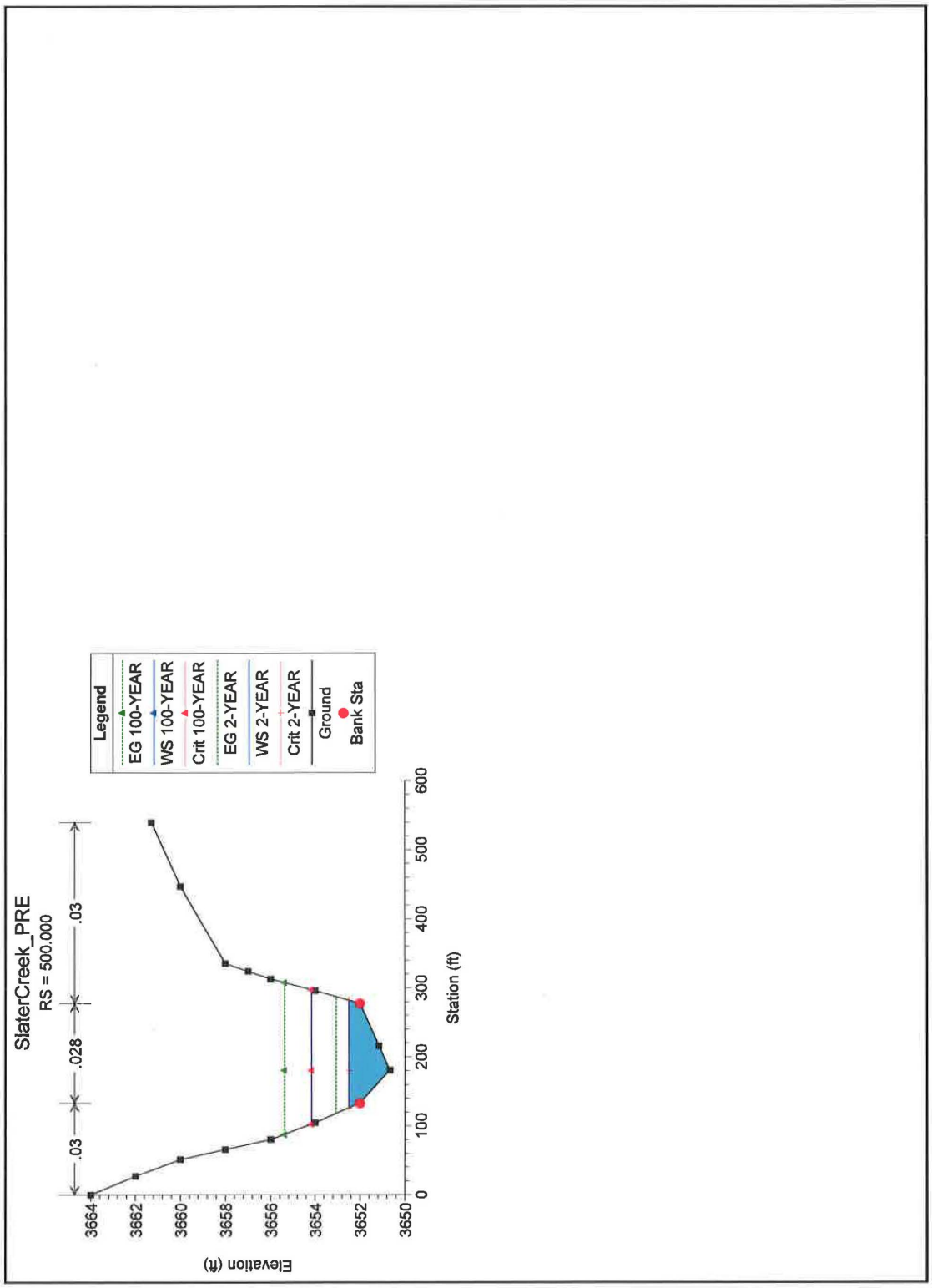
TFN 6 2/025
RECD NOV 14, 2014



DEQ 6-161

TFN 6 2/025
RECD NOV 14, 2014

DEQ 6-162



TFN 6 2/025
RECD NOV 14, 2014

R.85 W. R.84 W.

T. 57 N.

HIDDEN WATER CREEK

SLATER CREEK

E. 1376000 E. 1380000 E. 1384000 E. 1388000 E. 1392000 E. 1396000 E. 1400000 E. 1404000

N. 1944000 N. 1940000 N. 1936000 N. 1932000 N. 1928000

LEGEND

- BROOK MINE PERMIT BOUNDARY
- 20+00 HEC-RAS CROSS SECTION
- STREAM

CERTIFICATE OF ENGINEER

I, Jeffrey G. Barron, hereby certify that this drawing was prepared by myself or by engineers under my direct supervision and that it correctly represents the conditions described in the accompanying application which is designed to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

Professional Engineer (Civil) JEFFREY G. BARRON 13033 DATE 10/17/2014 WYOMING

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)
C.I. = 5'

RAMACO

BROOK MINE
SHERIDAN COUNTY, WY

1101 SUGARVIEW DR, STE. 201
SHERIDAN, WY 82801

REVISIONS	
Date	Description

ADDENDUM D6-3
EXHIBIT 1

TFN 6 2/1025
RECD Nov 14, 2014

PREMINE HEC-RAS CROSS SECTION LOCATIONS

Drawn By: DCJ
Checked By: JGB
Date: 7-15-14

WWC ENGINEERING
www.wwcengineering.com

FILE: D6-3_1_HEC_XSEC_LOC.dwg

K:\Sheridan\RAMACO\5137\9\CAD_WY\EIEC\DWGS_D6\ADDENDUM\D6-3_1_HEC_XSEC_LOC.dwg 10/14/2014 10:44:43 AM dave.johnson

ADDENDUM D6-4

Surface Water Hydrographs

TFN 6 2/025
RECD NOV 14, 2014

Table D6-1. Collected Surface Water Flow Data

Date	Max Daily Flowrate			
	Slater Creek		Hidden Water Creek	
	SM578512-SW-1	**SM578418-SW-1**	**SM578415-SW-1**	**SM578409-SW-1**
9/17/13		0.00		
9/18/13		0.00		
9/19/13		0.00		
9/20/13		0.00		
9/21/13		0.00		
9/22/13		0.00		
9/23/13		0.00		
9/24/13		0.00		
9/25/13		0.00		
9/26/13		0.00		
9/27/13		0.00		
9/28/13		0.00		
9/29/13		0.00		
9/30/13	0.00	0.00	0.00	0.00
10/1/13	0.00	0.00	0.00	0.00
10/2/13	0.00	0.00	0.00	0.00
10/3/13	0.00	0.00	0.00	0.00
10/4/13	0.00	0.00	0.00	0.00
10/5/13	0.00	0.00	0.00	0.00
10/6/13	0.00	0.00	0.00	0.00
10/7/13	0.00	0.00	0.00	0.00
10/8/13	0.00	0.00	0.00	0.00
10/9/13	0.00	0.00	0.00	0.00
10/10/13	0.00	0.00	0.00	0.00
10/11/13	0.00	0.00	0.00	0.00
10/12/13	0.00	0.00	0.00	0.00
10/13/13	0.00	0.00	0.00	0.00
10/14/13	0.00	0.00	0.00	0.00
10/15/13	0.00	0.00	0.00	0.00
10/16/13	0.00	0.00	0.00	0.00
10/17/13	0.00	0.00	0.00	0.00
10/18/13	0.00	0.00	0.00	0.00
10/19/13	0.00	0.00	0.00	0.00
10/20/13	0.00	0.00	0.00	0.00
10/21/13	0.00	0.00	0.00	0.00
10/22/13	0.00	0.00	0.00	0.00
10/23/13	0.00	0.00	0.00	0.00
10/24/13	0.00	0.00	0.00	0.00
10/25/13	0.00	0.00	0.00	0.00
10/26/13	0.00	0.00	0.00	0.00
10/27/13	0.00	0.00	0.00	0.00
10/28/13	0.00	0.00	0.00	0.00

TFN 6 2/025
RECD NOV 14, 2014

Table D6-1. Collected Surface Water Flow Data

Date	Max Daily Flowrate			
	Slater Creek		Hidden Water Creek	
	SM578512-SW-1	**SM578418-SW-1**	**SM578415-SW-1**	**SM578409-SW-1**
10/29/13	0.00	0.00	0.00	0.00
10/30/13	0.00	0.00	0.00	0.00
10/31/13	0.00	0.00	0.00	0.00
4/22/14		1.23		0.00
4/23/14		1.16		0.00
4/24/14	1.56	2.24	0.00	0.00
4/25/14	1.21	2.25	0.00	0.00
4/26/14	1.09	2.17	0.00	0.00
4/27/14	1.13	2.08	0.00	0.00
4/28/14	0.78	1.17	0.00	0.00
4/29/14	0.93	1.61	0.00	0.00
4/30/14	0.24	1.07	0.00	0.00
5/1/14	0.09	0.21	0.00	0.00
5/2/14	0.19	0.37	0.00	0.00
5/3/14	0.23	0.34	0.00	0.00
5/4/14	0.52	0.69	0.00	0.00
5/5/14	0.67	1.03	0.00	0.00
5/6/14	1.51	1.40	0.00	0.00
5/7/14	6.89	8.65	0.00	0.00
5/8/14	7.23	8.77	0.00	0.00
5/9/14	4.31	4.09	0.00	0.00
5/10/14	8.17	7.78	0.00	0.00
5/11/14	4.86	4.18	0.00	0.00
5/12/14	2.66	1.75	0.00	0.00
5/13/14	2.52	1.60	0.00	0.00
5/14/14	1.20	0.63	0.00	0.00
5/15/14	1.13	0.48	0.00	0.00
5/16/14	1.50	0.67	0.00	0.00
5/17/14	2.28	1.02	0.00	0.00
5/18/14	2.45	1.07	0.00	0.00
5/19/14	2.21	0.92	0.00	0.00
5/20/14	1.87	0.69	0.00	0.00
5/21/14	1.72	0.60	0.00	0.00
5/22/14	1.56	0.56	0.00	0.00
5/23/14	1.47	0.60	0.00	0.00
5/24/14	1.87	0.78	0.00	0.00
5/25/14	2.30	1.04	0.00	0.00
5/26/14	1.16	0.75	0.00	0.00
5/27/14	0.65	0.51	0.00	0.00
5/28/14	2.59	1.33	0.00	0.00
5/29/14	2.43	1.36	0.00	0.00
5/30/14	2.09	1.22	0.00	0.00
5/31/14	2.47	1.51	0.00	0.00

TFN 6 2/025
RECD NOV 14, 2014

Table D6-1. Collected Surface Water Flow Data

Date	Max Daily Flowrate			
	Slater Creek		Hidden Water Creek	
	SM578512-SW-1	**SM578418-SW-1**	**SM578415-SW-1**	**SM578409-SW-1**
6/1/14	2.38	1.56	0.00	0.00
6/2/14	2.11	1.34	0.00	0.00
6/3/14	2.43	1.52	0.00	0.00
6/4/14	2.07	1.50	0.00	0.00
6/5/14	2.82	1.85	0.00	0.00
6/6/14	1.56	1.83	0.00	0.00
6/7/14	1.92	1.48	0.00	0.00
6/8/14	2.13	1.65	0.00	0.00
6/9/14	1.53	1.35	0.00	0.00
6/10/14	1.34	1.20	0.00	0.00
6/11/14	1.61	1.16	0.00	0.00
6/12/14	2.04	1.11	0.00	0.00
6/13/14	1.72	1.11	0.00	0.00
6/14/14	2.12	0.94	0.00	0.00
6/15/14	1.84	1.29	0.00	0.00
6/16/14	1.59	0.94	0.00	0.00
6/17/14	2.46	0.93	0.00	0.00
6/18/14	1.99	1.29	0.00	0.00
6/19/14	1.90	1.02	0.00	0.00
6/20/14	1.04	0.99	0.00	0.00
6/21/14	2.47	0.84	0.00	0.00
6/22/14	1.89	1.40	0.00	0.00
6/23/14	2.12	0.90	0.00	0.00
6/24/14	1.86	0.78	0.00	0.00
6/25/14	1.27	0.56	0.00	0.00
6/26/14	1.23	0.20	0.00	0.00
6/27/14	2.66	0.07	0.00	0.00
6/28/14	2.75	0.36	0.00	0.00
6/29/14	2.31	0.39	0.00	0.00
6/30/14	1.12	0.06	0.00	0.00
7/1/14	0.55	0.00	0.00	0.00
7/2/14	0.39	0.00	0.00	0.00
7/3/14	0.41	0.00	0.00	0.00
7/4/14	0.26	0.00	0.00	0.00
7/5/14	0.13	0.00	0.00	0.00
7/6/14	0.09	0.00	0.00	0.00
7/7/14	0.11	0.00	0.00	0.00
7/8/14	0.01	0.00	0.00	0.00
7/9/14	0.08	0.00	0.00	0.00
7/10/14	0.04	0.00	0.00	0.00
7/11/14	0.06	0.00	0.00	0.00
7/12/14	0.14	0.00	0.00	0.00
7/13/14	0.00	0.00	0.00	0.00

TFN 6 2/025
RECD NOV 14, 2014

Table D6-1. Collected Surface Water Flow Data

Date	Max Daily Flowrate			
	Slater Creek		Hidden Water Creek	
	SM578512-SW-1	**SM578418-SW-1**	**SM578415-SW-1**	**SM578409-SW-1**
7/14/14	0.00	0.00	0.00	0.00
7/15/14	0.00	0.00	0.00	0.00
7/16/14	0.00	0.00	0.00	0.00
7/17/14	0.00	0.00	0.00	0.00
7/18/14	0.00	0.00	0.00	0.00
7/19/14	0.00	0.00	0.00	0.00
7/20/14	0.00	0.00	0.00	0.00
7/21/14	0.00	0.00	0.00	0.00
7/22/14	0.00	0.00	0.00	0.00
7/23/14	0.00	0.00	0.00	0.00
7/24/14	0.00	0.00	0.00	0.00
7/25/14	0.00	0.00	0.00	0.00
7/26/14	0.00	0.00	0.00	0.00
7/27/14	0.00	0.00	0.00	0.00
7/28/14	0.00	0.00	0.00	0.00
7/29/14	0.00	0.00	0.00	0.00
7/30/14	0.00	0.00	0.00	0.00
7/31/14	0.00	0.00	0.00	0.00
8/1/14	0.00	0.00	0.00	0.00
8/2/14	0.00	0.00	0.00	0.00
8/3/14	0.00	0.00	0.00	0.00
8/4/14	0.00	0.00	0.00	0.00
8/5/14	0.00	0.00	0.00	0.00
8/6/14	0.00	0.00	0.00	0.00
8/7/14	0.00	0.00	0.00	0.00
8/8/14	0.00	0.00	0.00	0.00
8/9/14	0.00	0.00	0.00	0.00
8/10/14	0.00	0.00	0.00	0.00
8/11/14	0.00	0.00	0.00	0.00
8/12/14	0.00	0.00	0.00	0.00
8/13/14	0.00	0.00	0.00	0.00
8/14/14	0.00	0.00	0.00	0.00
8/15/14	0.00	0.00	0.00	0.00
8/16/14	0.00	0.00	0.00	0.00
8/17/14	0.00	0.00	0.00	0.00
8/18/14	0.00	0.00	0.00	0.00
8/19/14	0.00	0.00	0.00	0.00
8/20/14	0.00	0.00	0.00	0.00
8/21/14	0.00	0.00	0.00	0.00
8/22/14	0.14	0.00	0.00	0.00
8/23/14	0.28	0.00	0.00	0.00
8/24/14	0.01	0.00	0.00	0.00
8/25/14	0.00	0.00	0.00	0.00

TFN 6 2/025
RECD NOV 14, 2014

Table D6-1. Collected Surface Water Flow Data

Date	Max Daily Flowrate			
	Slater Creek		Hidden Water Creek	
	SM578512-SW-1	**SM578418-SW-1**	**SM578415-SW-1**	**SM578409-SW-1**
8/26/14	0.00	0.00	0.00	0.00
8/27/14	0.00	0.00	0.00	0.00
8/28/14	0.00	0.00	0.00	0.00
8/29/14	0.00	0.00	0.00	0.00
8/30/14	0.01	0.00	0.00	0.00
8/31/14	0.00	0.00	0.00	0.00
9/1/14	0.01	0.00	0.00	0.00
9/2/14	0.00	0.00	0.00	0.00
9/3/14	0.00	0.00	0.00	0.00
9/4/14	0.00	0.00	0.00	0.00
9/5/14	0.00	0.00	0.00	0.00
9/6/14	0.00	0.00	0.00	0.00
9/7/14	0.03	0.00	0.00	0.00
9/8/14	0.02	0.00	0.00	0.00
Peak Flowrate (cfs)	**8.17**	**8.77**	**0.00**	**0.00**
Average Flowrate (cfs)[1]	**0.63**	**0.41**	**0.00**	**0.00**

Notes: [1]Average flowrate is calculated using all flow data collected.

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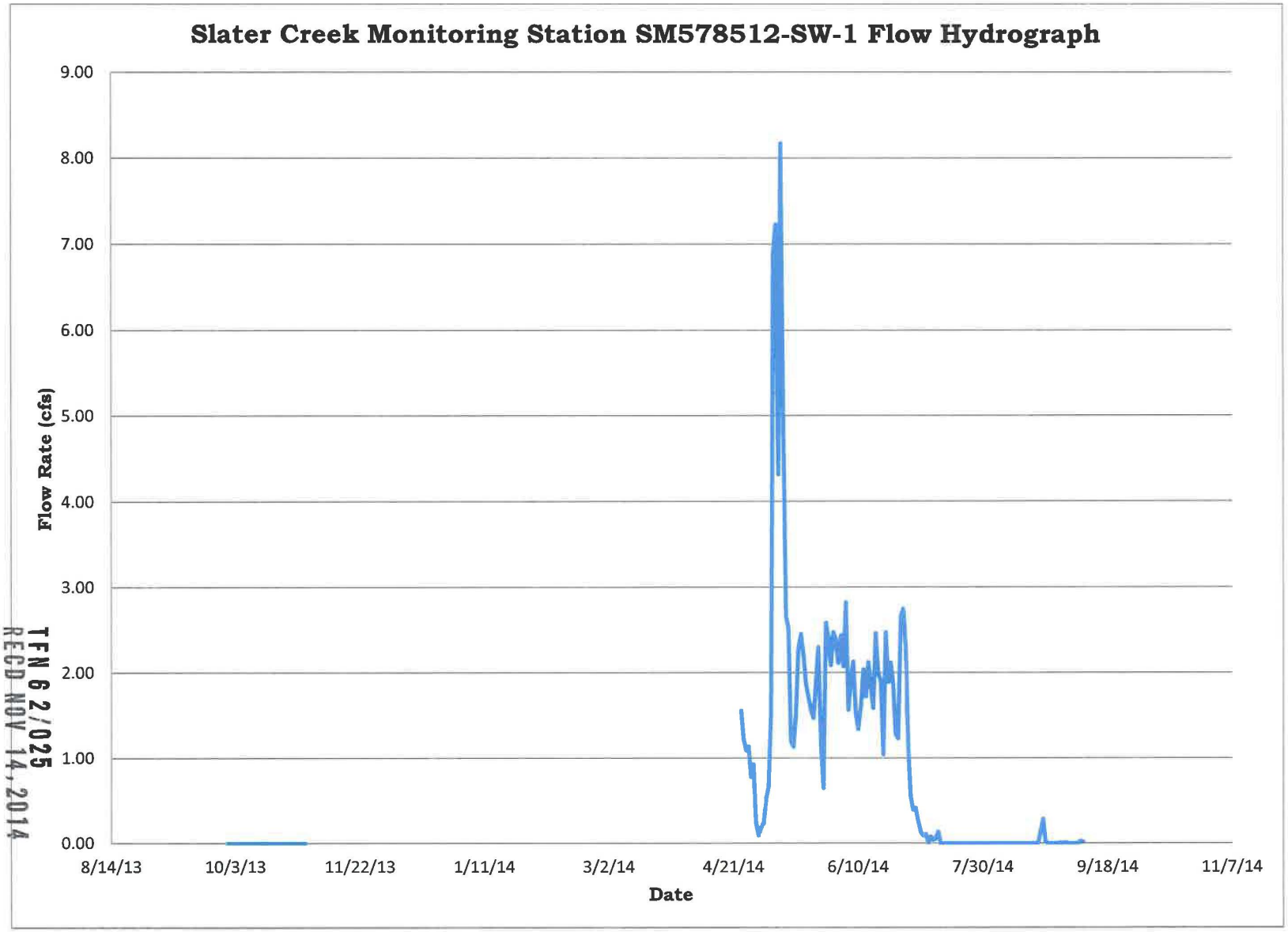

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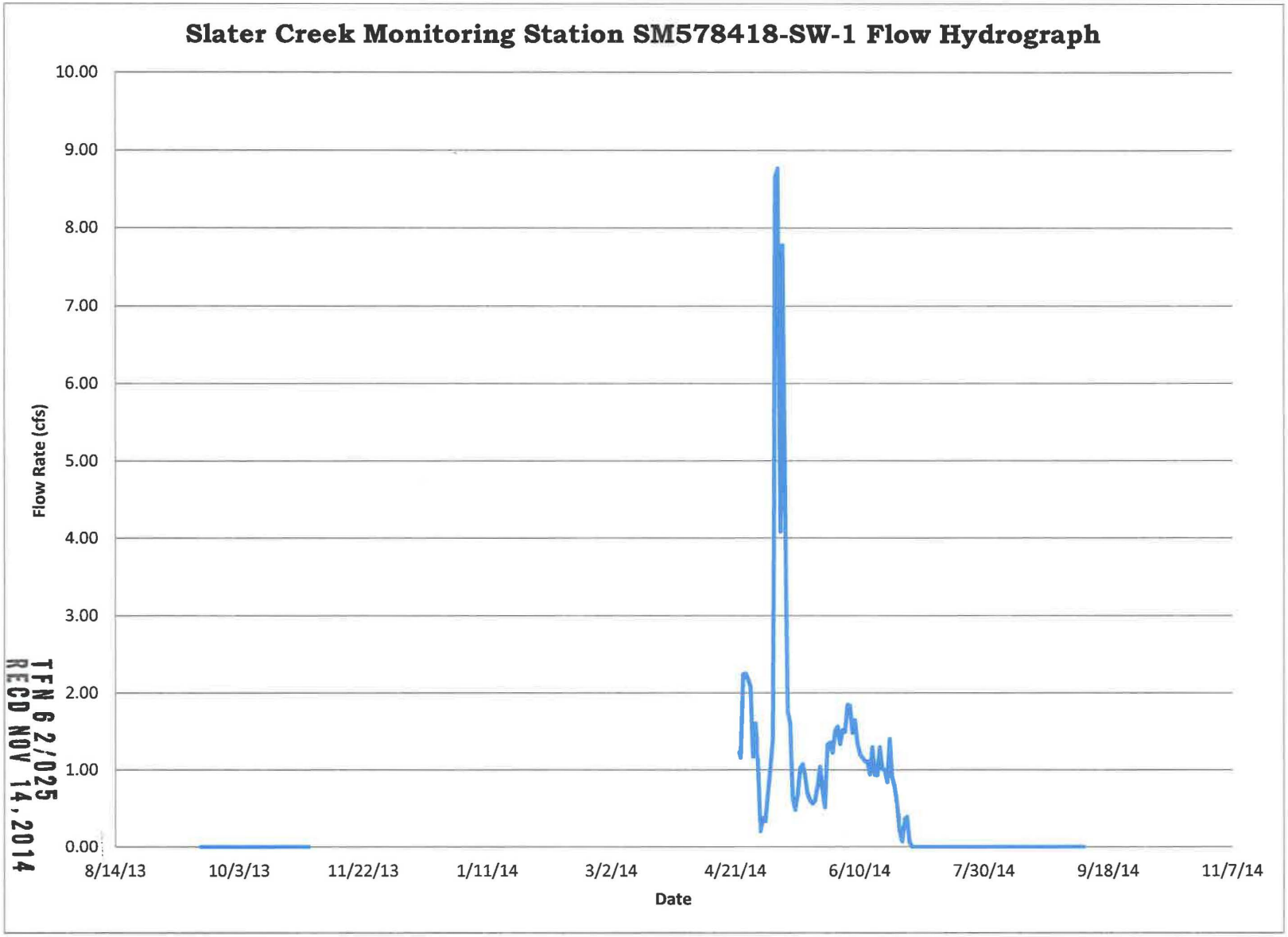

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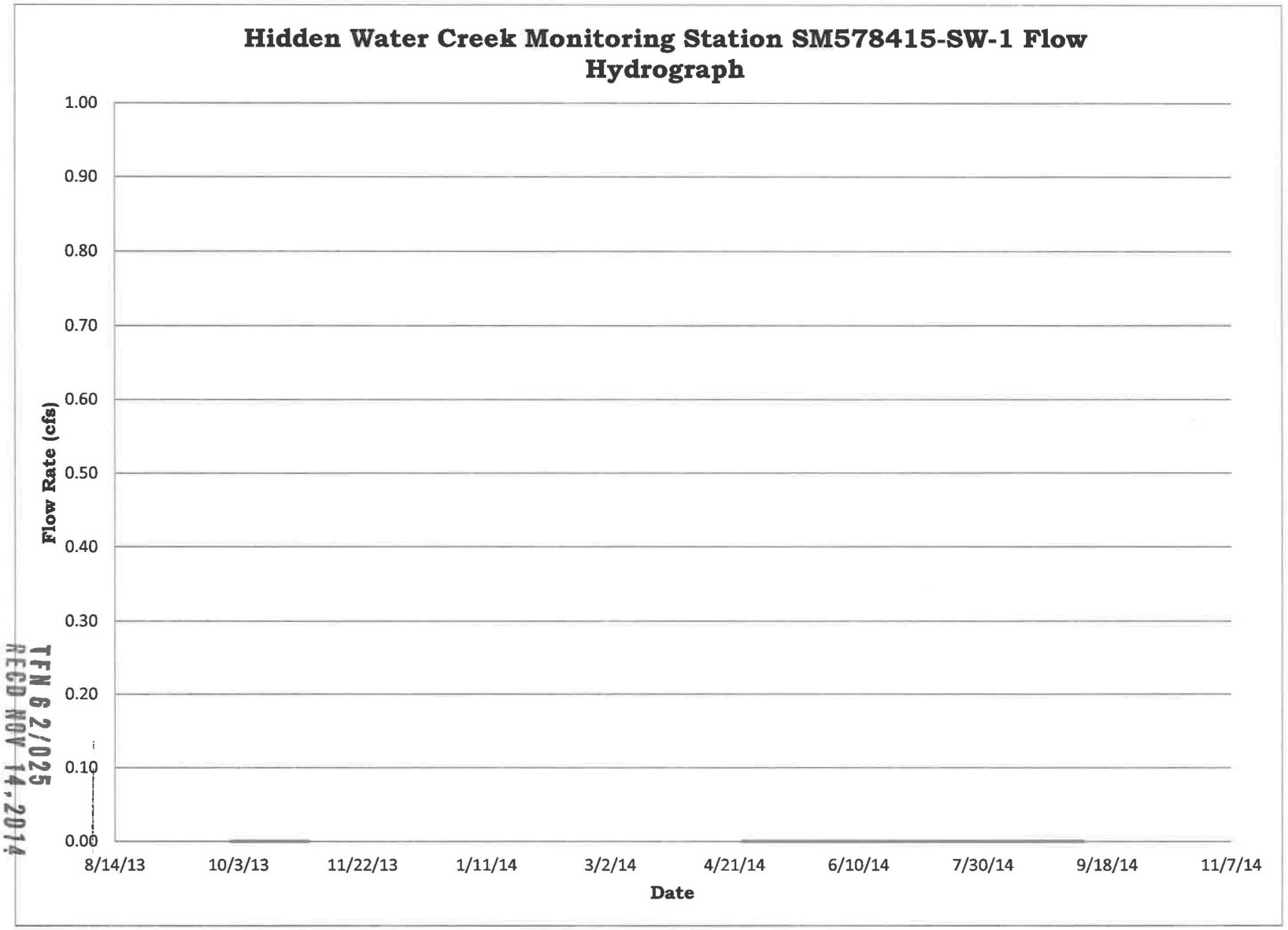

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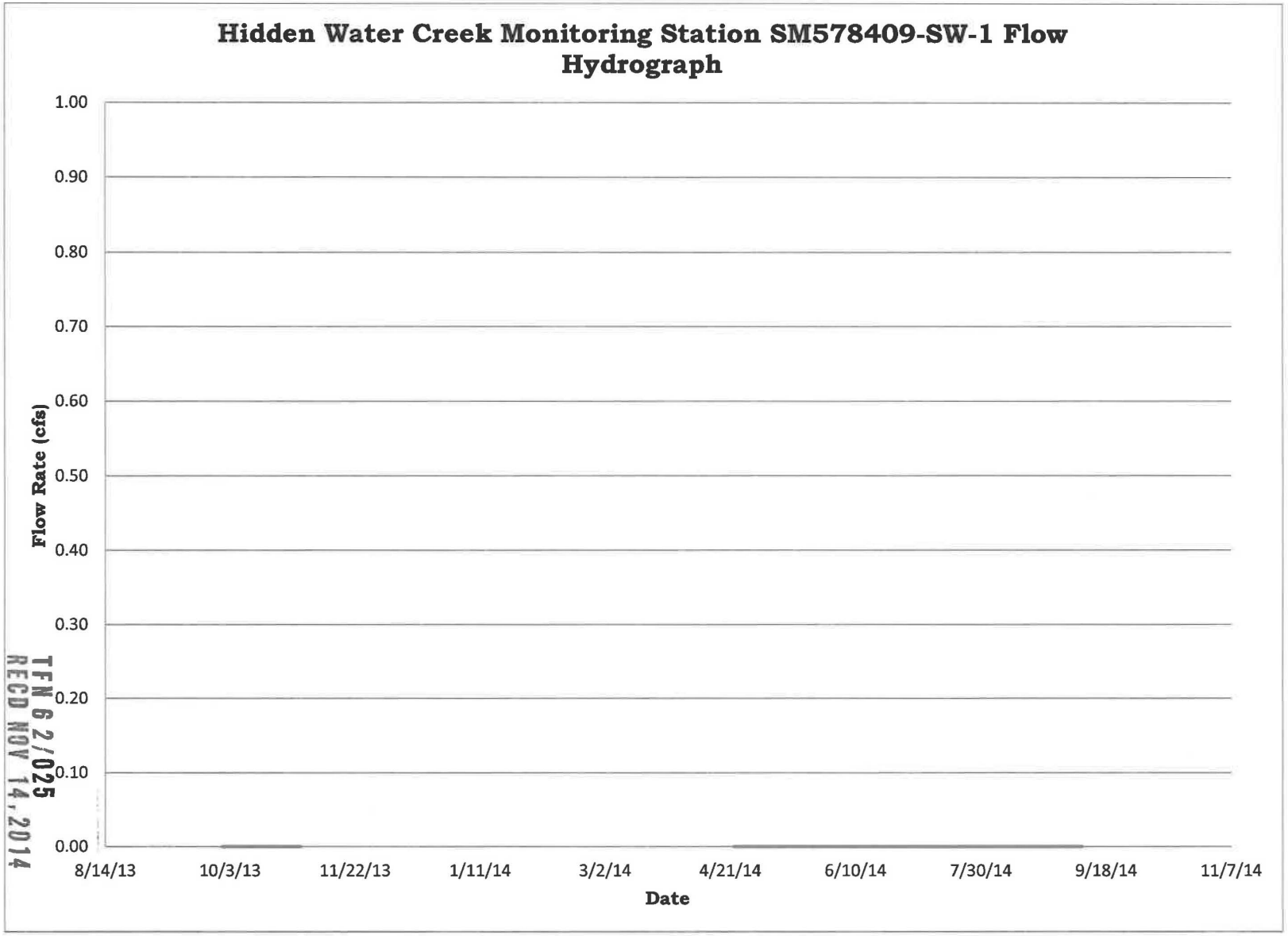

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ADDENDUM D6-5

Rating Curves

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Attachment D6-5-B Rating Curves Stream Monitoring Stations

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D6-5 RATING CURVE DEVELOPMENT FOR STREAM MONITORING STATIONS

D6-5.1 Background

To measure streamflow occurring within the proposed Brook Mine permit boundary four continuous stage recorders were installed along Slater Creek and Hidden Water Creek and have been designated SM578418-SW-1, SM578512-SW-1, SM578409-SW-1 and SM578415-SW-1 (Figures D6-1 through D6-4). The monitoring stations are part of the baseline monitoring network for the mine permit application.

In an effort to depict flow conditions experienced at Slater Creek and Hidden Water Creek monitoring stations, rating curves were developed. Surveys of the channel thalweg and cross section at each monitoring station locations were completed by Prestfeldt Surveying in September 2013. WWC Engineering (WWC) developed rating curves for each monitoring site based on the surveyed stream cross sections and profiles.

D6-5.2 Approach

Uniform flow calculations were performed to determine flow rates within the Slater Creek and Hidden Water Creek channels. The Manning equation was used to calculate the flow. The Manning equation is:

$$Q = \frac{1.486}{n} AR^{0.67} S^{0.5}$$

where:

Q = flow (cfs)
n = Manning's roughness coefficient
A = area of flow (sq ft)
R = A/Wp = hydraulic radius (Wp = wetted perimeter in ft)
S = channel bottom slope (ft/ft)

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The Manning's roughness coefficient (n) was selected based on the vegetation growth within channel. Table D6-1 provides the roughness coefficients used for each location.

The channel thalweg at each monitoring station was surveyed upstream and downstream of each site. Figures D6-1 through D6-4 show the channel profiles. An average slope was determined from the surveyed information. Table D6-2 provides the slope used for each location.

Based on the survey data, a cross section was developed at the location of each monitoring station. Figures D6-1 through D6-4 show the cross sections and profiles for each monitor site.

Flows were calculated using Manning's equation for each channel cross section at 0.1-foot increments (Attachment D6-5-A). The minimum elevation chosen for calculations was the lowest point of each channel cross section. The maximum elevation chosen for calculations was based on judgment of appropriate flow rates anticipated for the channel.

D6-6.3 Results

Complete results of this uniform flow analysis are provided in Attachment D6-5-A (Rating Tables) and Attachment D6-5-B (Rating Curves). Table D6-3 provides a summary of minimum and maximum calculated flow rates for each cross section. Additionally, an equation was fit to each flow rate versus stage curve. Table D6-4 provides the equation for each curve at each station, as well as the R^2-value to demonstrate wellness of fit. Each equation calculates flow (Q) as a function of water stage (s).

D6-6.4 References

FlowMaster v8i. (2009). Bentley Systems, Inc.

Sturm, T. W. (2001). *Open Channel Hydraulics.* Singapore: McGraw-Hill Higher Education.

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Table D6-1. Manning's Roughness Coefficients for Individual Monitoring Station Locations

Monitoring Station	Channel (n)
SM578418-SW-1	0.030
SM578512-SW-1	0.030
SM578415-SW-1	0.030
SM578409-SW-1	0.030

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Table D6-2. Average Channel Slope for the Proximity of Each Monitoring Station Location

Monitoring Station	Average Slope (ft/ft)
SM578418-SW-1	0.00758
SM578512-SW-1	0.01427
SM578415-SW-1	0.01502
SM578409-SW-1	0.01459

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Table D6-3. Summary of Minimum and Maximum Flow Rates for Each Monitoring Station

Monitoring Station	Elevation (ft amsl)	Stage (ft)	Flow Rate (cfs)
SM578418-SW-1	3663.8	0.1	0.3
	3670.8	7.1	3,580
SM578512-SW-1	3743.2	0.1	0.1
	3750.3	7.2	4,460
SM578409-SW-1	3769.5	0.1	0.2
	3774.7	5.3	1,660
SM578415-SW-1	3656.0	0.1	0.2
	3661.0	5.1	1,730

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Table D6-4. Equations Fit to Rating Curves

Monitoring Station	Equation	R^2
SM578418-SW-1	$Q = 74.745s^2 - 5477178s + 1E+09$	0.9999
SM578512-SW-1	$Q = 102.15s^2 - 764877s + 1E+09$	0.9983
SM578409-SW-1	$Q = 54.658s^2 - 412028s + 8E+08$	0.9998
SM578415-SW-1	$Q = 69.329s^2 - 506949s + 9E+08$	0.9995

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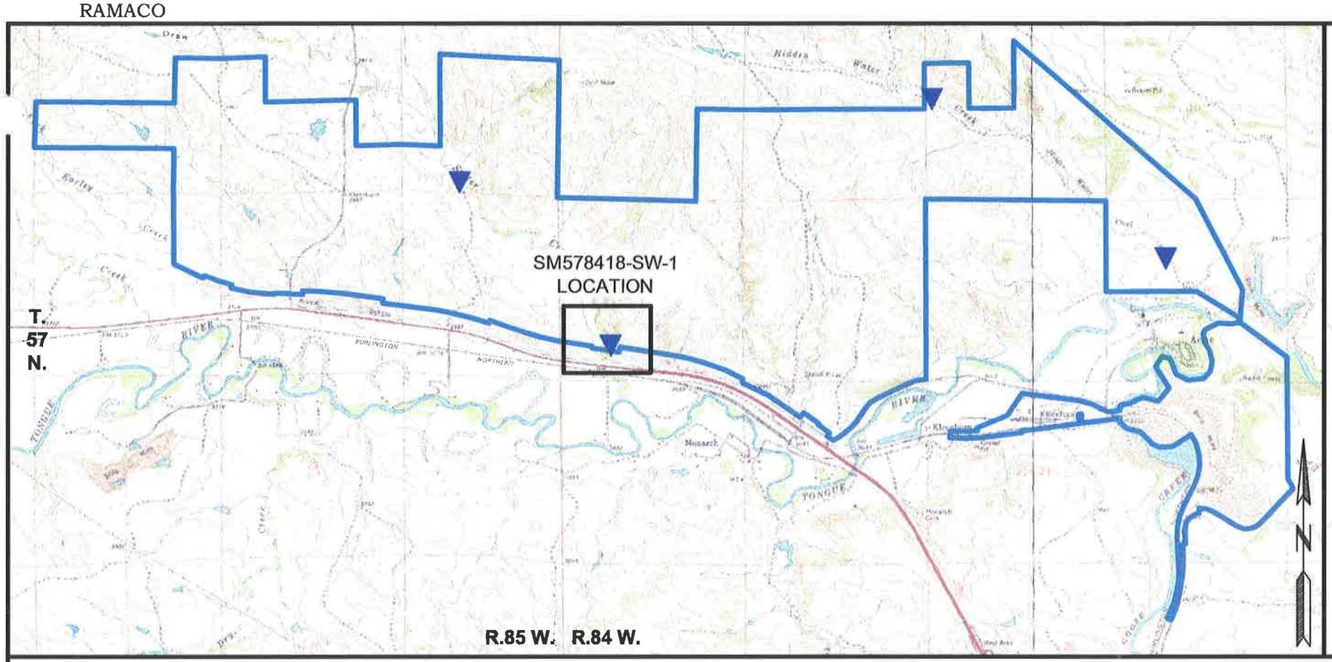

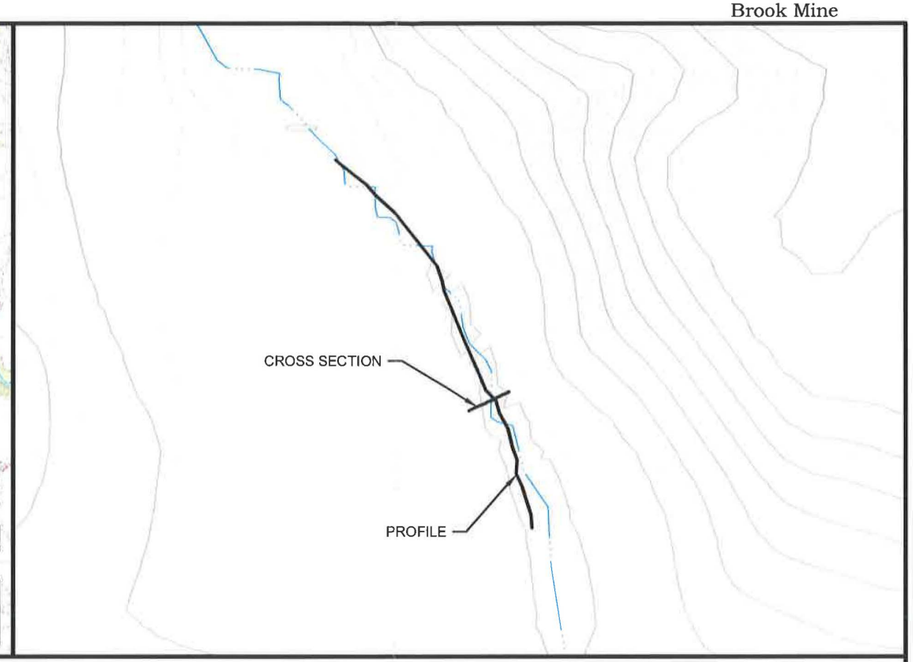

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SECTION/PROFILE VIEW
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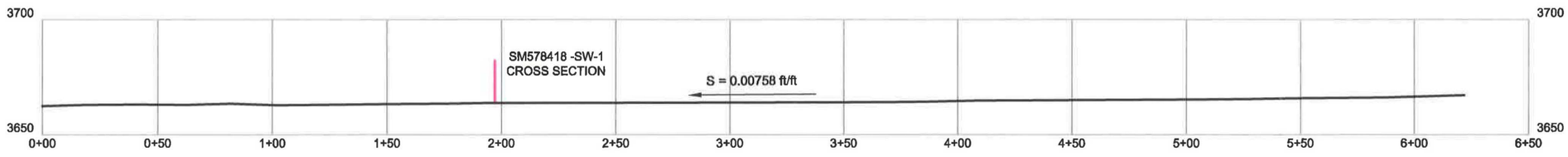

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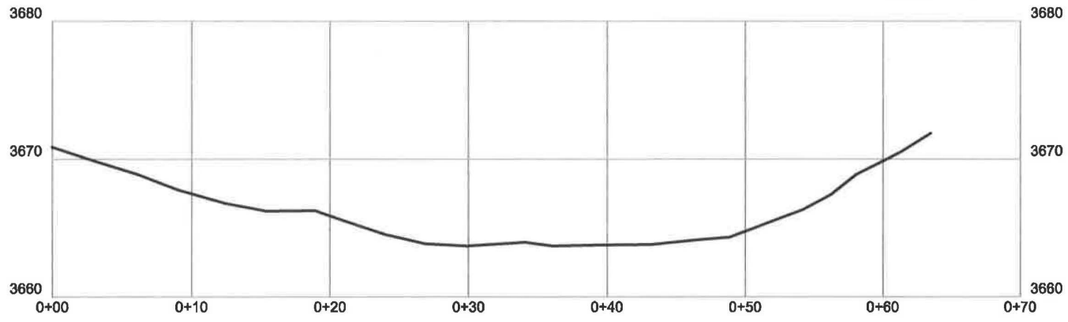

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ADDENDUM D6-5
FIGURE D6-1

SM578418-SW-1
MONITOR STATION PLAN VIEW, PROFILE AND CROSS SECTION

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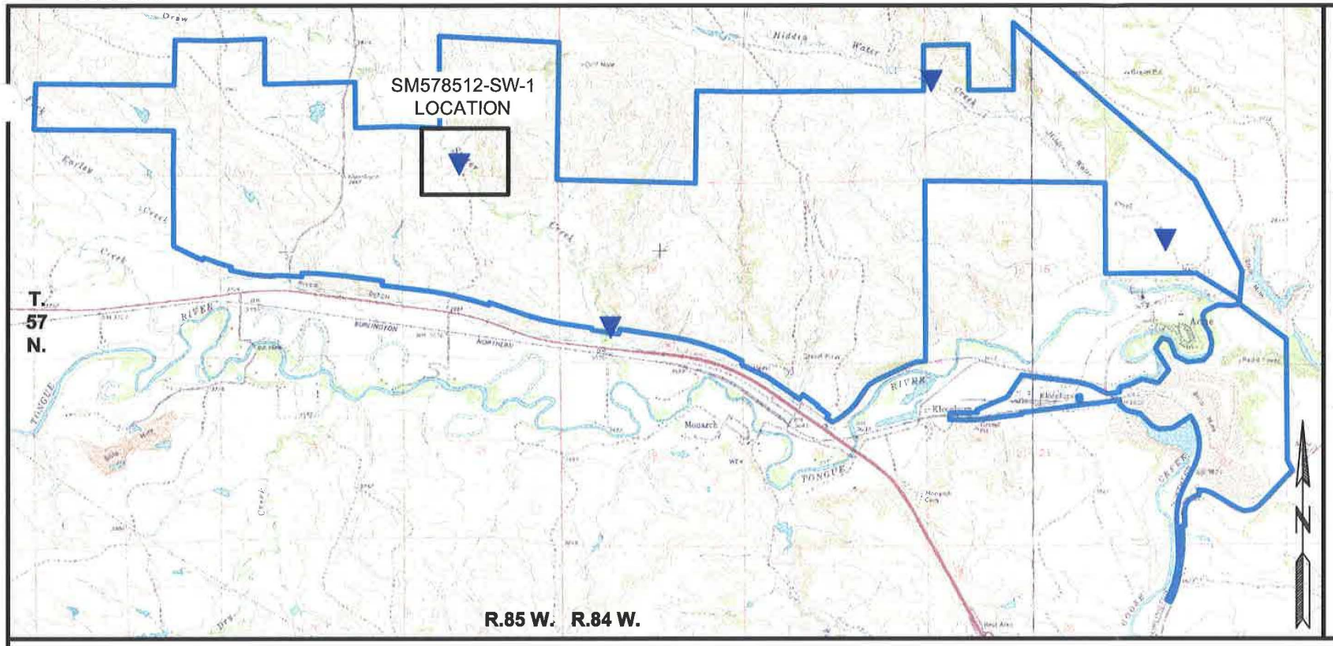

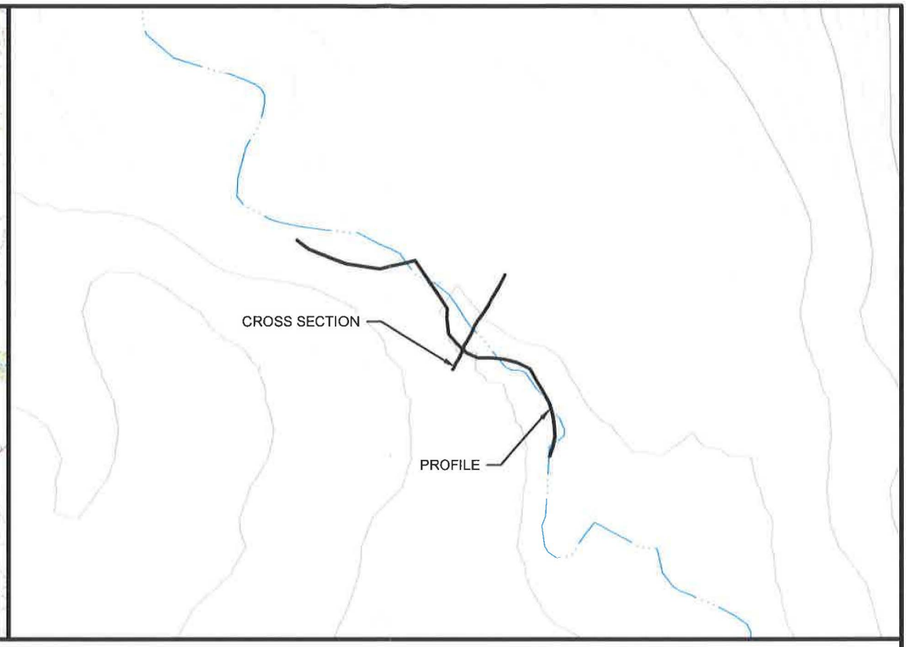

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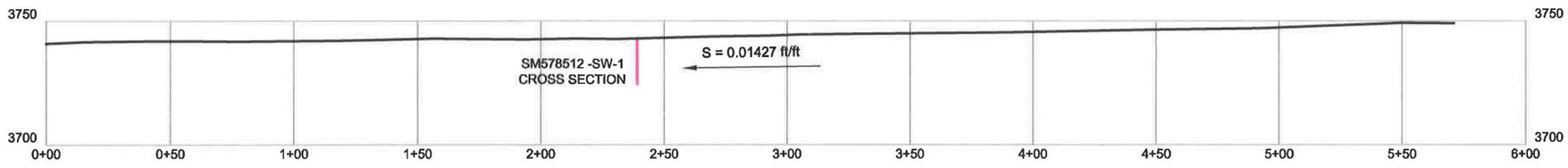

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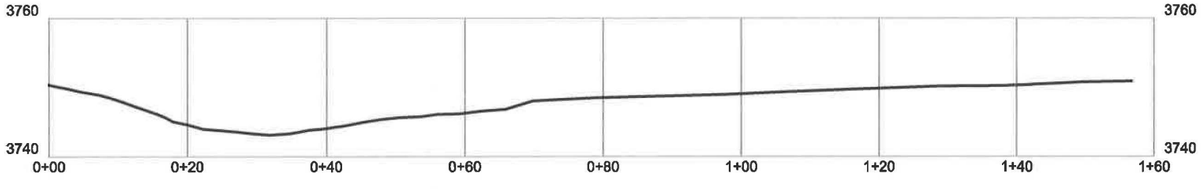

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ADDENDUM D6-5
FIGURE D6-2

SM578512 -SW-1
MONITOR STATION PLAN VIEW, PROFILE AND CROSS SECTION

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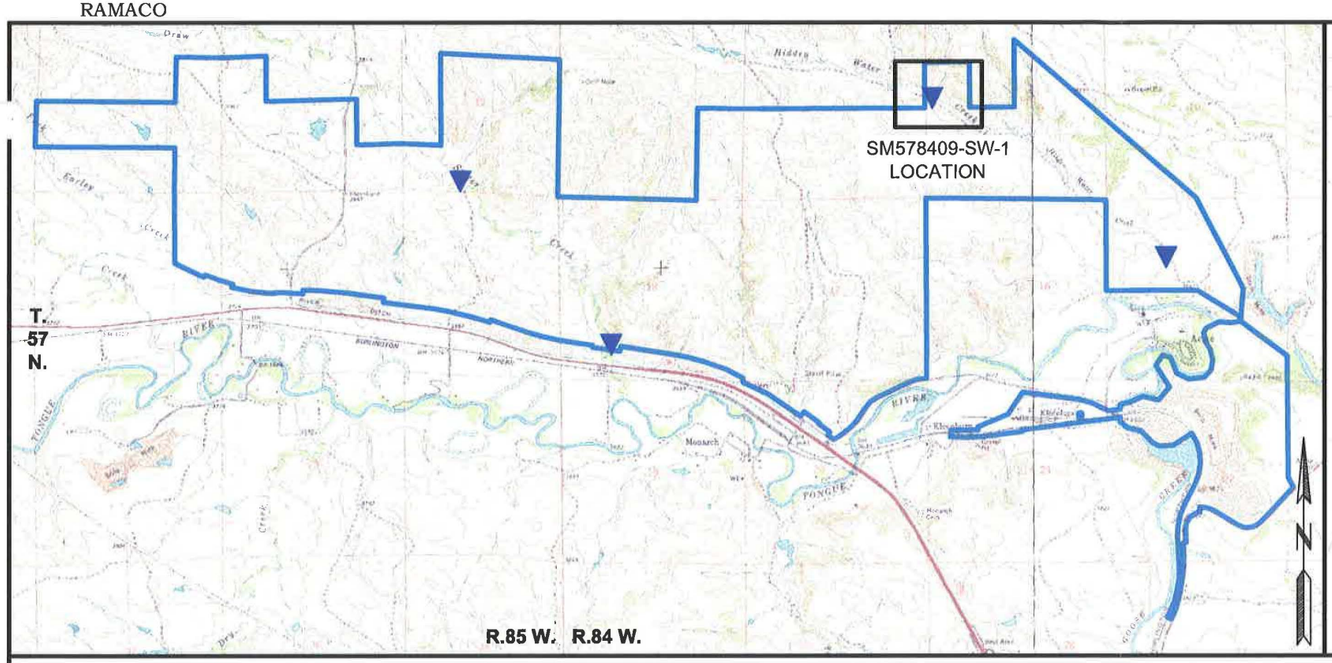

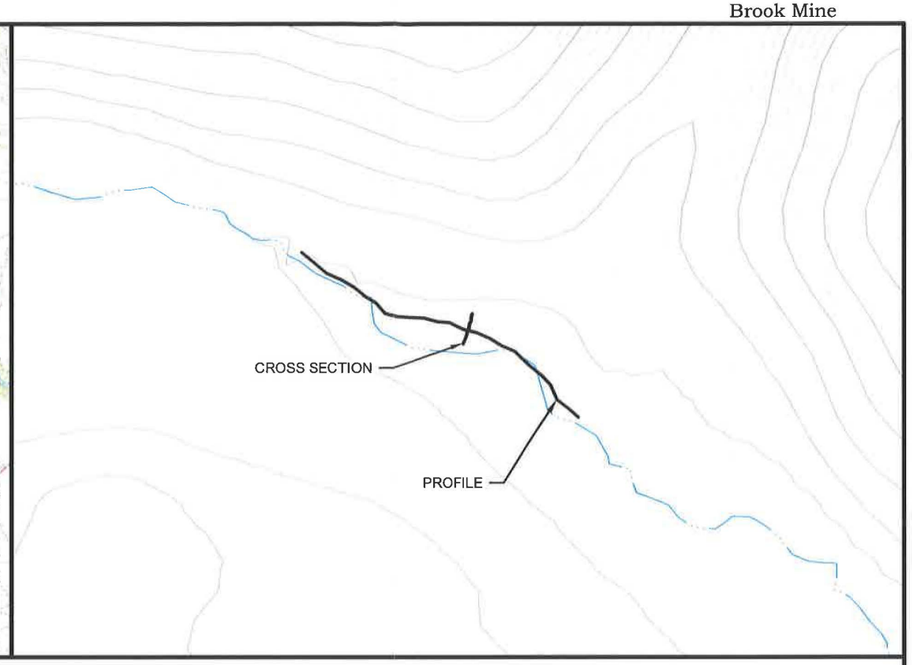

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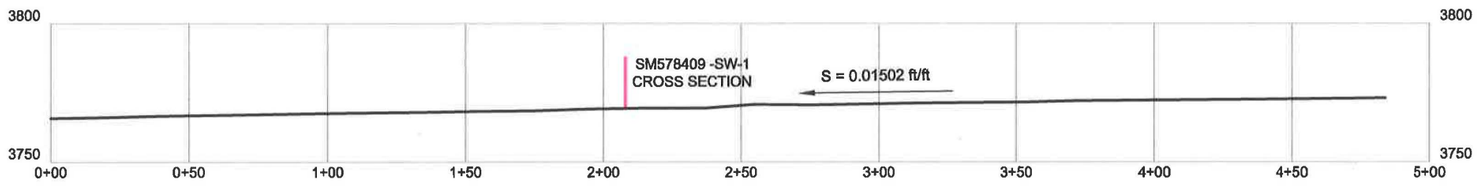

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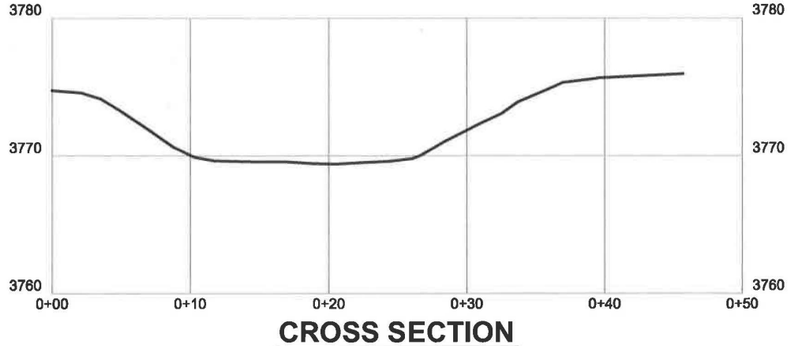

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ADDENDUM D6-5
FIGURE D6-3

SM578409-SW-1
MONITOR STATION PLAN VIEW, PROFILE AND CROSS SECTION

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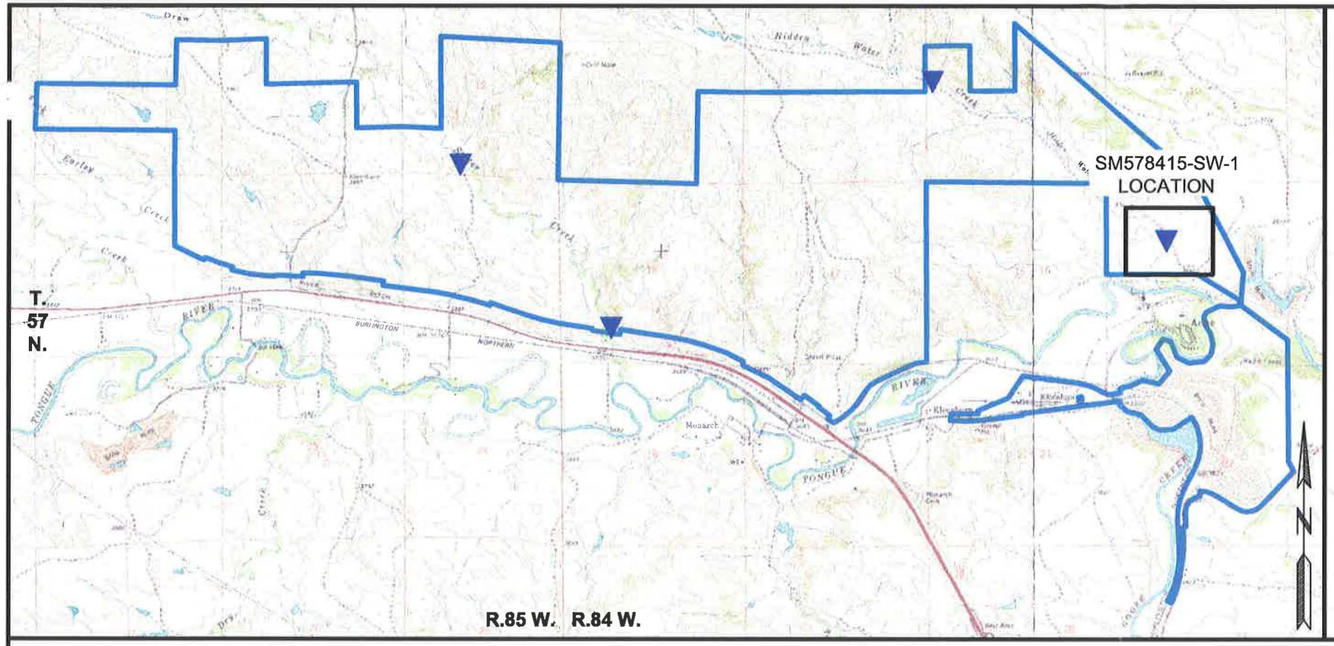

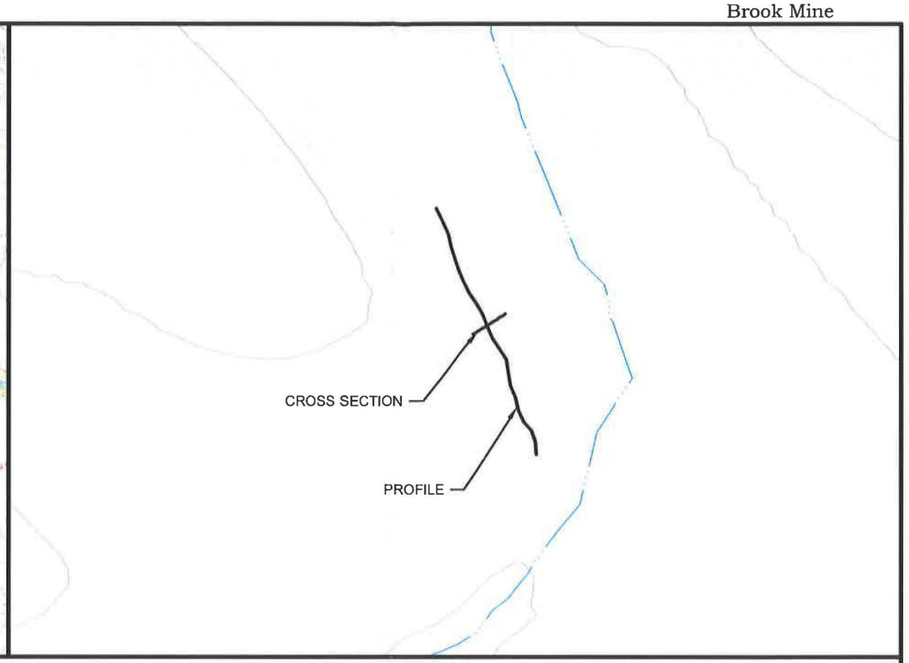

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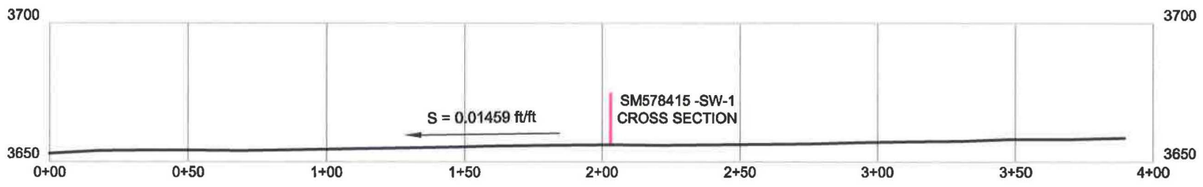

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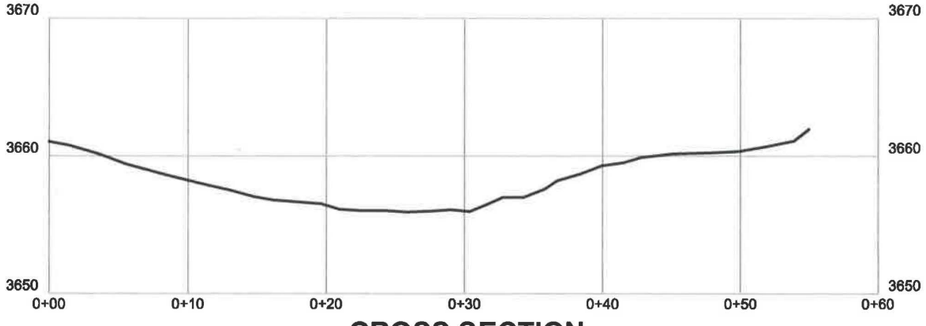

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ADDENDUM D6-5
FIGURE D6-4

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SM578415-SW-1
MONITOR STATION PLAN VIEW, PROFILE AND CROSS SECTION

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ATTACHMENT D6-5-A

Rating Tables
Stream Monitoring Stations

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Slater Creek Monitoring Station SM578418-SW-1 Rating Table			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3663.7	0	0.03	0
3663.8	0.1	0.03	0.29
3663.9	0.2	0.03	2.01
3664	0.3	0.03	5.43
3664.1	0.4	0.03	10.5
3664.2	0.5	0.03	16.96
3664.3	0.6	0.03	24.75
3664.4	0.7	0.03	34.34
3664.5	0.8	0.03	45.59
3664.6	0.9	0.03	58.3
3664.7	1	0.03	72.35
3664.8	1.1	0.03	87.68
3664.9	1.2	0.03	104.27
3665	1.3	0.03	122.1
3665.1	1.4	0.03	141.17
3665.2	1.5	0.03	161.45
3665.3	1.6	0.03	182.95
3665.4	1.7	0.03	205.66
3665.5	1.8	0.03	229.63
3665.6	1.9	0.03	254.77
3665.7	2	0.03	281.12
3665.8	2.1	0.03	308.68
3665.9	2.2	0.03	337.45
3666	2.3	0.03	367.42
3666.1	2.4	0.03	398.62
3666.2	2.5	0.03	431.03
3666.3	2.6	0.03	436.7
3666.4	2.7	0.03	472.39
3666.5	2.8	0.03	509.69
3666.6	2.9	0.03	548.44
3666.7	3	0.03	588.64
3666.8	3.1	0.03	630.3
3666.9	3.2	0.03	675.34
3667	3.3	0.03	721.83
3667.1	3.4	0.03	769.76
3667.2	3.5	0.03	819.15
3667.3	3.6	0.03	869.98
3667.4	3.7	0.03	922.27
3667.5	3.8	0.03	976.51
3667.6	3.9	0.03	1032.39
3667.7	4	0.03	1089.71
3667.8	4.1	0.03	1149.05
3667.9	4.2	0.03	1210.4
3668	4.3	0.03	1273.18

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Slater Creek Monitoring Station SM578418-SW-1 Rating Table cont.			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3668.1	4.4	0.03	1337.38
3668.2	4.5	0.03	1403.01
3668.3	4.6	0.03	1470.06
3668.4	4.7	0.03	1538.54
3668.5	4.8	0.03	1608.44
3668.6	4.9	0.03	1679.75
3668.7	5	0.03	1752.49
3668.8	5.1	0.03	1826.66
3668.9	5.2	0.03	1901.72
3669	5.3	0.03	1976.21
3669.1	5.4	0.03	2052.19
3669.2	5.5	0.03	2129.64
3669.3	5.6	0.03	2208.6
3669.4	5.7	0.03	2289.05
3669.5	5.8	0.03	2371.01
3669.6	5.9	0.03	2454.49
3669.7	6	0.03	2539.49
3669.8	6.1	0.03	2626.23
3669.9	6.2	0.03	2714.81
3670	6.3	0.03	2804.93
3670.1	6.4	0.03	2896.59
3670.2	6.5	0.03	2989.79
3670.3	6.6	0.03	3084.55
3670.4	6.7	0.03	3180.87
3670.5	6.8	0.03	3278.75
3670.6	6.9	0.03	3378.88
3670.7	7	0.03	3480.85
3670.8	7.1	0.03	3584.38

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Slater Creek Monitoring Station SM578512-SW-1 Rating Table			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3743.1	0	0.03	0
3743.2	0.1	0.03	0.09
3743.3	0.2	0.03	0.59
3743.4	0.3	0.03	1.79
3743.5	0.4	0.03	3.78
3743.6	0.5	0.03	6.59
3743.7	0.6	0.03	10.32
3743.8	0.7	0.03	15.07
3743.9	0.8	0.03	20.5
3744.0	0.9	0.03	27.2
3744.1	1	0.03	36.81
3744.2	1.1	0.03	47.83
3744.3	1.2	0.03	60.28
3744.4	1.3	0.03	74.18
3744.5	1.4	0.03	89.75
3744.6	1.5	0.03	106.93
3744.7	1.6	0.03	125.56
3744.8	1.7	0.03	145.75
3744.9	1.8	0.03	167.52
3745.0	1.9	0.03	190.84
3745.1	2	0.03	216.09
3745.2	2.1	0.03	243.22
3745.3	2.2	0.03	272.01
3745.4	2.3	0.03	302.06
3745.5	2.4	0.03	332.84
3745.6	2.5	0.03	365.47
3745.7	2.6	0.03	395.53
3745.8	2.7	0.03	423.93
3745.9	2.8	0.03	463.88
3746.0	2.9	0.03	505.94
3746.1	3	0.03	544.06
3746.2	3.1	0.03	577.38
3746.3	3.2	0.03	628.6
3746.4	3.3	0.03	721.83
3746.5	3.4	0.03	738.21
3746.6	3.5	0.03	795.02
3746.7	3.6	0.03	852.77
3746.8	3.7	0.03	913.21
3746.9	3.8	0.03	979.08
3747.0	3.9	0.03	1054.01
3747.1	4	0.03	1131.55
3747.2	4.1	0.03	1211.61
3747.3	4.2	0.03	1294.18
3668.0	4.3	0.03	1273.18

TFN 6 2/025
RECD NOV 14, 2014

Slater Creek Monitoring Station SM578512-SW-1 Rating Table cont.			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3747.5	4.4	0.03	1466.88
3747.6	4.5	0.03	1556.99
3747.7	4.6	0.03	1649.63
3747.8	4.7	0.03	1538.54
3747.9	4.8	0.03	1842.47
3748.0	4.9	0.03	1942.68
3748.1	5	0.03	2026.83
3748.2	5.1	0.03	2105.64
3748.3	5.2	0.03	2183.58
3748.4	5.3	0.03	2259.16
3748.5	5.4	0.03	2339.41
3748.6	5.5	0.03	2378.84
3748.7	5.6	0.03	2424.09
3748.8	5.7	0.03	2498.57
3748.9	5.8	0.03	2580.75
3749.0	5.9	0.03	2673.34
3749.1	6	0.03	2789.7
3749.2	6.1	0.03	2911.65
3749.3	6.2	0.03	3039.28
3749.4	6.3	0.03	3171.1
3749.5	6.4	0.03	3306.56
3749.6	6.5	0.03	3448.67
3749.7	6.6	0.03	3596.97
3749.8	6.7	0.03	3748.79
3749.9	6.8	0.03	3900.96
3750.0	6.9	0.03	4060.34
3750.1	7	0.03	4226.99
3750.2	7.1	0.03	4332.03
3750.3	7.2	0.03	4463.66

TFN 6 2/025
RECD NOV 14, 2014

Hidden Water Creek Monitoring Station SM578409-SW-1 Rating Table			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3769.4	0	0.03	0
3769.5	0.1	0.03	0.22
3769.6	0.2	0.03	1.22
3769.7	0.3	0.03	4.16
3769.8	0.4	0.03	8.87
3769.9	0.5	0.03	15.34
3770.0	0.6	0.03	23.5
3770.1	0.7	0.03	33.1
3770.2	0.8	0.03	44.03
3770.3	0.9	0.03	56.22
3770.4	1	0.03	69.65
3770.5	1.1	0.03	84.29
3770.6	1.2	0.03	100.1
3770.7	1.3	0.03	117.22
3770.8	1.4	0.03	135.56
3770.9	1.5	0.03	155.03
3771.0	1.6	0.03	175.61
3771.1	1.7	0.03	197.22
3771.2	1.8	0.03	219.86
3771.3	1.9	0.03	243.59
3771.4	2	0.03	268.41
3771.5	2.1	0.03	294.31
3771.6	2.2	0.03	321.3
3771.7	2.3	0.03	349.36
3771.8	2.4	0.03	378.51
3771.9	2.5	0.03	408.69
3772.0	2.6	0.03	439.92
3772.1	2.7	0.03	472.25
3772.2	2.8	0.03	505.67
3772.3	2.9	0.03	540.19
3772.4	3	0.03	575.66
3772.5	3.1	0.03	612.13
3772.6	3.2	0.03	649.73
3772.7	3.3	0.03	721.83
3772.8	3.4	0.03	728.34
3772.9	3.5	0.03	769.36
3773.0	3.6	0.03	811.54
3773.1	3.7	0.03	855.93
3773.2	3.8	0.03	901.62
3773.3	3.9	0.03	948.32
3773.4	4	0.03	996.15
3773.5	4.1	0.03	1045.13
3773.6	4.2	0.03	1095.24
3668.0	4.3	0.03	1273.18

TFN 6 2/025
RECD NOV 14, 2014

Hidden Water Creek Monitoring Station SM578409-SW-1 Rating Table cont.			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3773.8	4.4	0.03	1198.9
3773.9	4.5	0.03	1251.6
3774.0	4.6	0.03	1304.23
3774.1	4.7	0.03	1538.54
3774.2	4.8	0.03	1409.96
3774.3	4.9	0.03	1462.43
3774.4	5	0.03	1516.35
3774.5	5.1	0.03	1571.74
3774.6	5.2	0.03	1619.11
3774.7	5.3	0.03	1655.01

TFN 6 2/025
RECD NOV 14, 2014

Hidden Water Creek Monitoring Station SM578415-SW-1 Rating Table			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3655.9	0	0.03	0
3656.0	0.1	0.03	0.15
3656.1	0.2	0.03	1.29
3656.2	0.3	0.03	3.96
3656.3	0.4	0.03	7.78
3656.4	0.5	0.03	12.65
3656.5	0.6	0.03	18.53
3656.6	0.7	0.03	24.63
3656.7	0.8	0.03	31.68
3656.8	0.9	0.03	40.11
3656.9	1	0.03	50.65
3657.0	1.1	0.03	59.53
3657.1	1.2	0.03	73.62
3657.2	1.3	0.03	89.18
3657.3	1.4	0.03	106.1
3657.4	1.5	0.03	124.36
3657.5	1.6	0.03	143.86
3657.6	1.7	0.03	164.72
3657.7	1.8	0.03	187.19
3657.8	1.9	0.03	211.01
3657.9	2	0.03	236.26
3658.0	2.1	0.03	263.02
3658.1	2.2	0.03	291.15
3658.2	2.3	0.03	320.38
3658.3	2.4	0.03	349.86
3658.4	2.5	0.03	381.01
3658.5	2.6	0.03	413.78
3658.6	2.7	0.03	448.08
3658.7	2.8	0.03	484.29
3658.8	2.9	0.03	522.57
3658.9	3	0.03	562.42
3659.0	3.1	0.03	603.85
3659.1	3.2	0.03	646.86
3659.2	3.3	0.03	721.83
3659.3	3.4	0.03	735.84
3659.4	3.5	0.03	779.44
3659.5	3.6	0.03	825.93
3659.6	3.7	0.03	877.24
3659.7	3.8	0.03	931.03
3659.8	3.9	0.03	986.56
3659.9	4	0.03	1041.58
3660.0	4.1	0.03	1093.27
3660.1	4.2	0.03	1147.13
3668.0	4.3	0.03	1273.18

TFN 6 2/025
RECD NOV 14, 2014

Hidden Water Creek Monitoring Station SM578415-SW-1 Rating Table cont.			
Water Surface Elevation (ft)	Water Height (ft)	Wtd. Mannings Coefficient	Discharge (cfs)
3660.3	4.4	0.03	1206.84
3660.4	4.5	0.03	1273.44
3660.5	4.6	0.03	1344.3
3660.6	4.7	0.03	1538.54
3660.7	4.8	0.03	1492.95
3660.8	4.9	0.03	1569.45
3660.9	5	0.03	1646.94
3661.0	5.1	0.03	1726.96

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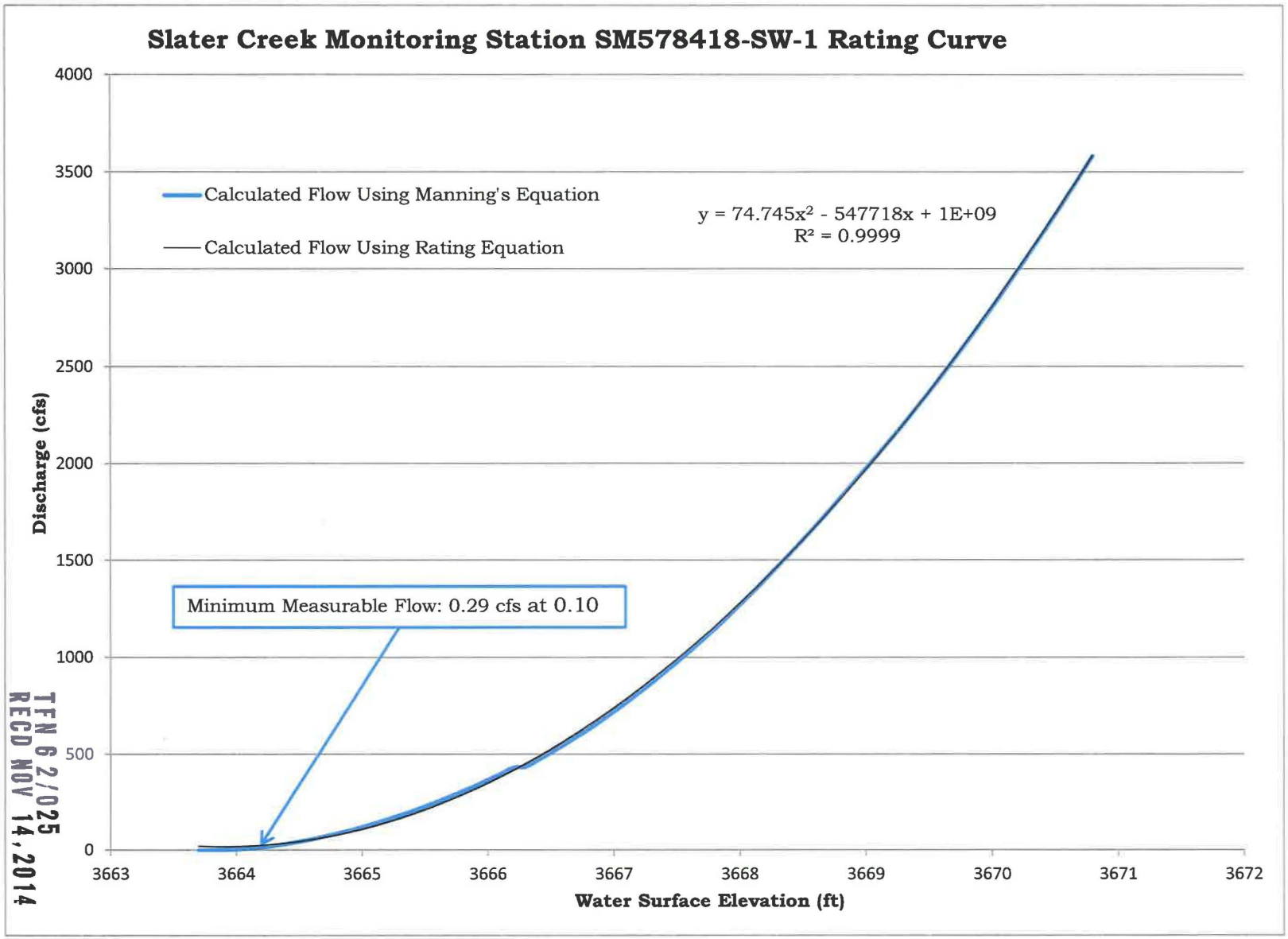
ATTACHMENT D6-5-B

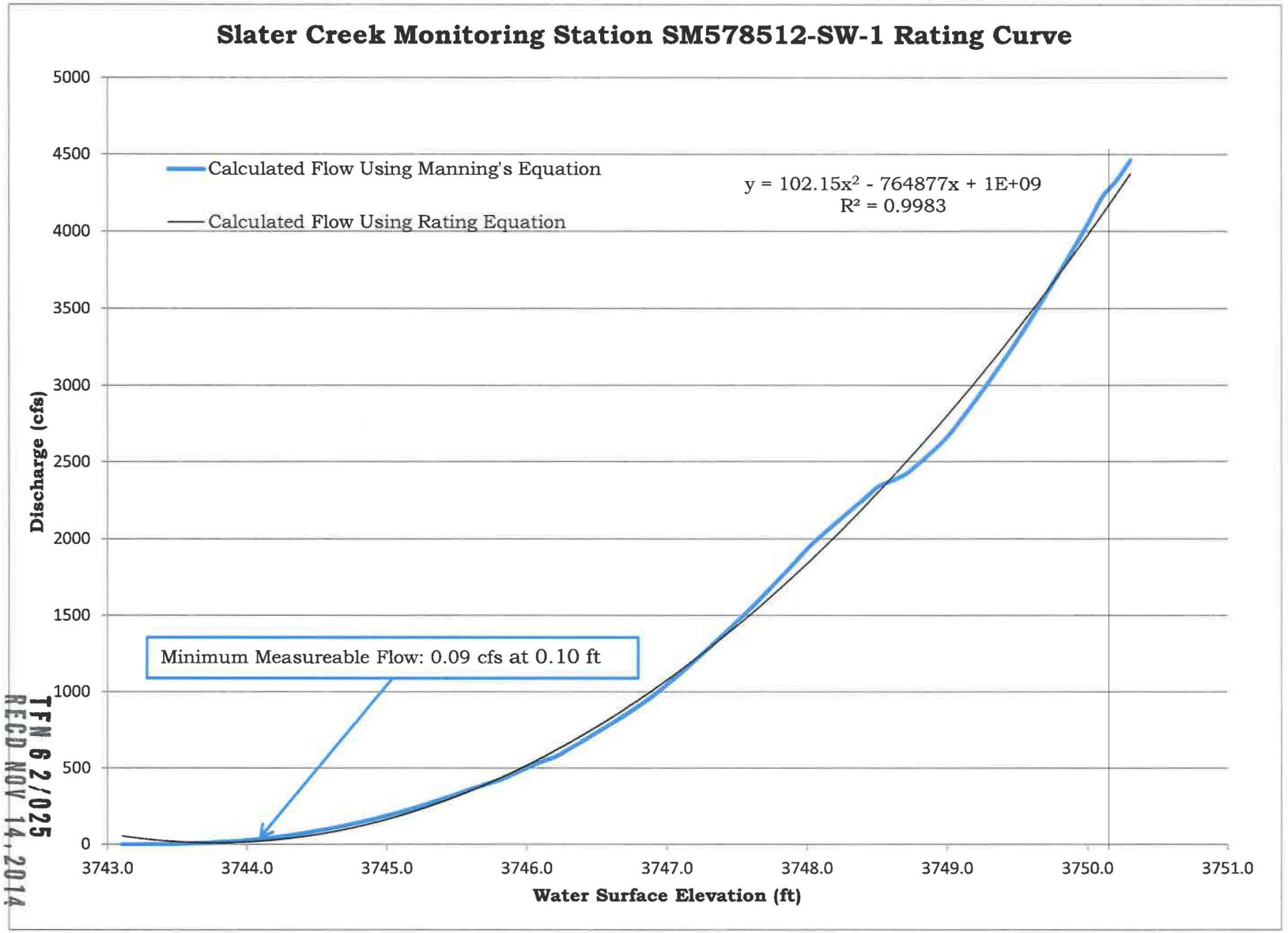
Rating Curves
Stream Monitoring Stations

TFN 6 2/025
RECD NOV 14,2014

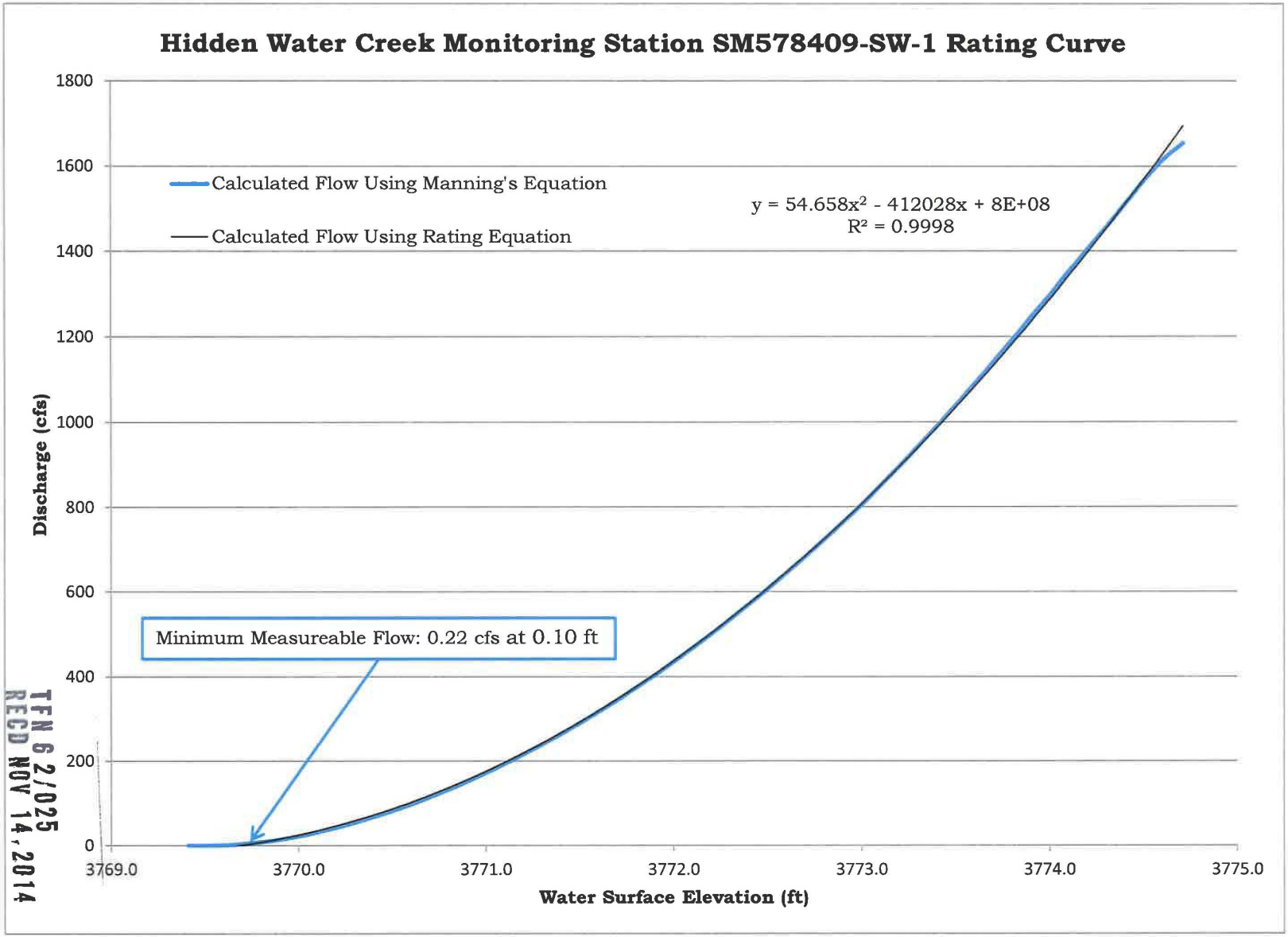


TFN 6 2/025
RECD NOV 14, 2014

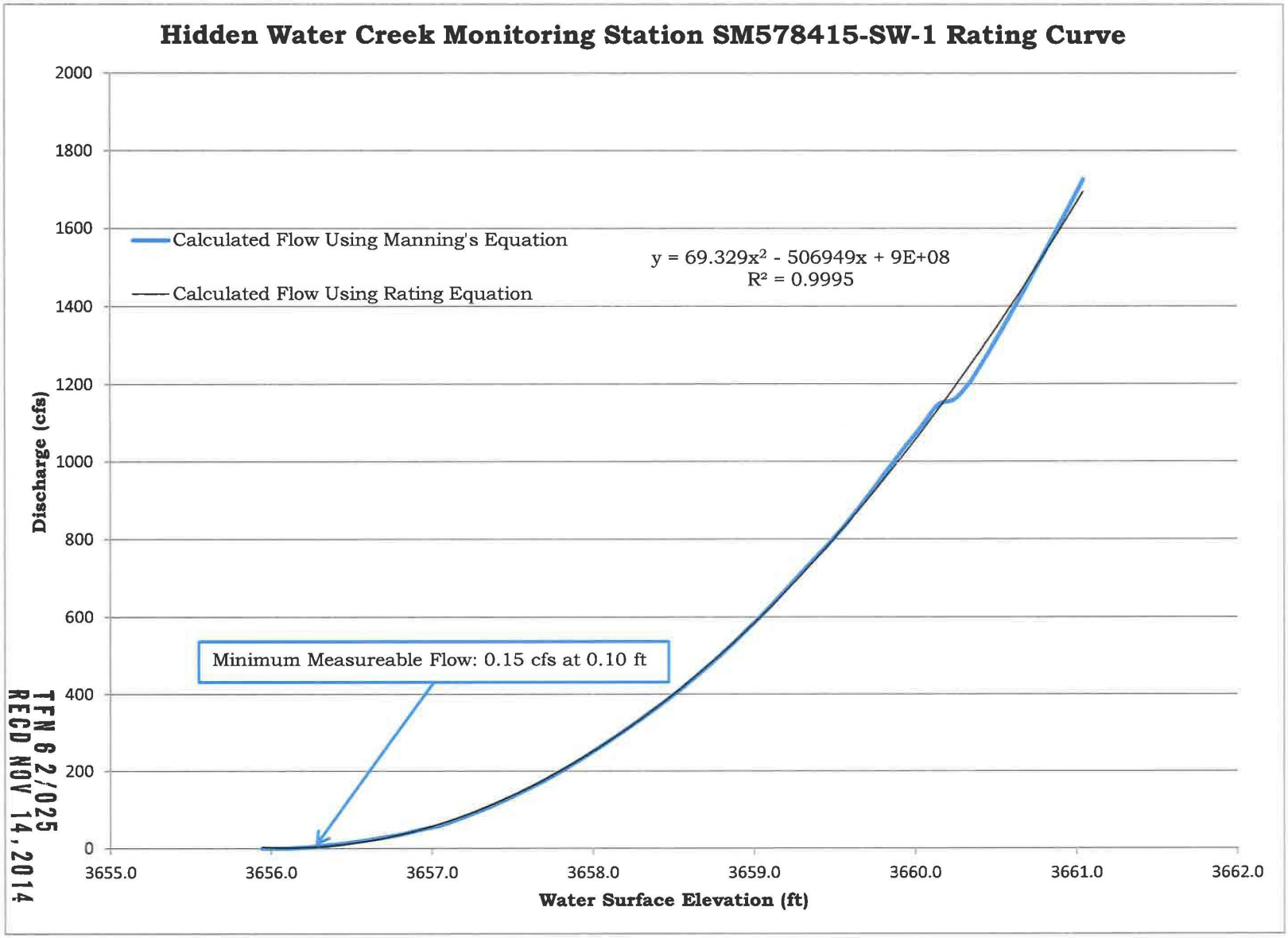
Slater Creek Monitoring Station SM578512-SW-1 Rating Curve



TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 2014



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ADDENDUM D6-6

ADDENDUM D6-6

Surface Water Quality

TFN 6 2/025
RECD NOV 14, 2014

RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578409-SW-1 (Hidden Water Creek - US)

Date 9/10/13 @ 1300

Technician/Engineer Jeff Barron / Rod Fuller

Devices

Flow/Automatic sampler Device Site investigation

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge ——— Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed ——— Ft

Crest gage readings if installed ——— Ft

Note: Investigation for suitable surface water site.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device ———

Flow Rate ——— CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
———							

Lab Information

Lab COC # ———

Date Samples to Lab ———

TFN 6 2/025
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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name SM578409-SW-1 (Hidden Water Creek - US)

Date 9/13/13

Technician/Engineer Joe Crump / Rod Fuller

Devices

Flow/Automatic sampler Device Not installed yet (ISCO Flowmeter)

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge — Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

*Note: Installed instrument Shelter, Solar panel battery, 1" pipe for tubing. Waiting for shipment of instrument

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578415-SW-1 (Hidden Water Creek - DS)

Date 9/10/13 @ 1400

Technician/Engineer Jeff Barron / Rod Fuller

Devices

Flow/Automatic sampler Device Site investigation

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge — Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Note: Investigated for suitable surface water site.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
—							

Lab Information

Lab COC # —

Date Samples to Lab —

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Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578415-SW-1 (Hidden Water Creek - DS)

Date 9/13/13

Technician/Engineer Joe Crump / Rod Fuller

Devices

Flow/Automatic sampler Device Not installed yet (Flowmeter)

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge ____ Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed ____ Ft

Crest gage readings if installed ____ Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device ____

Flow Rate ____ CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # ____

Date Samples to Lab ____

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RAMACO

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Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578418-SW-1 (Slatter Creek - DS)

Date 9/10/13 @ 1000

Technician/Engineer Jeff Barron / Rod Fuller

Devices

Flow/Automatic sampler Device Site investigation

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge — Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* note: Investigated for suitable surface water site.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client RAMACO

Site Name. SM578418-SW-1 (Slatter Creek - DS)

Date 9/12/13 @ 0900

Technician/Engineer Joe Crump, Rod Fuller

Devices

Flow/Automatic sampler Device Not installed yet. (Sampler/Flowmeter)

Device Flow or Stage Reading 0.00 CFS/FT Dry

Device Battery Charge — Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Note: Installed instrument shelter, solar panel battery, 1" pipe for tubing. Waiting for shipment of instrument

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate Dry CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

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WWC ENGINEERING

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578418-SW-1 (Slatter Creek - DS)

Date 9/17/13 @ 1430

Technician/Engineer Q. Fuller

Devices

Flow/Automatic sampler Device ISCO 6712 Sampler/Flowmeter

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Note: Installed ISCO 6712 S/F instrument on this day.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
—							

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name SM578512-SW-1 (Slatter Creek - US)

Date 9/10/13 @ 1130

Technician/Engineer Jeff Barron / Rod Fuller

Devices

Flow/Automatic sampler Device Site investigation

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge ——— Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed ——— Ft

Crest gage readings if installed ——— Ft

Note: Investigated for suitable surface water site.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device ———

Flow Rate ——— CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
———							

Lab Information

Lab COC # ———

Date Samples to Lab ———

TFN 6 2/025
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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578512-SW-1 (Slatter Creek - US)

Date 9/12/13 @ 1400

Technician/Engineer Joe Crump, Rod Fuller

Devices

Flow/Automatic sampler Device Not installed yet (ISCO flowmeter)

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge — Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Note: Installed instrument shelter, solar panel/battery, 1" PVC pipe for tubing. Waiting for shipment of instrument.

Instantaneous Flow

Measured Flow Yes or (No) Dry

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SMS78409-SW-1

Date 9/30/13 @ 1320

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device ISCO flowmeter - Installed on this date

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
—							

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578415-SW-1 (D.S. Hidden Water Crks)

Date 9/30/13 @ 1415

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device Isco flowmeter (Installed on this date)

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed ____ Ft

Crest gage readings if installed ____ Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device ____

Flow Rate ____ CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # ____

Date Samples to Lab ____

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578418-SW-1 (D.S. Slatten Crk.)

Date 9/30/13 @ 1115

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device ISCO 6712

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed ~ Ft

Crest gage readings if installed ~ Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device ~

Flow Rate ~ CFS

Include Stream Gaging Data

Grab Sample Collected Yes or No

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
~							

Lab Information

Lab COC # ~

Date Samples to Lab ~

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578512-SW-1 (U.S. Slatten Crk)

Date 9-30-13 @ 1200

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device Installed Flowmeter (ISCO)

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

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Brook Mine

Surface Water Field Sheet

Project/Client ~~SM578409~~ Ramaco

Site Name. SM578409-SW-1

Date 10/31/13 @ 1340

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device Isco flowmeter

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Took down site for Winter

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578415 -SW-1

Date 10/31/13

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device Isco Flowmeter

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Took site down for Winter

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. SM578418-SW-1

Date 10/31/13 @ 1040

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device Isco 6712

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Took down site for winter

nstantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco

Site Name. ~~[illegible]~~ SM578512-SW-1 (U.S. Slatter Creek)

Date 10/31/13 @ 1000

Technician/Engineer Fuller

Devices

Flow/Automatic sampler Device Isco flowmeter

Device Flow or Stage Reading 0.00/0.00 CFS/FT Dry

Device Battery Charge Good Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Took down site for winter.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
—							

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM 578409-SW-1

Date 4/22/14 @ 1600

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco Signature flowmeter

Device Flow or Stage Reading 0.0/0.0 CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Installed instrument for season. Slight flow - not enough to measure, Increase solar pannel size to increase charging to battery.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # _____

Date Samples to Lab _____

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM578415-SW-1

Date 4/24/14

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco Flowmeter (Signature)

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Set up instrument for season. Increase size of solar panel for increase charging to battery. Put up some fence around instrument/solar panel.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # —

Date Samples to Lab —

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco - 2013137-07

Site Name. SM578418-SW-1

Date 4/22/14 @ 1100

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco 6712 sampler/flowmeter

Device Flow or Stage Reading 0.84/0.14 CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed ---- Ft

Crest gage readings if installed ---- Ft

Installed instrument for season. Installed bigger solar panel for increased charging to battery.

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device ----

Flow Rate ---- CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # ----

Date Samples to Lab ----

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM578418-SW-1

Date 4/24/14

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device ISCO 6712 Sampler / Flowmeter

Device Flow or Stage Reading 2.19 / 0.21 CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected (Yes) or No

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
1440	8.48	1851	12.1	16.92	—		

HCF

Lab Information

Lab COC # 151522

Date Samples to Lab 4/24/14

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM 978512-SW-1

Date 4-22-14 @ 1300

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco Signature flow meter

Device Flow or Stage Reading 0.0/0.0 CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

* Set up site for season. No flow on device due to tubing not in thalwag. Need to add tubing to get to thalwag. Increase solar pannel size to increase solar pannel charging to battery.

Instantaneous Flow

Measured Flow (Yes) or No

Measurement Device Estimated

Flow Rate 3.0 CFS CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # _____

Date Samples to Lab _____

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

RUIT dw sample

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM 578512 - SW-1

Date 4/24/14

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco Signature flowmeter

Device Flow or Stage Reading 1.53/0.28 CFS/FT

Device Battery Charge Good Volts

Device Data Download Yes or (No)

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device —

Flow Rate — CFS

Include Stream Gaging Data

Grab Sample Collected (Yes) or No

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP
1400	8.58	1504	13.8	17.84	—	—	—

HCF

Lab Information

Lab COC # 151522

Date Samples to Lab 4/24/14

TFN 6 2/025
RECD NOV 14, 2014

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Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/1/2014
Report ID: S1404416001

Project: Ramaco-2013139-07
Lab ID: S1404416-002
Client Sample ID: SM578418-SW-1
COC: 151522

Work Order: S1404416
Collection Date: 4/24/2014 2:40:00 PM
Date Received: 4/24/2014 3:47:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.48			s.u.	04/24/2014 1440	Field
Conductivity	1851			µmhos/cm	04/24/2014 1440	Field
Turbidity	16.92			NTU	04/24/2014 1440	Field
Temperature	12.1			°C	04/24/2014 1440	Field
General Parameters						
pH	8.4	0.1		s.u.	04/28/2014 1558 KV	SM 4500 H B
Electrical Conductivity	1890	5		µmhos/cm	04/28/2014 1558 KV	SM 2510B
Total Dissolved Solids (180)	1560	10		mg/L	04/25/2014 1506 BT	SM 2540
Solids, Total Dissolved (Calc)	1350	10		mg/L	04/30/2014 0813 JJ	SM 1030E
Total Suspended Solids	9	5		mg/L	04/28/2014 1006 BT	SM 2540
Alkalinity, Total (As CaCO3)	340	5		mg/L	04/28/2014 1558 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	816	1		mg/L	04/30/2014 0813 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	04/28/2014 1144 RH	EPA 350.1
'gen, Dissolved	10	1		mg/L	04/24/2014 1553 KB	SM 4500-O G
.'rbidity	13.9	0.1		NTU	04/25/2014 1454 KB	SM 2130
Sodium Adsorption Ratio	2.2	0.1			04/30/2014 0813 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	395	5		mg/L	04/28/2014 1558 KV	SM 2320B
Alkalinity, Carbonate as CO3	10	5		mg/L	04/28/2014 1558 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	04/28/2014 1558 KV	SM 2320B
Chloride	8	1		mg/L	04/27/2014 0300 AMB	EPA 300.0
Fluoride	0.6	0.1		mg/L	04/28/2014 1558 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	04/28/2014 1422 RH	EPA 353.2
Sulfate	732	1		mg/L	04/27/2014 0300 AMB	EPA 300.0
Cations						
Calcium	104	1		mg/L	04/25/2014 1730 DG	EPA 200.7
Magnesium	136	1		mg/L	04/25/2014 1730 DG	EPA 200.7
Potassium	16	1		mg/L	04/25/2014 1730 DG	EPA 200.7
Sodium	147	1		mg/L	04/25/2014 1730 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- M Value exceeds Monthly Ave or MCL or is less than LCL
- O Outside the Range of Dilutions
- X Matrix Effect
- C Calculated Value
- H Holding times for preparation or analysis exceeded
- L Analyzed by a contract laboratory
- ND Not Detected at the Reporting Limit
- S Spike Recovery outside accepted recovery limits

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-6-25

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/1/2014
Report ID: S1404416001

Project: Ramaco-2013139-07
Lab ID: S1404416-002
Client Sample ID: SM578418-SW-1
COC: 151522

Work Order: S1404416
Collection Date: 4/24/2014 2:40:00 PM
Date Received: 4/24/2014 3:47:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	6.47	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Carbonate as CO3	0.31	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Chloride	0.21	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Fluoride	0.02	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Sulfate	15.24	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Calcium	5.17	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Magnesium	11.15	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Potassium	0.40	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Sodium	6.37	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	23.11	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
ion Sum	22.27	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
ion-Anion Balance	1.84	0.01		%	04/30/2014 0813 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.6	0.1		mg/L	04/25/2014 1730 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	04/25/2014 1459 MS	EPA 200.8
Barium	ND	0.1		mg/L	04/25/2014 1459 MS	EPA 200.8
Boron	0.2	0.1		mg/L	04/25/2014 1730 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	04/25/2014 1459 MS	EPA 200.8
Chromium	ND	0.01		mg/L	04/25/2014 1730 DG	EPA 200.7
Copper	ND	0.01		mg/L	04/25/2014 1459 MS	EPA 200.8
Iron	0.35	0.05		mg/L	04/25/2014 1730 DG	EPA 200.7
Lead	ND	0.02		mg/L	04/25/2014 1459 MS	EPA 200.8
Manganese	0.12	0.02		mg/L	04/25/2014 1730 DG	EPA 200.7
Mercury	ND	0.001		mg/L	04/30/2014 1130 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	04/25/2014 1459 MS	EPA 200.8
Nickel	ND	0.01		mg/L	04/25/2014 1730 DG	EPA 200.7
Selenium	ND	0.005		mg/L	04/25/2014 1459 MS	EPA 200.8
Zinc	ND	0.01		mg/L	04/25/2014 1730 DG	EPA 200.7
Total Metals						
Iron	0.39	0.05		mg/L	04/28/2014 2154 DG	EPA 200.7
Manganese	0.13	0.02		mg/L	04/28/2014 2154 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14,2014

Addendum D6-6-26

RAMACO
Inter-Mountain Labs
INTER-MOUNTAIN LABS
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/1/2014
Report ID: S1404416001

Work Order: S1404416
Project: Ramaco-2013139-07
Collection Date: 4/24/2014 2:00:00 PM
Lab ID: S1404416-001
Date Received: 4/24/2014 3:47:00 PM
Client Sample ID: SM578512-SW-1
Sampler: RF
COC: 151522
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.58			s.u.	04/24/2014 1400	Field
Conductivity	1504			µmhos/cm	04/24/2014 1400	Field
Turbidity	17.84			NTU	04/24/2014 1400	Field
Temperature	13.8			°C	04/24/2014 1400	Field
General Parameters						
pH	8.4	0.1		s.u.	04/28/2014 1547 KV	SM 4500 H B
Electrical Conductivity	1540	5		µmhos/cm	04/28/2014 1547 KV	SM 2510B
Total Dissolved Solids (180)	1220	10		mg/L	04/25/2014 1505 BT	SM 2540
Solids, Total Dissolved (Calc)	1050	10		mg/L	04/30/2014 0813 JJ	SM 1030E
Total Suspended Solids	8	5		mg/L	04/28/2014 1005 BT	SM 2540
Alkalinity, Total (As CaCO3)	303	5		mg/L	04/28/2014 1547 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	653	1		mg/L	04/30/2014 0813 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	04/28/2014 1143 RH	EPA 350.1
'gen, Dissolved	10	1		mg/L	04/24/2014 1553 KB	SM 4500-O G
.'rbidity	13.4	0.1		NTU	04/25/2014 1452 KB	SM 2130
Sodium Adsorption Ratio	1.9	0.1			04/30/2014 0813 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	347	5		mg/L	04/28/2014 1547 KV	SM 2320B
Alkalinity, Carbonate as CO3	11	5		mg/L	04/28/2014 1547 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	04/28/2014 1547 KV	SM 2320B
Chloride	5	1		mg/L	04/27/2014 0245 AMB	EPA 300.0
Fluoride	0.5	0.1		mg/L	04/28/2014 1547 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	04/28/2014 1421 RH	EPA 353.2
Sulfate	550	1		mg/L	04/27/2014 0245 AMB	EPA 300.0
Cations						
Calcium	87	1		mg/L	04/25/2014 1728 DG	EPA 200.7
Magnesium	106	1		mg/L	04/25/2014 1728 DG	EPA 200.7
Potassium	11	1		mg/L	04/25/2014 1728 DG	EPA 200.7
Sodium	112	1		mg/L	04/25/2014 1728 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

- B Analyte detected in the associated Method Blank
- C Calculated Value
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- J Analyte detected below quantitation limits
- L Analyzed by a contract laboratory
- M Value exceeds Monthly Ave or MCL or is less than LCL
- ND Not Detected at the Reporting Limit
- O Outside the Range of Dilutions
- S Spike Recovery outside accepted recovery limits
- X Matrix Effect

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-6-27

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/1/2014
Report ID: S1404416001

Project: Ramaco-2013139-07
Lab ID: S1404416-001
Client Sample ID: SM578512-SW-1
COC: 151522

Work Order: S1404416
Collection Date: 4/24/2014 2:00:00 PM
Date Received: 4/24/2014 3:47:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	5.69	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Carbonate as CO3	0.36	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Chloride	0.14	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Fluoride	0.02	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Sulfate	11.45	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Calcium	4.34	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Magnesium	8.71	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Potassium	0.28	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Sodium	4.89	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	18.23	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
ion Sum	17.68	0.01		meq/L	04/30/2014 0813 JJ	SM 1030E
ion-Anion Balance	1.53	0.01		%	04/30/2014 0813 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	04/25/2014 1728 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	04/25/2014 1426 MS	EPA 200.8
Barium	ND	0.1		mg/L	04/25/2014 1426 MS	EPA 200.8
Boron	0.1	0.1		mg/L	04/25/2014 1728 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	04/25/2014 1426 MS	EPA 200.8
Chromium	ND	0.01		mg/L	04/25/2014 1728 DG	EPA 200.7
Copper	ND	0.01		mg/L	04/25/2014 1426 MS	EPA 200.8
Iron	ND	0.05		mg/L	04/25/2014 1728 DG	EPA 200.7
Lead	ND	0.02		mg/L	04/25/2014 1426 MS	EPA 200.8
Manganese	0.08	0.02		mg/L	04/25/2014 1728 DG	EPA 200.7
Mercury	ND	0.001		mg/L	04/30/2014 1124 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	04/25/2014 1426 MS	EPA 200.8
Nickel	ND	0.01		mg/L	04/25/2014 1728 DG	EPA 200.7
Selenium	ND	0.005		mg/L	04/25/2014 1426 MS	EPA 200.8
Zinc	ND	0.01		mg/L	04/25/2014 1728 DG	EPA 200.7
Total Metals						
Iron	0.35	0.05		mg/L	04/28/2014 2150 DG	EPA 200.7
Manganese	0.09	0.02		mg/L	04/28/2014 2150 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Inter-Mountain Labs

Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

Page of

151522

All shaded fields must be completed.
This is a legal document: any misrepresentation may be construed as fraud.

October 2014

RAMACO

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC/Ramaco	Ramaco - 2013139-07	Rod Fuller	

Report Address	Contact Name	Email	Phone
WWC	Jeff Barron - WWC		

Invoice Address	Purchase Order #	Quote #
WWC		440

ANALYSES / PARAMETERS: Quote 440

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME	SAMPLE IDENTIFICATION	Matrix	# of Containers	REMARKS
1	31404 4/6- 01	4/24/14	1400	SM578512-SW-1	WT	4	✓
2				pH = 8.58, EC = 1504, T = 13.8, TUR = 17.84			
3							
4	002	4/24/14	1440	SM578418-SW-1	WT	4	✓
5				pH = 8.48, EC = 1851, T = 12.1, TUR = 16.92			
6							
7							
8							
9							
10							
11							
12							
13							
14							

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-6-29

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
RO1	Rod Fuller	4/24/14	1547	Kathy Fox	4.24.14	15:47

Brook Mine

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION	ADDITIONAL REMARKS
☐ UPS	Water	(WT)	**Check desired service**	Compliance Monitoring? Y / N	
☐ Fed Express	Soil	SL	☒ Standard turnaround	Program (SDWA, NPDES,...)	
☐ US Mail	Solid	SD	☐ **RUSH - 5 Working Days**	PWSID / Permit #	
☐ Hand Carried	Filter	FT	☐ **URGENT** - < 2 Working Days	Chlorinated? Y / N	
☐ Other _____	Other	OT	***Rush & Urgent Surcharges will be applied***	Sample Disposal: Lab Client	

RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM578409-SW-1

Date 5/20/14 @ 1430

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco signature flow meter

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge 13.15 Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device _____

Flow Rate _____ CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # _____

Date Samples to Lab _____

TFN 6 2/025
RECD NOV 14, 2014

K:\WWC\ADM\FORMS\Surface_Water_Field_Sheet.doc

Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM578415-SW-1

Date 5/20/14

Technician/Engineer Q. Fulks

Devices

Flow/Automatic sampler Device ISCO - Signature flow meter

Device Flow or Stage Reading Dry CFS/FT

Device Battery Charge Good - 13.06 Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No;)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

nstantaneous Flow

Measured Flow Yes or (No)

Measurement Device _____

Flow Rate _____ CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # _____

Date Samples to Lab _____

TFN 6 2/025
RECD NOV 14, 2014

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RAMACO

WWC ENGINEERING

Brook Mine

Surface Water Field Sheet

Project/Client Ramaco - 2013139-07

Site Name. SM578418-SW-1

Date 5/22/14

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco Signature flowmeter

Device Flow or Stage Reading 0.50/0.12 CFS/FT

Device Battery Charge Good Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device

Flow Rate CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC #

Date Samples to Lab

TFN 6 2/025
RECD NOV 14, 2014

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Surface Water Field Sheet

Project/Client Ramaco / 2013139-07

Site Name. SM5TB512-SW-1

Date 5/22/13 @ 1405

Technician/Engineer R. Fuller

Devices

Flow/Automatic sampler Device Isco Signature flowmeter

Device Flow or Stage Reading 1.41/0.26 CFS/FT

Device Battery Charge 12.91 Volts

Device Data Download (Yes) or No

Sample Collected by Device Yes or (No)

Staff gage reading if installed — Ft

Crest gage readings if installed — Ft

Instantaneous Flow

Measured Flow Yes or (No)

Measurement Device _____

Flow Rate _____ CFS

Include Stream Gaging Data

Grab Sample Collected Yes or (No)

Water Quality Field Parameters for Storm or Instantaneous Sample

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	DO mg/l	DO %	ORP

Lab Information

Lab COC # _____

Date Samples to Lab _____

TFN 6 2/025
RECD NOV 14, 2014

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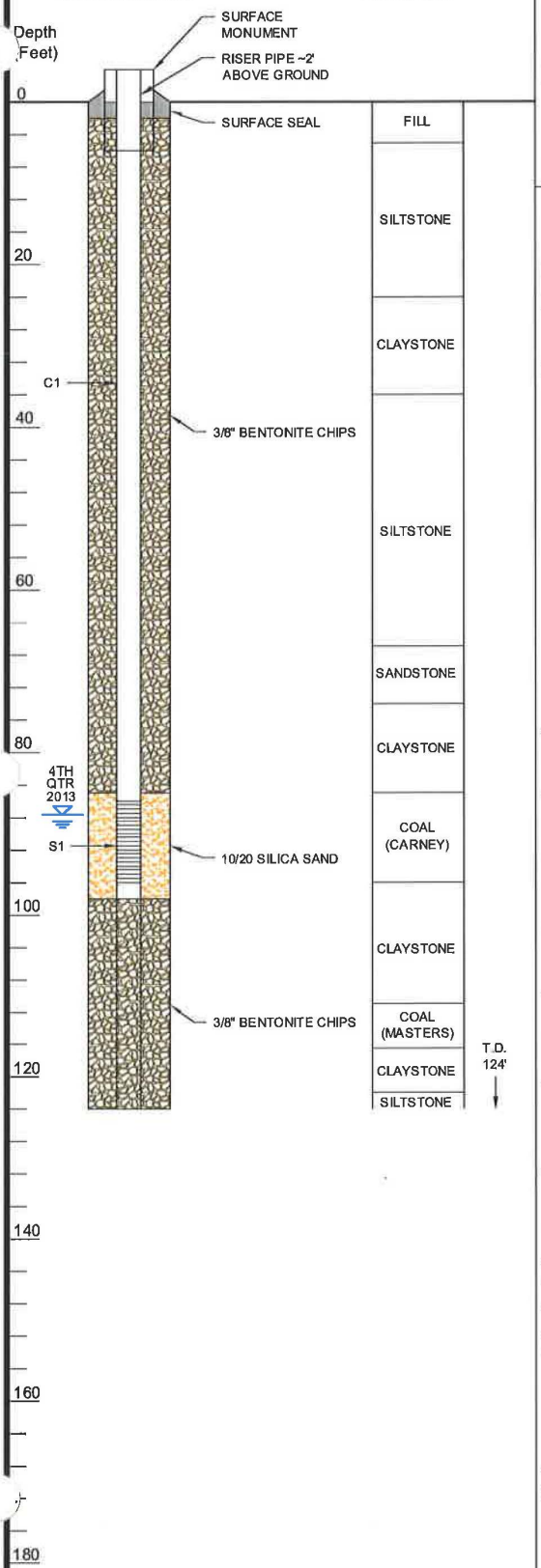
ADDENDUM D6-7

Monitor Well Completion Data

TFN 6 2/025
RECD JUL 30, 2015

DEQ 6-237



Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578408-CRN

Location: N 1,394,415.5 E 1,941,809.9 EL 3,887.7

NE /4, SE /4, Section 8 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 98'

Hole Dia.: 5-1/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 5-1/8" core barrel

Fluid: Water and foam

Casing: 2" SCH 40 flush thread PVC

Well Data

Casing: C=Casing S=Screen

C1 - 86 - +2 | S1 - 96 - 86

Monument or Surface Casing:
6" Locking Steel

Centralizer:
5 at 20' intervals

Casing C1:
2" SCH 40 flush thread PVC

Screen S1:
2" SCH 40 flush thread PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 98 - 85

Bentonite:
3/8" chips
Depth: 124 - 98
85 - 2.0

Cement:
Type 1
Depth: 2.0 - 0

Other:
44 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
8/30/13	1:00pm	3:00pm
9/3/13	7:00am	10:30am

Casing:	Start	End
9/3/13	11:15am	2:50pm

Well Development

Began development on 9/3/13 at 2:15pm.

Well produced very turbid mist.

Inject water, little spray then mist from well.

Cleaned up slightly.

Cease development at 2:40pm.

Remarks

Cored to bottom of Masters - 124'.

Chipped to bottom of Carney to install well - 98' (4 bags bentonite).

Wellbore wash-out occurred, evident by volume of annular sealant required.

TFN 6 2/025
RECD JUL 30, 2015

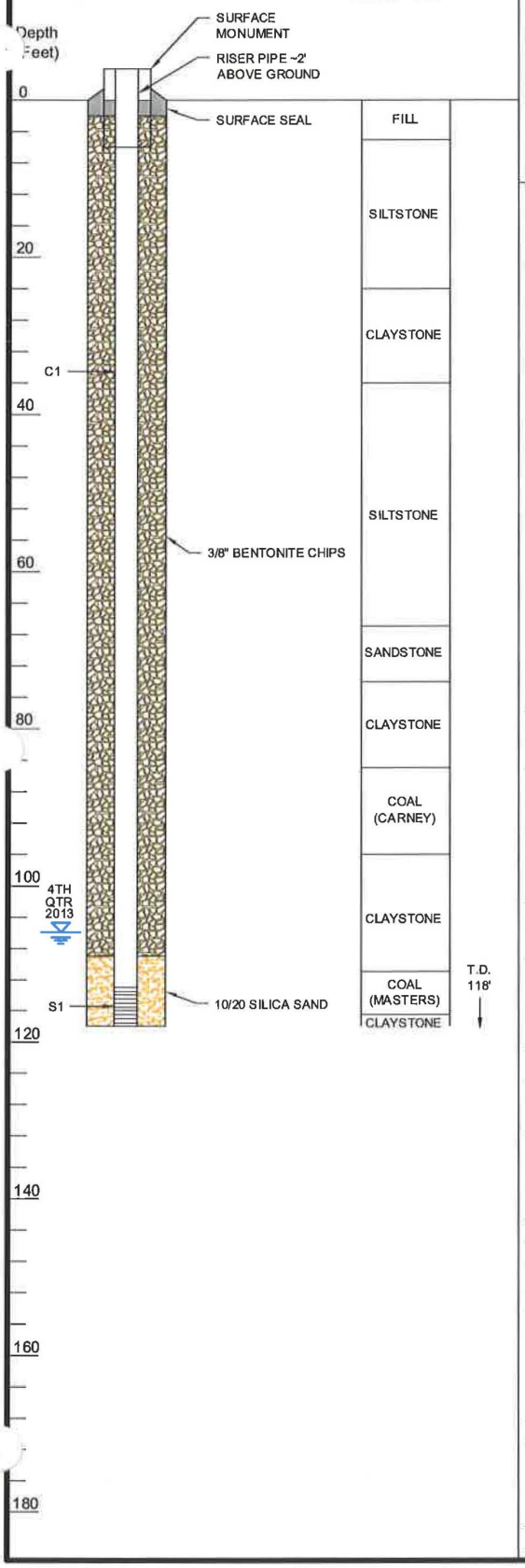
Abandoned

Date:

Method:

WWC ENGINEERING

K:\Sheridan\RAMACO\13139\ACAD_WY83EC\DWGS_D6_RESPONSE\MW_578408-CRN_R1.dwg 5/20/2015 1:34:45 PM dave johnson



Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578408-MST

Location: N 1,394,423.1 E 1,941,802.4 EL 3,887.9

NE /4, SE /4, Section 8 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 118'

Hole Dia.: 5-5/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 5-5/8" Spade

Fluid: Water and foam

Casing: 2" SCH 40 flush thread PVC

Well Data

Casing: C=Casing S=Screen

C1 - 113 - +2 | S1 - 113 - 118

Monument or Surface Casing:
6" Locking Steel

Centralizer:
5 at 25' intervals

Casing C1:
2" SCH 40 flush thread PVC

Screen S1:
2" SCH 40 flush thread PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 109 - 118

Bentonite:
3/8" chips
Depth: 109 - 2.0

Cement:
Type 1
Depth: 2.0 - 0

Other:
23 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
8/30/13	7:00am	8:00am

Casing:	Start	End
8/30/13	9:00am	11:30am

Well Development

Began development on 8/30/13 at 11:30am.

Residual drilling foam evident in produced water.

Flush well with water to remove foam.

Blow dry - little spray, then mist.

Cleaned up slightly.

Ceased development at 12:00pm.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

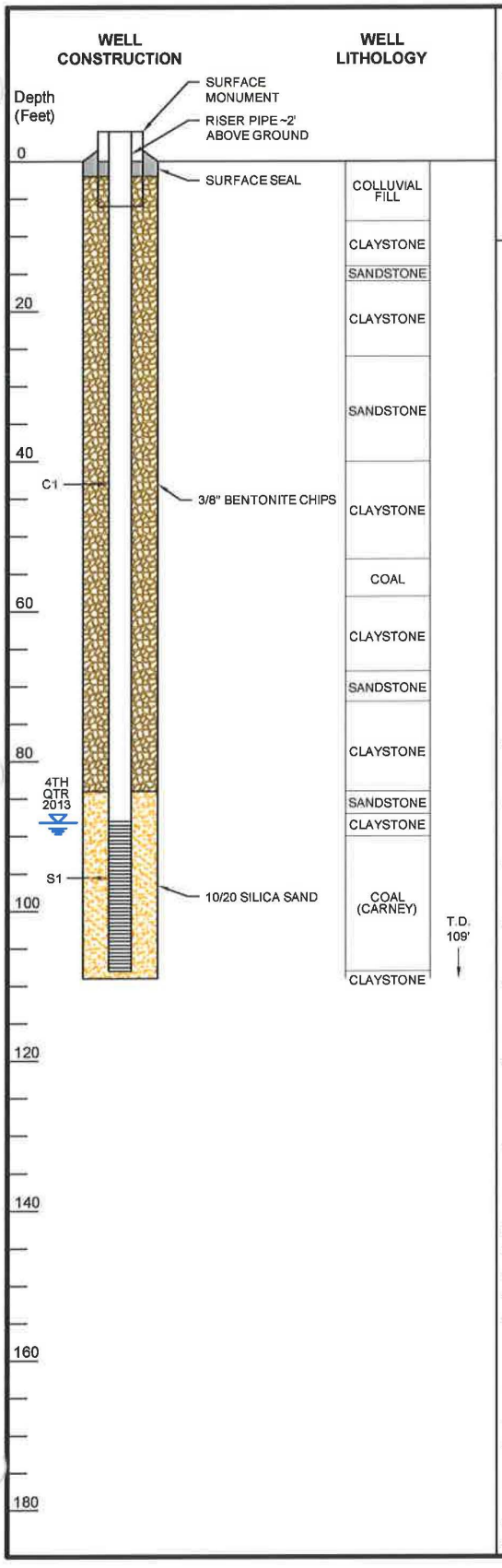
Abandoned

Date:

Method:

WWC ENGINEERING

K:\Sheridan\RAMACO\13139\ACAD_WY83EC\DWGS_D6_RESPONSE\MW_578408-MST_R1.dwg 5/20/2015 1:35:01 PM dave johnson



Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578409-CRN

Location: N 1,940,097.5 E 1,399,549.2 EL 3,710.1

SE /4, SE /4, Section 9 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 109'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller (surface)
9-7/8" PDC

Fluid: Water, air, foam

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 88 - +2 | S1 - 88 - 108

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 on screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 84 - 109

Bentonite:
3/8" chips
Depth: 84 - 1

Cement:
Type 1
Depth: 1 - +0.5

Other:
20 bags sand in annulus
42 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
10/1/13	3:00pm	3:30pm
10/2/13	6:00am	7:55am

Casing:	Start	End
10/2/13	7:55am	8:45am

Well Development

Began development on 10/2/13 at 8:45am.

Blow out drilling fluid and begin injecting water.

Blow out

Well making approximately 1gpm.

Sample at 9:00am:
Turb: 167NTU
Temp: 10.2°C
PH: 8.41
Conduct: 1157µS
(residual river water)

Let sit from 9:00am to 9:14am.

Sample at 9:20am:
Turb: 160NTU
Temp: 9.9°C
PH: 8.56
Conduct: 1303µS

Water from truck:
Temp: 9.6°C
PH: 8.83
Conduct: 388µS

Let sit from 9:22am to 9:33am.

Sample at 9:38am:
Turb: 96.4NTU
Temp: 9.4°C
PH: 8.64
Conduct: 1480µS

Cease development at 9:40am.

Produced approximately 20 gallons from well during development.

Remarks

Filter pack slightly higher tan intended sandstone above Carney may be in communication with the filter pack. Low air development rates suggest that communication is not an issue.

TFN 6 2/025
RECD OCT 23, 2015

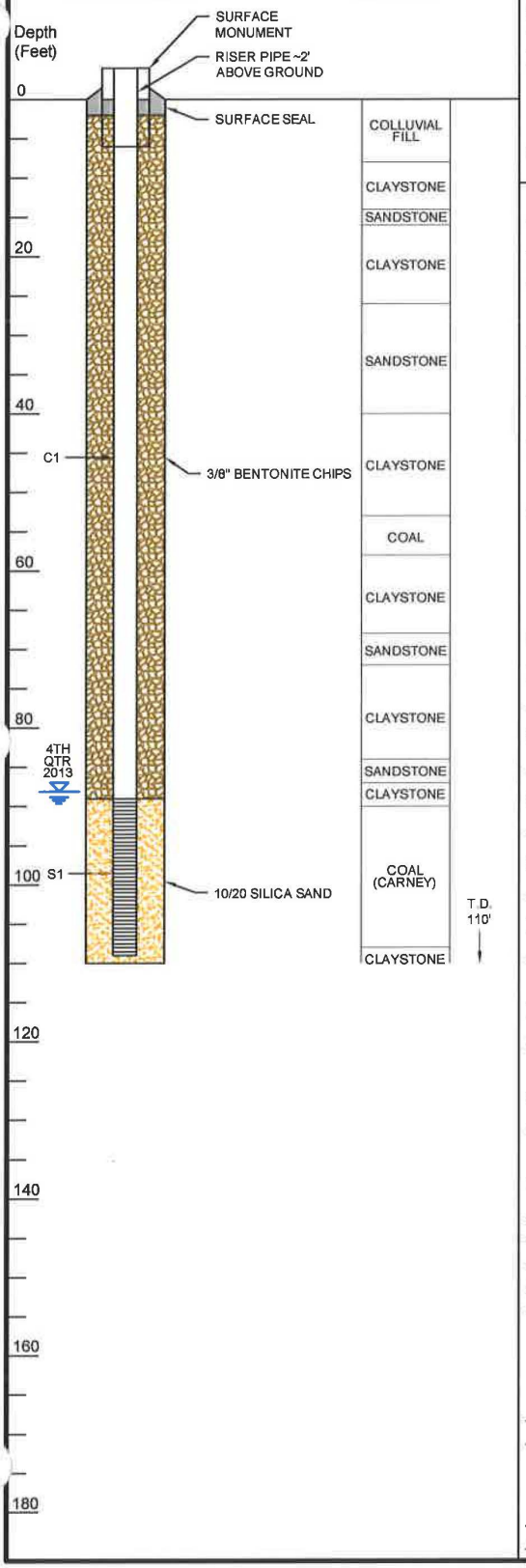
Abandoned

Date:

Method:

WWC ENGINEERING

K:\Sheridan\RAMACO\13139\ACAD_WY83EC\DWGS_D6_RESPONSE_2\MW_578409-CRN_R2.dwg 9/25/2015 8:42:09 AM loren ruttinger



Well Construction Summary

Client: Ramaco
Project: Brook Mine Monitor Network Well: 578409-CRN-OB
Location: N 1,940,108.4 E 1,399,537.8 EL 3,710.3
SE /4, SE /4, Section 9 T. 57 N. R. 84 W.
Geologist: Swayne Redinger

Drilling Summary

Total Depth: 110'
Hole Dia.: 9-7/8"
Driller: Shawn Ankney

Rig: Gardner Denver 1500
Bit(s): 14-3/4" roller (surface)
9-7/8" PDC

Fluid: Water, air, foam, polymer

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 89 - +2 | S1 - 89 - 109

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 on screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 89 - 110

Bentonite:
3/8" chips
Depth: 89 - 1

Cement:
Type 1
Depth: 1 - +0.5

Other:
18 bags sand in annulus
49 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
10/2/13	10:00am	11:30am

Casing:	Start	End
10/2/13	11:30am	12:25pm

Well Development

Began development on 10/2/13 at 12:25pm.

Blow out drilling fluid and begin injecting water.

Blow out water.

Well making approximately 3gpm (estimate)

Sample at 12:45pm:
Turb: 491NTU
Temp: 11.9°C
PH: 8.37
Conduct: 3.23mS

Cannot feel any pressure at adjacent CRN wellhead during development.

Sample at 12:55pm:
Turb: 895NTU
Temp: 11.6°C
PH: 8.49
Conduct: 2.75mS

Let well sit from 12:55pm to 1:04pm.
Well surged when development restarted.

Sample at 1:08pm:
Turb: 671NTU
Temp: 11.7°C
PH: 8.52
Conduct: 2.63mS

Let sit from 1:11pm to 1:20pm.

Sample at 1:25pm:
Turb: 788NTU
Temp: 11.7°C
PH: 8.56
Conduct: 2.55mS

Sample at 1:30pm:
Turb: 963NTU
Temp: 11.8°C
PH: 8.61
Conduct: 2.51mS

Cease development at 1:32 pm
Well produced approximately 90 gallons during development.

Remarks

Driller notes that he followed a fracture that threw him off course at approximately 40'.

TFN 6 2/025
RECD OCT 23, 2015

Abandoned

Date:
Method:

WWC ENGINEERING

K:\Sheridan\RAMACO\13139\ACAD_WY83EC\DWGS_D6_RESPONSE_2MW_578409-CRN-OB_R2.dwg 9/25/2015 8:43:24 AM loren ruttinger

Well Construction Summary

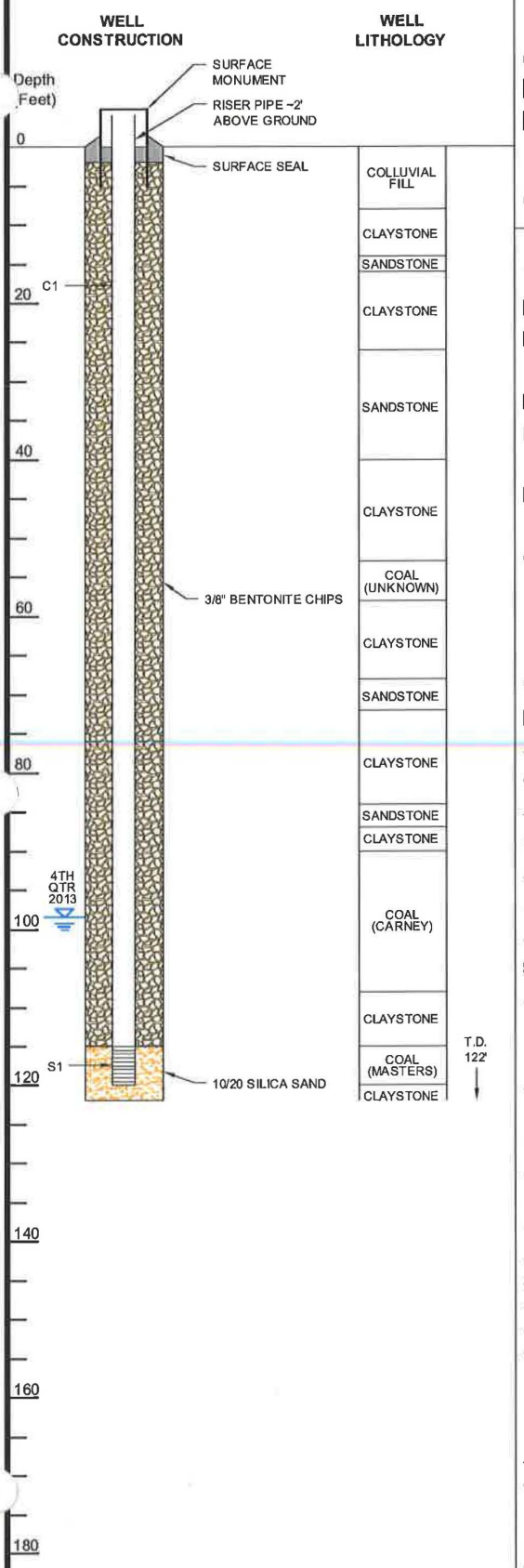
Client: Ramaco

Project: Brook Mine Monitor Network Well: 578409-MST

Location: N 1,940,087.6 E 1,399,559.3 EL 3,709.8

SE /4, SE /4, Section 9 T. 57 N. R. 84 W.

Geologist: Swayne Redinger



Drilling Summary

Total Depth: 122'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller (surface)
9-7/8" PDC

Fluid: Water, foam, air

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 115 - +2 | S1 - 115 - 120

Monument or Surface Casing:
8" Locking Steel

Centralizer:
2

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 115 - 122

Bentonite:
3/8" chips
Depth: 115 - 1

Cement:
Type 1
Depth: 1 - +0.5

Other:
5 bags sand in annulus
57 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
10/1/13	11:20am	12:50am

Casing:	Start	End
10/1/13	12:50am	1:45pm

Well Development

Began development on 10/1/13 at 1:45pm.

Blow out drill fluid and inject water and blow out.

Well making approximately 1gpm or less (estimate).

Sample at 1:55pm:
Turb: 852NTU
Temp: 14.1°C
Conduct: 866µS
PH: 8.38

Sample at 2:05pm:
Turb: 910NTU
Temp: 13.5°C
Conduct: 1833µS
PH: 8.69

Sample at 2:25pm:
Turb: 851NTU
Temp: 14.0°C
Conduct: 1912µS
PH: 8.77

Sample at 2:35pm:
Turb: 573NTU
Temp: 14.0°C
Conduct: 1932µS
PH: 8.82

Cease development at 2:35pm.

Produced approximately 40 gallons from well.

Parameters began to stabilize, may require additional development when more time is available.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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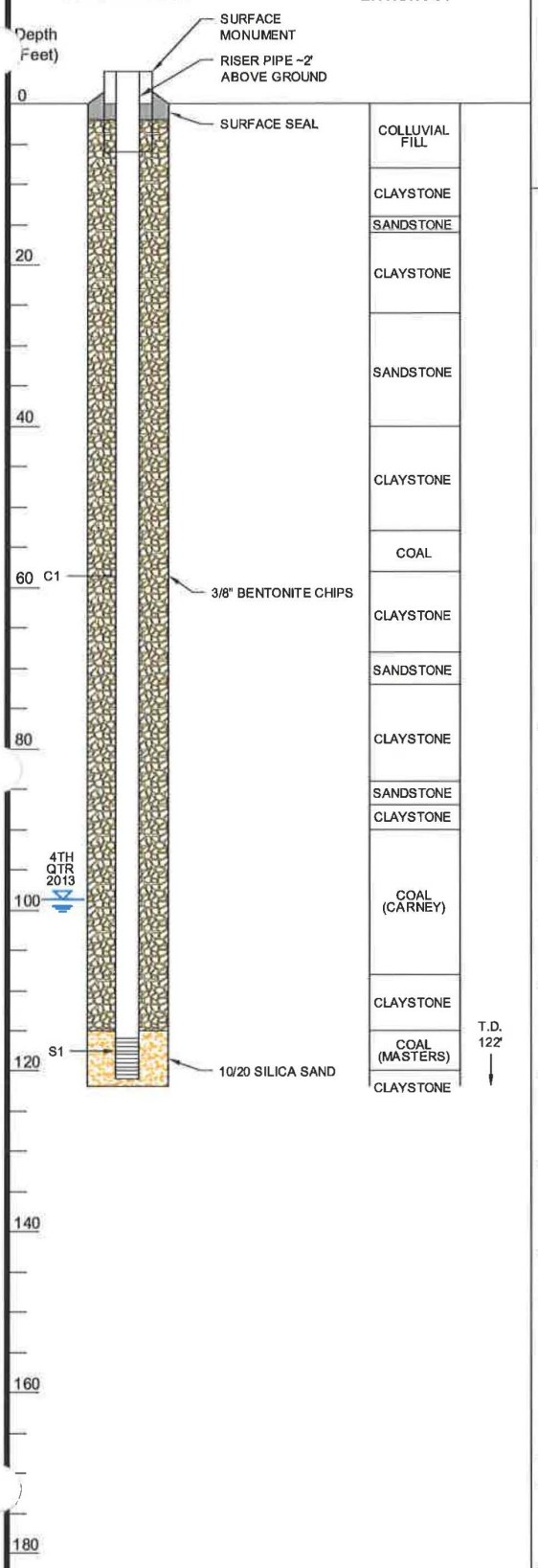


Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578409-MST-OB

Location: N 1,940,084.5 E 1,399,546.6 EL 3,710.3

SE /4, SE /4, Section 9 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 122'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller (surface)
9-7/8" PDC

Fluid: Air, water, foam

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 116 - +2 | S1 - 116 - 121

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 on screen, 1 20' up

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 122 - 115

Bentonite:
3/8" chips
Depth: 115 - 1

Cement:
Type 1
Depth: 1 - +0.5

Other:
5 bags sand in annulus
70 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
10/2/13	1:55pm	3:30pm

Casing:	Start	End
10/2/13	3:30pm	4:30pm

Well Development

Began development on 10/2/13 at 4:30pm.

Blow out drilling fluid and inject water.

Blow dry.

Well making approximately 1-2gpm.

Cease development at 4:55pm due to time constraints (weather).

Produced approximately 10 gallons from well.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

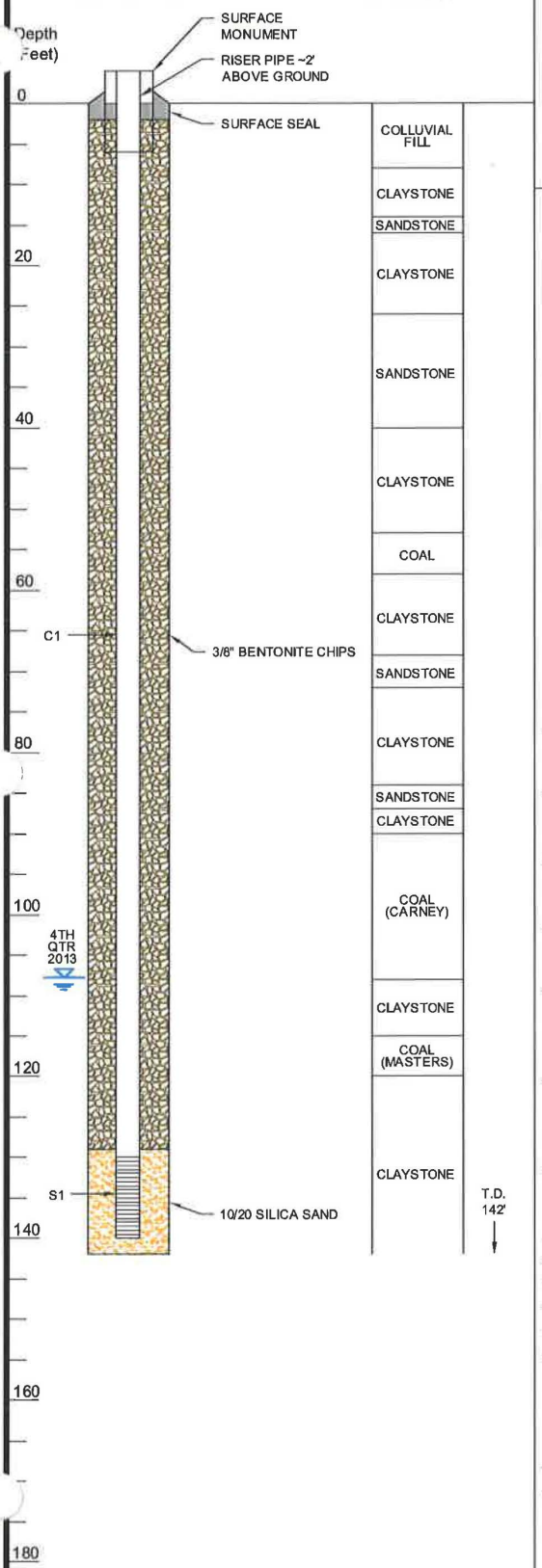
Abandoned

Date:

Method:

WWC ENGINEERING

K:\Sheridan\RAMACO\13139\ACAD_WY83EC\DWGS_D6_RESPONSE\MW_578409-MST-OB_R1.dwg 5/20/2015 1:36:06 PM dave johnson



Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578409-MST-UB

Location: N 1,940,076.6 E 1,399,568.3 EL 3,709.7

SE /4, SE /4, Section 9 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 142'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller (surface)
9-7/8" PDC

Fluid: Water, foam, polymer

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 130 - +2 | S1 - 130 - 140

Monument or Surface Casing:
8" Locking Steel

Centralizer:
3 at 20' intervals on bottom half of well

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 129 - 142

Bentonite:
3/8" chips
Depth: 129 - 1

Cement:
Type 1
Depth: 1 - +0.5

Other:
12 bags sand in annulus
60 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
10/1/13	6:30am	9:00am
Casing:	**Start**	**End**
10/1/13	9:00am	10:10am

Well Development

Began development on 10/1/13 at 10:15am.

Begin by blowing out excess drilling fluid and then adding water.

Blow until mist.

Well making approximately 1-2gpm (estimate)

Blow until 10:35am.

Still very turbid - adding more water.

Sample at 10:50am:
Turb: ~~17.72NTU~~ ERROR
Temp: 11.2°C
PH: 8.56
Conduct: 3.45mS

Cease development at 10:55am.

Produced approximately 60 gallons from well.

Additional development would be beneficial, however due to time constraints (weather) we ceased development at 10:55am.

Remarks

3 bags of chips from 119-129, may have small bridge in that interval.

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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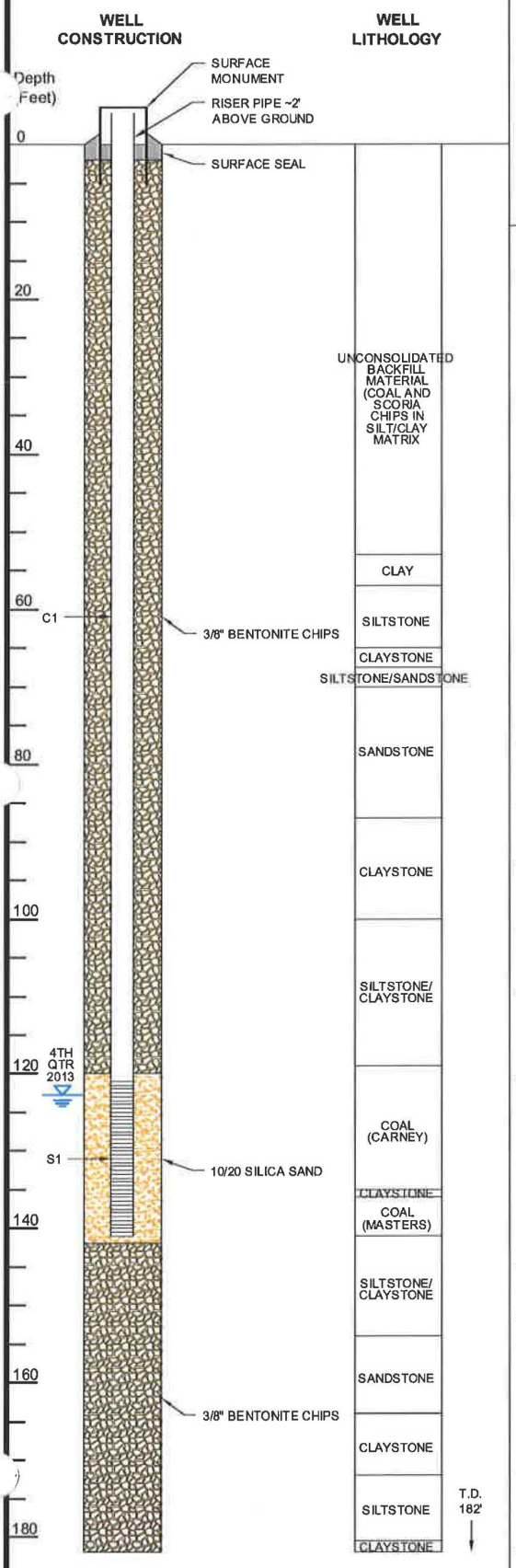

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578415-CRN/MST

Location: N 1,936,077.6 E 1,404,291.8 EL 3,611.4

NW /4, SE /4, Section 15 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 182'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller
9-7/8" roller and PDC

Fluid: Water, air, foam, gel

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 121 - +2 | S1 - 121 - 141

Monument or Surface Casing:
8" Locking Steel

Centralizer:
4 at 30' intervals

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 142 - 120

Bentonite:
3/8" chips
Depth: 120 - 1

Cement:
Type 1
Depth: 1 - +0.5

Other:
25 bags bentonite to plug back hole
21 bags sand in annulus
70 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
10/3/13	7:00am	
10/9/13		1:30pm

Casing:	Start	End
10/9/13	2:00pm	3:10pm

Well Development

Began development on 10/9/13 at 3:10pm.

Blow out drilling fluid and inject water from 3:24pm to 3:29pm.

Well making approximately 1-2gpm.

Sample at 3:42pm:
Turb: Error
Temp: 11.4°C
Conduct: 1398µS
PH: 8.17

Inject more water from 3:43pm to 3:54pm.

Sample at 4:00pm:
Turb: 319NTU
Temp: 10.7°C
Conduct: 1009µS
PH: 8.40

Sample at 4:15pm:
Turb: 144NTU
Temp: 11.4°C
Conduct: 1325µS
PH: 8.60

Cease development at 4:16pm.

Well produced approximately 50 gallons during development.

Remarks

Carney 119' - 135'.
Master 136' - 141'.
Completing together in one well.

Drilled to 182' but did not intersect any other coal bands.

Chipped back to 142' and complete well 121' HS - 141'.

Left 40' of 10" surface casing in hole as it separated from first joint.

TFN 6 2/025

RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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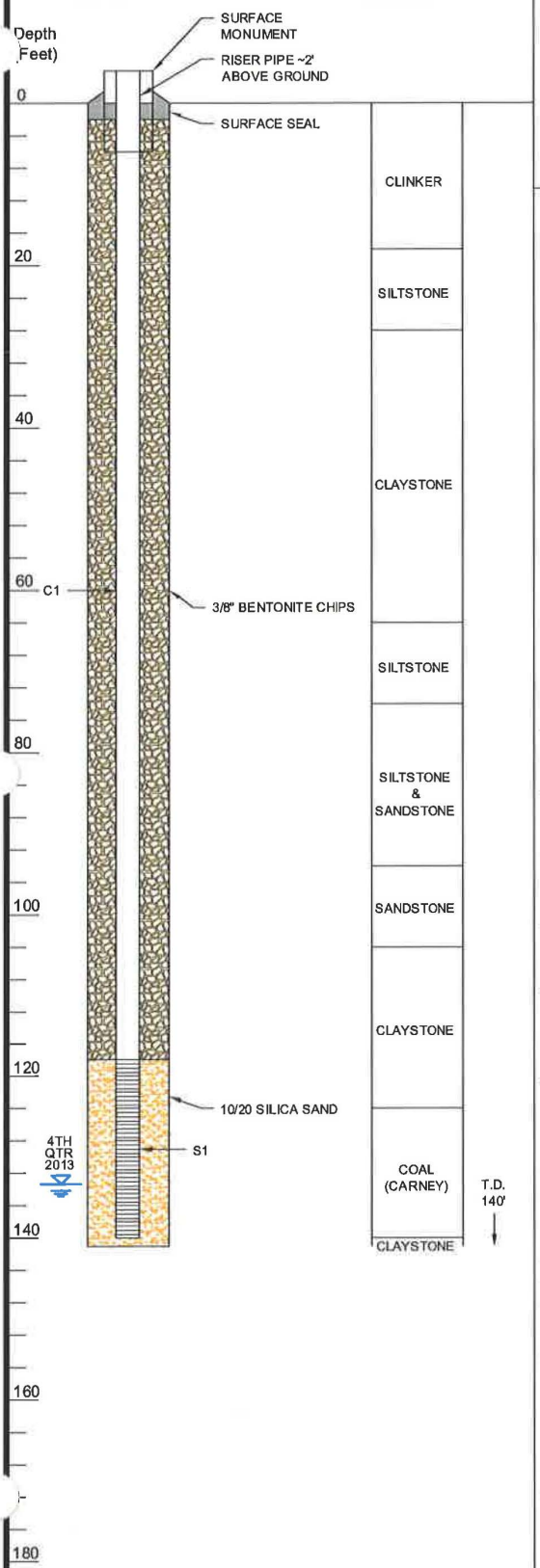

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578417-CRN

Location: N 1,391,364.2 E 1,939,152.3 EL 3,926.4

NW /4, NW /4, Section 17 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 141'

Hole Dia.: 5-5/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 5 5/8" spade

Fluid: Water and foam

Casing: 2" SCH 40 flush thread PVC

Well Data

Casing: C=Casing S=Screen

C1 - 120 - +2 | S1 - 118 - 140

Monument or Surface Casing:
6" Locking Steel

Centralizer:
5 at 25' intervals

Casing C1:
2" SCH 40 flush thread PVC

Screen S1:
2" SCH 40 flush thread PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 140 - 118

Bentonite:
3/8" chips
Depth: 118 - 2.0

Cement:
Type 1
Depth: 2.0 - 0

Other:
27 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
8/21/13	2:30pm	3:40pm

Casing:	Start	End
8/21/13	3:45pm	5:00pm

Well Development

Began development on 8/22 at 7:26am.

Well producing approximately 0.5 gpm.

Surged well in 15 minute increments.

Ceased air development at 8:27pm, well producing approximately 0.25 gpm.

Water very turbid.

Remarks

SWL = 131.67 on 8/26/13 at 8:00am.

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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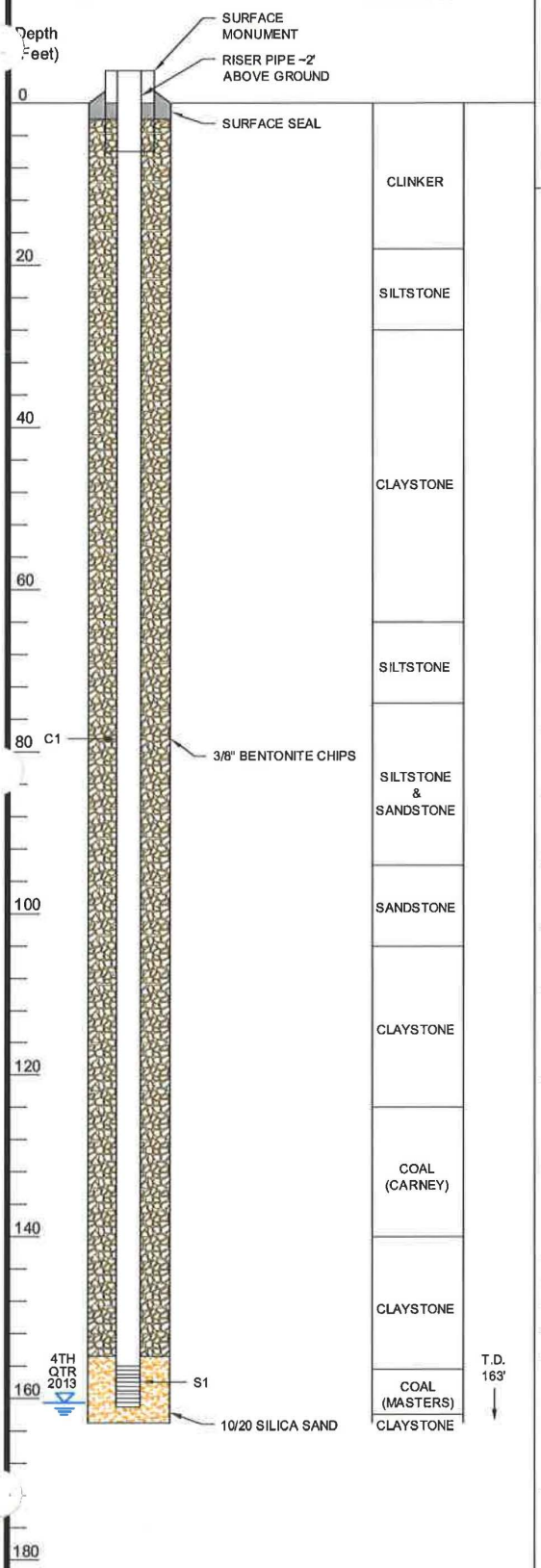

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578417-MST

Location: N 1,391,382.0 E 1,939,174.6 EL 3925.9

NW /4, NW /4, Section 17 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 163'

Hole Dia.: 5-1/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 5-1/8" core barrel

Fluid: Water, air

Casing: 2" SCH 40 flush thread PVC

Well Data

Casing: C=Casing S=Screen

C1 - 156 - +2 | S1 - 161 - 156

Monument or Surface Casing: 6" Locking Steel

Centralizer: 5 at 30' intervals

Casing C1: 2" SCH 40 flush thread PVC

Screen S1: 2" SCH 40 flush thread PVC with 0.020" slots

Filter Pack: 10/20 Colorado Silica Sand Depth: 163 - 155

Bentonite: 3/8" chips Depth: 155 - 2.0

Cement: Type 1 Depth: 2.0 - 0

Other: 22 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
8/21/13	6:30am	8:45am

Casing:	Start	End
8/21/13	9:00am	12:30pm

Well Development

Began development on 8/21/13 at 1:00pm.

Well producing approximately 0.25-0.5 gpm during airlift.

Added water and blew out.

Surged well in 15 minute increments.

Ceased development at 2:00pm.

Cleaned up slightly, still very turbid.

Remarks

Poured 4 bags very slow (10min/bag).

Bentonite at 90' after 4 bags, bridged. Cannot assume Masters sealed.

SWL comparisons between wells may demonstrate if communication exists between coals in this cluster.

SWL = 160.66 on 8/26/13 @ 8:00am.

TFN 6 2/025

RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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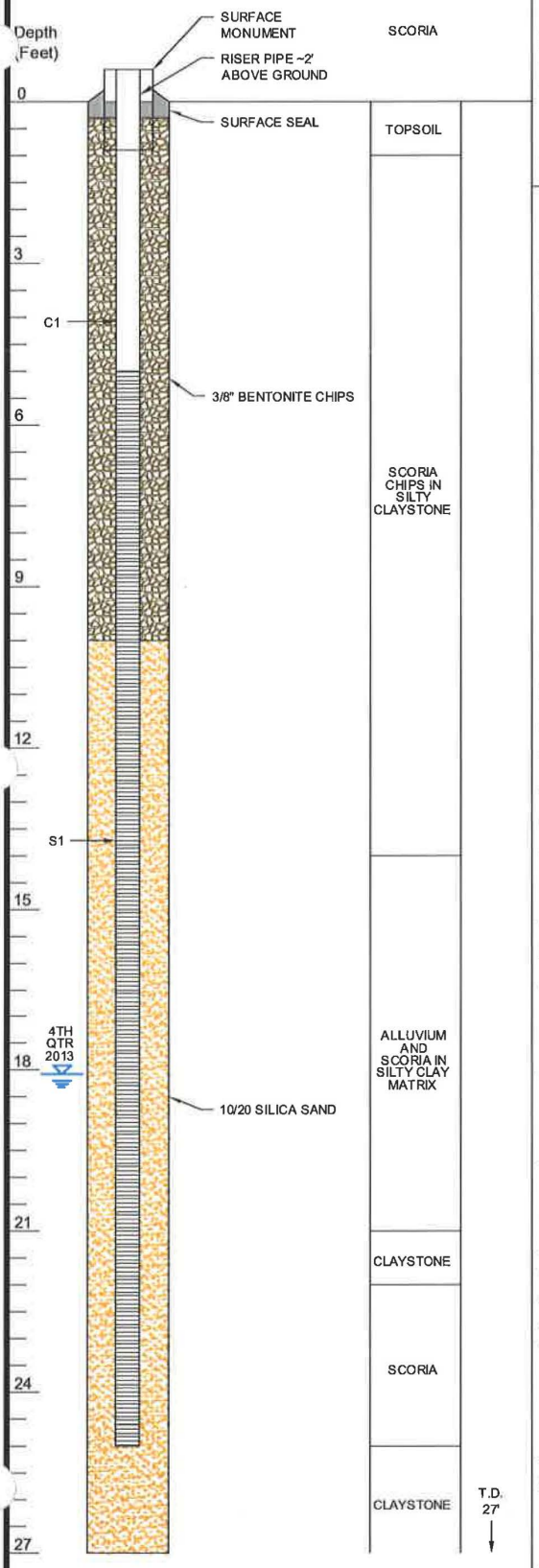

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578418-AL-1

Location: N 1,935,962.2 E 1,386,058.5 EL 3,687.5

NW /4, SW /4, Section 18 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 27'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" roller

Fluid: Gel

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 5 - +2 | S1 - 25 - 5

Monument or Surface Casing:
8" Locking Steel

Centralizer:
none

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 27 - 10

Bentonite:
3/8" chips
Depth: 10 - 2.0

Cement:
Type 1
Depth: 2.0 - 0.5

Other:
16 bags sand in annulus
3-1/2 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
9/30/13	10:30am	11:15am

Casing:	Start	End
9/30/13	11:15am	11:45am

Well Development

Begin development on 9/30/13 at 11:45am.
Blow out until 11:50.
Add water and blow out until mist.
Add more water and blow out until mist.
Well is making very little water.
Cease development at 12:30pm.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:
Method:

WWC ENGINEERING

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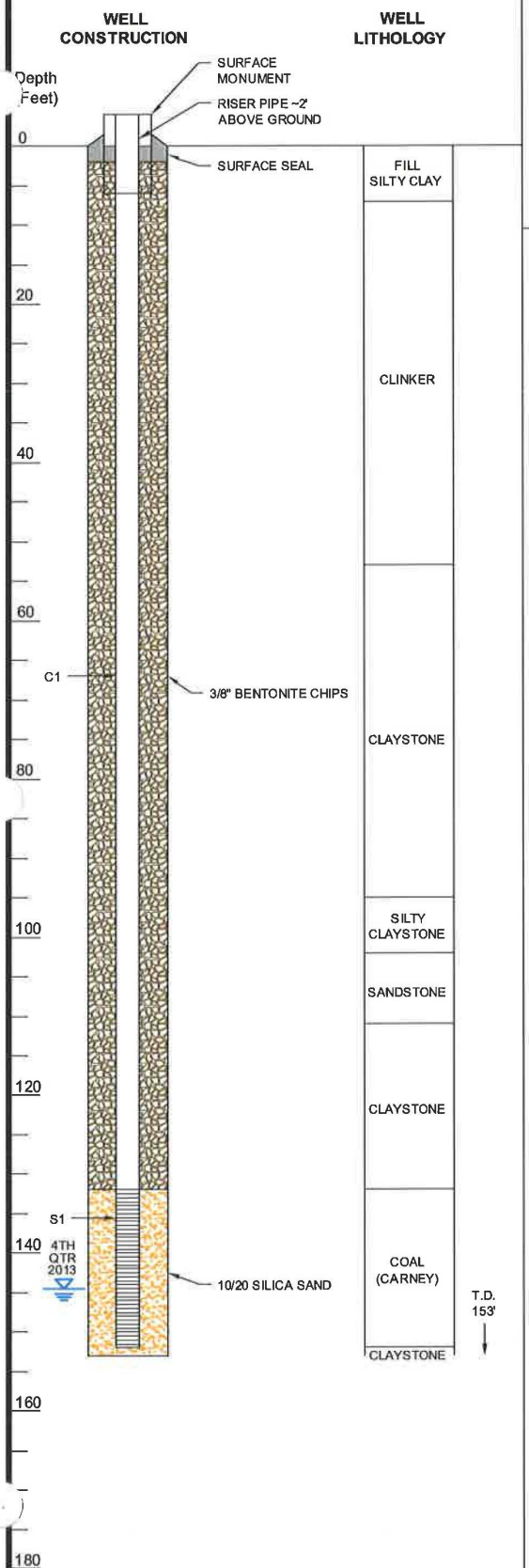

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578418-CRN

Location: N 1,936,927.8 E 1,387,102.2 EL 3,882.4

NW /4, NW /4, Section 18 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 153'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller (surface)
9-7/8" PDC to ream

Fluid: Water, foam, bentonite gel, polymer

Casing: 5" SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 132 - +3 | S1 - 152 - 132

Monument or Surface Casing:
8" locking steel

Centralizer:
1 at top of screen

Casing C1:
5" SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 153 - 132

Bentonite:
3/8" chips
Depth: 132 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
71 bags bentonite in annulus
14 bags sand in filter pack

Construction Time Log

Drilling:	Start	End
9/17/13	4:00pm	5:00pm
9/19/13	6:30am	11:45am

Casing:	Start	End
9/19/13	11:45am	12:45pm

Well Development

Began development on 9/19/13 at 1:00pm.

Inject water and blow dry.

Well appears dry or close to dry.

Fine mist at end of development, not sufficient to collect field sample.

Cease development @ 1:25pm.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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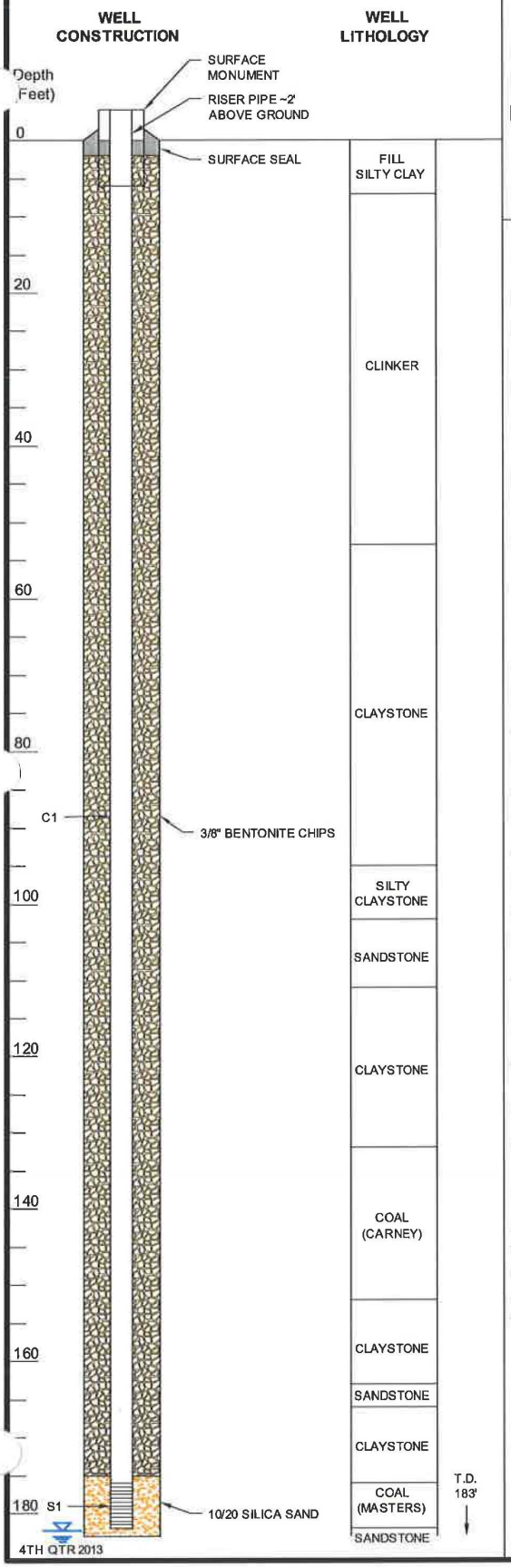

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578418-MST

Location: N 1,936,922.9 E 1,387,130.9 EL 3,883.6

NE /4, SW /4, Section 18 T. 57 N. R. 84 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 183'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller (surface)
9-7/8" PDC to ream

Fluid: Water, foam, polymer, bentonite mud

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 176 - +2 | S1 - 183 - 176

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 above screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 183 - 175

Bentonite:
3/8" chips
Depth: 175 - 7.0

Cement:
Type 1
Depth: 2.0 - 0

Other:

Construction Time Log

Drilling:	Start	End
9/16/13	9:00am	5:00pm
9/17/13	9:30am	11:15am

Casing:	Start	End
9/17/13	11:30am	1:15pm

Well Development

Began development on 9/17/13.

Blow 5 minutes - mist very black turbid.

Inject water for 5 minutes, cleaning up.

Blow dry, well appears dry.

Let sit from 1:36 to1:48, no surge.

Add water and blow dry, well dry or very close to it.

Ceased development at 2:00pm.

Remarks

SWL = 182.05' on 9/19/13 at 11:30am.

Appears dry as screen 176-182'.

TFN 6 2/025

RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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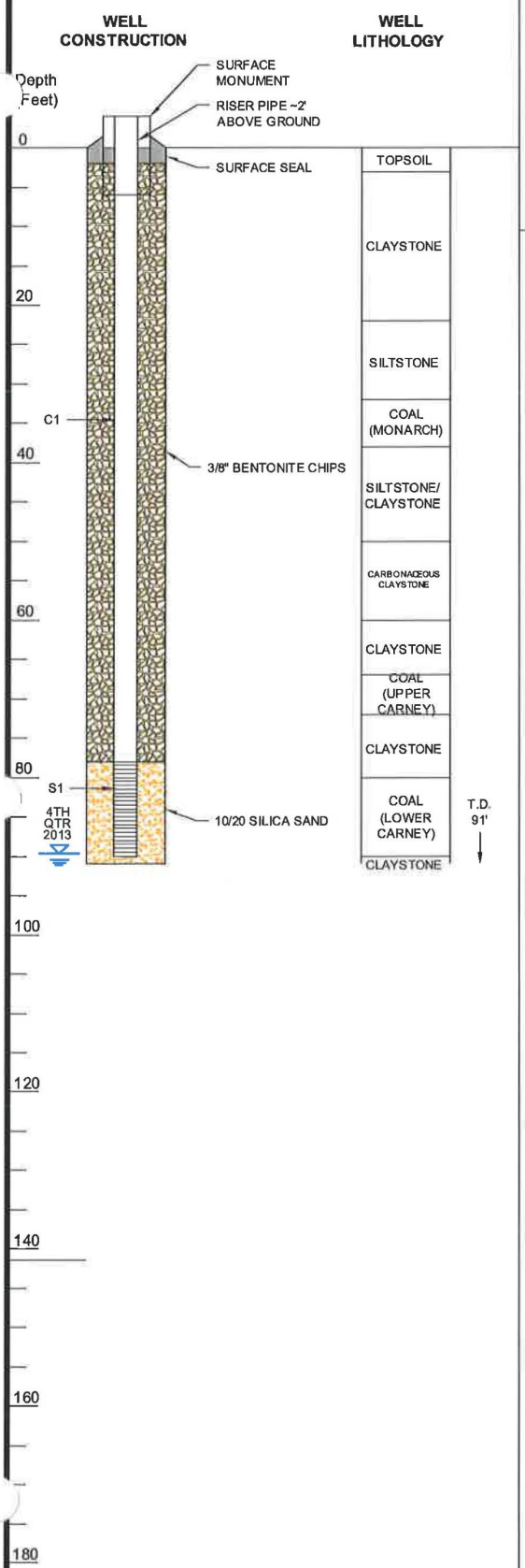

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578510-CRN

Location: N 1,941,542.1 E 1,371,807.2 EL 3,962.4

NE /4, SW /4, Section 10 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 91'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" PDC to ream

Fluid: Air and water

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 78 - +2 | S1 - 90 - 78

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 above screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 91 - 78

Bentonite:
3/8" chips
Depth: 78 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
43 bags bentonite in annulus
10 bags sand in filter pack

Construction Time Log

Drilling:	Start	End
9/24/13	1:15pm	2:00pm

Casing:	Start	End
9/24/13	2:00pm	2:30pm

Well Development

Began development on 9/24/13 at 2:35pm.
Added water and blew dry.
Well appears dry.
Cease Development at 3:00pm.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:
Method:

WWC ENGINEERING

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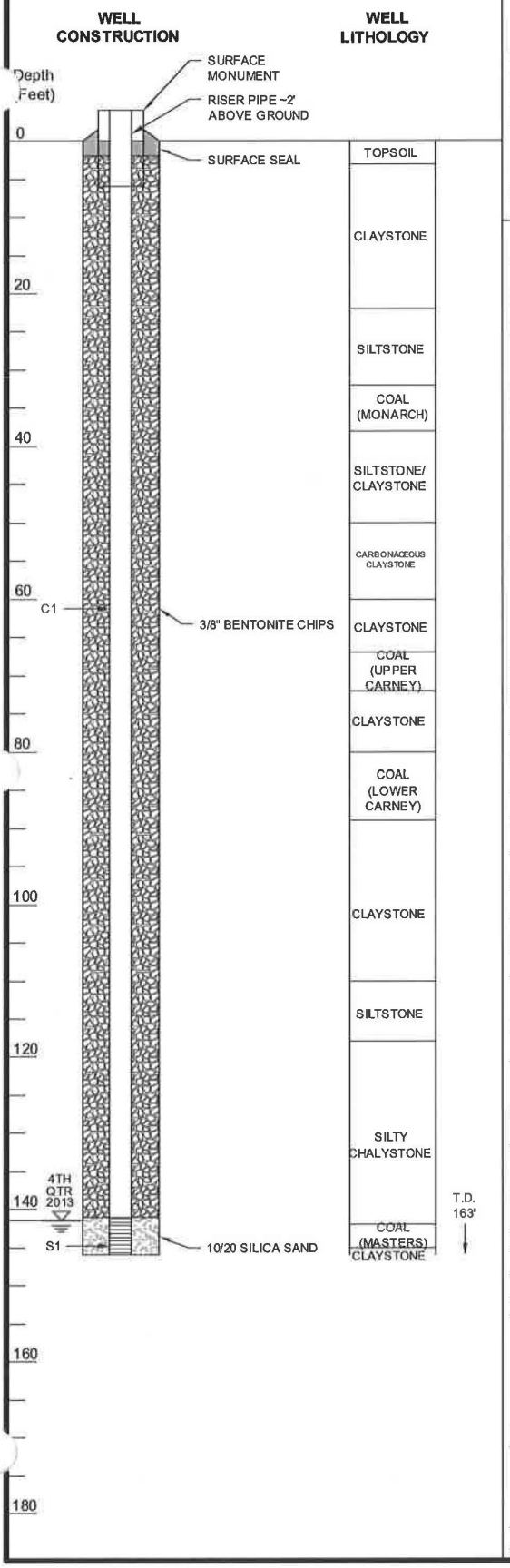

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578510-MST

Location: N 1,941,558.1 E 1,371,823.0 EL 3,962.4

NE /4, SW /4, Section 10 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 146'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" PDC to ream

Fluid: Air, water

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 141 - +2 | S1 - 146 - 141

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 above screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 146 - 141

Bentonite:
3/8" chips
Depth: 141 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
72 bags bentonite in annulus
4 bags sand in filter pack

Construction Time Log

Drilling:	Start	End
9/24/13	9:30am	10:45am

Casing:	Start	End
9/24/13	10:45am	12:00pm

Well Development

Began development on 9/24/13 at 12:00pm.
Add water and blow dry.
Let sit for 20 minutes, no surge.
Well dry.
Cease development at 12:45pm.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:
Method:

WWC ENGINEERING

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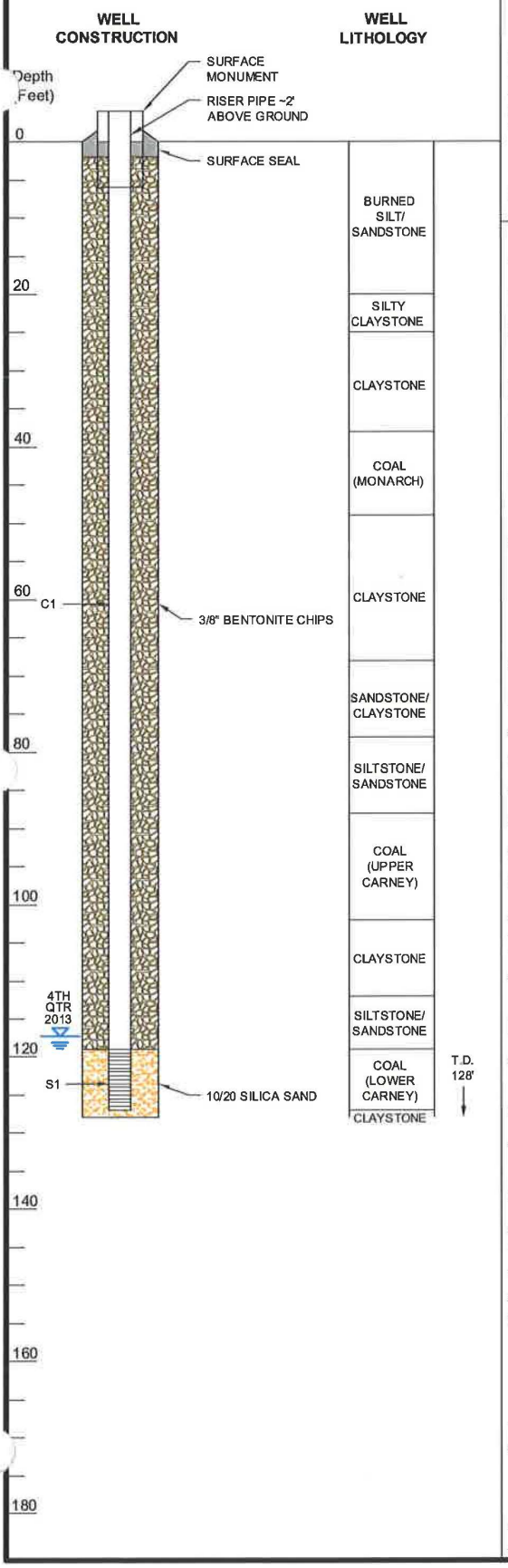

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578511-CRN

Location: N 1,940,246.5 E 1,377,926.5 EL 3,893.8

SW /4, SE /4, Section 11 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 128'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" PDC for ream
14-3/4" roller (surface)

Fluid: Water, air, some foam at surface

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 119 - +2 | S1 - 127 - 119

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 above screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 128 - 119

Bentonite:
3/8" chips
Depth: 119 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:

Construction Time Log

Drilling:	Start	End
9/23/13	12:45pm	2:30pm

Casing:	Start	End
9/23/13	2:30pm	3:30pm

Well Development

Began development on 9/23/13 at 3:30pm.

Add water and blow out.

Blow until 3:47pm.

Sample at 3:47pm:
Turb: 909NTU
Temp: 12.4°C
Conduct: 571µS
PH: 8.05

Let sit 15 minutes.

After letting well sit we attempted to blowout and there wasn't even a mist.

Well completely dry.

Cease development at 4:05pm.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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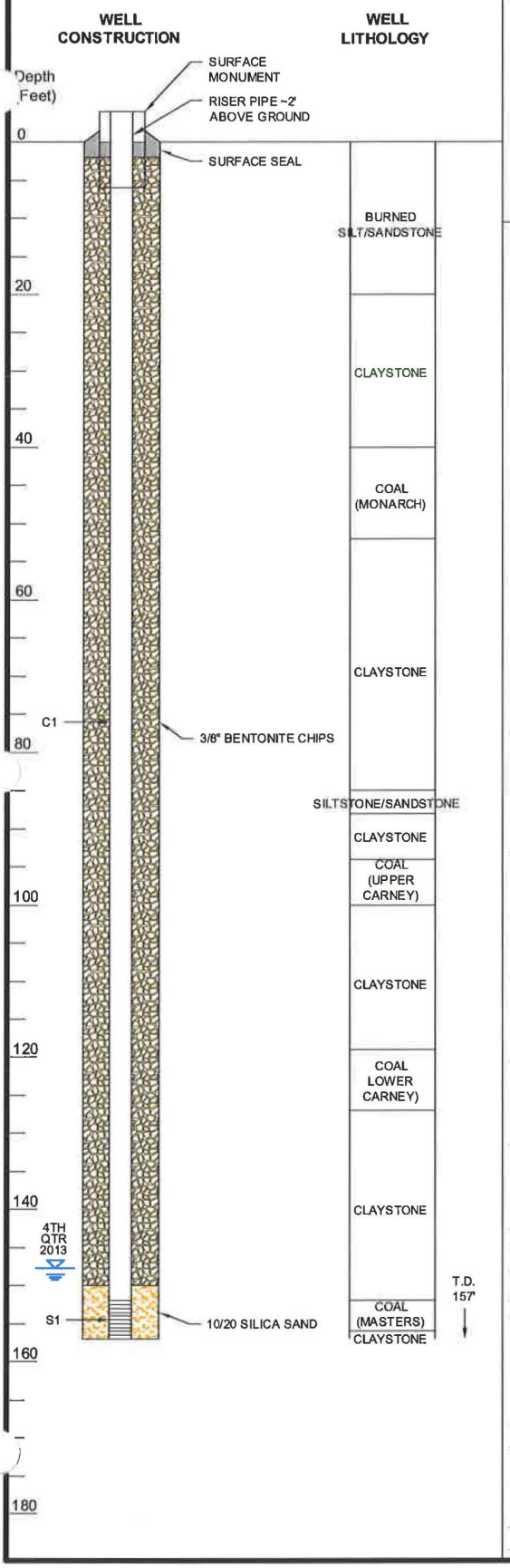

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578511-MST

Location: N 1,940,243.6 E 1,377,944.7 EL 3,894

SW /4, SE /4, Section 11 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 157'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" PDC to ream
14-3/4" roller (surface)

Fluid: Water, air, some foam at surface

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 152 - +2 | S1 - 157 - 152

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 on screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 157 - 150

Bentonite:
3/8" chips
Depth: 150 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
89 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
9/23/13	6:30am	10:15am

Casing:	Start	End
9/23/13	10:15am	11:30am

Well Development

Began development on 9/23/13 at 11:40am.

Blow, add water and blow till mist.

Well making less than 1 gpm.

Let sit 10 minutes and blow out, slight surge.

Sample at 12:05pm:
Turb: 761NTU
Temp: 14.1
Conduct: 656 µS
PH: 7.95

Cease development at 12:10pm.

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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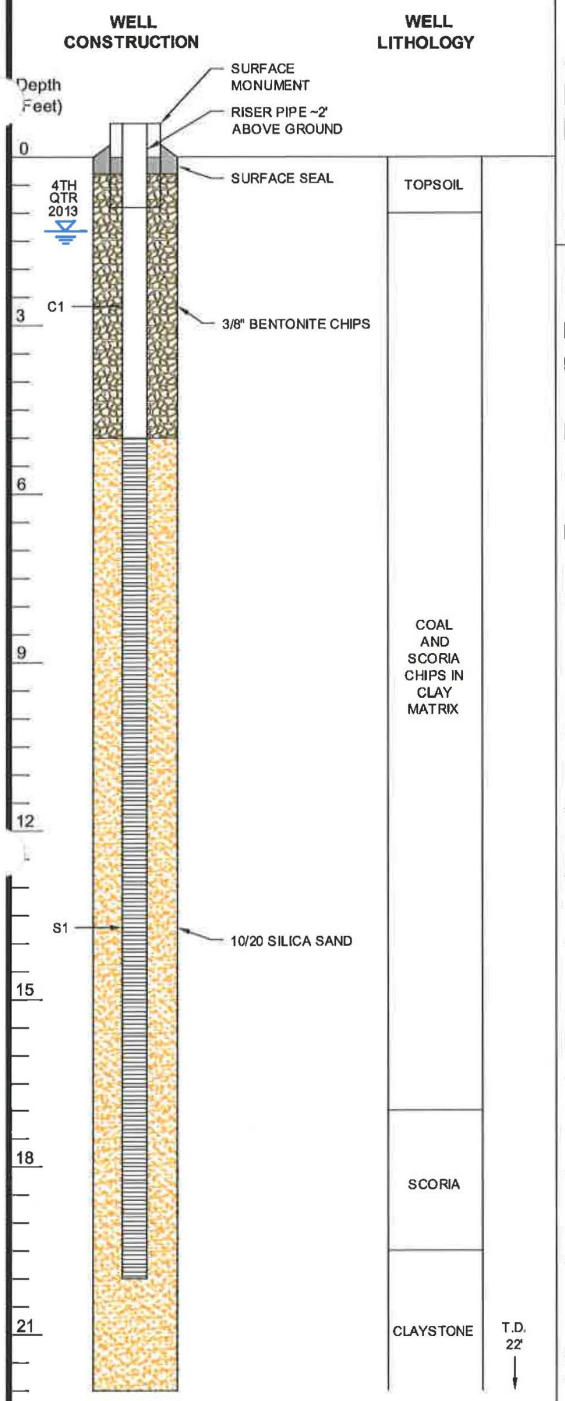

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578512-AL

Location: N 1,940,880.3 E 1,381,530.1 EL 3,758

SE /4, SW /4, Section 12 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 22'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" roller

Fluid: Gel

Casing: 5" SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 5 - +2 | S1 - 20 - 5

Monument or Surface Casing:
8" Locking Steel

Centralizer:
None

Casing C1:
5" SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 22 - 5

Bentonite:
3/8" chips
Depth: 5 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
2 bags bentonite in annulus
16 bags sand in filter pack

Construction Time Log

Drilling:	Start	End
9/25/13	2:30pm	3:00pm

Casing:	Start	End
9/25/13	3:10pm	3:45pm

Well Development

Began development on 9/25/13 at 3:45pm.

Well making 15-20gpm (estimated)

Sample at 4:16pm:
Turb: 249NTU
Temp: 11.3°C
Conduct: 4.25mS
PH: 8.09

Additional pumping may help clean well.

Air development is difficult this shallow.

Produced approximately 500 gallons.

Cease development at 4:18pm.

Sample from nearby surface water (pond):
Turb: 10.67NTU
Temp: 14.0°C
Conduct: 4.69mS
PH: 8.59

Remarks

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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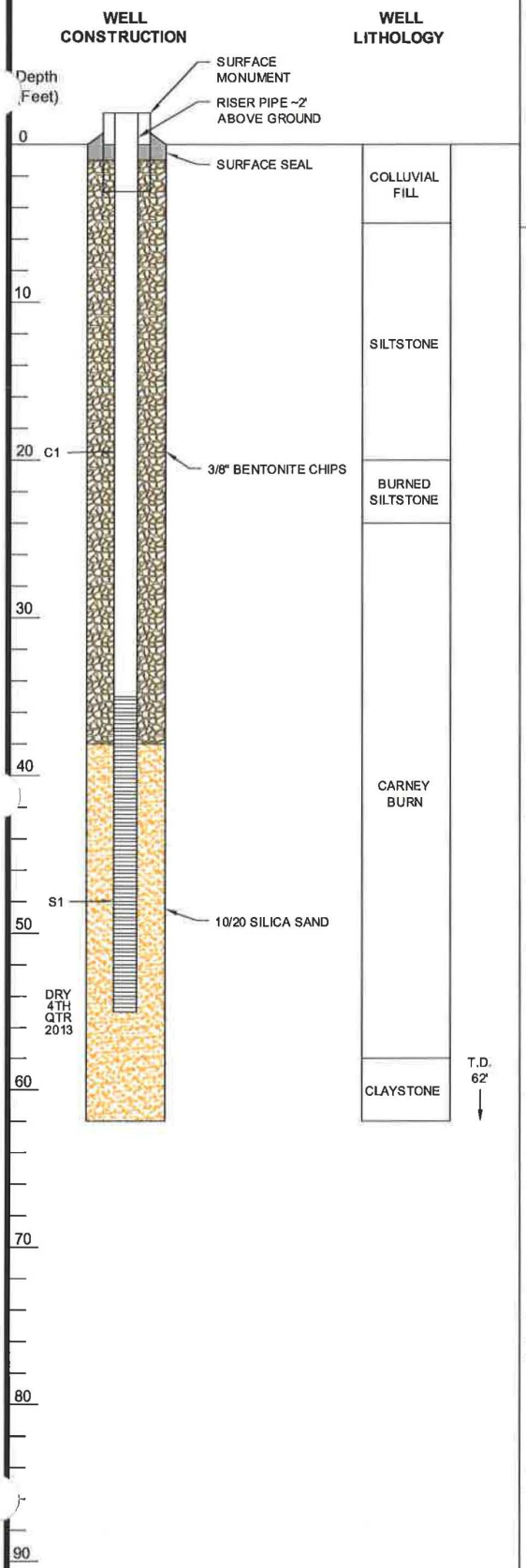

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578512 CRN

Location: N 1,943,160.0 E 1,382,757.0 EL 3,931.0

SW /4, NE /4, Section 12 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 62'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" roller

Fluid: Air, water, foam, polymer

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 35 - +2 | S1 - 55 - 35

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 in middle of screen

Casing C1:
105" SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 62 - 38

Bentonite:
3/8" chips
Depth: 38 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
35 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
9/20/13	2:05pm	3:30pm

Casing:	Start	End
9/20/13	3:30pm	3:50pm

Well Development

Began development on 9/20/13 at 4:00pm.

Blew out lots of drilling foam.

Added water.

No returns to surface, well takes every thing we inject.

Recommend cleaning in another way (bleach?) as polymer was not cleaned out of hole, unless well is dry and cannot be sampled.

Remarks

Air line stuck in hole after development and lifted screen 3' above intended completion interval. Would not push back down due to filter pack.

TFN 6 2/025
RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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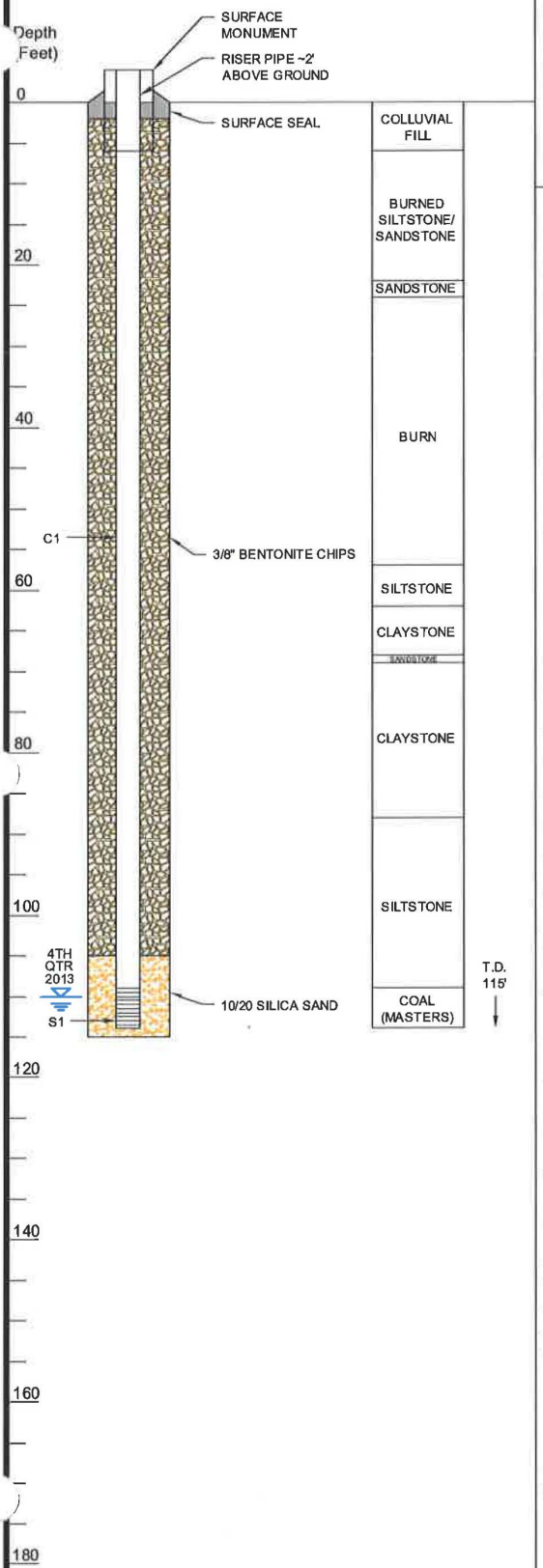

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578512-MST

Location: N 1,943,171.6 E 1,382,742.6 EL 3,930.9

SW /4, NE /4, Section 12 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 115'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 14-3/4" roller (surface)
9-7/8" PDC to ream

Fluid: Air, water, foam, polymer

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 109 - +2 | S1 - 114 - 109

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 above screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 115 - 105

Bentonite:
3/8" chips
Depth: 105 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
65 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
9/20/13	7:00am	11:45am

Casing:	Start	End
9/20/13	11:55am	1:00pm

Well Development

Began development on 9/20/13 at 1:00pm.
Blow dry (Drilling fluid).
Add water and blow dry.
Let sit for 15 minutes and blow dry again.
No surge.
Well appears dry.
Cease development at 1:30pm.

Remarks

Much more burn than expected.

Exploration hole uphill from this location had approximately 10' less burn than this location.

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RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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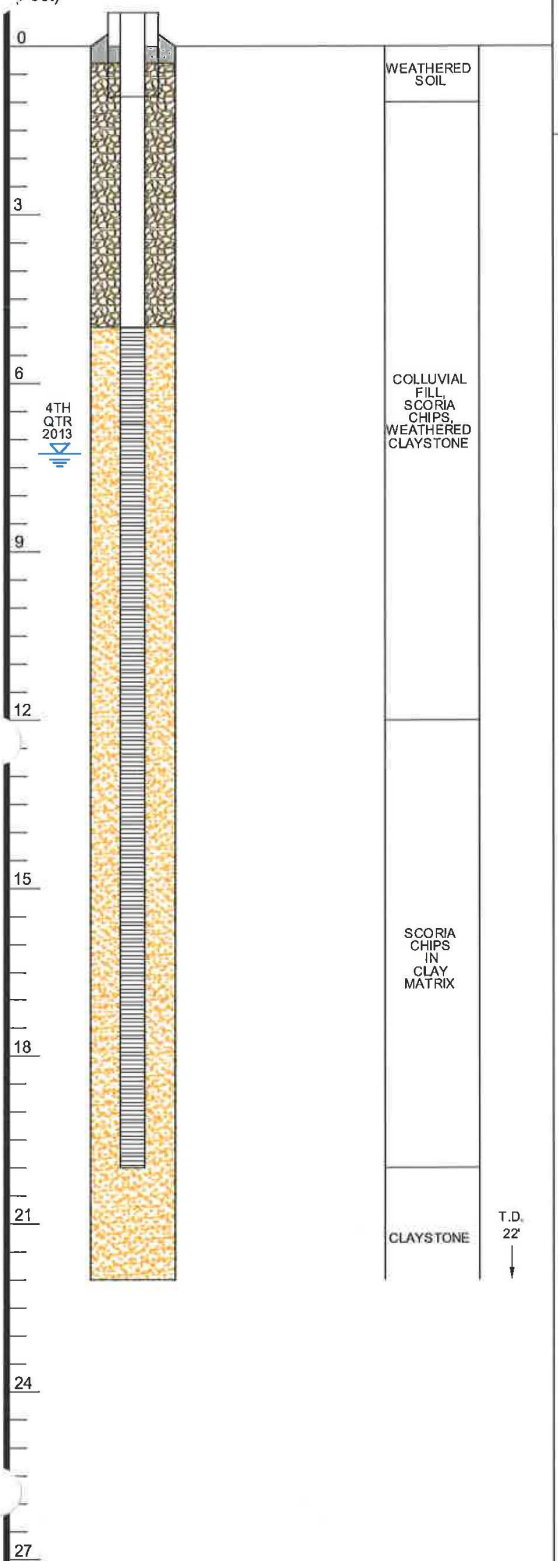

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578513-AL-1

Location: N 1,938,633.9 E 1,383,970.4 EL 3,721.9

NE /4, NE /4, Section 13 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 22'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" roller

Fluid: Gel

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 5 - +2 | S1 - 20 - 5

Monument or Surface Casing:
8" Locking Steel

Centralizer:
none

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 22 - 5

Bentonite:
3/8" chips
Depth: 5 - 2
- -

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
17 bags sand in annulus
1 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
9/30/13	7:15am	7:55am

Casing:	Start	End
9/30/13	7:55am	8:30am

Well Development

Began development on 9/30/13 at 8:30am.

Blow out and then inject water to clean up.

Surge several times.

Well making approximately 20gpm (estimated).

Sample at 8:50am:
Turb: 655NTU
Temp: 10.3°C
Conduct: 3.58mS
PH: 8.12

Sample at 9:05am:
Turb: 865NTU
Temp: 10.2°C
Conduct: 3.81mS
PH: 8.19

Surge well 9:05am - 9:19am.

Sample at 9:25am:
Turb: 357NTU
Temp: 10.4°C
Conduct: 3.85mS
PH: 8.20

Sample at 9:30am:
Turb: 223NTU
Temp: 10.4°C
Conduct: 3.91mS
PH: 8.24

Cease development at 9:35am.

Approximately 450 gallons developed from well.

Remarks

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RECD JUL 30, 2015

Abandoned

Date:

Method:

WWC ENGINEERING

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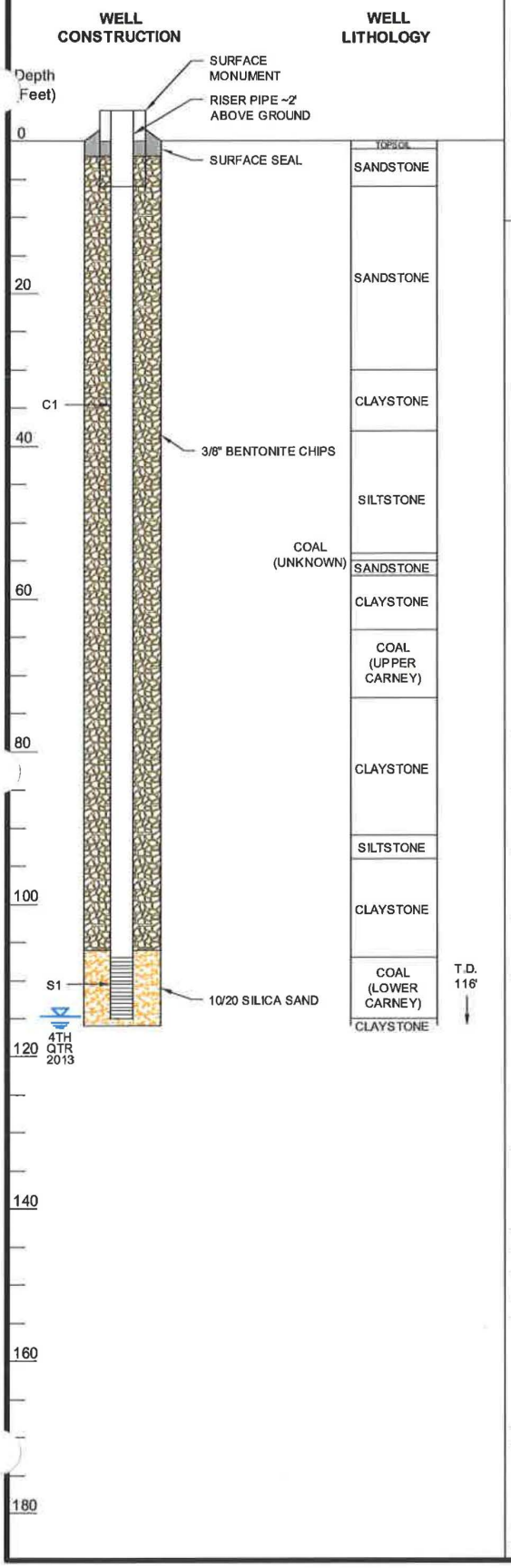

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578513-CRN

Location: N 1,938,329.3 E 1,381,665.6 EL 3,847.7

SE /4, NW /4, Section 13 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 116'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" PDC to ream

Fluid: Air and water

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 107 - +2 | S1 - 115 - 107

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 above screen

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 116 - 106

Bentonite:
3/8" chips
Depth: 106 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
55 bags bentonite in annulus
7 bags sand in filter pack

Construction Time Log

Drilling:	Start	End
9/25/13	10:45am	11:45m

Casing:	Start	End
9/25/13	11:45am	12:30pm

Well Development

Began development on 9/24/13 at 12:30pm.
Blow dry and then add water and blow out.
Goes to mist and then dry.
Hole appears dry.
Cease development at 1:00pm.

Remarks

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Abandoned

Date:

Method:

WWC ENGINEERING

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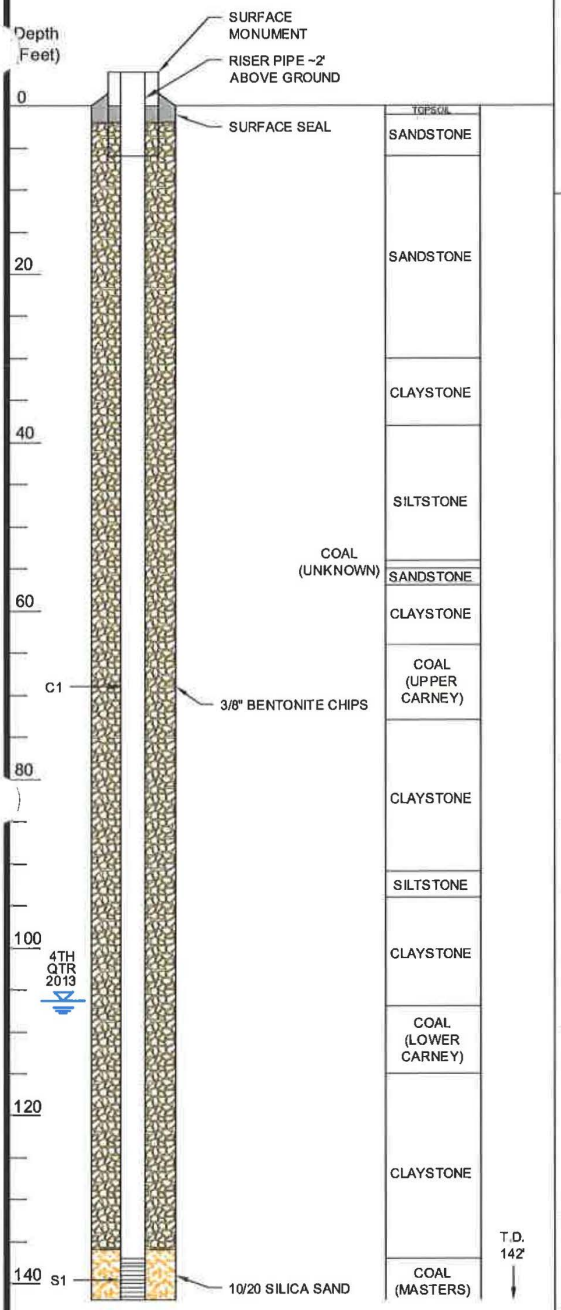

Well Construction Summary

Client: Ramaco

Project: Brook Mine Monitor Network Well: 578513-MST

Location: N 1,938,341.4 E 1,381,680.6 EL 3,848.4

SE /4, NW /4, Section 13 T. 57 N. R. 85 W.

Geologist: Swayne Redinger

Drilling Summary

Total Depth: 142'

Hole Dia.: 9-7/8"

Driller: Shawn Ankney

Rig: Gardner Denver 1500

Bit(s): 9-7/8" PDC to ream

Fluid: Air and water

Casing: 5" Certa-Lok SDR-17 PVC

Well Data

Casing: C=Casing S=Screen

C1 - 137 - +2 | S1 - 142 - 137

Monument or Surface Casing:
8" Locking Steel

Centralizer:
1 above screen and one 40' up

Casing C1:
5" Certa-Lok SDR-17 PVC

Screen S1:
5" PVC with 0.020" slots

Filter Pack:
10/20 Colorado Silica Sand
Depth: 142 - 136

Bentonite:
3/8" chips
Depth: 136 - 2.0

Cement:
Type 1
Depth: 2.0 - +0.5

Other:
65 bags bentonite in annulus

Construction Time Log

Drilling:	Start	End
9/25/13	7:30am	9:00am

Casing:	Start	End
9/25/13	9:00am	9:45am

Well Development

Began development on 9/25/13 at 9:50am.

Inject water and blow dry.

Sample at 9:55am:
Turb: 309NTU
Temp: 13.5°C
Conduct: 3.46mS
PH: 8.02

Driller injected water to help clean well out.

Well making approximately 7gpm.

Sample at 10:07am:
Turb: 304NTU
Temp: 11.6°C
Conduct: 3.50mS
PH: 8.18

Sample at 10:20am:
Turb: 59.2NTU
Temp: 11.2°C
Conduct: 3.49mS
PH: 8.34

Cease development at 10:17am.

Produced approximately 190 gallons.

Remarks

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Abandoned

Date:

Method:

WWC ENGINEERING

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ADDENDUM D6-8

ADDENDUM D6-8

Pumping Test Report

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Attachment D6-8-C	Masters Pumping Test November 12, 2013, Discharge Rate Data
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Attachment D6-8-G	Section 9 Aquifer Pumping Test, Observation Well 578409-MST-OB, Plots of Time-Drawdown and Analyses
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D6-8 PUMPING TEST

D6-8.1 Introduction

This report presents the results of the pumping test program conducted in support of the Brook Mine Permit Application. The program was conducted at the Section 9 baseline characterization well cluster located in the SESE quarter/quarter of Section 9, Township 57 north, Range 84 west. After discussion with WDEQ and analysis of historic well data surrounding the permit area, a cluster of wells in the eastern portion of permit was chosen because the coal seam aquifers in the western portion of the permit area were dry, or exhibited very little saturation. The Section 9 well cluster is depicted on Figure D6-1.

The Section 9 cluster consists of five separate monitor wells. Two monitor wells are completed in the Carney Coal, two are completed in the Masters Coal, and one monitor well is completed in the underburden beneath the Masters Coal. Wells were not completed in the overburden and interburden because these units were dry. No alluvial material is present within the immediate vicinity of the cluster so alluvial monitor wells were not completed as part of the cluster. Separate pumping tests were conducted on wells completed in the Masters and the Carney Coal seams. Only one underburden well was used for the testing as the underburden was typically unsaturated. Figure D6-2 depicts the relative location of each of the wells in the cluster.

D6-8.1.1 Purpose and Scope

This report describes the methods and techniques used to measure the aquifer characteristics of hydraulic conductivity (K), transmissivity (T), and storativity (S) of the aquifers of interest and provides the test results.

D6-8.2 Pumping Test Procedures

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Prior to performing the pumping tests, WWC Engineering (WWC) developed a pumping test plan to serve as an operational guide for field

personnel during the pumping test. The pumping tests were performed in accordance with this plan. This plan is included in Attachment D6-8-A.

D6-8.2.1 Pumping Test Equipment/Discharge Management

The pumped wells were equipped with a Grundfos Redi-Flo2 0.5 horsepower submersible pump powered by a portable generator. The pump setting depth was approximately 119 feet below ground level (bgl) in the Masters well (MST-1), and 105 feet bgl in the Carney well (CRN-1). During each test the discharge rate was controlled with a ball valve, a pressure gage, and a 0.5 gpm Dole valve. The flow was manually controlled using the ball valve to maintain a constant pressure reading, which ensured a constant discharge rate. Flow rates were measured using a bucket and stop watch. A blank example field form is included in Attachment D6-8-B. Discharge measurement field data sheets for the Masters and Carney pumping test areas are provided in Attachments D6-8-C and D6-8-D, respectively. The flow rate was maintained at approximately 0.33 gpm during both pumping tests. Pumped water was contained onsite within excavated pits. No water was discharged to any drainages during the tests.

D6-8.2.2 Background Monitoring

Background monitoring for each test was conducted using a combination of transducers and manual depth measurements. Three transducers were used during each test. All three transducers were manufactured by In-Situ Inc. Two of the transducers had a full scale reading range of 15 psi and the other one had a 50 psi range. All the transducers were set to record water level on one minute increments prior to and during the pumping tests.

D6-8.2.2.1 MST-1 Pumping Test Background Monitoring

For the MST-1 pumping test, the 15 psi transducers were installed in the MST-1 and the Masters Observation well (MST-OB) approximately 19 hours before the start of the pumping test. The 50 psi transducer was

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installed in the Masters underburden well (MST-UB) at the same time the Master's wells were instrumented. Manual groundwater level measurements were used to verify the transducer data prior to and during the pumping tests. Prior to the pumping test there had been no drilling, sampling, or pumping activities near the site for 35 days. Water levels measured over the 19 hour pre-test monitoring period demonstrated that the aquifer was stable prior to the pumping tests since no measurable changes in the water levels were observed.

D6-8.2.2.2 CRN-1 Pumping Test Background Monitoring

For the CRN-1 pumping test, the 15 psi transducers were installed in the CRN-1 and the Carney Observation well (CRN-OB) approximately 16 hours before the start of the pumping test. The 50 psi transducer was installed in MST-1 at the same time the Carney wells were instrumented. Manual groundwater level measurements were used to verify the transducer data prior to and during the pumping tests. The Carney Coal seam pumping test was conducted two days after the pumping test conducted in the Masters Coal seam; however, prior to, during, and after the Masters pumping test manual water level measurements were taken in the Carney wells. Water level data collected from the Carney wells demonstrated that water levels in the Carney Coal did not deviate during the Masters pumping test and were stable prior to the pumping test.

D6-8.2.3 Test Procedures and Methods of Analysis

Prior to conducting the pumping tests, discharge rates and resulting time-drawdown data were recorded at the designated pumping wells during routine water quality sample collection. Based on the drawdown response at each pumped well, a pumping rate that would effectively stress the aquifer for an appropriate test duration was determined, thus eliminating the need to conduct a step-drawdown analysis on the pumping wells to select the optimum pumping rates.

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The raw pressure transducer data were downloaded in the field and then converted into Microsoft Excel files. As applicable, manual water level measurements were added to transducer data in order to extend the data set. The time-drawdown data, along with the pumping rates and well completion information, were then imported into the AquiferWin32 program (ESI 2003) for analysis and presentation.

D6-8.3 Pumping Tests

D6-8.3.1 Well Locations and Completion Intervals

The Cluster 9 wells are located within the same general vicinity (within a 50 foot radius as shown on Figure D6-2). Completion information for each well is provided in Table D6-1.

D6-8.3.2 Pumping Rate and Duration

D6-8.3.2.1 Masters Pumping Rate and Duration

Within the Masters Coal seam, the pumping test commenced in MST-1 at 11:12AM on November 12, 2013 and ended at 9:52PM on November 12, 2013 for a total duration of 640 minutes. MST-1 was pumped at an average discharge rate of 0.33 gpm. Discharge measurement field data sheets are included in Attachment D6-8-C. After the pumping period, the transducers remained in MST-1 and MST-OB until 4:30PM on November 13, 2013. Manual water level observations continued until 8:00AM on November 16, 2013.

D6-8.3.2.2 Carney Pumping Rate and Duration

Within the Carney Coal seam the pumping test commenced in CRN-1 at 8:41AM on November 14, 2013. After approximately 12 minutes the pump overloaded, and shut down. The pump was immediately restarted and then it shut down again at approximately 9:00AM (7 minutes). Believing that the pump may have been set in the mud at the bottom of the well the pump was raised four feet and restarted at 9:03AM. After raising the pump in the well, no further problems were encountered and the pump continued to pump at a

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steady rate with no shut-downs until the test was terminated at 7:35PM. The total duration of the test was 632 minutes. CRN-1 was pumped at an average rate of 0.33 gpm. Discharge measurement field data sheets are included in Attachment D6-8-D. After the pumping period, the transducers remained in CRN-1 and CRN-OB until 8:00AM on November 16, 2013.

D6-8.3.2.3 Well Responses

Groundwater level hydrographs for the pumped well and the observation wells for the Masters and the Carney pumping tests are presented in Attachments D6-8-E and D6-8-F, respectively. Tables D6-2 and D6-3 summarize the maximum amount of drawdown observed in each well during the pumping tests.

The pumping test results demonstrate that the observation and pumped wells within each respective coal seam are in hydraulic communication with each other. When the Masters well (MST-1) was pumped, there was no response due to pumping in the Carney wells, and conversely when the Carney well (CRN-1) was pumped no response was observed in the Masters wells. In both cases no response due to pumping was recorded in the underburden well (MST-UB) which demonstrates that the Masters and Carney wells are not in hydraulic communication with each other nor are they in communication with the underburden.

It is unlikely that a longer pumping period would have resulted in communication across the interburden between the coals because there are significant differences between the static water levels in the Carney coal and the Masters coal. As shown on Table D6-2, the initial water level in the Carney Coal was approximately 11.5 feet higher than the water level in the Masters Coal and the initial water level in the Masters Coal was approximately 9 feet higher than the initial water level in the underburden well. If there were a hydrologic connection between the aquifers, it is likely that the water levels in the aquifers would have come into equilibrium.

As noted on Tables D6-2 and D6-3, increased water levels were noted in the Carney Coal wells during the Masters Coal pumping test that are attributed to changes in barometric pressure. A similar rise in water levels due to the barometric pressure was noted in the Masters Coal wells during the Carney Coal pumping test although the rising water level may also be attributed to recovery from the previous pumping test in the Masters coal. Field water level measurements as compared to barometric pressure measurements collected at the Sheridan County Airport (approximately 10 miles south of the wells) is included as Attachment D6-8-K.

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Only very minor water level variations in the Masters underburden well (MST-UB) were noted during both pumping tests. As shown on the well completion form in Addendum D6-7, MST-UB was completed in an interval that was predominately claystone with an estimated yield less than 2 gpm. Essentially, the strata in which MST-UB is completed is more of an aquitard than an aquifer. As a result, it takes a lot longer for the water levels in the well to adjust to changing atmospheric pressure because water does not enter or discharge from the formation very fast. The lack of barometric responses in the MST-UB are attributed to the fact that the low yielding aquitard in which the well is completed has a lower barometric efficiency than the wells completed in the coal aquifers.

D6-8.4 Determination of Aquifer Parameters

Drawdown data from pumping tests completed in each respective coal seam were used to determine the hydraulic coefficients of the Carney and Masters Coal. The Aquifer^{Win32}, Version 3, software was used to analyze the drawdown and recovery data for the pumped wells and the observation wells.

At the Section 9 cluster, the Masters Coal seam is approximately six feet thick and the Carney Coal seam is approximately 18 feet thick. As shown on Table D6-1 the screened interval in the Masters Coal wells is five feet. The screened interval in the Carney Coal wells is 20 feet. In a confined aquifer, the optimum screen length should be 80 to 90 percent of the aquifer's thickness (Driscoll 1986). Therefore, all the wells are considered to be fully penetrating wells.

The aquifer coefficients of transmissivity (T) and storativity (S) for the pumped well and the observation well were calculated using the Cooper-Jacob (1946) and Theis (1935) methods. The results are summarized in Table D6-4 and plots of the time-drawdown data and analyses are included in Attachments D6-8-G through D6-8-J. The transmissivity estimates resulting from the various analysis methods were consistent and for the Carney Coal range from 5.1 to 5.6 ft^2/day, and for the Masters Coal the transmissivity ranged from 2.9 to 3.6 ft^2/day. The drawdown data for all four wells closely follow the Theis curve. No hydrologic boundary conditions were encountered and the hydraulic conductivity values presented in Table D6-4 are considered valid. No responses were observed across the interburden, therefore the vertical hydraulic conductivity of the interburden is too low to measure and no analysis were performed to assess the aquifer parameters in the interburden. Additionally, the differing static water levels in the Carney and Masters coal seams demonstrate that the vertical hydraulic conductivity of the interburden is very low. Storativity values were determined using the Theis drawdown analysis on the observation wells. The storativity estimated at the Carney

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observation well (CRN-OB) is 3.6 x 10^{-4} and at the Masters Observation well (MST-OB) is 2.5 x 10^{-4}. These storativity values suggest confined aquifer conditions.

There are several faults identified within the region, however no hydrologic boundary conditions were observed in the data, therefore it can be surmised that the faults did not have an impact on the results of the aquifer tests. As can be seen on Exhibit D6.2-2, the 578409 well cluster is located approximately 2,100 feet south and east of the nearest mapped fault. Since neither the Carney nor the Masters coal seams are very robust aquifers and have low transmissivity values, it is not surprising that the nearest fault would not influence the pumping test results. For example, using Theis drawdown equations and the aquifer characteristics measured in the Masters coal (transmissivity of 3.2 ft^2/day, storativity of 2.5 x 10^{-4}, and a pumping rate of 0.5 gpm), it is estimated that it would take over 70 days of continuous pumping for a water level response greater than 0.5 feet to be observed 2,000 feet away. Therefore the likelihood that the faults would have influenced the pumping test results is very low.

D6-8.5 Summary and Conclusions

The goals of the aquifer pumping test program were 1) to evaluate the aquifer hydraulic characteristics of the coals and develop baseline data to be used for modeling and permitting purposes, 2) to evaluate the level of hydraulic communication between the coals and the underburden beneath the Masters Coal. The pumping test program successfully met both goals. As shown in Table D6-4, data from the pumping test was able to be successfully used to estimate the hydraulic conductivity and the storativity of the coal aquifers. The test also demonstrated the lack of hydraulic communication between the coal seams and the underburden at the test site.

D6-8.6 References

Cooper, H.H., Jr., and C.E. Jacob, 1946, A generalized graphical method for evaluating formation constants and summarizing well field history, Trans. Amer. Geophysical Union, Vol. 27 pp. 526-534.

Driscoll, F.G., 1986, Groundwater and Wells, Second Edition, Johnson Division, St. Paul, Minnesota

Environmental Simulation Inc. (ESI), 2003, AquiferWin32Version 3, (aquifer test analysis software). Available online at: <http://www.groundwatermodels.com/ESI_Software.php>

Theis, C.V., 1935, The relation between the lowering of the piezometric surface and the rate and duration of discharge of a well using groundwater storage, Trans. Amer. Geophys. Union, Vol. 16, pp. 519-524.

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D6-8.7 Certification

I, Michael J. Evers, hereby certify that this report was prepared by myself or under my direct supervision and that it correctly represents the conditions described in the accompanying addendum which is provided to meet the requirements of the Wyoming Environmental Quality Act and its accompanying regulations.

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Table D6-1. Well Completion Information

Well ID	Geologic Unit Monitored	Well Type	Depth to Top of Screen (ft bgs)	Depth to Bottom of Screen (ft bgs)	Total Depth (ft)
CRN-1	Carney Coal	Pumped Well	88	108	109
CRN-OB	Carney Coal	Observation	89	109	110
MST-1	Masters Coal	Pumped Well	115	120	122
MST-OB	Masters Coal	Observation	116	121	122
MST-UB	Masters Coal Underburden	Observation	130	140	142

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Table D6-2. Pumping Test Drawdown and Response Summary for Masters Coal Pumping Test

Well ID	Well Type	Initial Depth to Water (ft)	Initial Water Level Elevation (ft amsl)	Maximum Drawdown (ft)	Time After Pump On for First Drawdown Response (min)	Radial Distance from Pumped Well (ft)
CRN-1	Observation	91.2	3621.5	+0.23 ft*	No Response	14.1
CRN-OB	Observation	91.1	3621.9	+0.23 ft*	No Response	29.8
MST-1	Pumped	101.7	3610.7	10.4	0	0
MST-OB	Observation	102.3	3611.0	6.3	2	13.1
MST-UB	Observation	110.1	3602.0	0	No Response	14.1

* Rising water levels during the test were attributed to changes in barometric pressure over the course of the test. Over the course of the test the barometric pressure measured at the Sheridan County Airport decreased by 0.31 feet. Assuming a similar change in barometric pressure occurred at the site, the water level in the observation wells would be expected to rise as a result.

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Table D6-3. Pumping Test Drawdown and Response Summary for Carney Coal Pumping Test

Well ID	Well Type	Initial Depth to Water (ft)	Initial Water Level Elevation (ft amsl)	Maximum Drawdown (ft)	Time After Pump On for First Drawdown Response (min)	Radial Distance from Pumped Well (ft)
CRN-1	Pumped Well	90.9	3621.8	6.1	0	0
CRN-OB	Observation	90.9	3622.1	2.9	2	15.7
MST-1	Observation	101.8	3610.6	0	No Response	14.1
MST-OB	Observation	102.5	3610.8	+0.27*	No Response	13.3
MST-UB	Observation	110.1	3602.0	+0.29*	No Response	28.2

* The rise in water level recorded in the MST-OB and MST-UB wells is attributed to the combined effects of continued water level recovery and barometric pressure changes, over the course of the test. The barometric pressure is estimated to have decreased by 0.19 feet which would result in a rise in the water levels in the well. In addition, the Masters Coal wells were still recovering from the pumping test two days earlier which may also explain the water level recovery observed in the wells.

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Table D6-4. Masters and Carney Pumping Tests Summary of Hydraulic Characteristics

Well ID	Well Type	Interpretation Method	Transmissivity (ft^2/day)	Aquifer Thickness (ft)	Hydraulic Conductivity (ft/day)	Storativity (unitless)
Carney Coal Hydraulic Characteristics						
578409-CRN-1	Pumped	Cooper Jacob Straight Line Drawdown	5.7	18	0.32	-
		Theis Drawdown (Confined)	5.1	18	0.28	-
		Theis Recovery	5.2	18	0.29	-
578409-CRN-OB	Observation	Cooper Jacob Straight Line Drawdown	6.0	18	0.33	0.000343
		Theis Drawdown (Confined)	5.9	18	0.33	0.000384
		Theis Recovery	5.6	18	0.31	-
		Minimum	**5.1**		**0.28**	**0.000343**
		Maximum	**6.0**		**0.33**	**0.000384**
		Average	**5.6**		**0.31**	**0.000364**
Masters Coal Hydraulic Characteristics.						
578409-MST-1	Pumped	Cooper Jacob Straight Line Drawdown	3.2	6	0.53	-
		Theis Drawdown (Confined)	3.2	6	0.53	-
		Theis Recovery	2.9	6	0.48	-
578409-MST-OB	Observation	Cooper Jacob Straight Line Drawdown	3.6	6	0.6	0.000203
		Theis Drawdown (Confined)	3.3	6	0.55	0.000294
		Theis Recovery	3.1	6	0.52	-
		Minimum	**2.9**		**0.48**	**0.000203**
		Maximum	**3.6**		**0.60**	**0.000294**
		Average	**3.2**		**0.54**	**0.000249**

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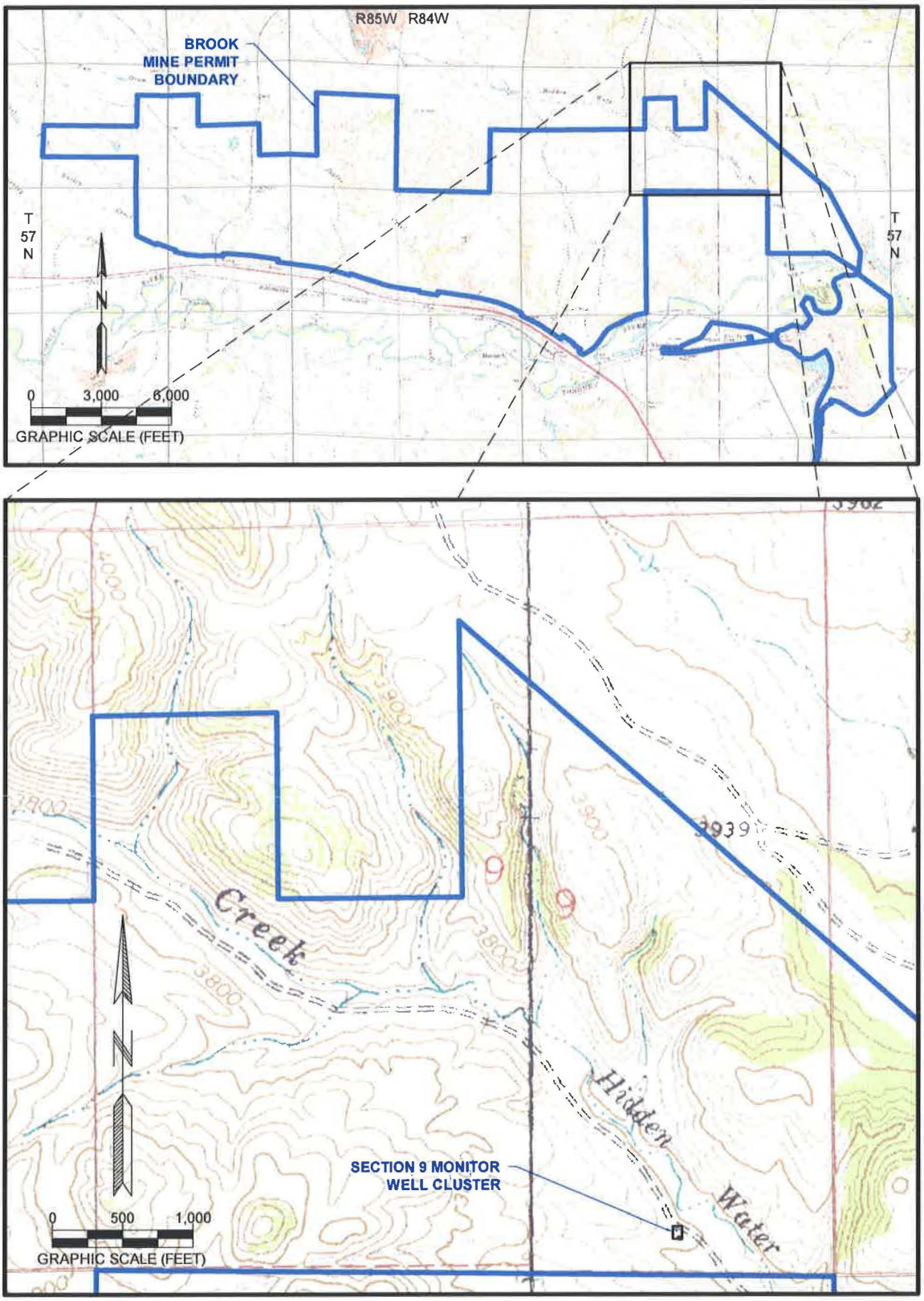

Figure D6-1. Brook Mine Section 9 Pumping Test Area

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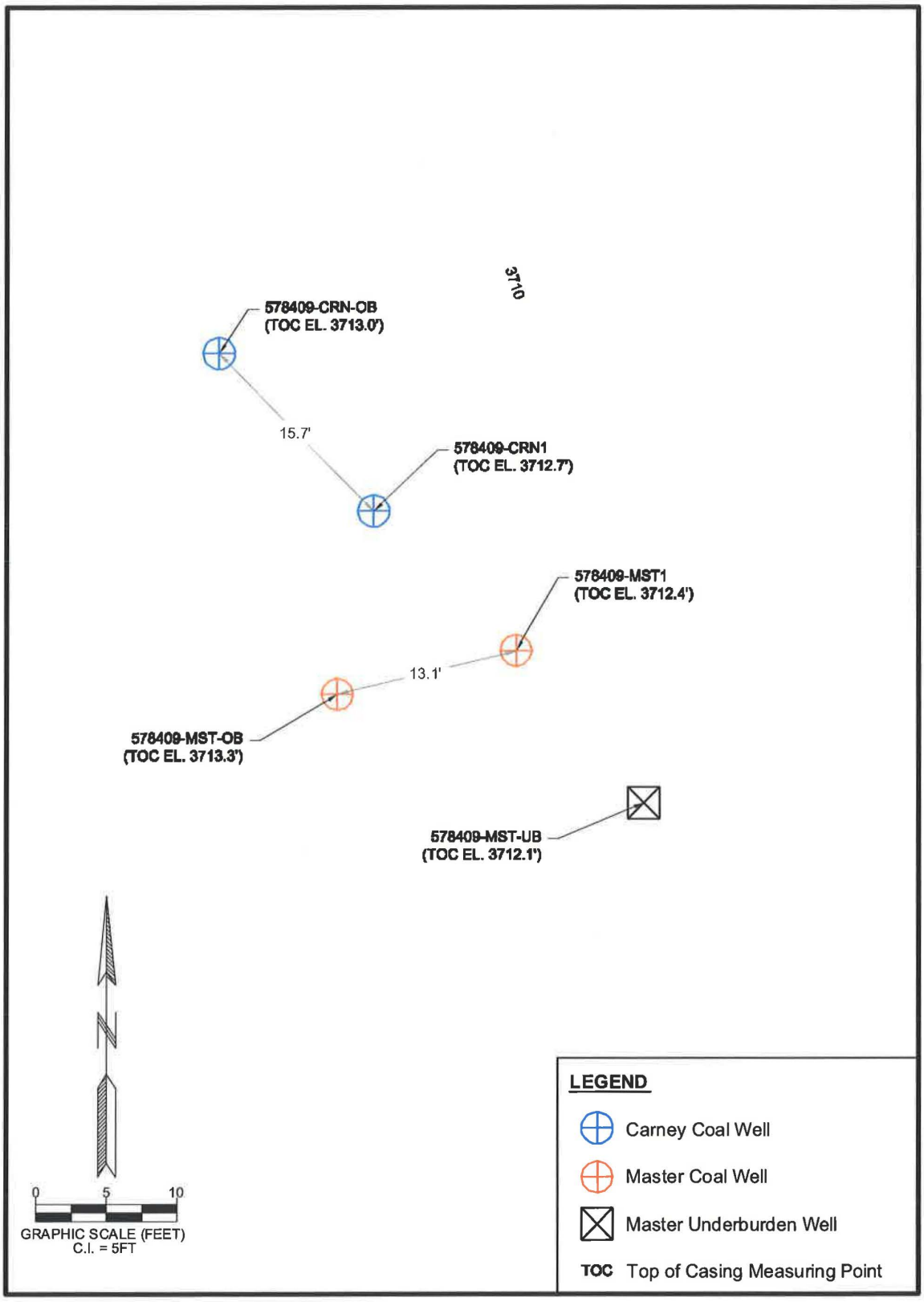

Figure D6-2. Brook Mine Section 9 Pumping Test Well Layout Details

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ATTACHMENT D6-8-A

RAMACO Proposed Brook Mine
Pumping Test Plan

TFN 6 2/025
RECD NOV 14, 2014

RAMACO Proposed Brook Mine Pumping Test Plan
November 4, 2013

INTRODUCTION

This work plan details procedures to complete a pumping test on baseline monitor wells constructed as part of RAMACO's proposed Brook mine. The goal of the pumping test is to determine aquifer hydraulic properties for the Carney and Masters coal seams within the project area.

PUMPING TEST PROGRAM

Wells

RAMACO has completed 2 wells in both the Carney and the Masters coal seams. In each coal seam one well will serve as a pumping well and the other will serve as an observation well. In both coal seams the observation well is located approximately 15 feet from the proposed pumping well.

Antecedent Conditions

The pumped well and the observation well will each be equipped with recording pressure transducers. These transducers will collect water level data continuously. The pressure transducers will be vented, which eliminates the barometric effects on the sensor.

After the pressure transducers are installed in each well, water level data will be collected prior to the pumping test to establish antecedent conditions. Water level data will be collected for up to 24 hours prior to the test to demonstrate that aquifer conditions are stable. In order to evaluate aquifer stability, the pre-test hydrograph will be evaluated to determine if the observed water level changes are beyond what can be attributed to naturally occurring barometric effects. If water level changes are greater than barometric effects, the pre-test monitoring period will continue until background water level trends can be determined to properly evaluate test data.

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Test Discharge Rate and Duration

Anticipated pumping test constant discharge rates will range from 0.25 to 5 gpm. The duration of the test may range from 12 to 24 hours as field conditions merit. Ultimate test duration will be determined in the field with the test duration adjusted as necessary to ensure a drawdown response is observed in the observation well. Typically, the minimum acceptable response in an observation will be one foot. Field data will be collected and analyzed in real time to determine if boundary or equilibrium conditions are encountered. Example field forms are included in Attachment D6-8-B.

Discharge Management

Water will be collected in a stock tank and used for livestock or wildlife water or used for irrigation in those instances that it meets WQD rules and regulations, Chapter 8, Table 1, Class I, II or III. Water will not be directly discharged in a manner that allows it reach waters of the state.

TEST PROCEDURES AND METHODS OF ANALYSIS

Two separate pumping tests are planned, one of which will occur in the Carney Coal seam and the other will occur in the Masters Coal seam. The procedures for each test are described in detail below.

Water Level Measurement

During each pumping test water levels within the pumped well and the observation well completed in the same coal seam will be measured with recording pressure transducers. The pressure transducers will be installed in the observation wells prior to the pumping test and aquifer stabilization will be evaluated before the test commences. Table 1 provides proposed pressure transducer specifications. Prior to the test, water levels will be measured to the nearest hundredth foot with an electronic water level probe and pressure transducers will be set to record head changes once per minute. After pumping

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has ceased, water level measurement will continue through recovery of the pumped well. Typically, recovery will be defined as the point at which water levels in the pumping well reach 90 percent of the pre-pumping test levels. Depending on the specific aquifer conditions and the location of the well, recovery levels may be adjusted as necessary. All well response and discharge data will be recorded on the field form, an example of which is provided in Attachment D6-8-B.

Table 1. Monitor Well Transducer Specifications

Well Type	Transducer	Parameters Measured	Accuracy
Pumping Well	50 psi	Pressure level	Press. ± 0.01%
Production Observation Wells	15 psi	Pressure level	Press. ± 0.01%

In order to determine the degree of hydrologic continuity between each coal seam, periodic manual water level measurements will be taken throughout each pumping test in the observation well completed in the adjacent coal seam. In order to determine whether the pumping test is actually influencing water levels in the adjacent coal seam, manual water levels will be collected during each stage of the pumping test which includes the pre-pumping stabilization stage, pumping stage, and aquifer recovery stage.

Discharge Measurement

Dole Valves will be used to maintain constant flow rates during the pumping tests. For the first eight hours of the test the flow will also be manually recorded using a stop watch and container of known volume by field personnel on intervals not exceeding two hours. Depending on the performance of the pumping well during the initial pumping period, the frequency of the manual flow verification may be reduced for the remainder of the pumping test.

Field Measurement and Samples

Field parameters (pH) will also be measured in conjunction with flow measurements.

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Field Operations and Schedule

The pumping test will be conducted using a portable generator to provide power to a pump installed within the pumping well. A typical pumping test could take up to six days. The exact test schedule may vary depending on actual aquifer conditions encountered at the pumping test location. Table 2 summarizes a typical pumping test schedule.

Table 2. Typical Pumping Test Schedule

Transducer Installation	Stability Monitoring	Pump Test	Recovery
1 Day	1 Day	12-24 Hours	Up to 3 Days

Flow Management

A dole valve will be used to maintain a constant flow rate. Pressure upstream of the dole valve will be measured throughout the pumping test to ensure the pressure is appropriate for accurate flow regulation through the dole valve. A manual valve installed upstream of the both the dole valve and the pressure gauge will allow for adjustment of the pressure and ultimately flow through the dole valve to ensure flow is maintained at a constant rate. Manual flow measurements using a bucket and stopwatch will be used to verify flow rates.

METHODS OF ANALYSIS

Pumping test results will be analyzed using the Cooper and Jacob (1946) method for the drawdown portion of the test and the Theis (1935) for the recovery portion of the test.

Data will also be evaluated using the method(s) appropriate to the observed well responses. Depending upon the response recorded in the observation and pumping wells (i.e. confined, unconfined, leaky confined, and partial penetration). One or more of the following techniques will be used:

- Non-leaky confined, Theis (1935); Cooper and Jacob (1946)
- Leaky confined, Hantush and Jacob (1955)

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- Leaky confined with storage in confining layer, Hantush (1960)
- Partial penetration, Hantush (1964)
- Unconfined, Neuman (1972, 1975)

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ATTACHMENT D6-8-B

Example Field Form

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WWC ENGINEERING

AQUIFER TEST FIELD DATA

Project/Client _____

Pumped Well No. _____ Observation Well No. _____

Type of Pump Test: ☐ Constant Discharge ☐ Step-Drawdown

Pumped Well Casing ID _____ inches

Distance Between Pumped and Observation Wells _____ feet

Water Level Measurements by: ☐ electric tape ☐ pressure transducer

Discharge Measurements by: ☐ bucket/stopwatch ☐ flow meter ☐ flume/weir

Screen/Perforation Interval(s) (below land surface) _____

Depth of Pump Intake (below land surface) _____feet

Depth of Static Water Level (from measurement point) _____feet

Height of Measurement Point (above land surface) _____feet

Elevation of Measurement Point _____feet a.m.s.l.

Pump On Date _____/_____/_____ Time _____ AM/PM

Pump Off Date _____/_____/_____ Time _____ AM/PM

Weather Conditions _____

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Test Performed by _____

WWC ENGINEERING

October 2014

RAMACO

AQUIFER TEST FIELD DATA

Project/Client _____ Well No. _____

TIME			WATER LEVEL DATA				
Date	Clock Time	(t) Elapsed Time Since Pump ON or OFF (min)	Depth to Water Below M.P. (ft)	(s) Drawdown/ Recovery (ft)	(Q) Discharge (gpm)	Discharge Pipe Pressure (PSI)	COMMENTS

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Addendum D6-8-26

Brook Mine

ATTACHMENT D6-8-C

Masters Pumping Test
November 12, 2013
Discharge Rate Data

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WWC ENGINEERING

AQUIFER TEST FIELD DATA

Project/Client : RAMACO

Pumped Well No. MST-1 Observation Well No. MST-OB AND MST-UB

Type of Pump Test: ☒ Constant Discharge ☐ Step-Drawdown

Pumped Well Casing ID 4" inches

Distance Between Pumped and Observation Wells 12.8' TO MST-OB AND 14' TO MST-UB feet

Water Level Measurements by: ☒ electric tape ☒ pressure transducer

Discharge Measurements by: ☒ bucket/stopwatch ☐ flow meter ☐ flume/weir

0.5 gpm dole valve with constant pressure of 10 psi on valve.

Screen/Perforation Interval(s) (below land surface) _____

Depth of Pump Intake (below land surface) 119' feet

Depth of Static Water Level (from measurement point) 101.68' feet

Height of Measurement Point (above land surface) 2.64' feet

Elevation of Measurement Point _____ feet a.m.s.l.

Pump On Date 11 / 12 / 13 Time 11:11 (AM)/PM

Pump Off Date 11 / 12 / 13 Time 9:57 AM/(PM)

Weather Conditions Cool and foggy early then sunny.

Test Performed by Ray Moores and Rod Fuller

TFN 6 2/025
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Starting WL = 101.68

Pump On @ 11:12

WWC ENGINEERING

October 2014

RAMACO

AQUIFER TEST FIELD DATA

Project/Client RAMACO Well No. MST-1

TIME			WATER LEVEL DATA				
Date	Clock Time	(t) Elapsed Time Since Pump ON or OFF (min)	Depth to Water Below M.P. (ft)	(s) Drawdown/ Recovery (ft)	(Q) Discharge (gpm)	Discharge Pipe Pressure (PSI)	BUCKET TESTS COMMENTS
11-12-13	11:19	7 MINUTES	104.67	2.99	0.32	10 PSI	3:05 FOR ONE GALLON
11-12-13	11:25	13 MINUTES	105.10	3.42			
11-12-13	11:30	18 MINUTES			0.33	10 PSI	3:01 FOR ONE GALLON
11-12-13	11:31	19 MINUTES	105.88	4.2			
11-12-13	11:38	26 MINUTES	106.63	4.95			
11-12-13	11:50	38 MINUTES	107.40	5.72			
11-12-13	11:56	44 MINUTES	107.73	6.05	0.33	10 PSI	3:02 FOR ONE GALLON
11-12-13	12:15	63 MINUTES	108.46	6.78			
11-12-13	12:22	71 MINUTES	108.71	7.03			
11-12-13	12:42	80 MINUTES	109.19	7.51	0.32	10 PSI	3:05 FOR ONE GALLON
11-12-13	13:09	117 MINUTES	109.66	7.98			
11-12-13	13:23	131 MINUTES	109.87	8.19			
11-12-13	13:41	149 MINUTES	110.07	8.39	0.33	10 PSI	3:02 FOR ONE GALLON. INCREASED PRESSURE SLIGHTLY TO GET 10 PSI
11-12-13	14:24	192 MINUTES	110.58	8.9	0.34	10 PSI	2:56 FOR ONE GALLON
11-12-13	15:10	238 MINUTES	110.93	9.25		10 PSI	
11-12-13	15:24	252 MINUTES	111.02	9.34		10 PSI	
11-12-13	15:42	270 MINUTES	111.08	9.4	0.32	10 PSI	3:06 FOR ONE GALLON
11-12-13	16:06	294 MINUTES	111.20	9.52		10 PSI	

Addendum D6-8-29

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Brook Mine

WWC ENGINEERING

October 2014

RAMACO

AQUIFER TEST FIELD DATA

Project/Client RAMACO Well No. MST-1

TIME			WATER LEVEL DATA				
Date	Clock Time	(t) Elapsed Time Since Pump ON or OFF (min)	Depth to Water Below M.P. (ft)	(s) Drawdown/ Recovery (ft)	(Q) Discharge (gpm)	Discharge Pipe Pressure (PSI)	BUCKET TESTS COMMENTS
11-12-13	16:50	338 MINUTES	111.31	9.63		10 PSI	
11-12-13	17:07	355 MINUTES	111.36	9.68	0.32	10 PSI	3:06 FOR ONE GALLON
11-12-13	21:47	635 MINUTES	112.00	10.32	0.32	10 PSI	3:10 FOR ONE GALLON
11-12-13	21:54	642 MINUTES	112.06	10.38		10 PSI	
		Pulled pump out of well at approximately 21:57. When we pulled the pump it was leaking water back into the well from the discharge line so there is a chance that until 21:59, there could have been rapid increases in water levels from pulling the pump.					

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Addendum D6-8-30

Brook Mine

ATTACHMENT D6-8-D

Carney Pumping Test
November 14, 2013
Discharge Rate Data

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WWC ENGINEERING

AQUIFER TEST FIELD DATA

Project/Client : RAMACO

Pumped Well No. CRN-1 Observation Well No. CRN-OB

Type of Pump Test: ☒ Constant Discharge ☐ Step-Drawdown

Pumped Well Casing ID 5" (nominal) inches

Distance Between Pumped and Observation Wells 15.4' feet

Water Level Measurements by: ☒ electric tape ☒ pressure transducer

Discharge Measurements by: ☒ bucket/stopwatch ☐ flow meter ☐ flume/weir

0.5 gpm dole valve continuously maintaining 10 psi ahead of dole valve.

Screen/Perforation Interval(s) (below land surface) _____

Depth of Pump Intake (below land surface) estimated at 105' (no actual measurement) feet

Depth of Static Water Level (from measurement point) 90.94' feet

Height of Measurement Point (above land surface) 2.55' feet

Elevation of Measurement Point _____ feet a.m.s.l.

Pump On Date 11 / 14 / 13 Time 8:41 (AM)/PM

Pump Off Date 11 / 14 / 13 Time 7:35 AM/(PM)

Weather Conditions Chilly in morning then partly cloudy, sunny warming into the 50's.

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Test Performed by Ray Moores and Rod Fuller

Starting WL = 90.94

Pump On @ 8:41

WWC ENGINEERING

October 2014

RAMACO

AQUIFER TEST FIELD DATA

Project/Client RAMACO Well No. CRN-1

TIME			WATER LEVEL DATA				
Date	Clock Time	(t) Elapsed Time Since Pump ON or OFF (min)	Depth to Water Below M.P. (ft)	(s) Drawdown/ Recovery (ft)	(Q) Discharge (gpm)	Discharge Pipe Pressure (PSI)	BUCKET TESTS COMMENTS
11-14-13	08:41	0	90.94		~0.33		
11-14-13	08:50	9 MINUTES			0.32	10 PSI	ONE GALLON FOR 3:10
11-14-13	08:52	PUMP SHUT OFF					
11-14-13		RESTARTED					
11-14-13	09:00	PUMP SHUT OFF	PULLED PUMP OUT APPROX 4' TO GET OUT OF MUD				
11-14-13	09:03	RESTARTED					
11-14-13	09:08	27 MINUTES	93.56	2.62	0.33	10 PSI	
11-14-13	09:14	33 MINUTES	94.02		0.35	12 PSI	2:50 FOR ONE GALLON REDUCED PRESSURE
11-14-13	09:27	46 MINUTES	94.31	3.37	0.31	9 PSI	3:14 FOR ONE GALLON ADJUSTED TO 10 PSI
11-14-13	09:39	58 MINUTES	94.70	3.76	0.33		3:00 FOR ONE GALLON
11-14-13	10:01	80 MINUTES	95.47	4.53		10 PSI	
11-14-13	10:13	92 MINUTES	95.69	4.75		10 PSI	
11-14-13	10:27	106 MINUTES	95.87	4.93			
11-14-13	11:09	148 MINUTES	95.96	5.02	0.32	10 PSI	3:06 FOR ONE GALLON
11-14-13	11:23	162 MINUTES	96.07	5.13		10 PSI	
11-14-13	11:36	175 MINUTES	96.18	5.24		10 PSI	
11-14-13	11:50	189 MINUTES	96.26	5.32		10 PSI	
11-14-13	12:22	221 MINUTES	96.40	5.1	0.32		3:05 FOR ONE GALLON

Addendum D6-8-33

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Brook Mine

WWC ENGINEERING

October 2014

RAMACO

AQUIFER TEST FIELD DATA

Project/Client RAMACO Well No. CRN-1

TIME			WATER LEVEL DATA				
Date	Clock Time	(t) Elapsed Time Since Pump ON or OFF (min)	Depth to Water Below M.P. (ft)	(s) Drawdown/ Recovery (ft)	(Q) Discharge (gpm)	Discharge Pipe Pressure (PSI)	BUCKET TESTS COMMENTS
11-14-13	12:33	232	96.44	5.5	0.32	10 PSI	
11-14-13	16:40	479	96.95	6.1		10 PSI	
11-14-13	16:57	496	96.95		0.31	10 PSI	3:11 FOR ONE GALLON SLIGHTLY INCREASED FLOW
11-14-13	17:55	554	97.15	6.21		10 PSI	
11-14-13	19:18	577	97.27			10 PSI	
11-14-13	19:33	592	97.26		0.33	10 PSI	3:00 FOR ONE GALLON
		Shut off pump at 19:35, 5.25 psi above transducer at the end.					

Addendum D6-8-34

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Brook Mine

ATTACHMENT D6-8-E

Masters Wells Groundwater Level Hydrographs

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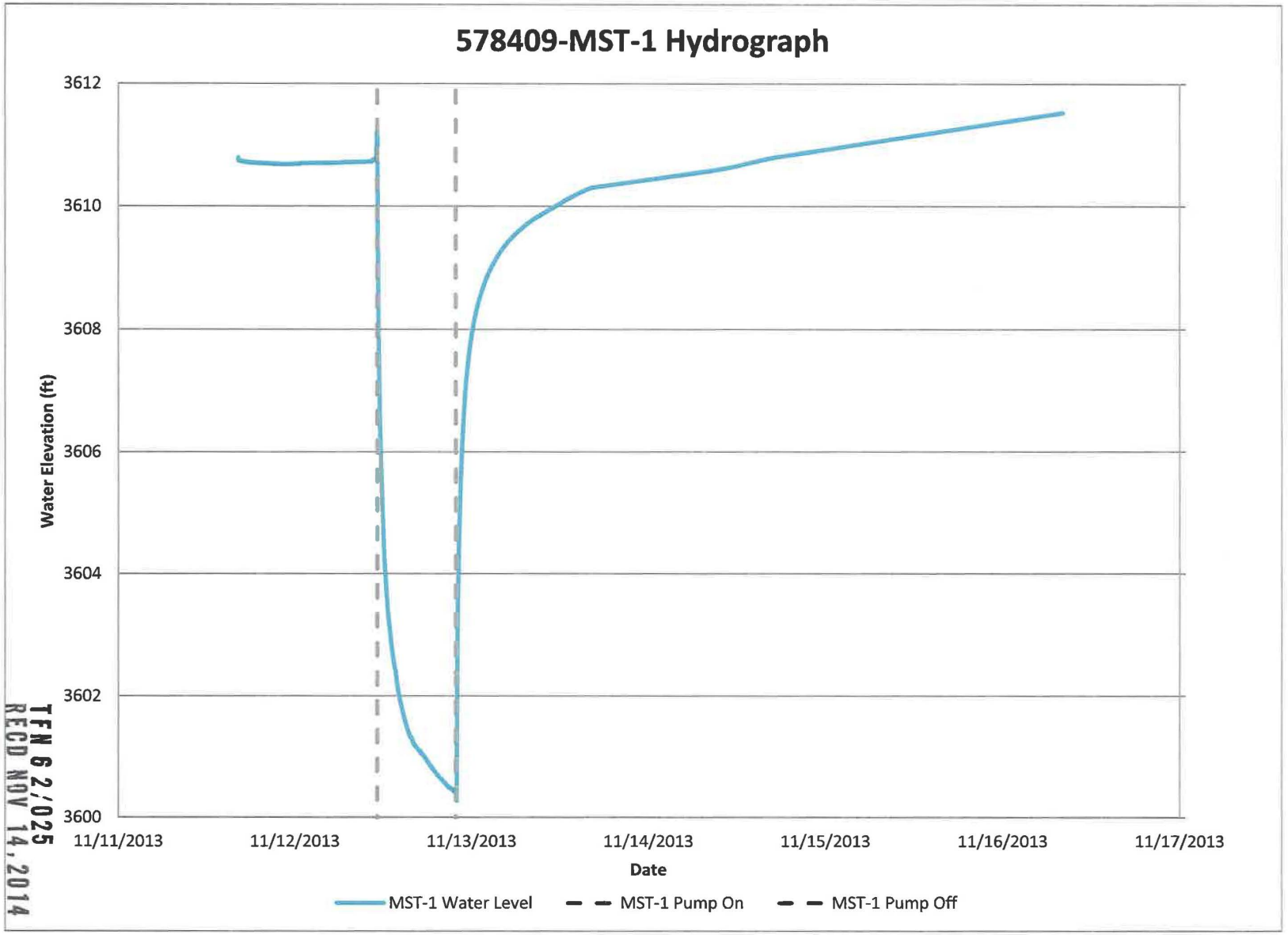
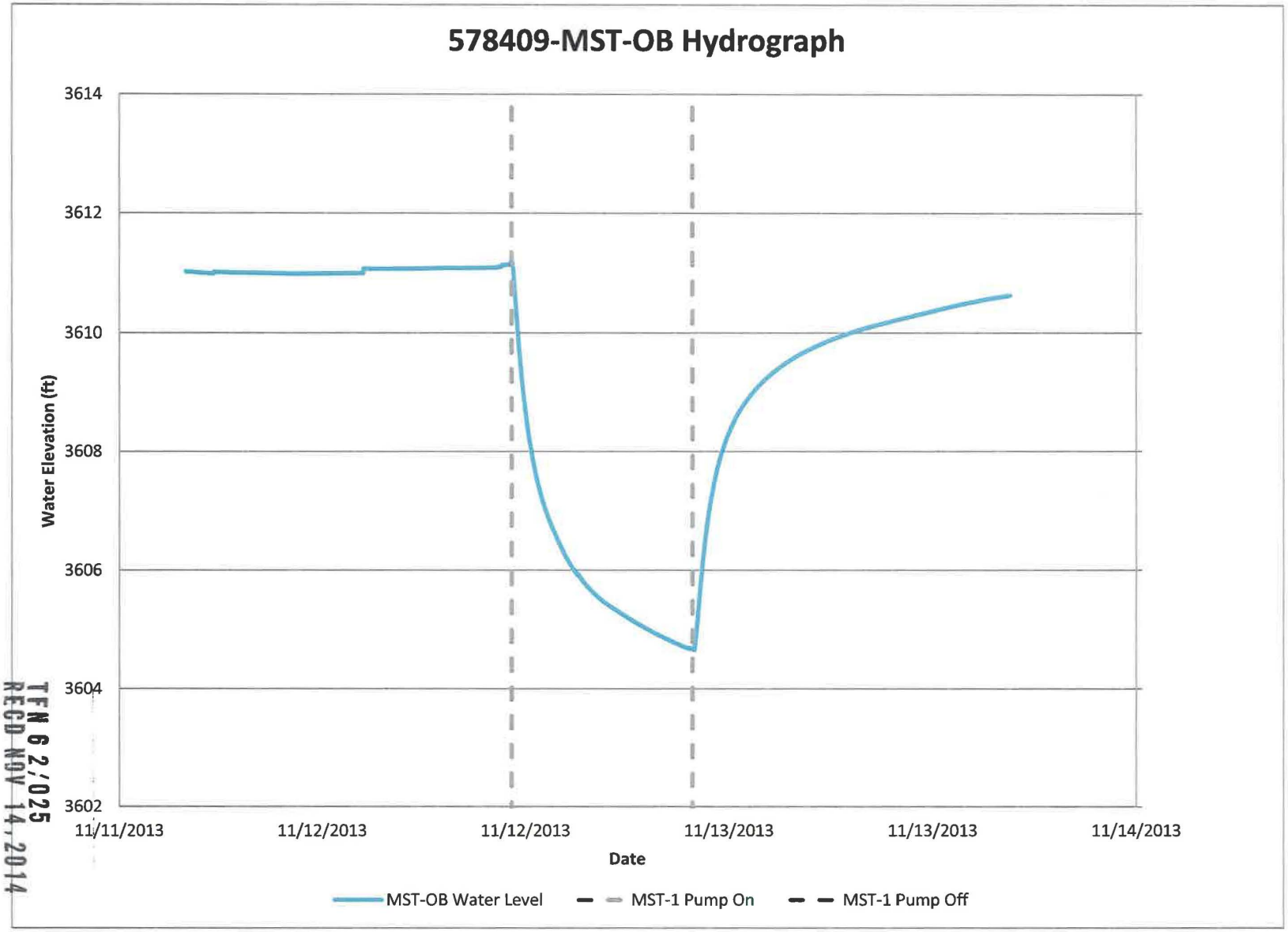
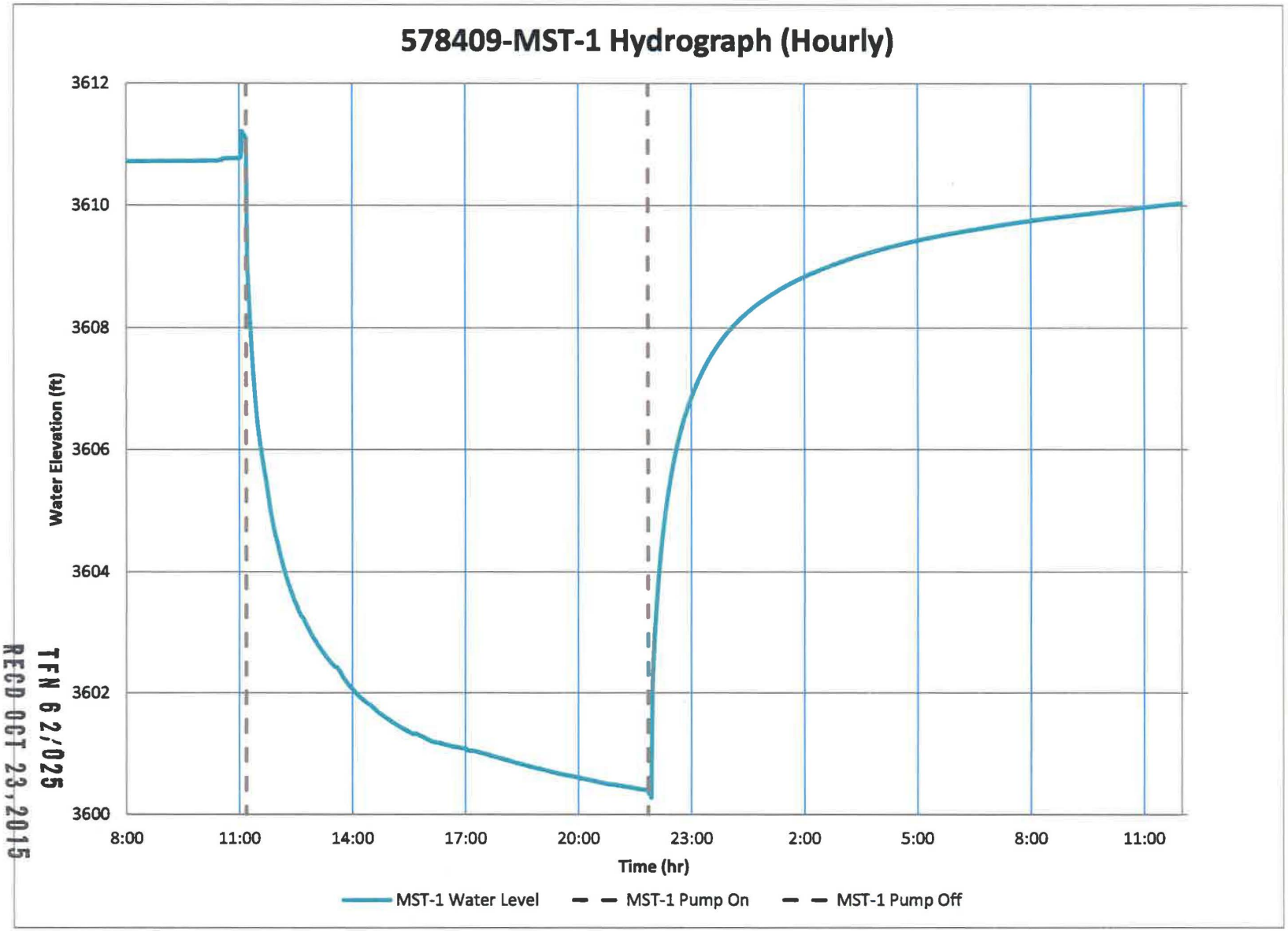


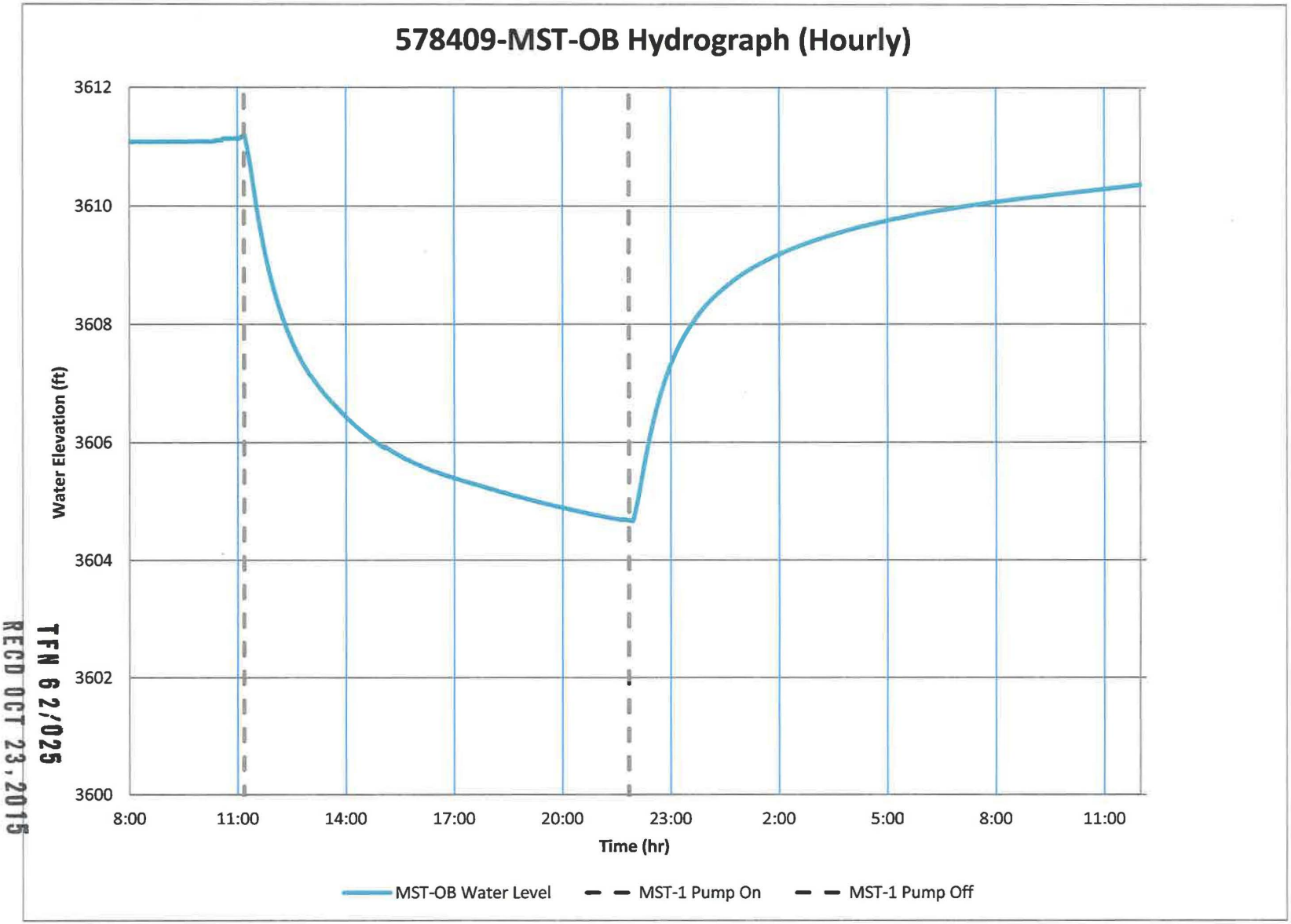
TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD OCT 23, 2015



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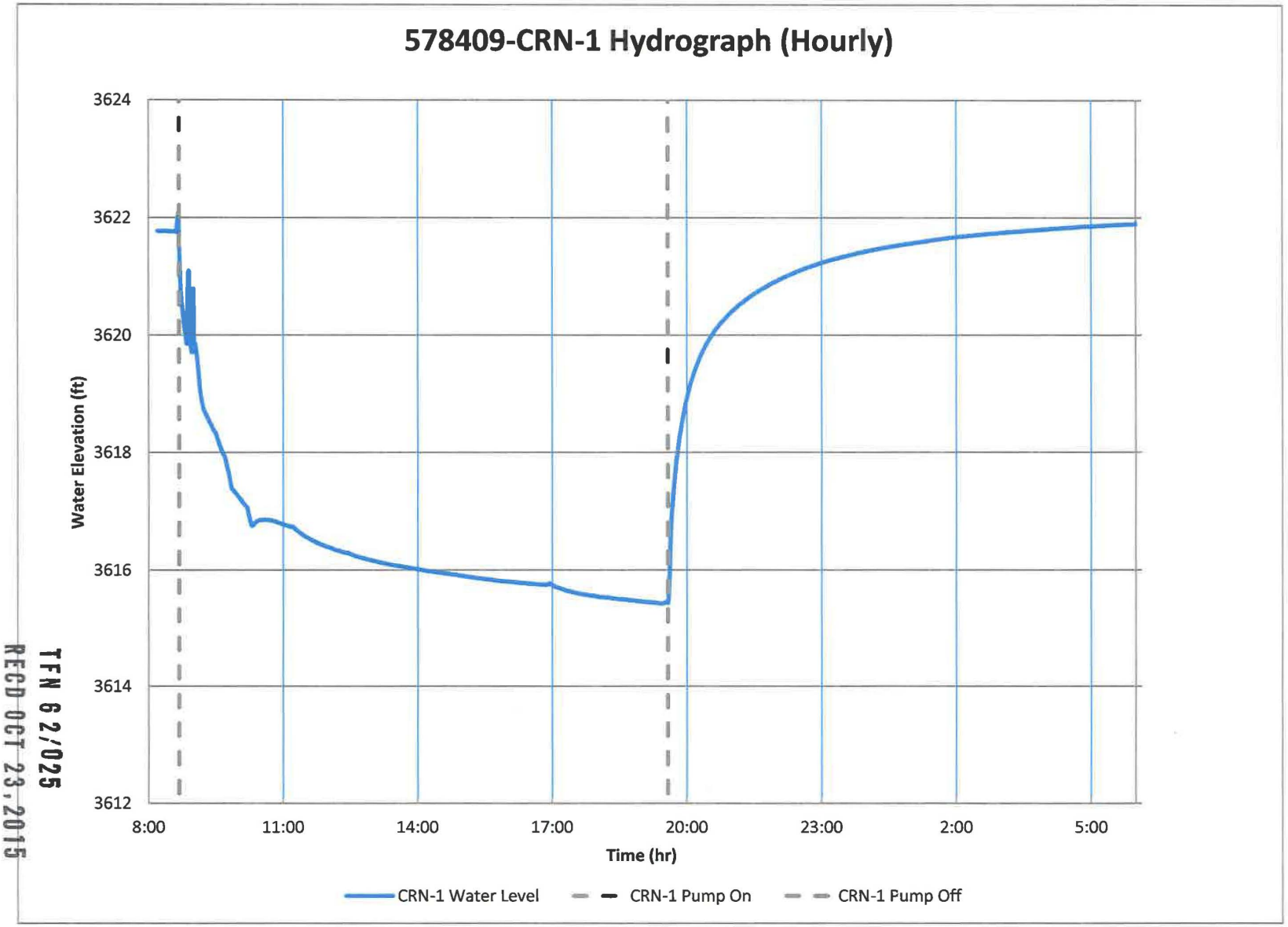

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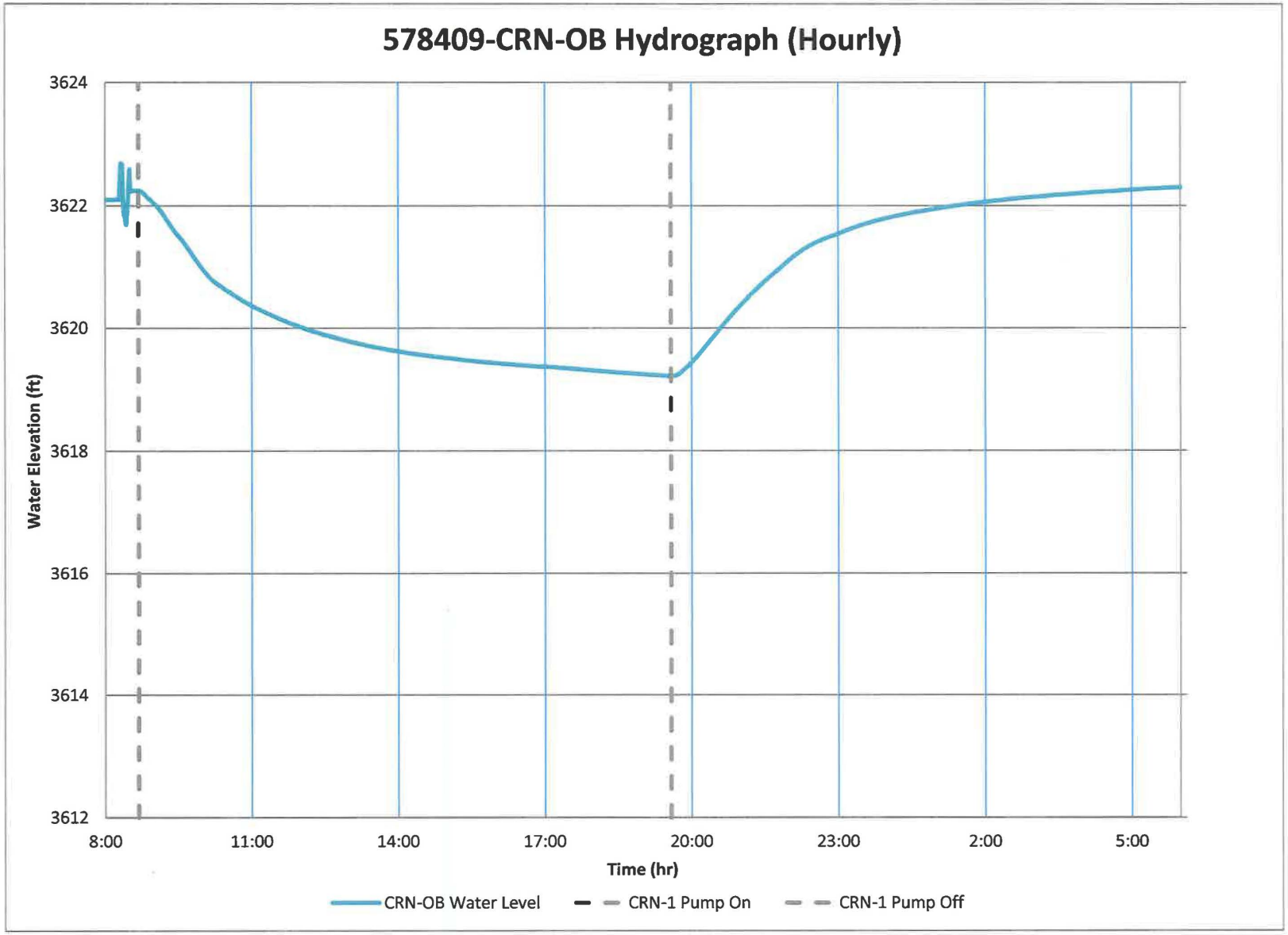
RECD OCT 23,2015

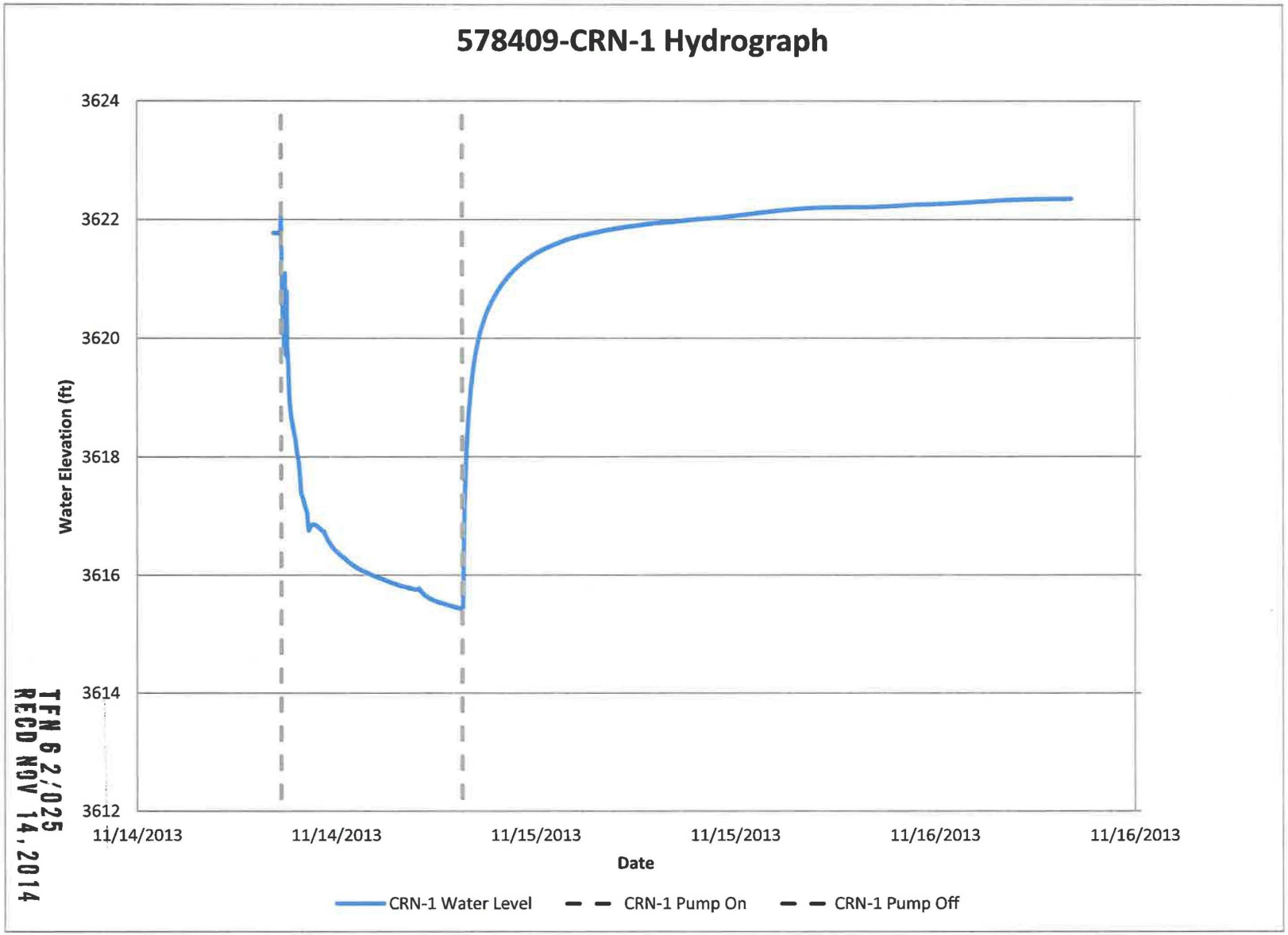
TFN 6 2/025
RECD OCT 23, 2015



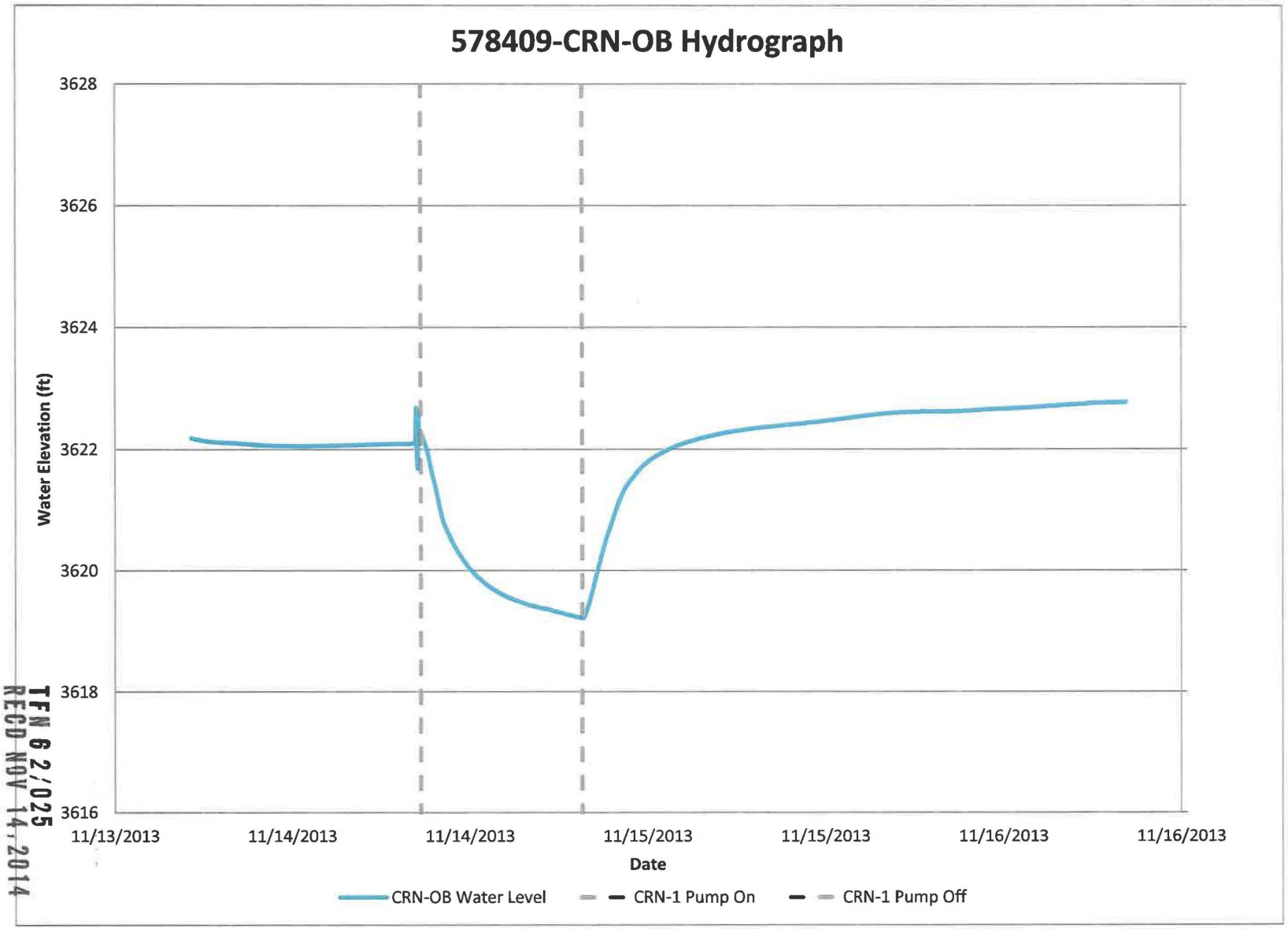
ATTACHMENT D6-8-F

Carney Wells Groundwater Level Hydrographs

TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 2014



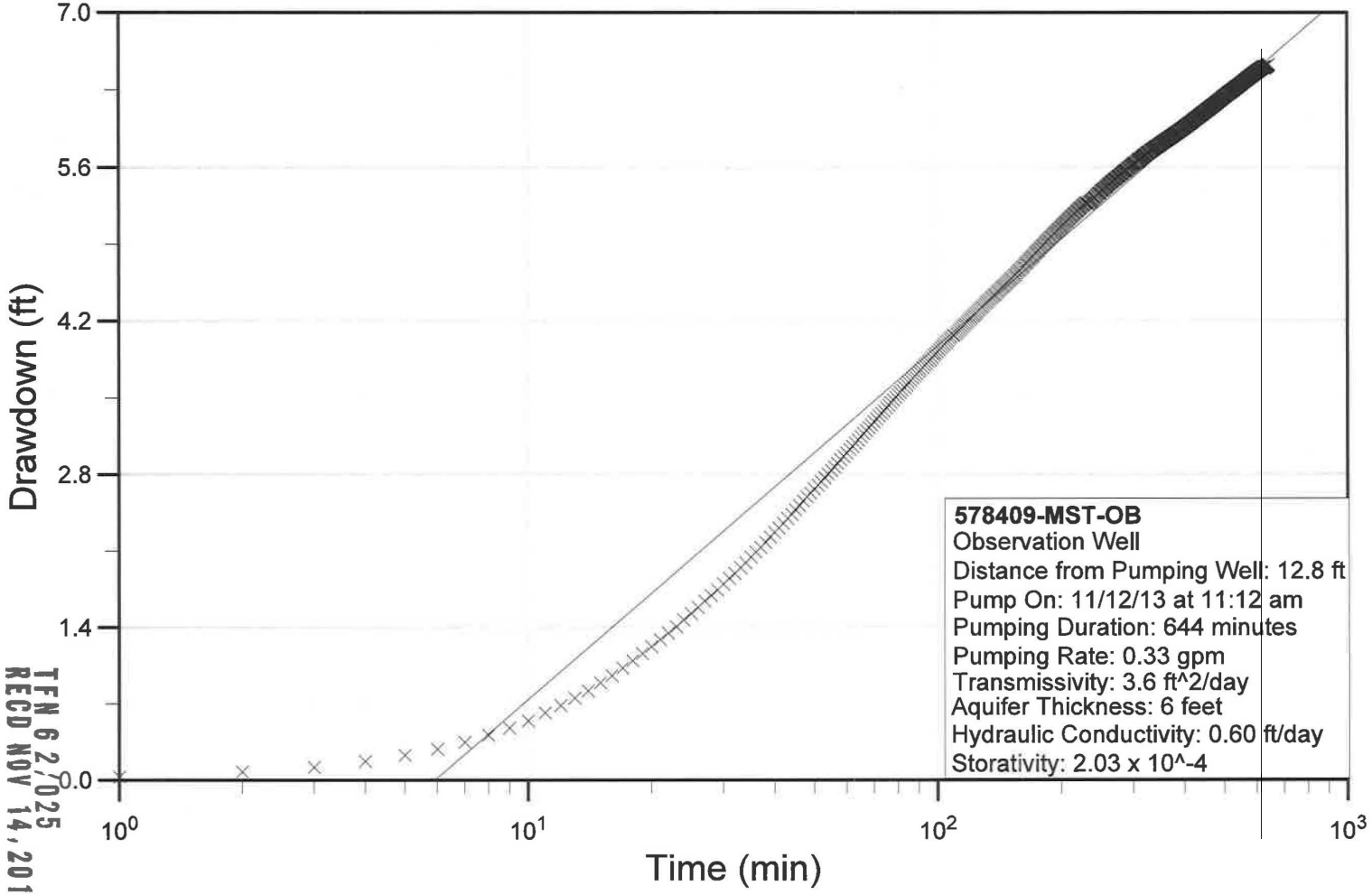
TFN 6 2/025
RECD NOV 14, 2014

ATTACHMENT D6-8-G

Section 9 Aquifer Pumping Test
Observation Well 578409-MST-OB
Plots of Time-Drawdown and Analyses

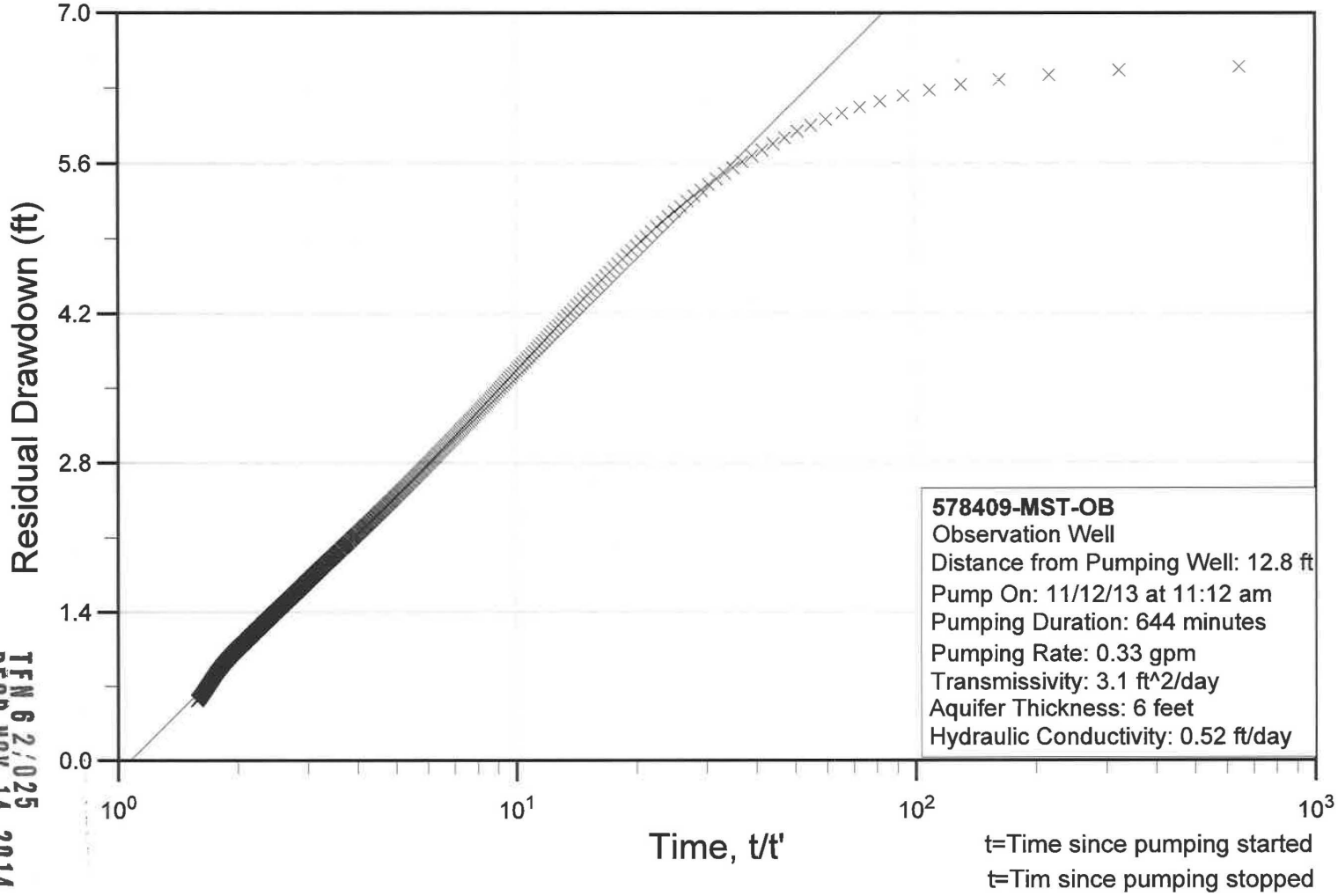
TFN 6 2/025
RECD NOV 14,2014

Cooper and Jacob - 578409-MST-OB



TFN 6 2/025
RECD NOV 14, 2014

Theis Recovery - 578409-MST-OB



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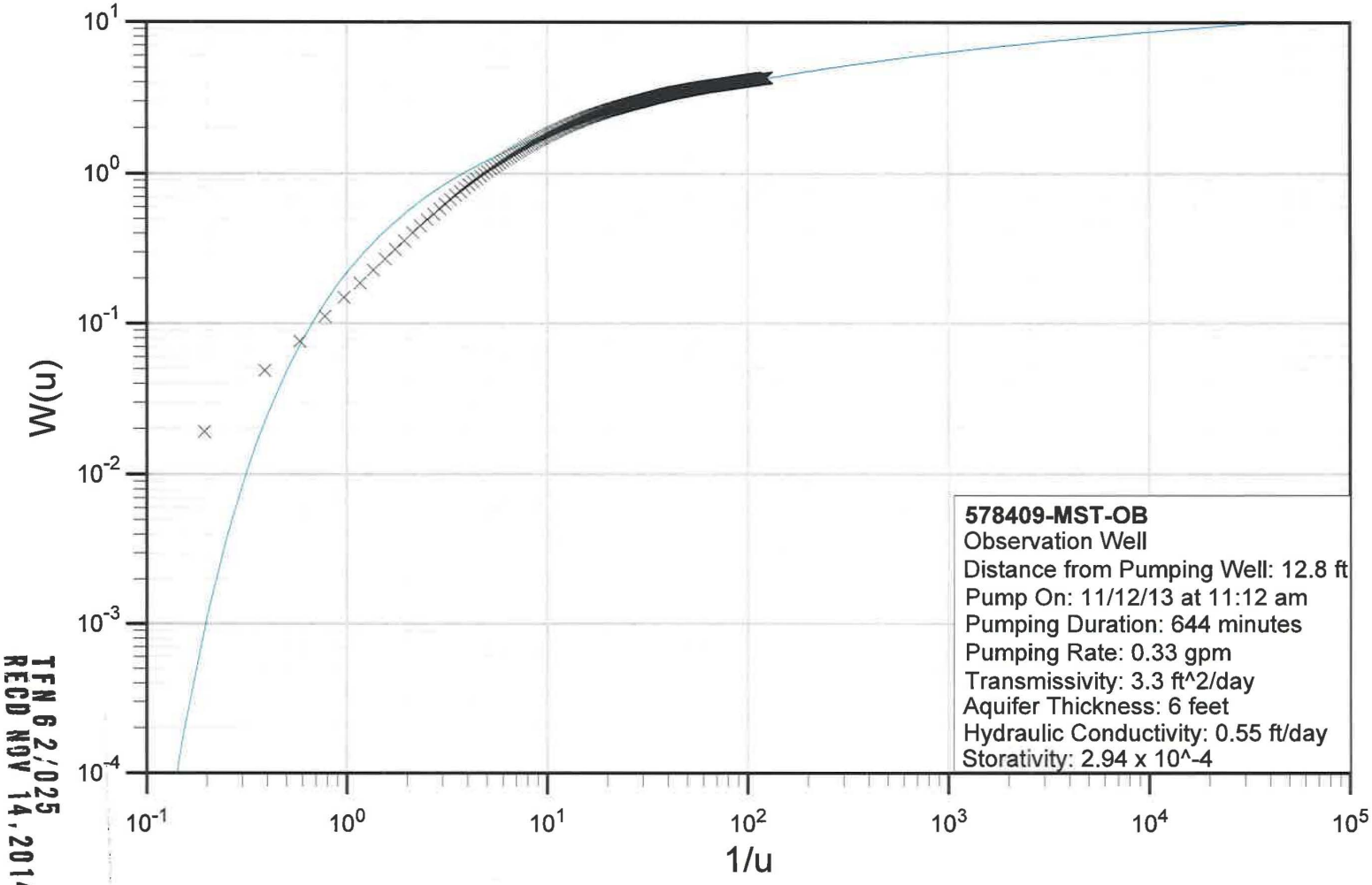
Theis - 578409-MST-OB



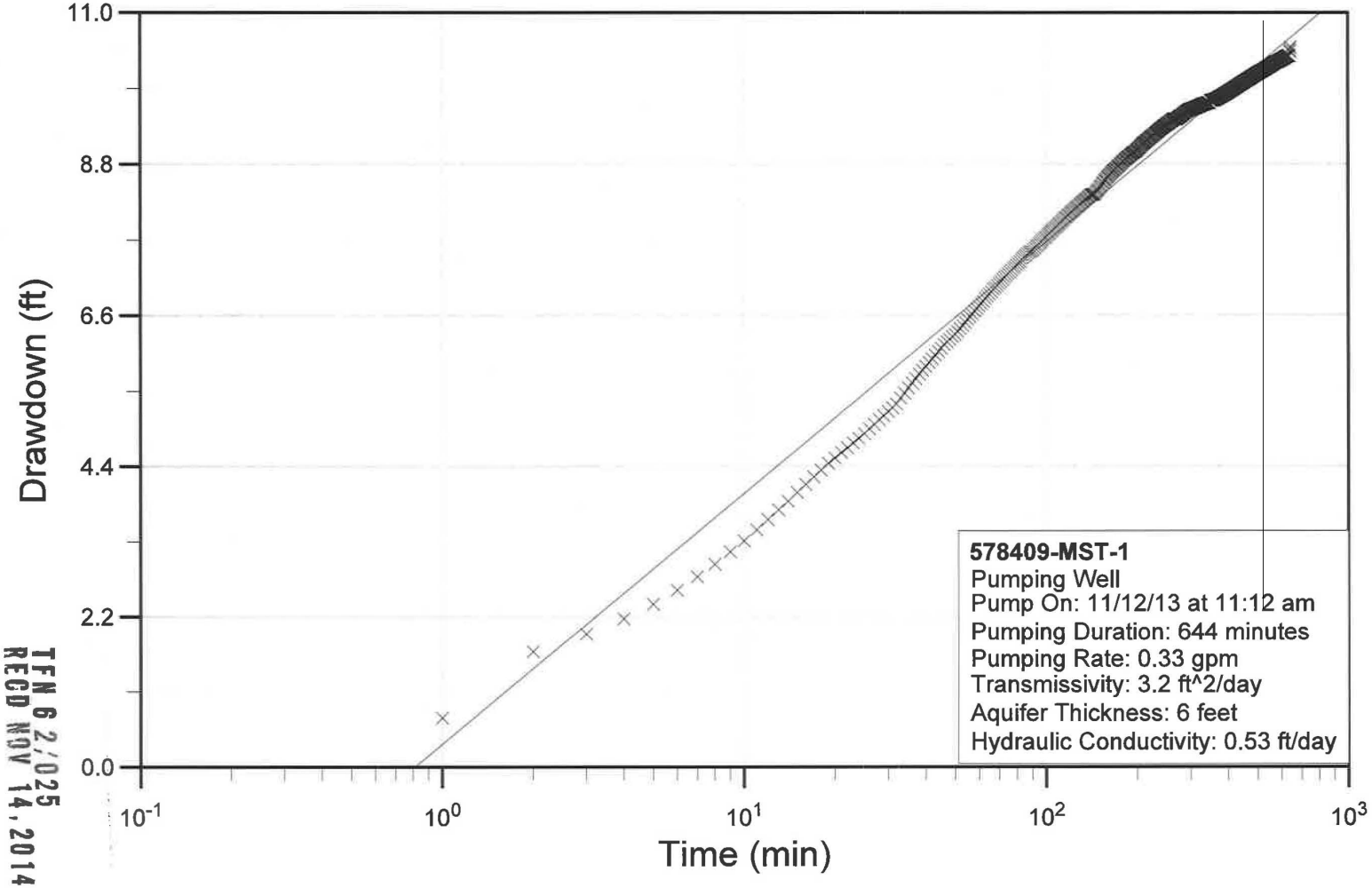
TFN 6 2/025
RECD NOV 14, 2014

ATTACHMENT D6-8-H

Section 9 Aquifer Pumping Test
Pumped Well 578409-MST-1
Plots of Time-Drawdown and Analyses

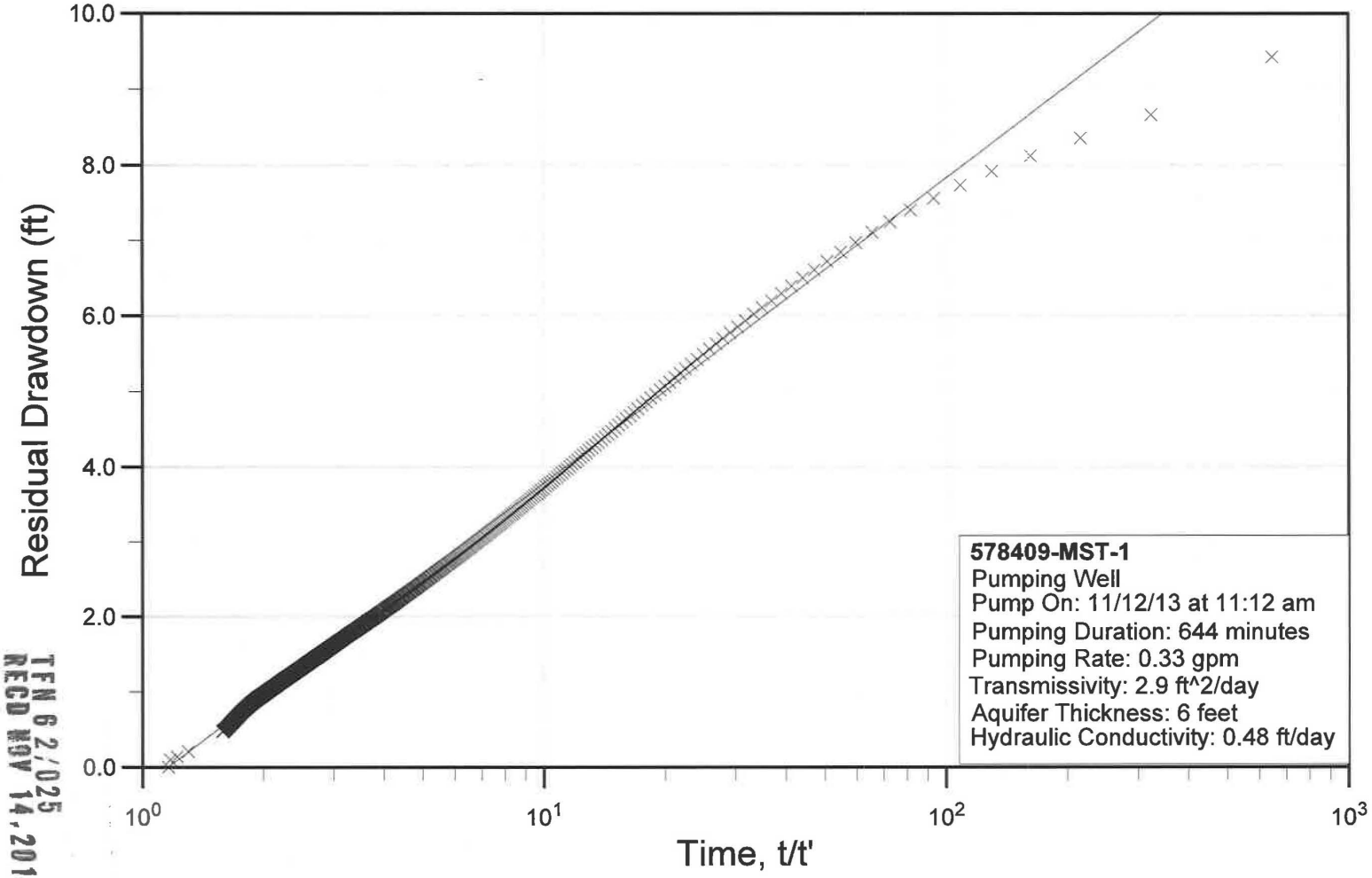
TFN 6 2/025
RECD NOV 14, 2014

Cooper and Jacob - 578409-MST-1



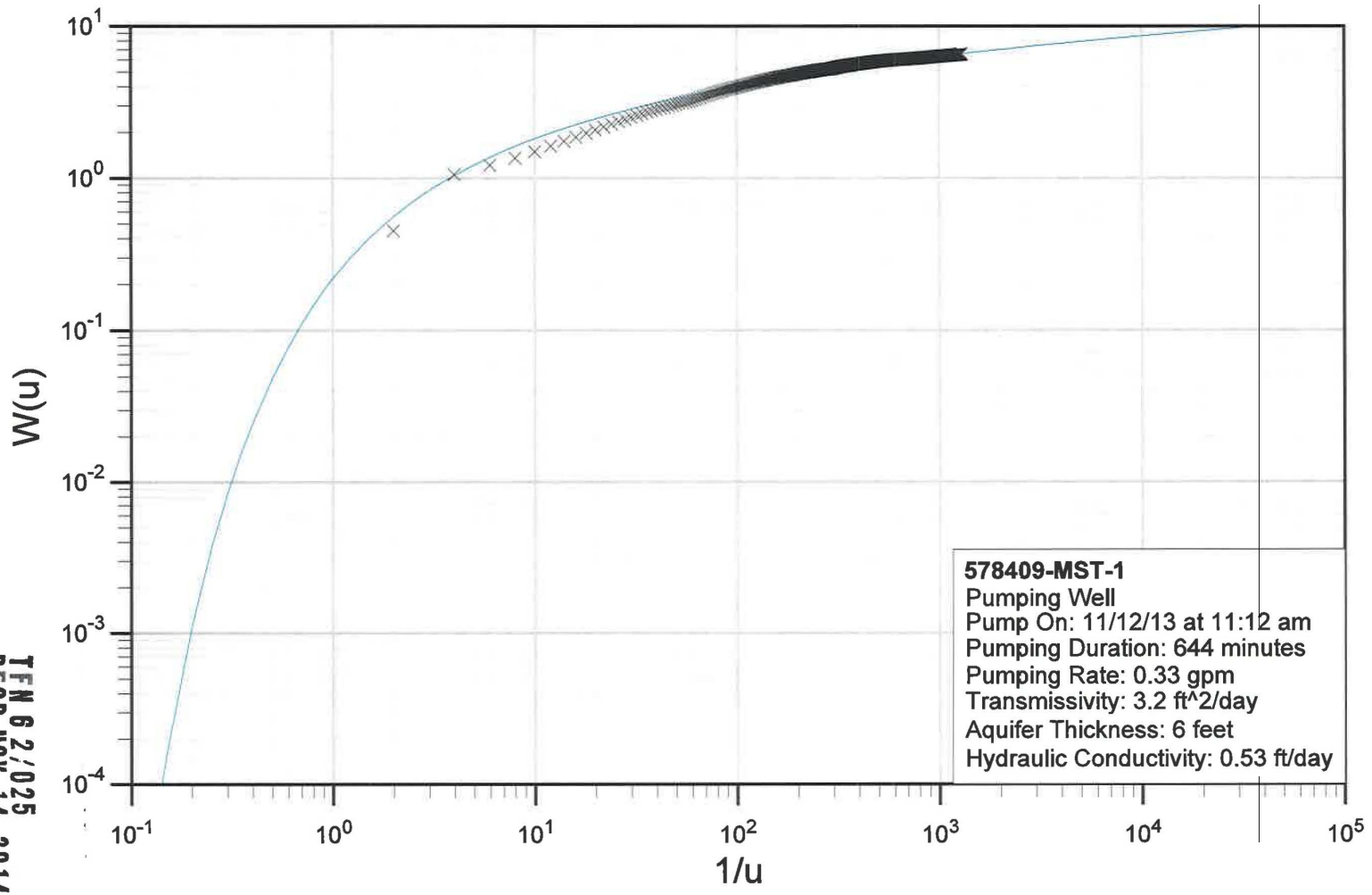
TFN 6 2/025
RECD NOV 14, 2014

Theis Recovery - 578409-MST-1



TFN 6 2/025
RECD NOV 14, 2014

Theis - 578409-MST-1



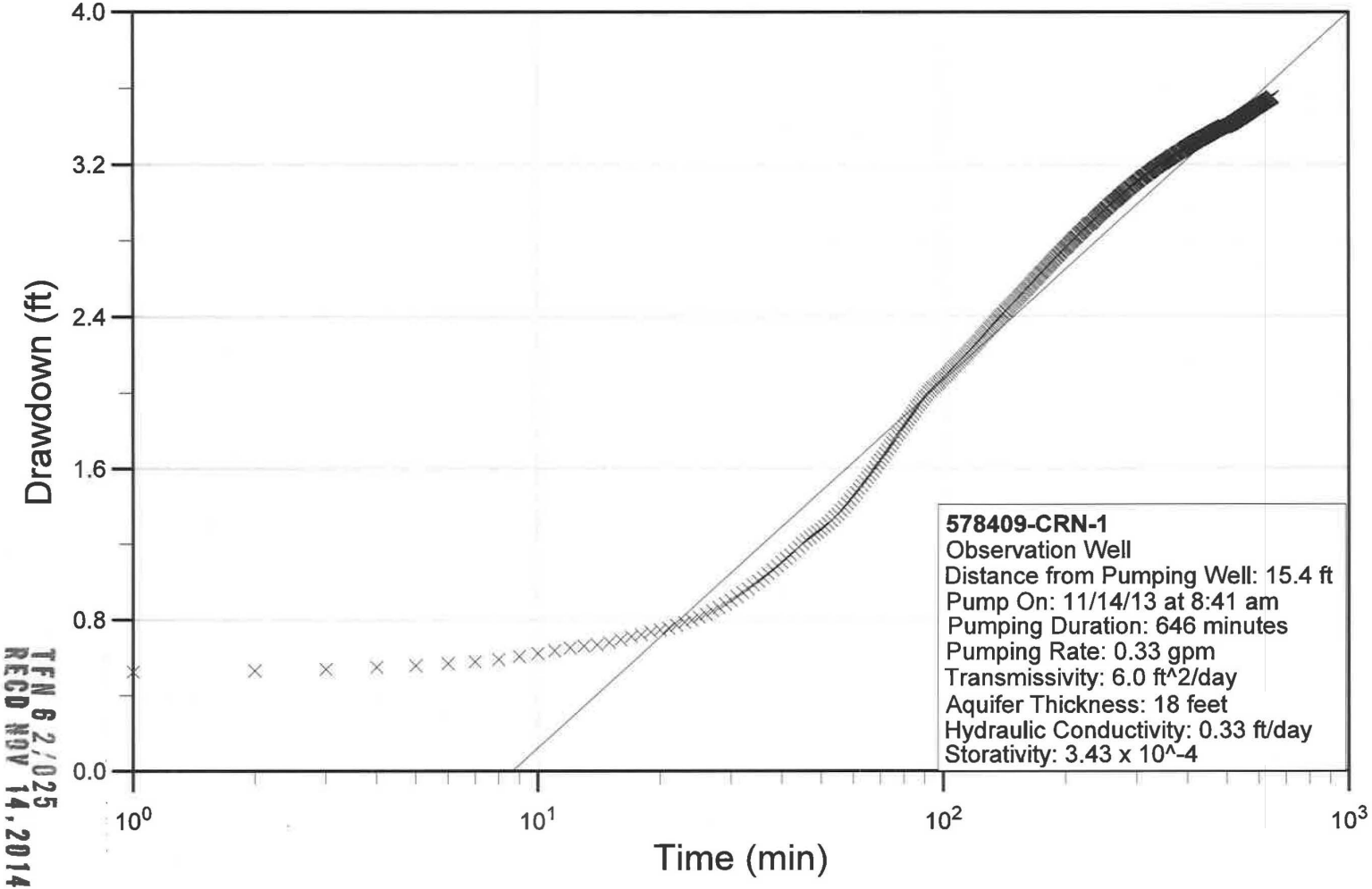
TFN 6 2/025
RECD NOV 14, 2014

ATTACHMENT D6-8-I

Section 9 Aquifer Pumping Test
Observation Well 578409-CRN-OB
Plots of Time-Drawdown and Analyses

TFN 6 2/025
RECD NOV 14, 2014

Cooper and Jacob - 578409-CRN-OB



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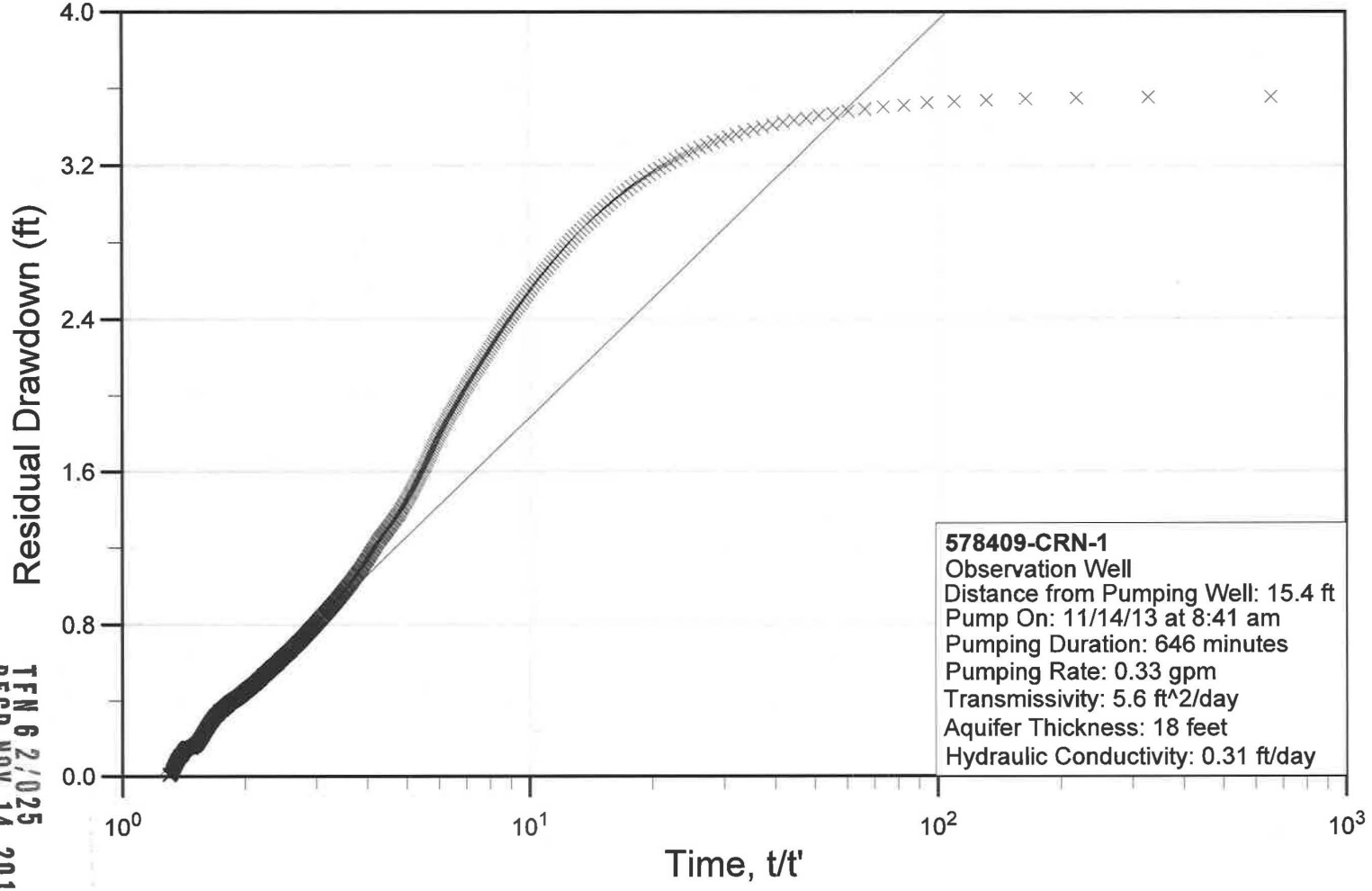
RECD NOV 14, 2014

Theis Recovery - 578409-CRN-OB



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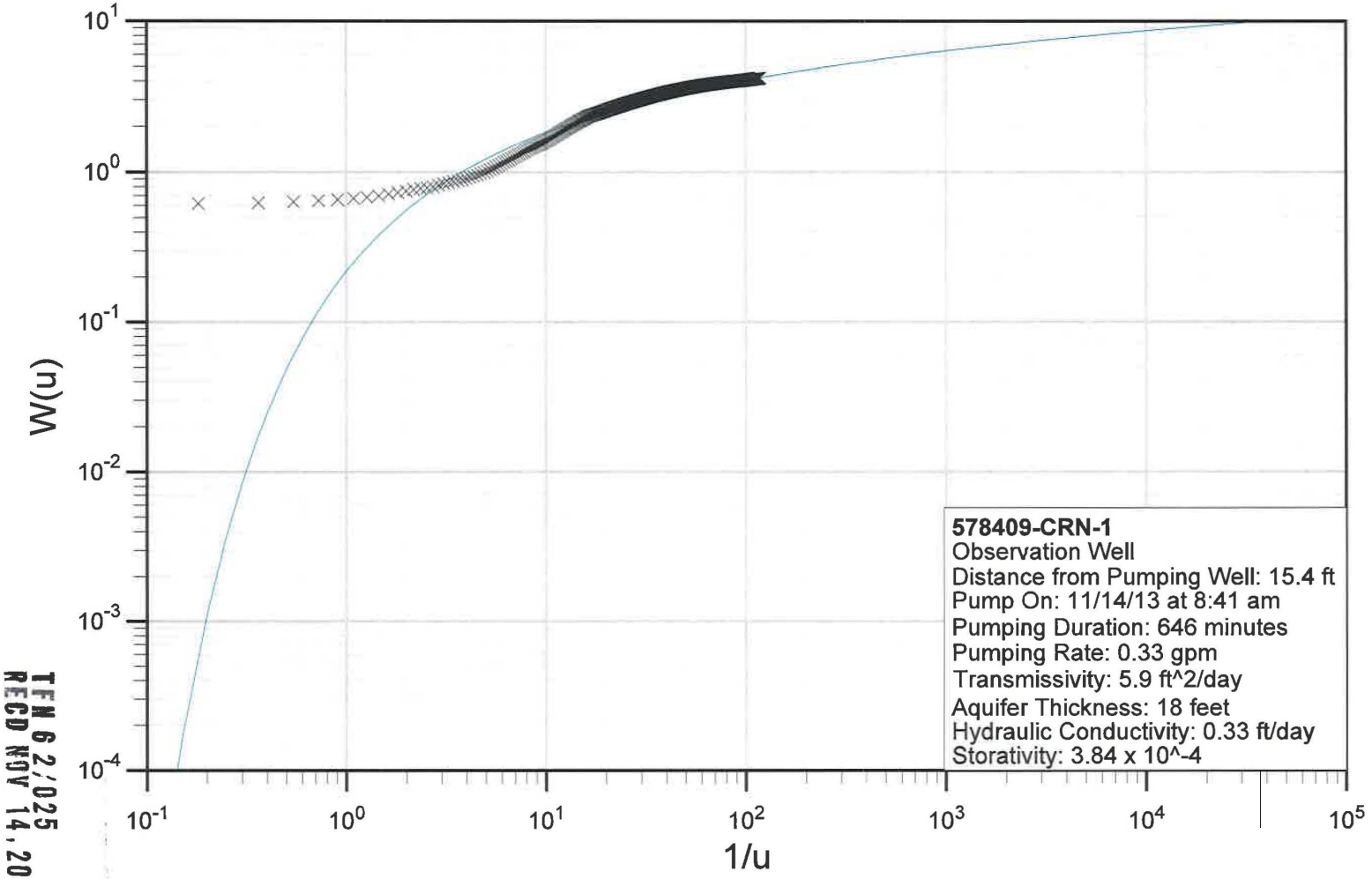
Theis - 578409-CRN-OB



TFN 6 2/025
RECD NOV 14, 2014

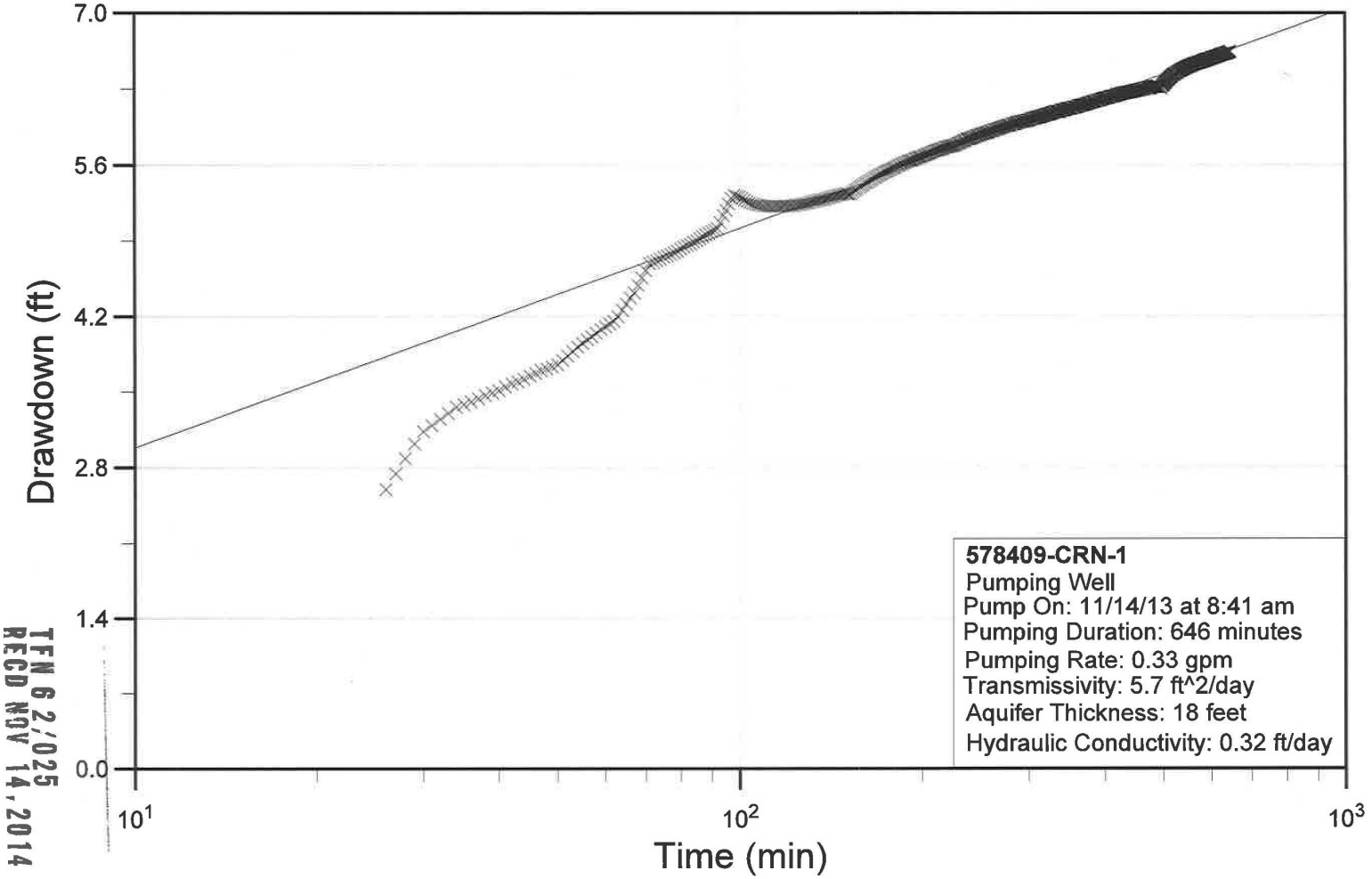
DEQ 6-318

ATTACHMENT D6-8-J

Section 9 Aquifer Pumping Test
Pumped Well 578409-CRN-1
Plots of Time-Drawdown and Analyses

TFN 6 2/025
RECD NOV 14,2014

Cooper and Jacob - 578409-CRN-1



TFN 6 2/025
RECD NOV 14, 2014

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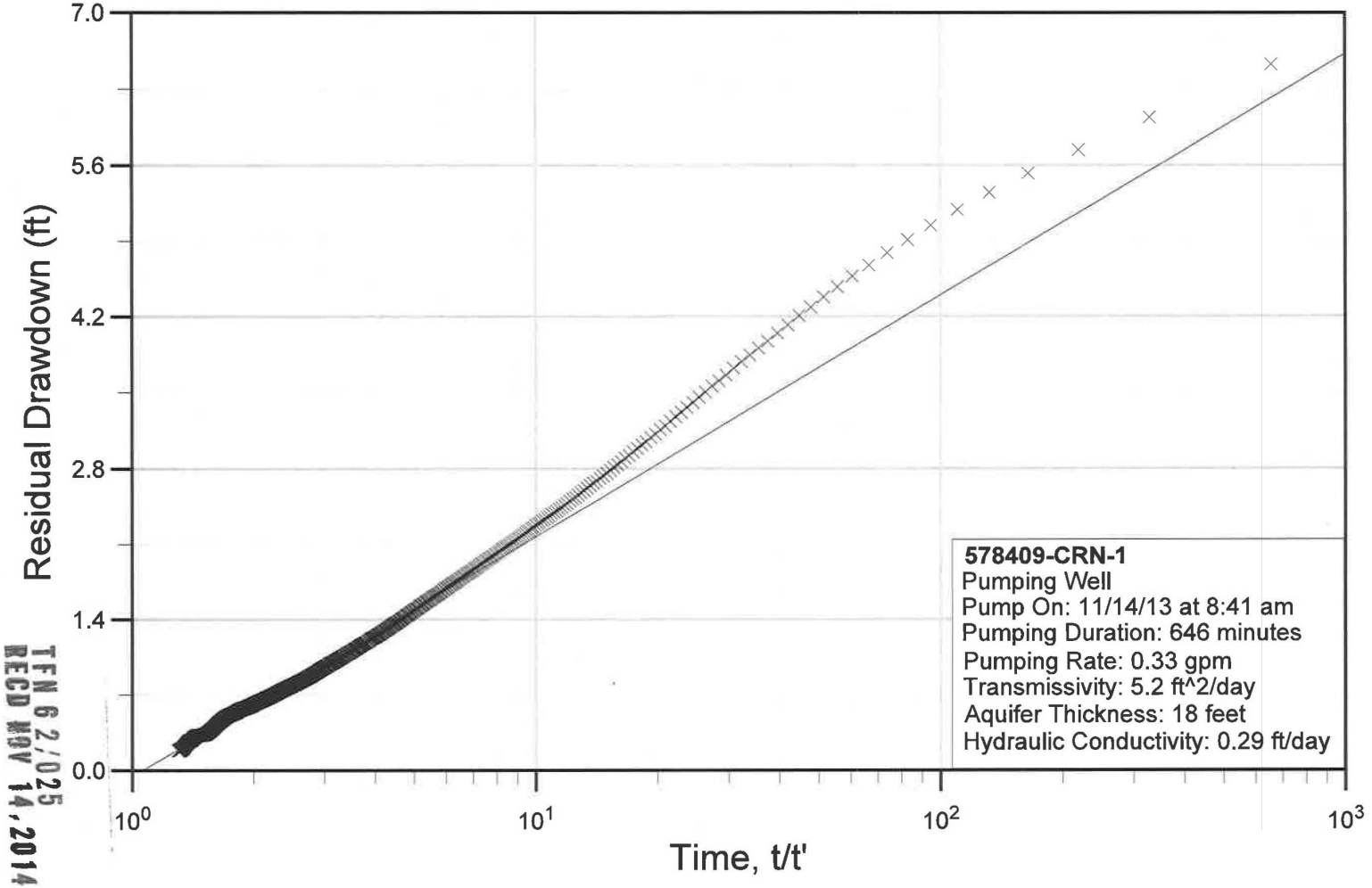

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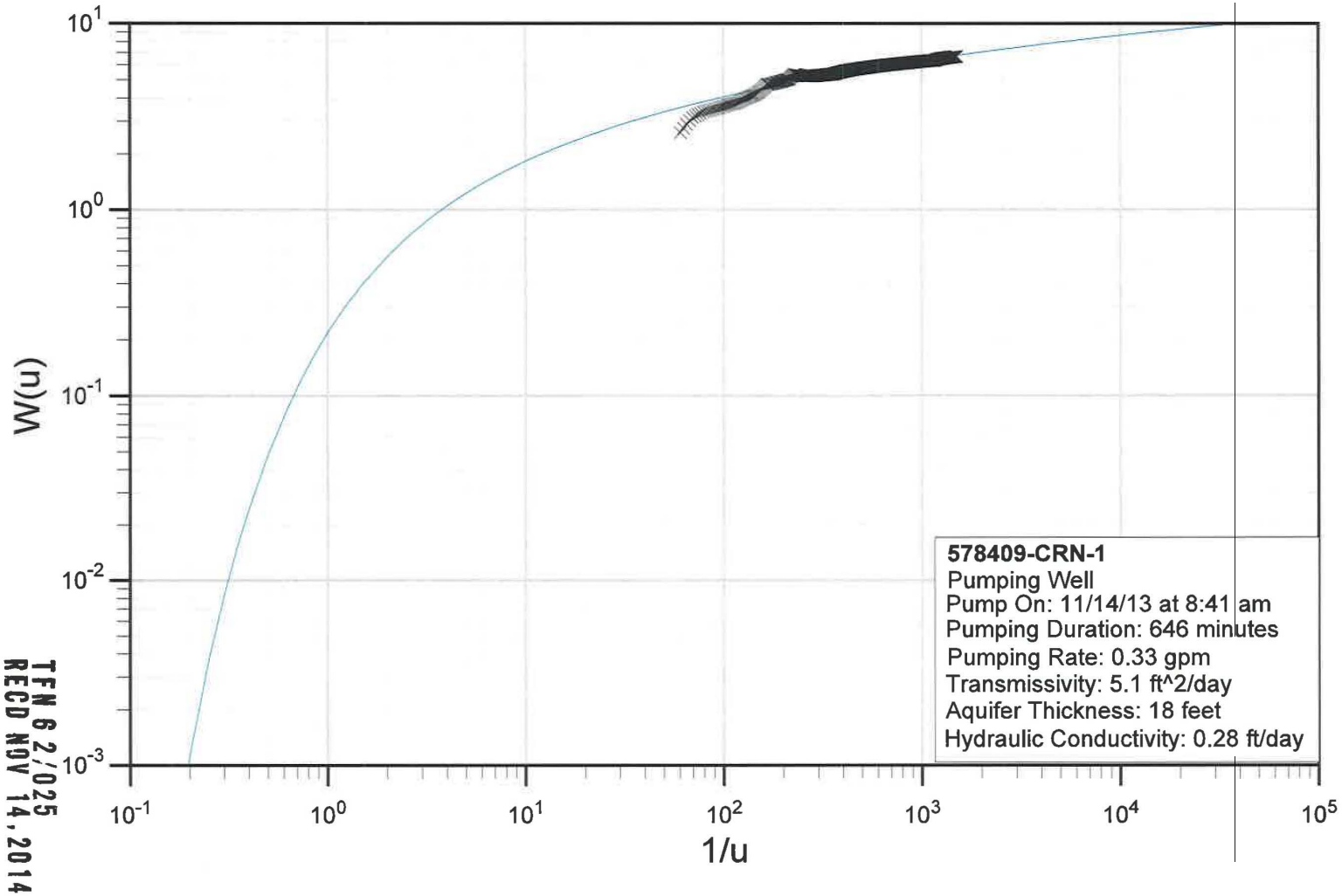
Theis - 578409-CRN-1



TFN 6 2/025
RECD NOV 14, 2014

Attachment D6-8-K Field Water Level Measurements vs. Barometric Pressure

Water Levels Measured in During the Masters Coal Pumping Test Compared to Barometric Pressure

Measurement[1]		1a (ft)	1b	1c	1d	1e	1f	1g	Difference (1g-1a)
Date		11/11/2013	11/12/2013	11/12/2013	11/12/13	11/12/2013	11/12/2013	11/13/2013	
Time		3:00	10:30	13:00	15:05	17:00	21:30	16:20	
Depth to Water From Well TOC (ft)	MST UB	110.08	110.07	110.05	110.07	110.09	110.08	110.08	0
	MST-1	101.67	101.68					102.26	-0.59
	MST-OB	102.3	102.33	106.33	107.58	108.1	108.83	102.9	-0.6
	CRN	91.17	91.16	91.12	91.09	91.08	91.05	90.94	0.23
	CRN-OB	91.1	91.1	91.07	91.04	91	91	90.87	0.23
Barometric Pressure (ft) H2O[3]		34.44	34.50	34.45	34.45	34.40	34.27	34.13	-0.31
Pressure change (ft)		0.00	0.07	0.01	0.01	-0.03	-0.17	-0.31	-0.31

Water Levels Measured During the Carney Coal Pumping Test Compared to Barometric Pressure

Measurement[1]		2a	2b	2c	2d	2e	2f	2g	Difference (2g-2a)
Date		11/14/13	11/14/13	11/14/13	11/14/13	11/14/13	11/14/13	11/16/13	
Time		7:55	9:50	11:16	12:26	17:00	19:22	8:09	
Depth to Water From TOC (ft)	MST UB	110.13	110.15	110.15	110.14	110.15	110.14	110.07	0.06
	MST-1[2]	101.83	101.8	101.76	101.72	101.6	101.56	100.87	0.96
	MST-OB[2]	102.48	102.45	102.4	103.35	102.24	102.19	101.55	0.93
	CRN	90.94	95.37					90.37	0.57
	CRN-OB	90.88	92.09	92.98	93.31	93.83	93.97	90.42	0.46
Barometric Pressure (ft) H2O[3]		34.09	34.09	34.04	34.02	33.96	33.89	33.24	-0.85
Pressure change (ft)		0.00	0.00	-0.05	-0.07	-0.12	-0.19	-0.85	-0.85

1 All measurements were taken with a hand operated electronic depth meter.
2 Water levels in the MST -1 and MST-OB wells were still recovering from the pumping test performed on 11/12/13.
3 Barometric pressure recorded at the Sheridan County airport AWOS (approximately 10 miles south of the well cluster). Data downloaded from NOAA. http://www.ncdc.noaa.gov/data-access/land-based-station-data/land-based-datasets/automated-weather-observing-system-awos

Note: The underbuden well (MST UB) did not respond to barometric changes to the same degree that the other wells did. Since the underburden water bearing unit has a very low yield, the well would not be able to respond to barometric pressure affects as quickly. Thus, the lack of barometric response in the underburden is attributed to the decreased barometric efficiency of the underburdern water bearing unit. Also, in between the Masters and Carney pumping tests, equipment was removed from the underburden well. The removal of the equipment and slow recovery rate in the well was attributed to the slight drop in water level in the MST UB well between tests.

TFN 6 2/025
RECD JUL 30, 2015

ADDENDUM D6-9

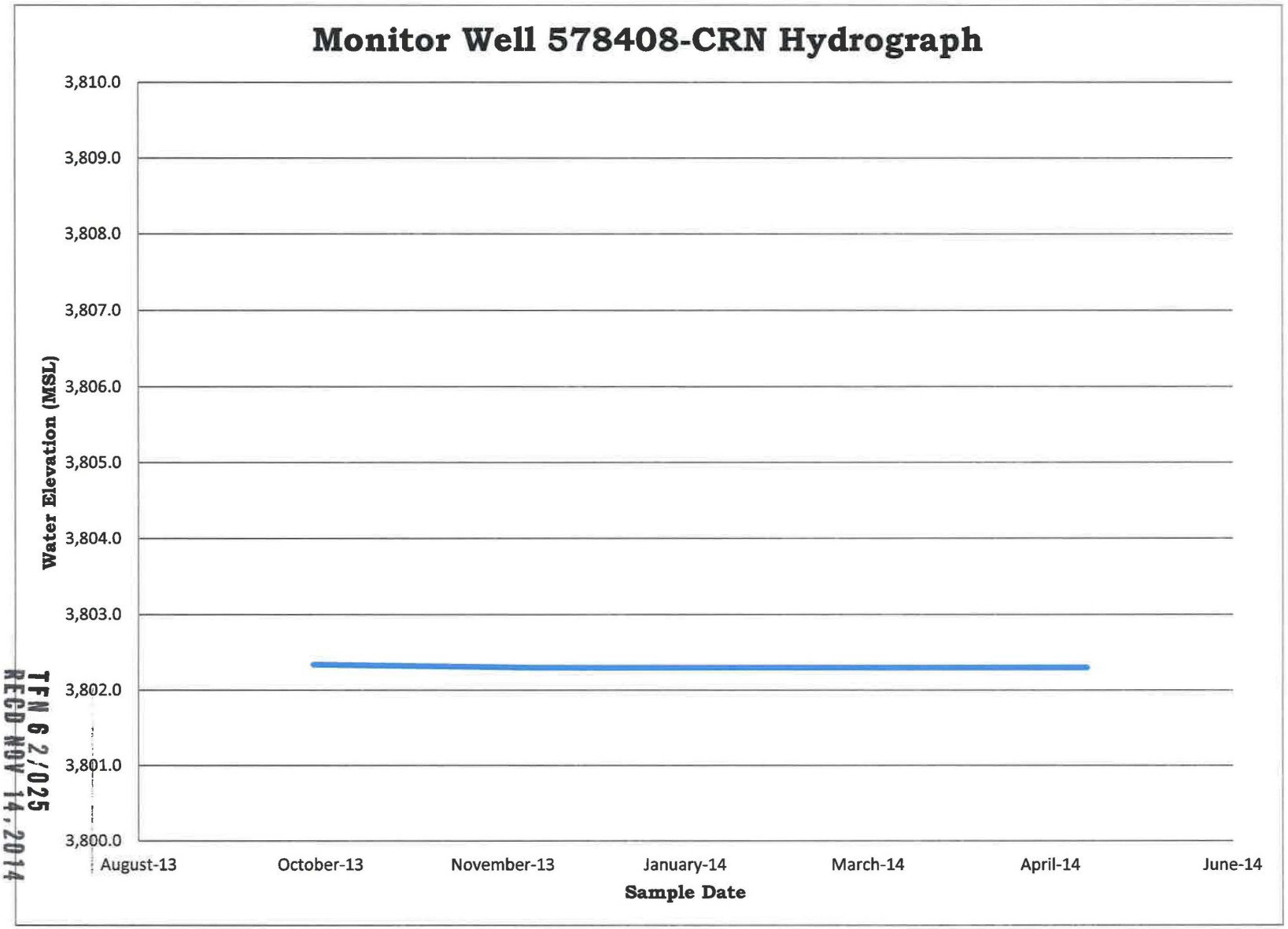
Groundwater Hydrographs

TFN 6 2/025
RECD NOV 14, 2014

Table D6-1. Collected Groundwater Elevations

StationName	Measuring Point Elevation (ft)	Drill Hole TD Elevation (ft)	Ground Coordinates		Water Elevation (ft MSL)			
			Northing	Easting	3Q13	4Q13	1Q14	2Q14
578408-CRN	3,890.0	3,791.7	1,394,416	1,941,810	3,802.3	3,802.3	3,802.3	3,802.3
578408-MST	3,890.5	3,770.3	1,394,423	1,941,802	3,786.0	3,784.6	3,787.6	3,790.7
578409-CRN	3,712.7	3,602.2	1,399,549	1,940,097	3,622.9	3,622.0	3,622.0	3,622.8
578409-CRN-OB	3,713.0	3,601.7	1,399,538	1,940,108	3,627.0	3,622.2	3,622.2	3,623.1
578409-MST-OB	3,713.3	3,589.5	1,399,547	1,940,085	3,611.5	3,611.6	3,611.2	3,611.8
578409-MST	3,712.4	3,589.6	1,399,559	1,940,088	3,611.2	3,611.3	3,611.2	3,611.5
578409-UBN	3,712.1	3,570.9	1,399,568	1,940,077	3,603.7	3,601.9	3,601.9	3,601.7
578415-CRN-MST	3,614.3	3,470.6	1,404,292	1,936,078	3,491.5	3,491.6	3,492.3	3,493.1
578417-CRN	3,929.1	3,786.7	1,391,364	1,939,152	3,796.0	3,795.8	3,796.0	3,795.6
578417-MST	3,928.7	3,764.9	1,391,382	1,939,175	3,767.9	3,768.2	3,768.5	3,768.2
578418-AL	3,690.2	3,665.7	1,386,058	1,935,962	3,669.6	3,669.4	3,669.6	3,670.1
578418-CRN	3,884.5	3,730.7	1,387,102	1,936,928	3,737.8	3,738.0	3,737.9	3,737.9
578418-MST	3,885.8	3,700.1	1,387,131	1,936,923	3,701.5	3,701.4	3,701.4	3,701.3
578510-CRN	3,965.4	3,872.7	1,371,807	1,941,542	3,873.2	Dry	Dry	Dry
578510-MST	3,964.4	3,817.2	1,371,823	1,941,558	3,821.0	3,818.3	3,818.1	3,818.1
578511-CRN	3,896.1	3,767.2	1,377,926	1,940,246	3,776.6	3,776.5	3,776.5	3,776.5
578511-MST	3,896.4	3,738.4	1,377,945	1,940,244	3,746.3	3,746.3	Dry	3,746.5
578512-AL	3,760.5	3,739.3	1,381,530	1,940,880	3,756.5	3,756.7	3,756.8	3,756.9
578512-CRN	3,932.5	3,882.7	1,382,758	1,943,160	Dry	Dry	Dry	Dry
578512-MST	3,932.7	3,817.7	1,382,743	1,943,172	3,820.8	3,820.8	3,820.8	3,820.8
578513-AL	3,724.0	3,703.2	1,383,970	1,938,634	3,714.5	3,714.6	3,716.3	3,717.8
578513-MST	3,850.6	3,706.6	1,381,680	1,938,341	3,742.4	3,742.1	3,741.8	3,742.7
578513-CRN	3,850.0	3,732.7	1,381,665	1,938,329	3,733.5	3,733.0	3,733.1	3,733.2

TFN 6 2/025
RECD JUL 30, 2015



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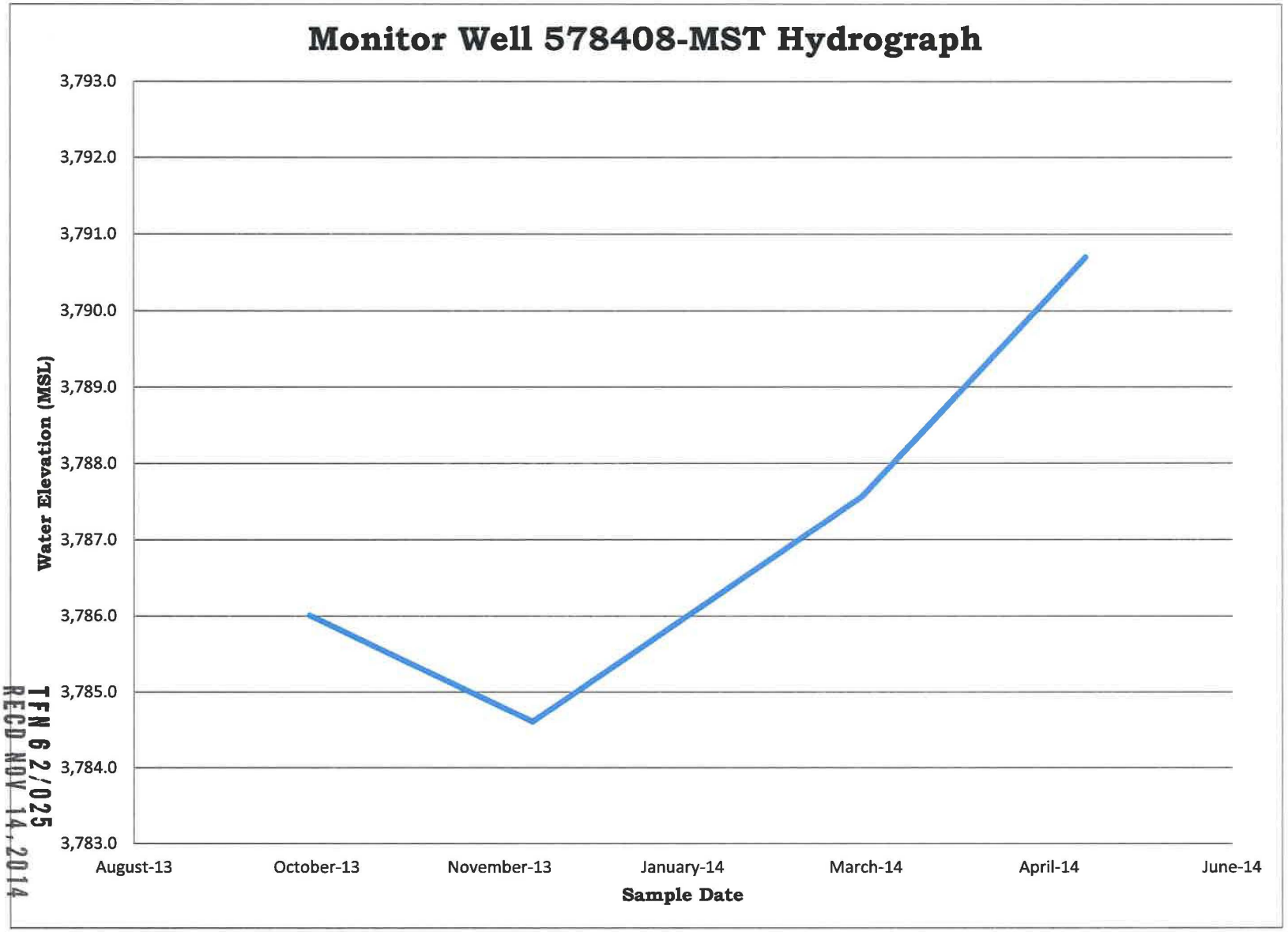

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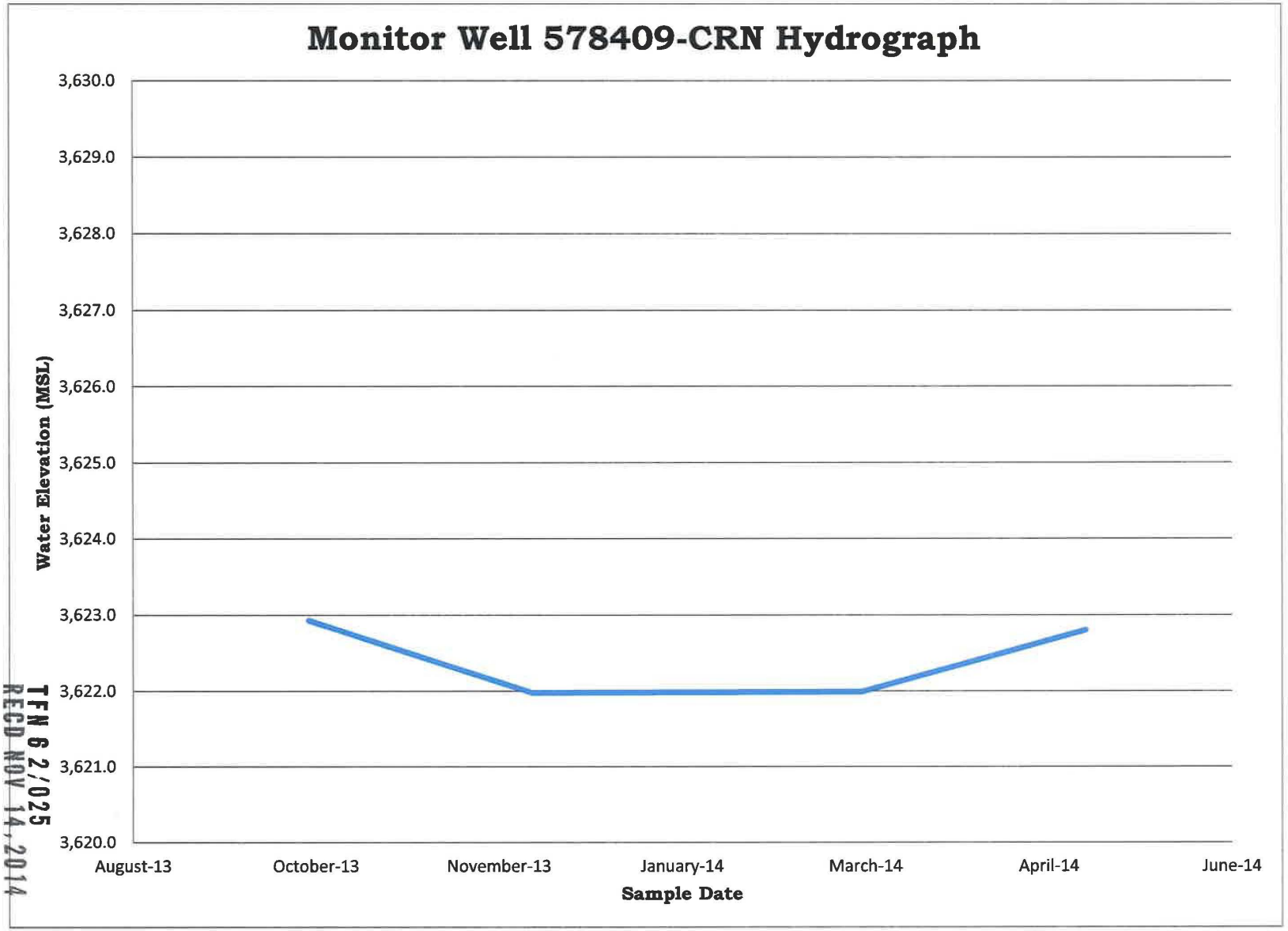

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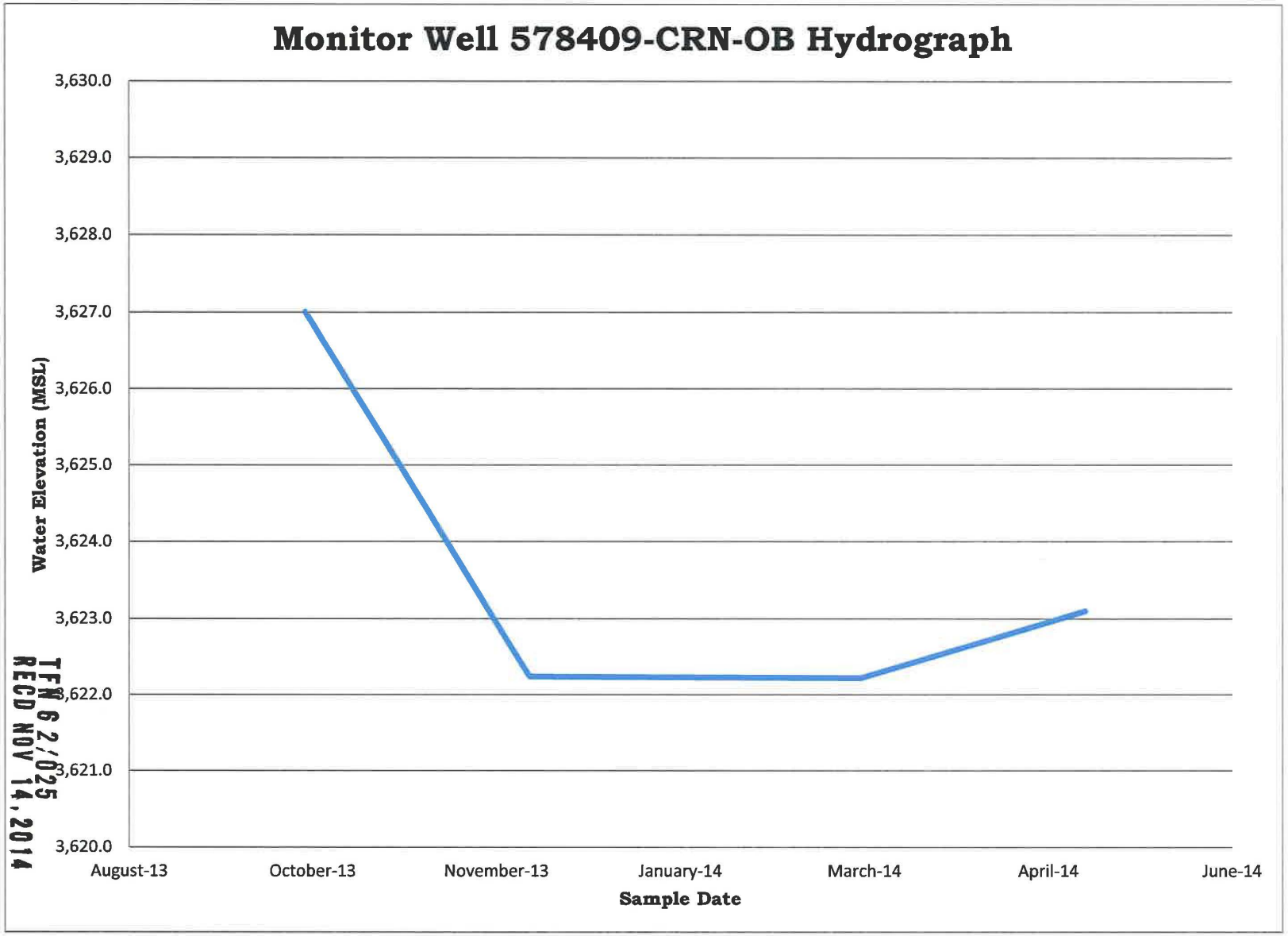

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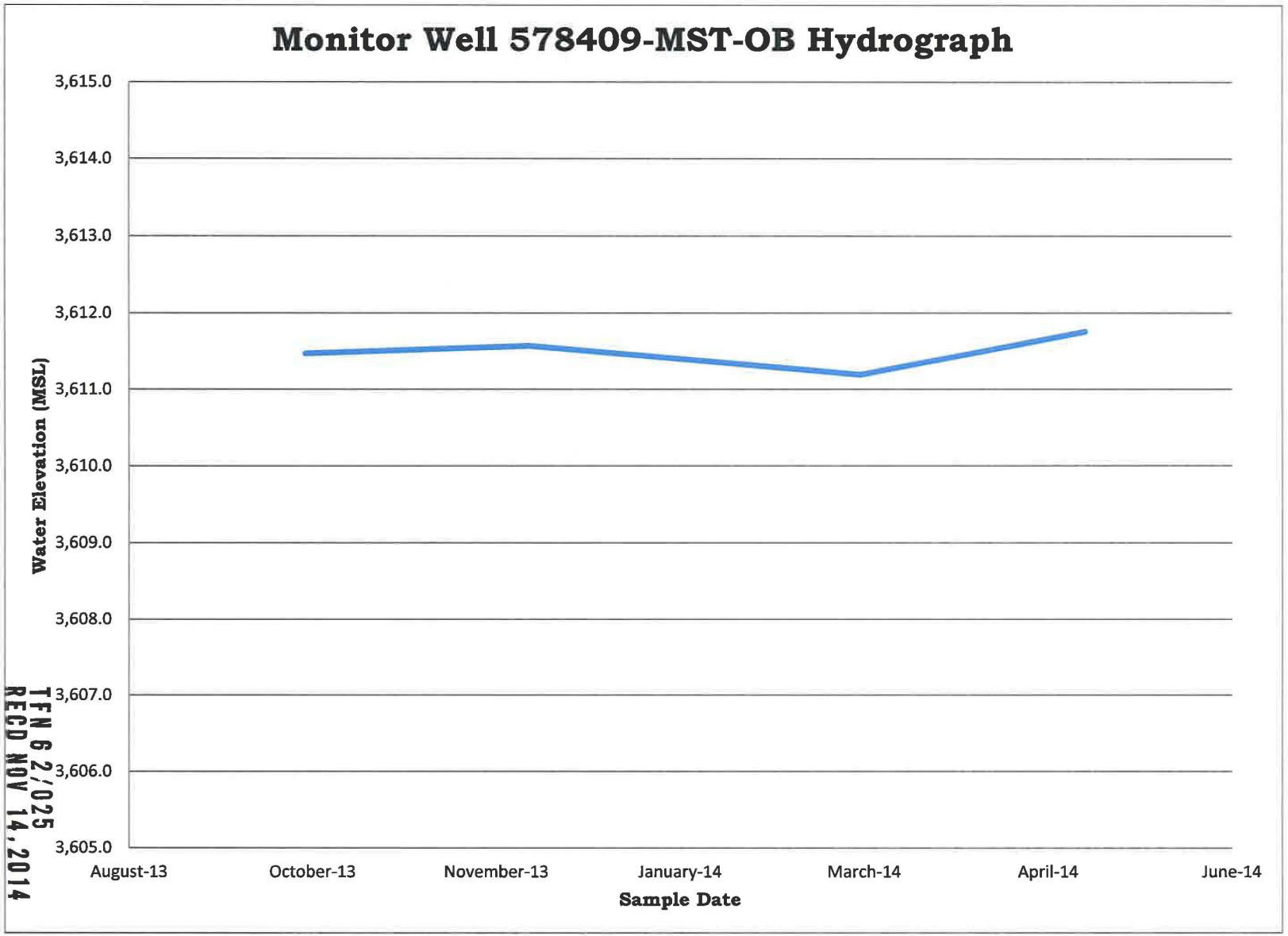

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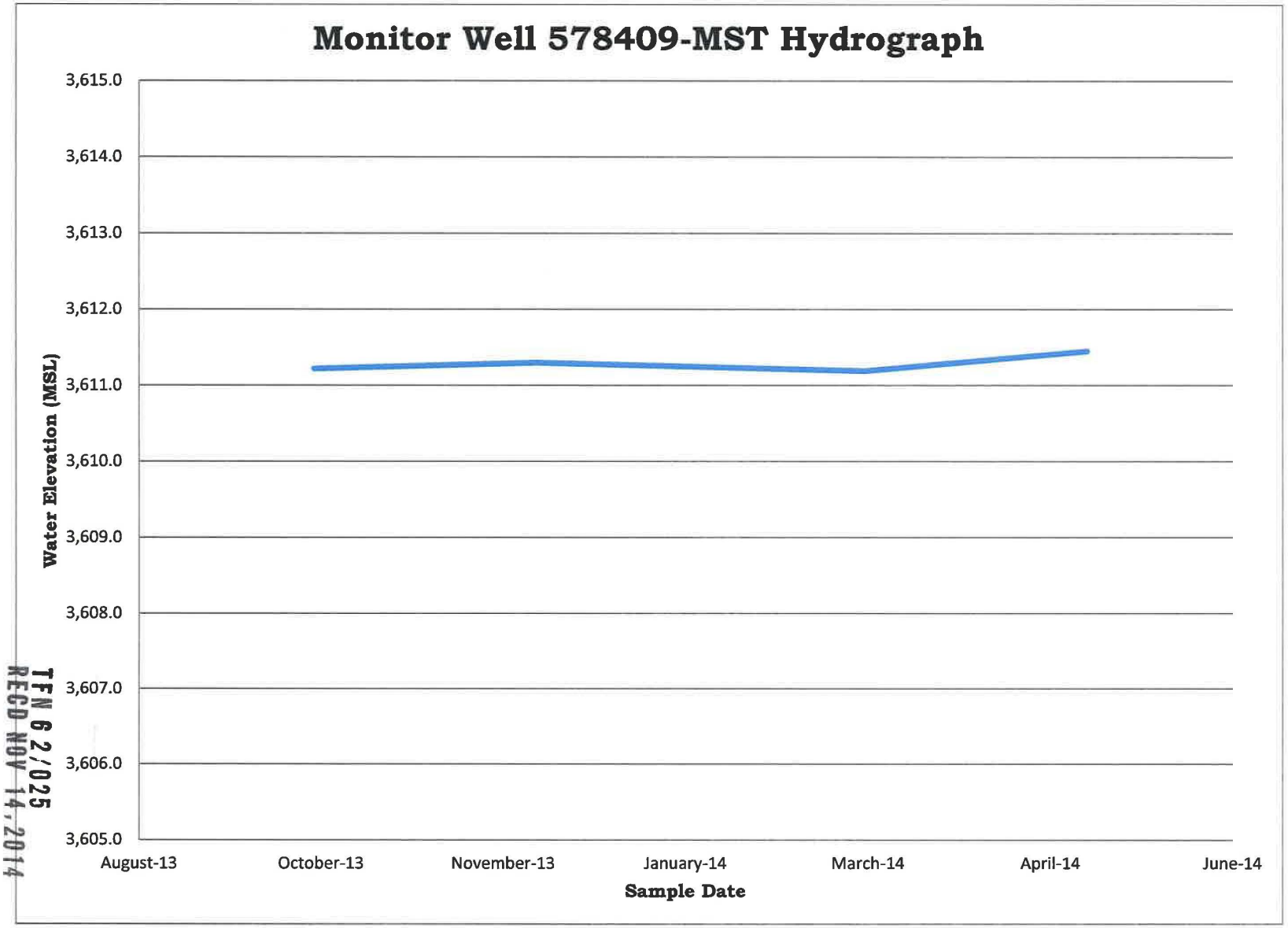
RECD NOV 14, 2014

Monitor Well 578409-MST Hydrograph



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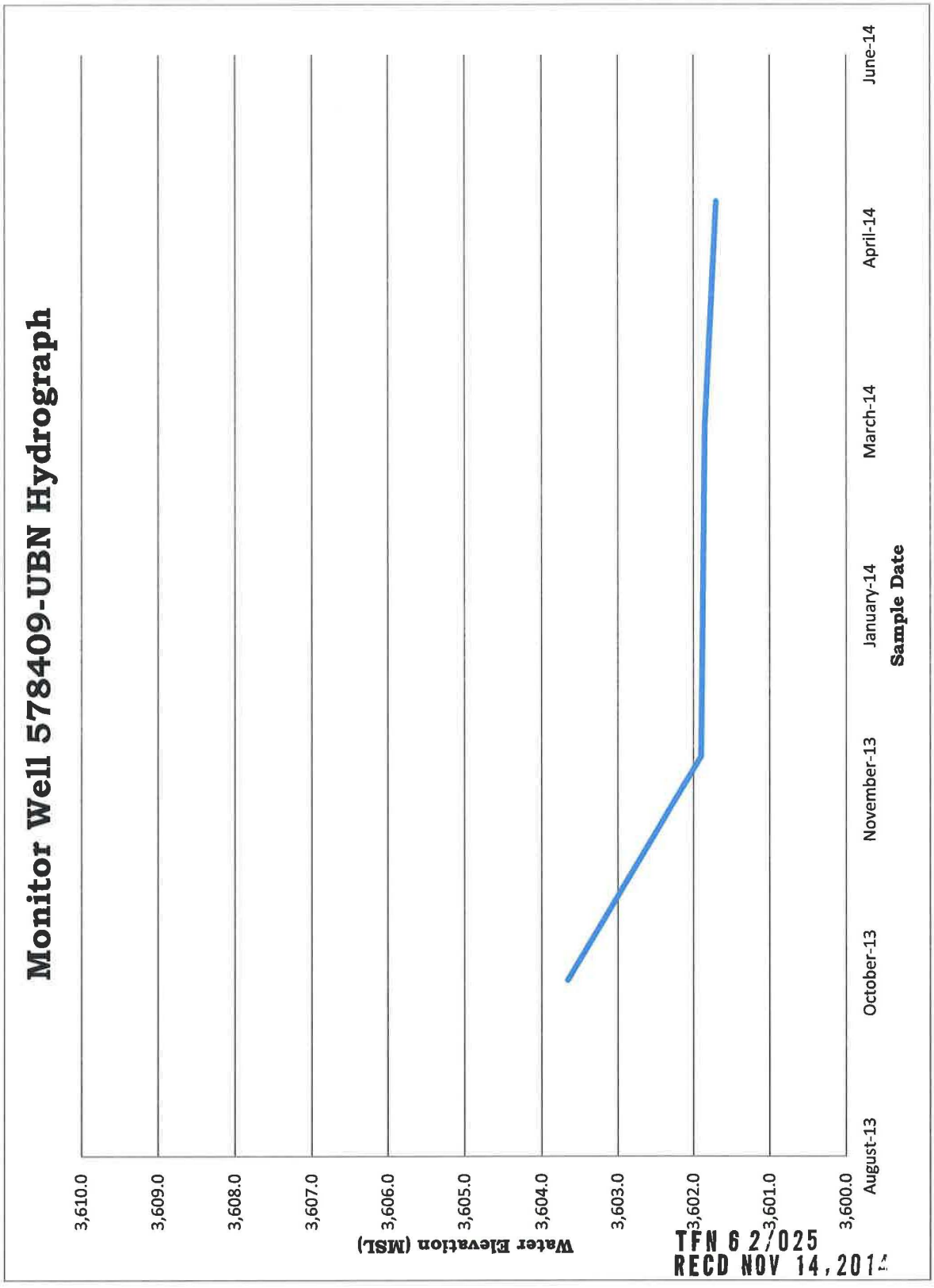
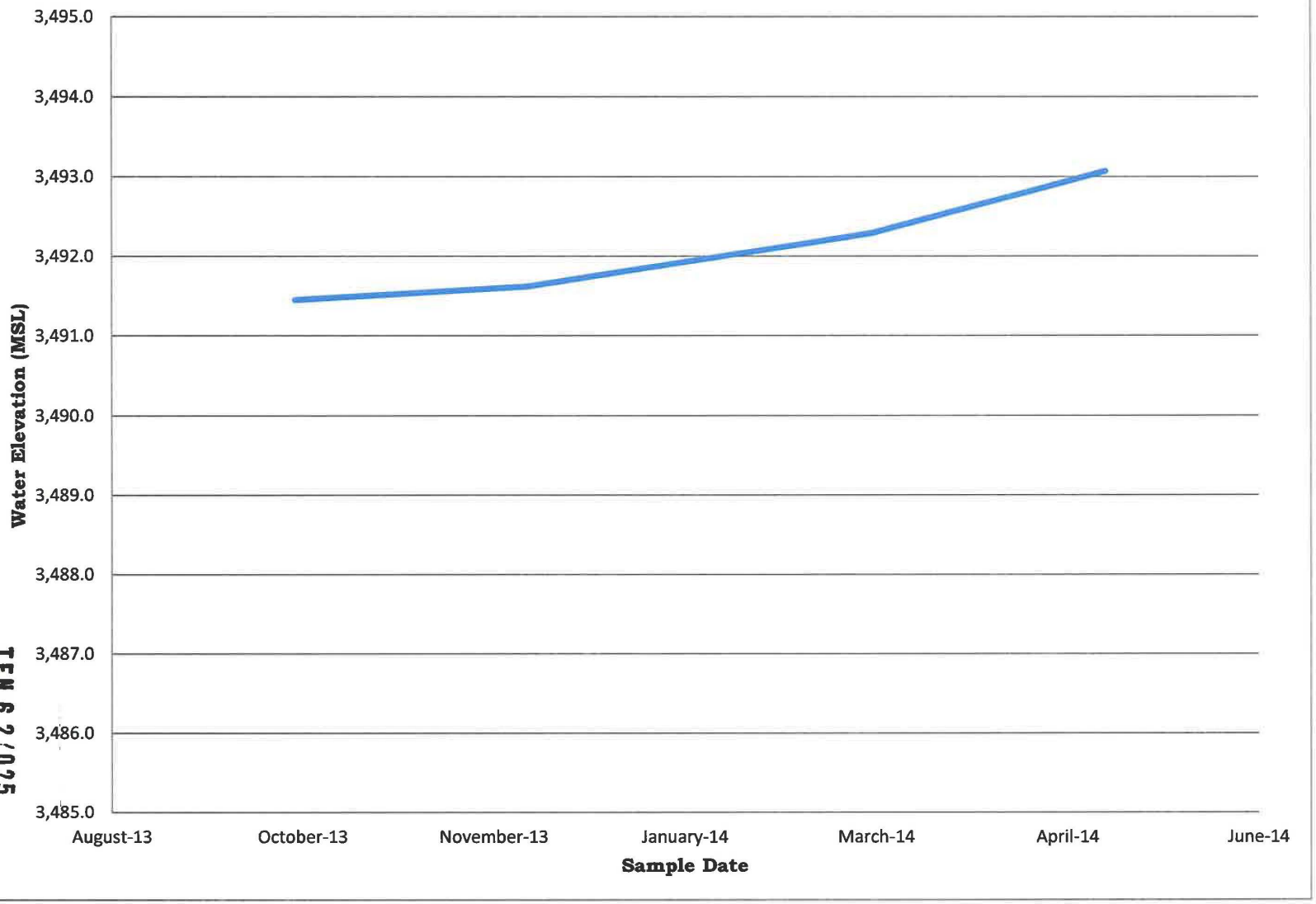
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 201

DEQ 6-332

Monitor Well 578415-CRN-MST Hydrograph



TFN 6 2/025
RECD NOV 14, 2014

TFN 6 2/025
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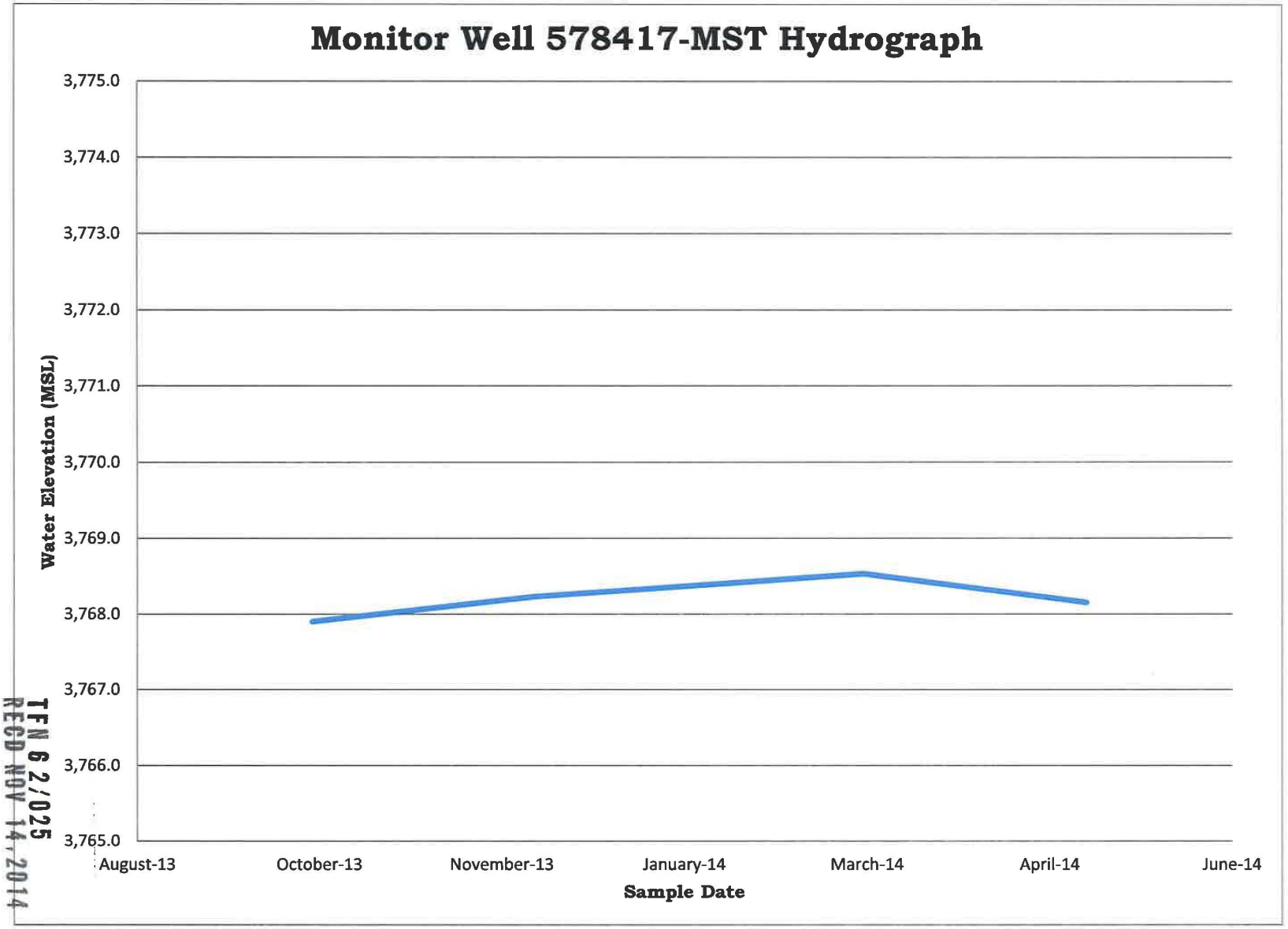
DEQ 6-334



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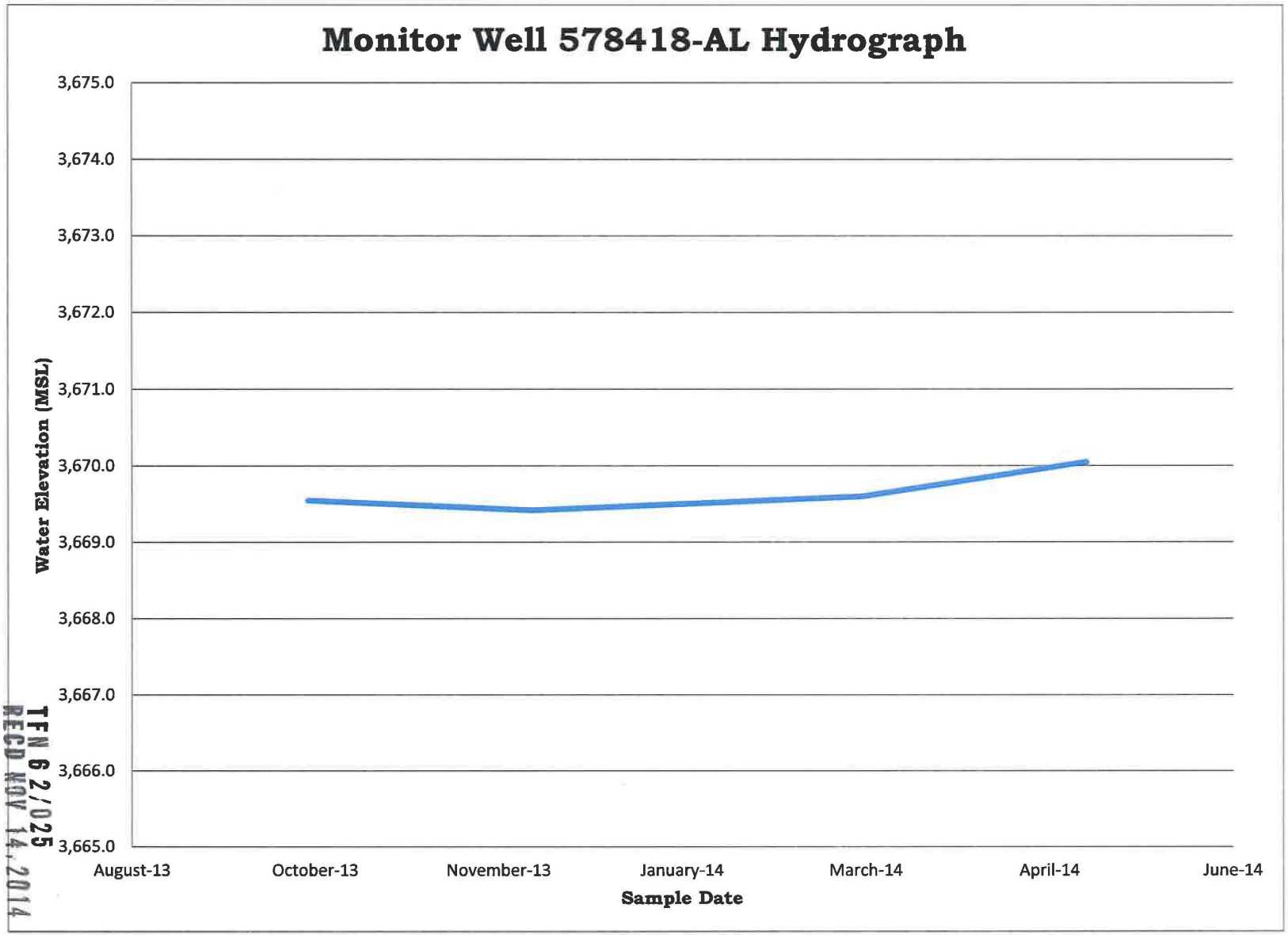

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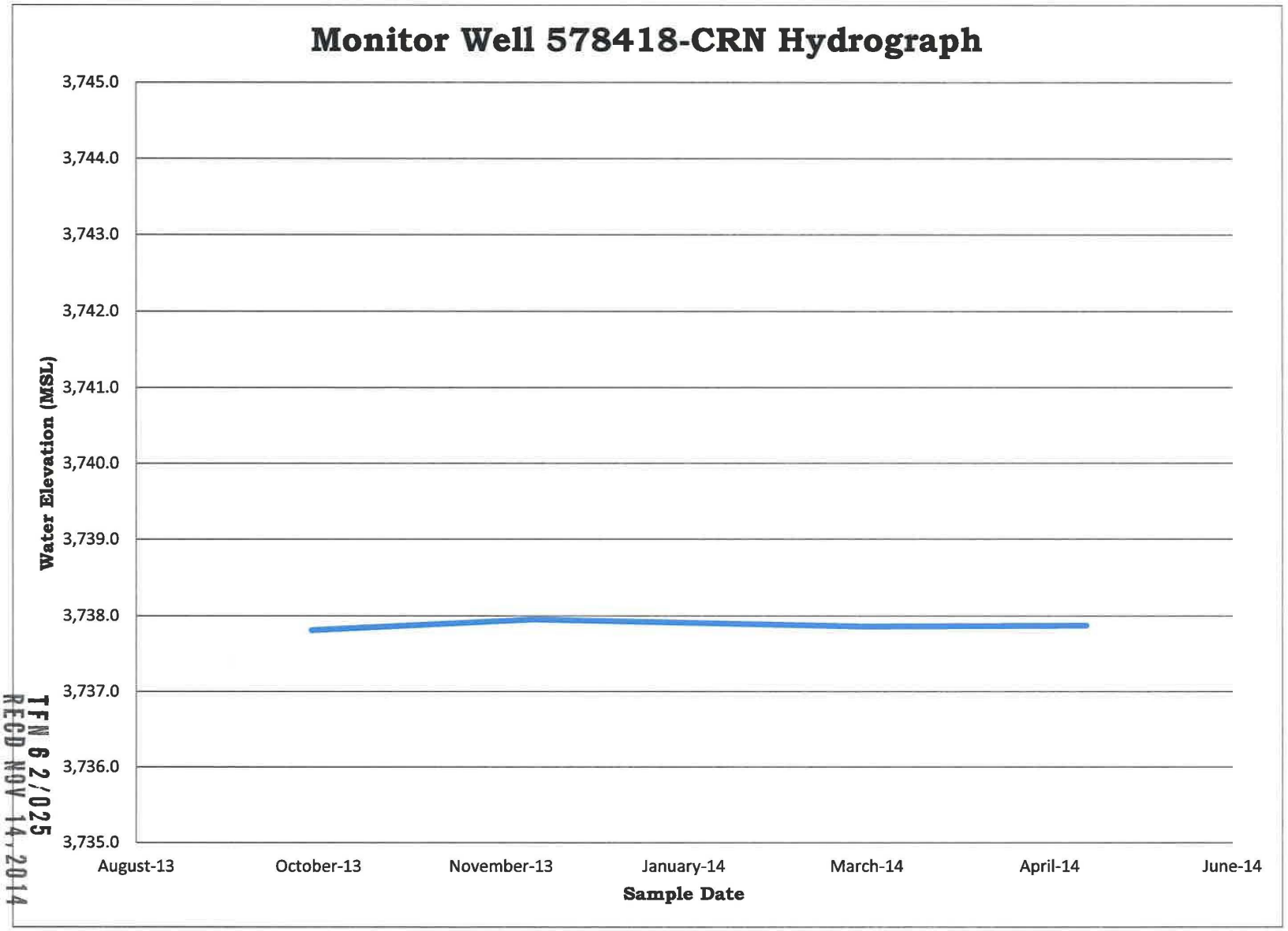

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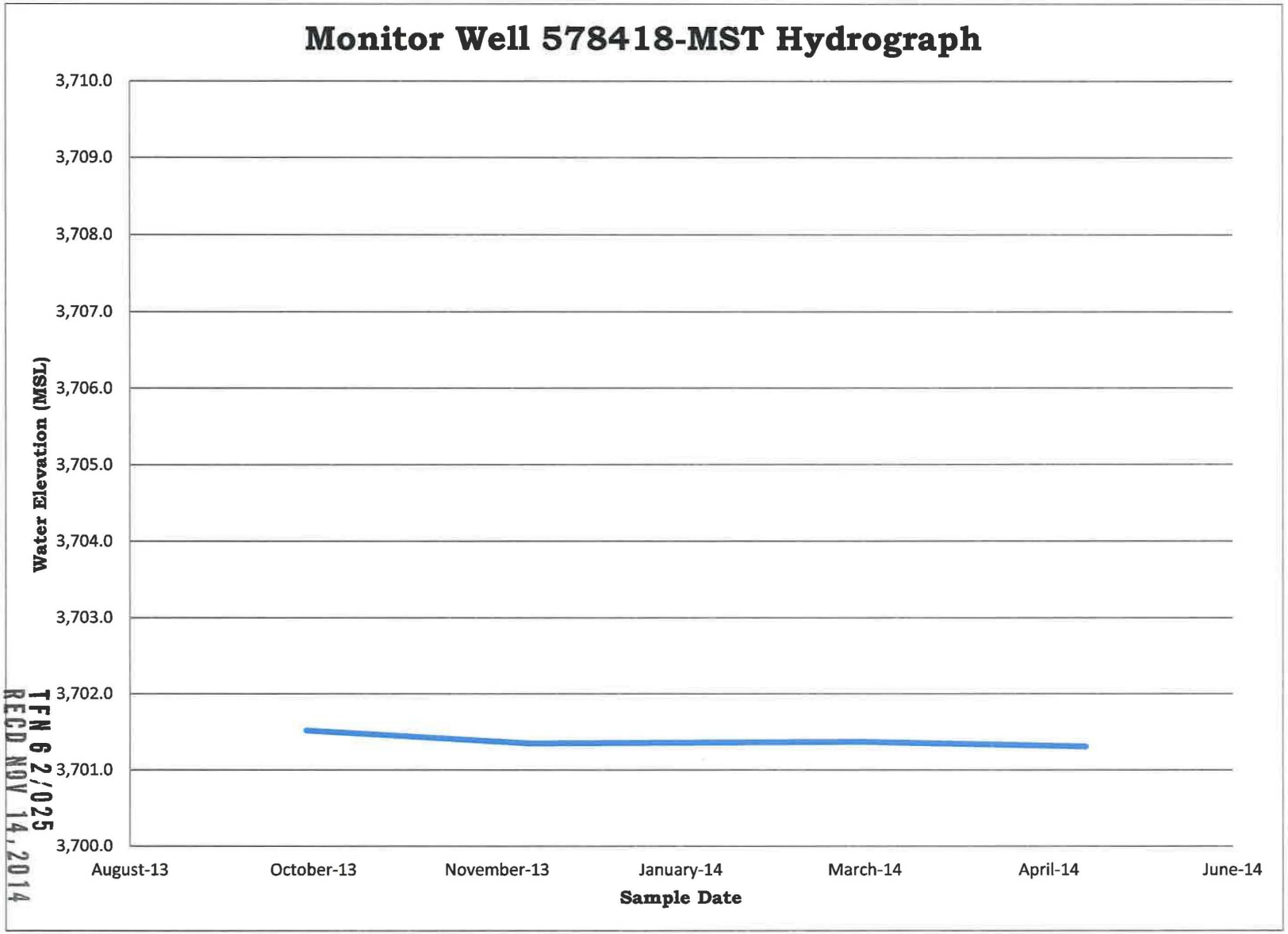

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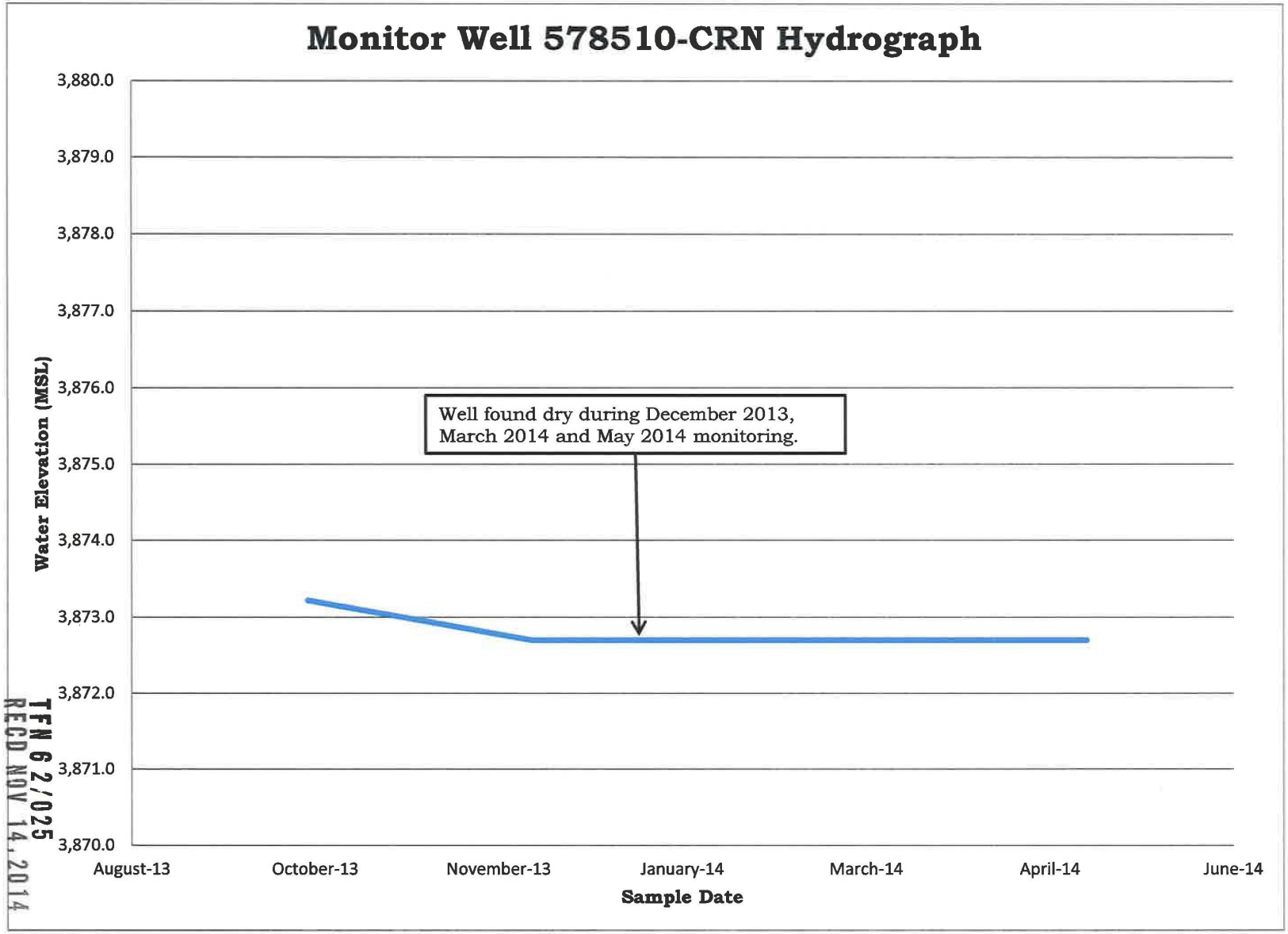
Monitor Well 578510-CRN Hydrograph



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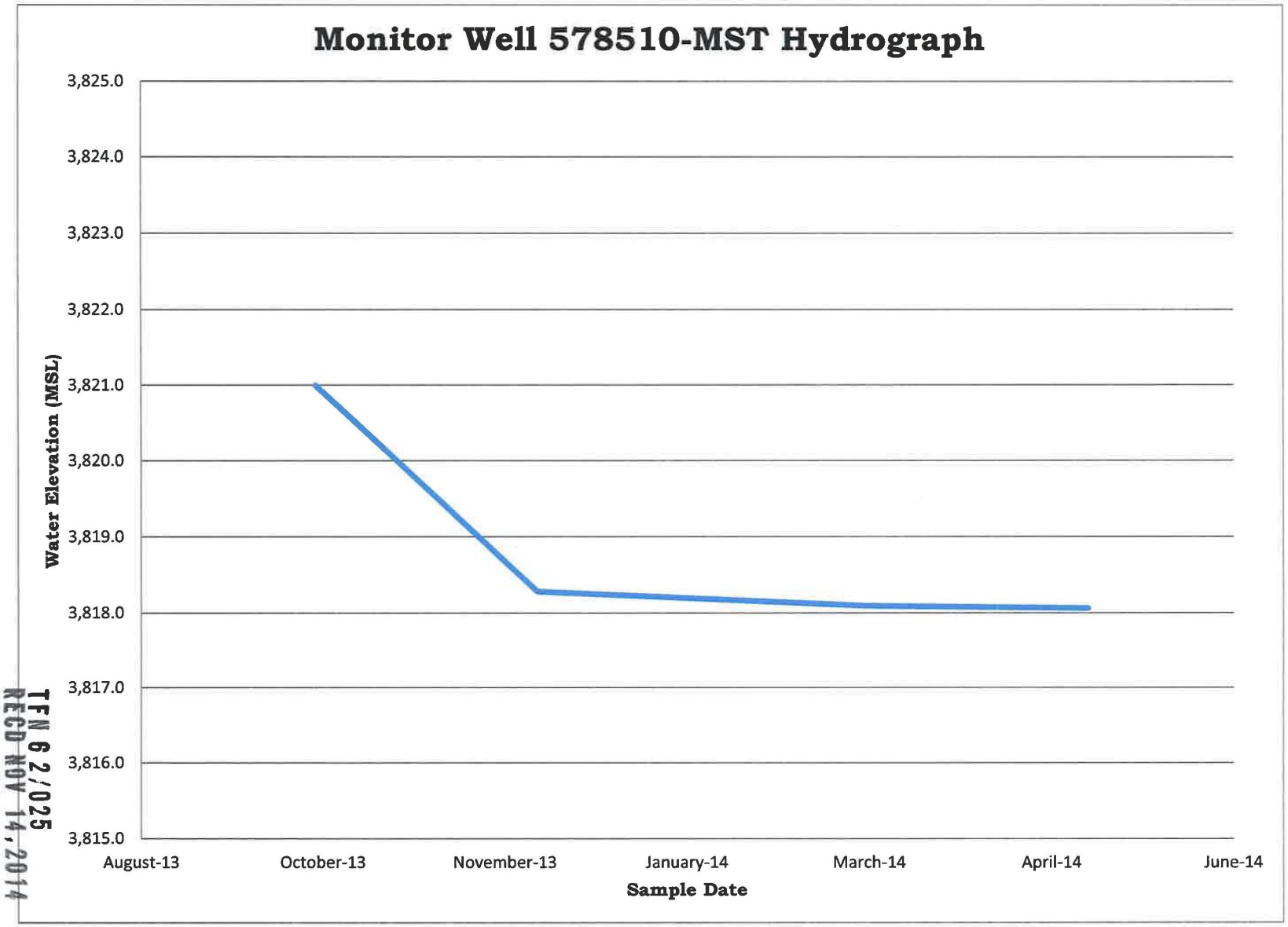
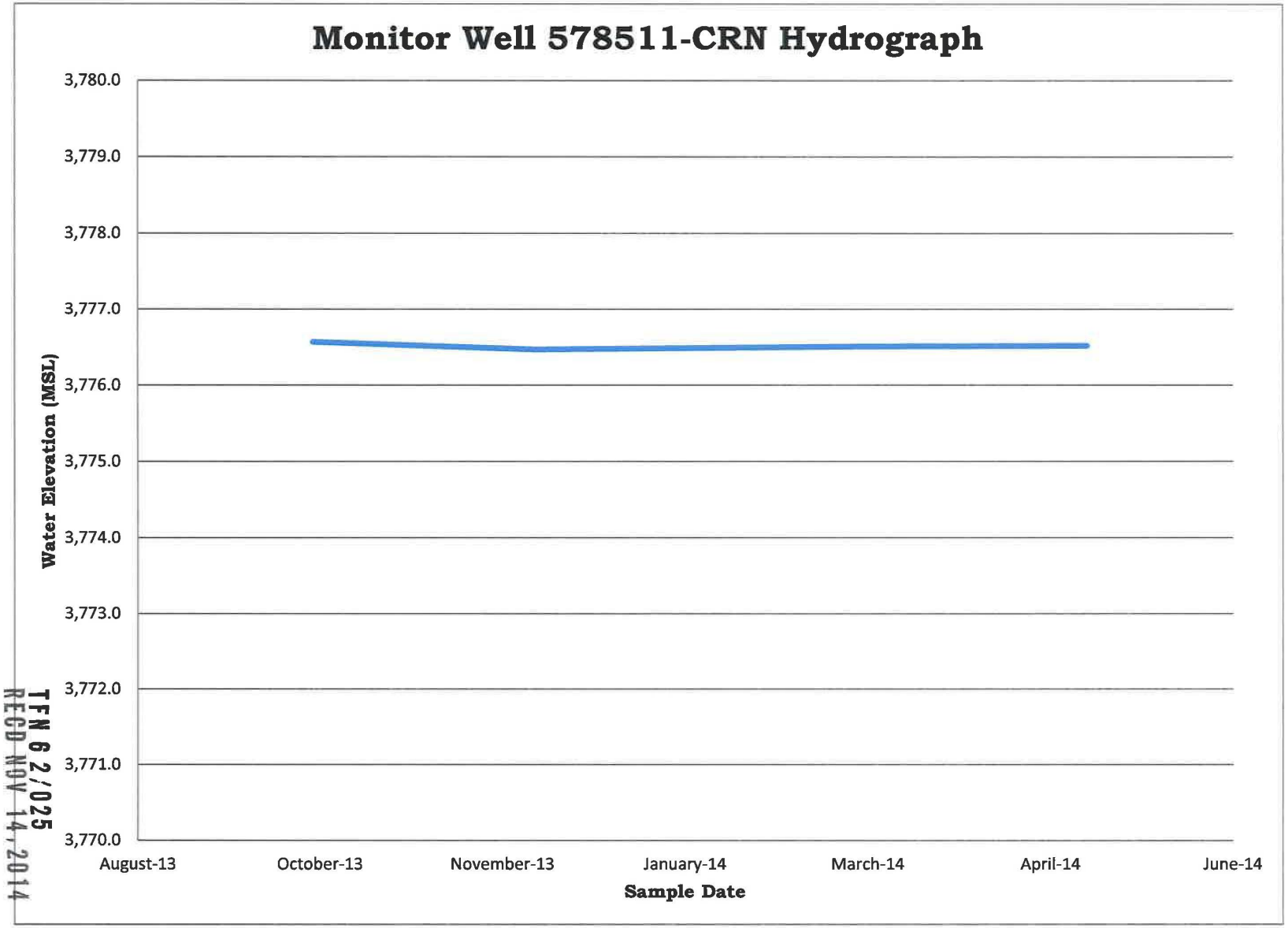
Monitor Well 578510-MST Hydrograph

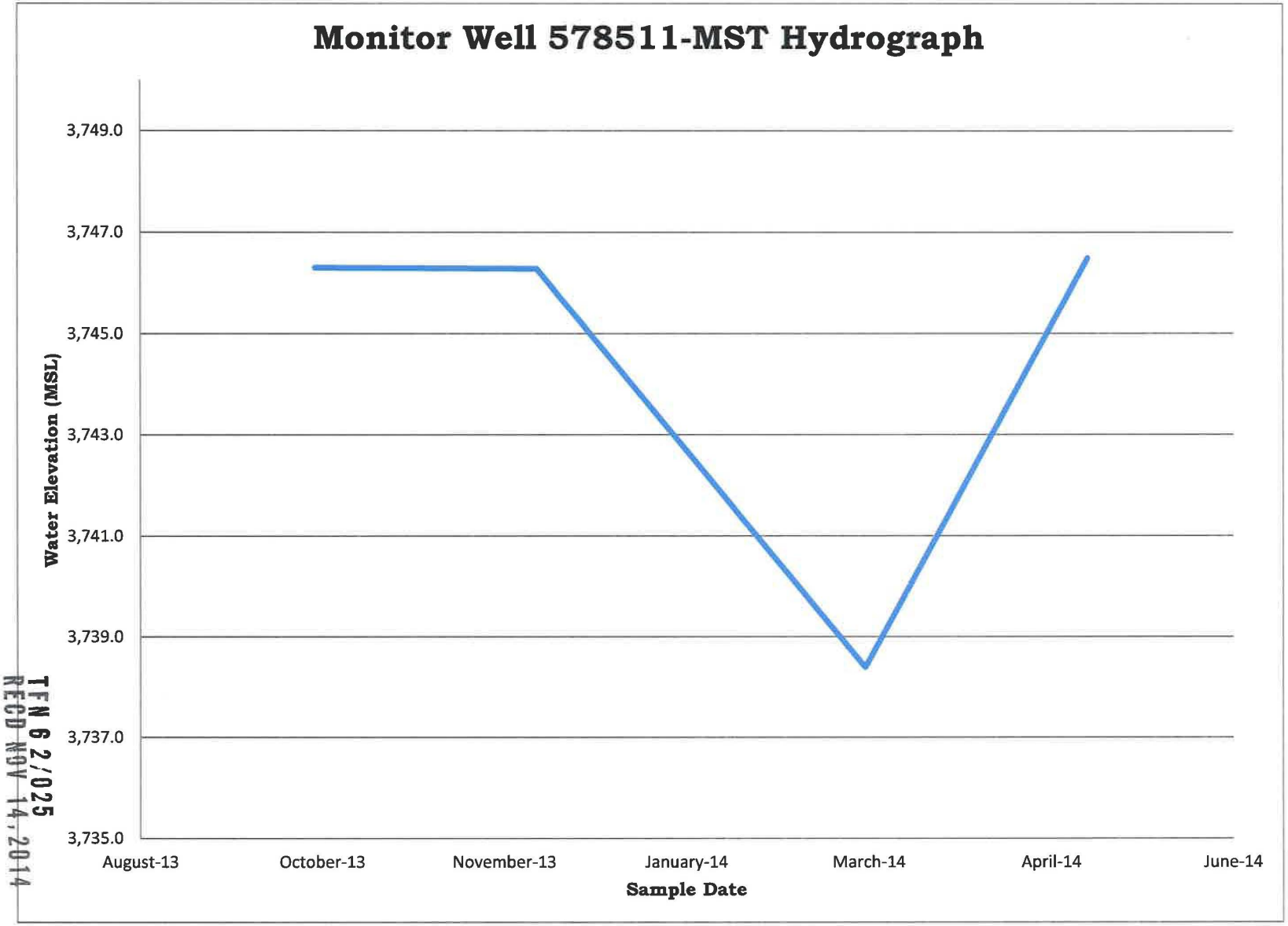


TFN 6 2/025
RECD NOV 14, 2014

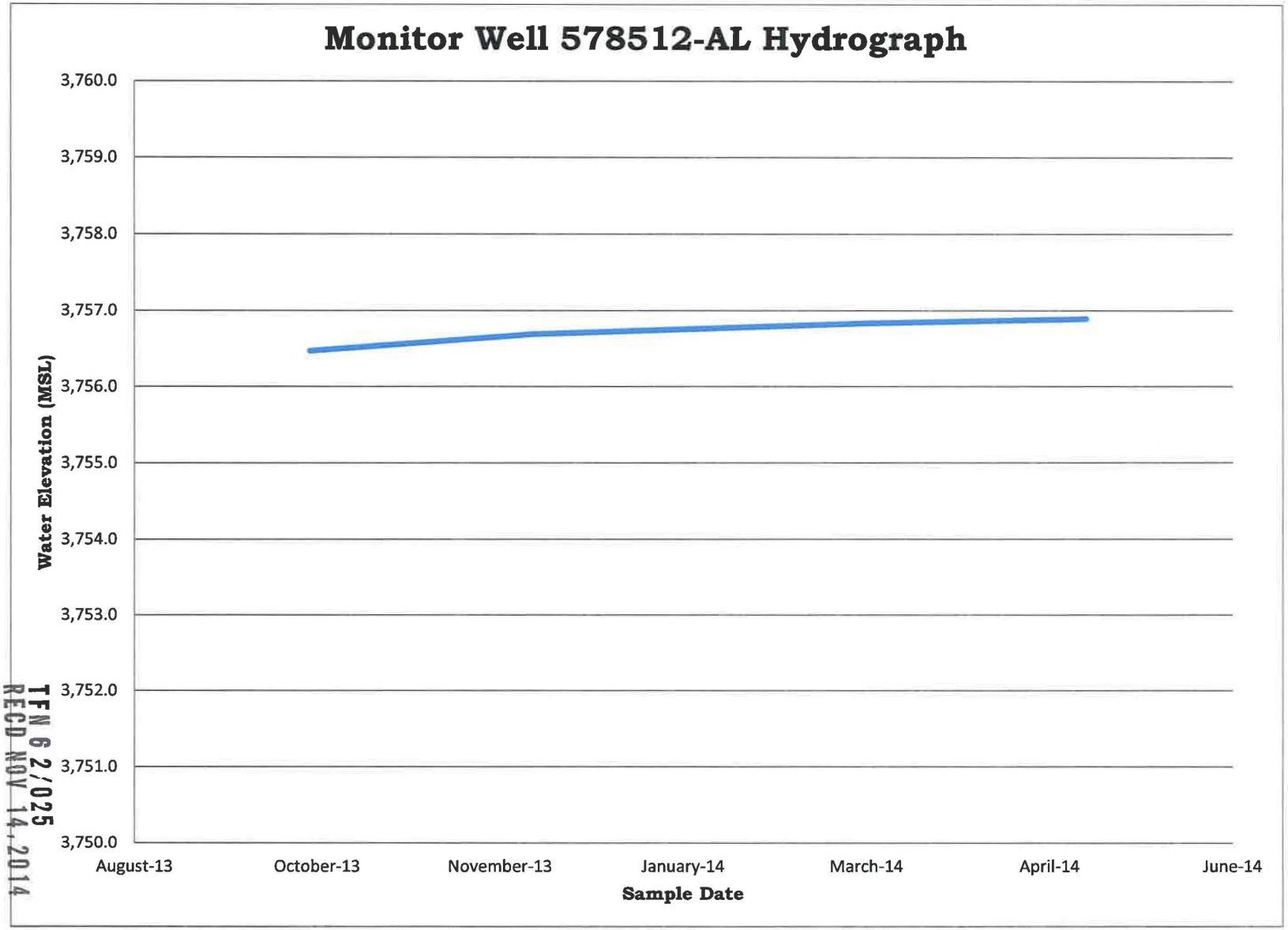


TFN 6 2/025
RECD NOV 14, 2014

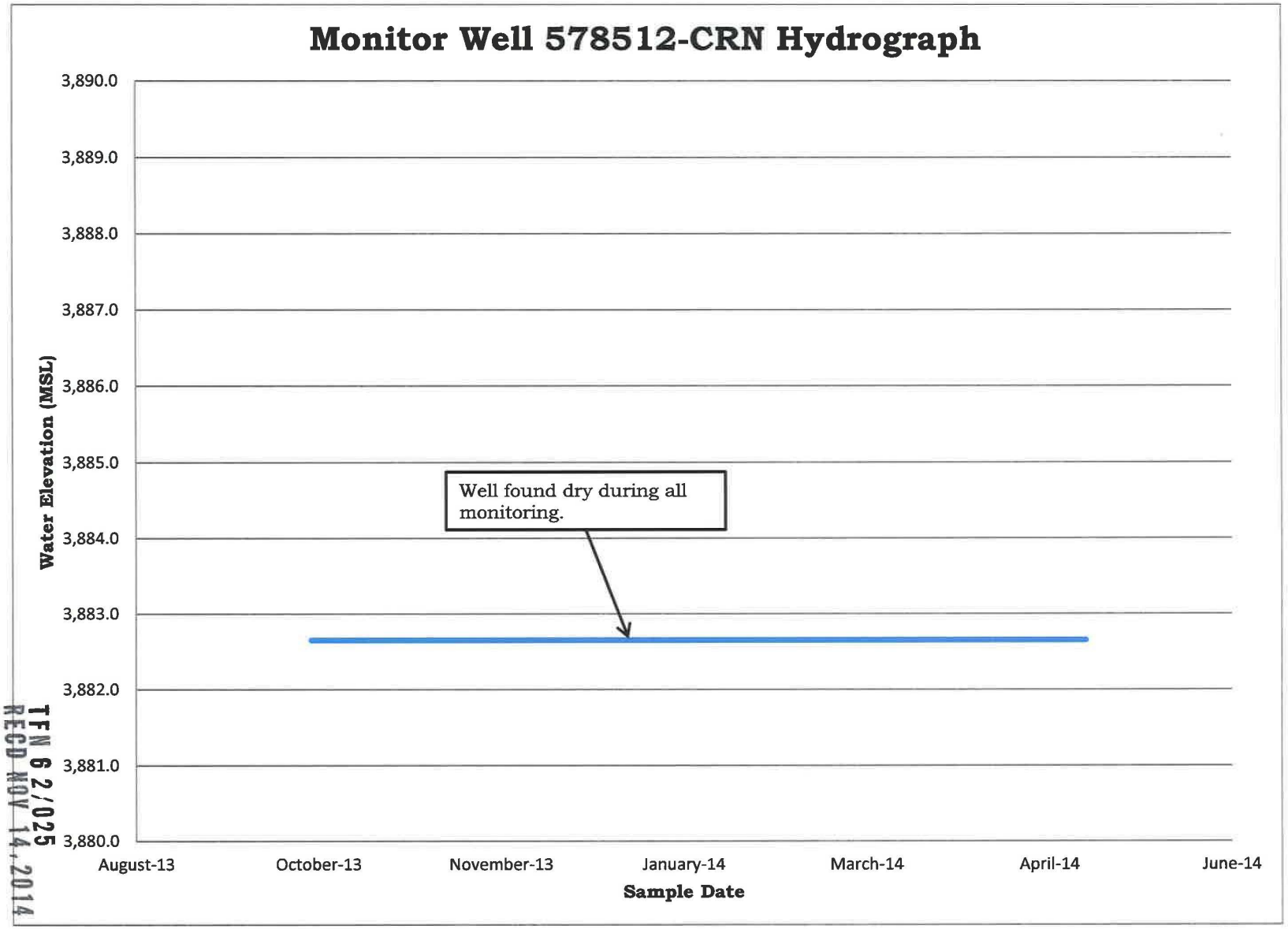
Monitor Well 578511-MST Hydrograph



TFN 6 2/025
RECD NOV 14, 2014

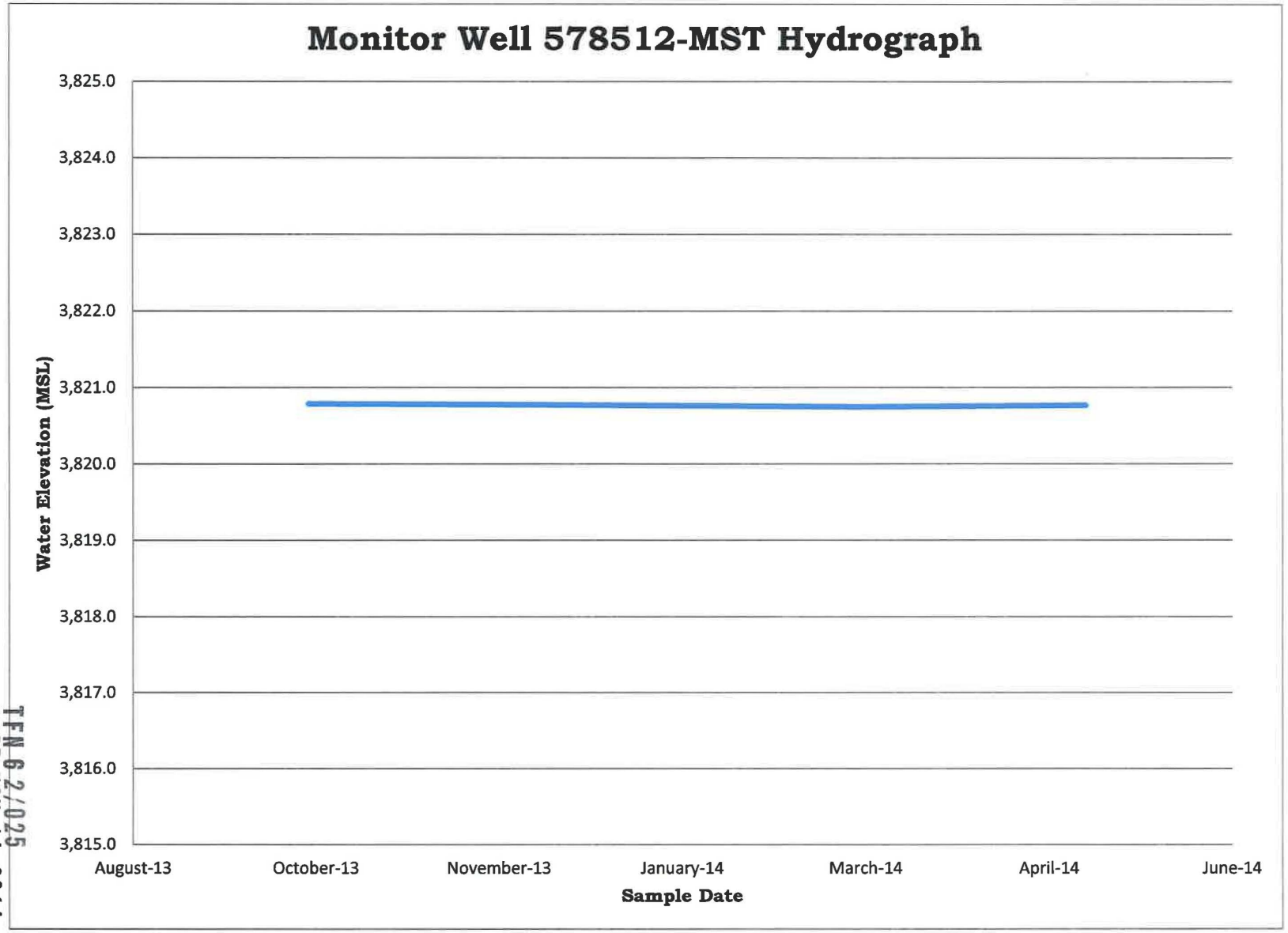


TFN 6 2/025
RECD NOV 14, 2014

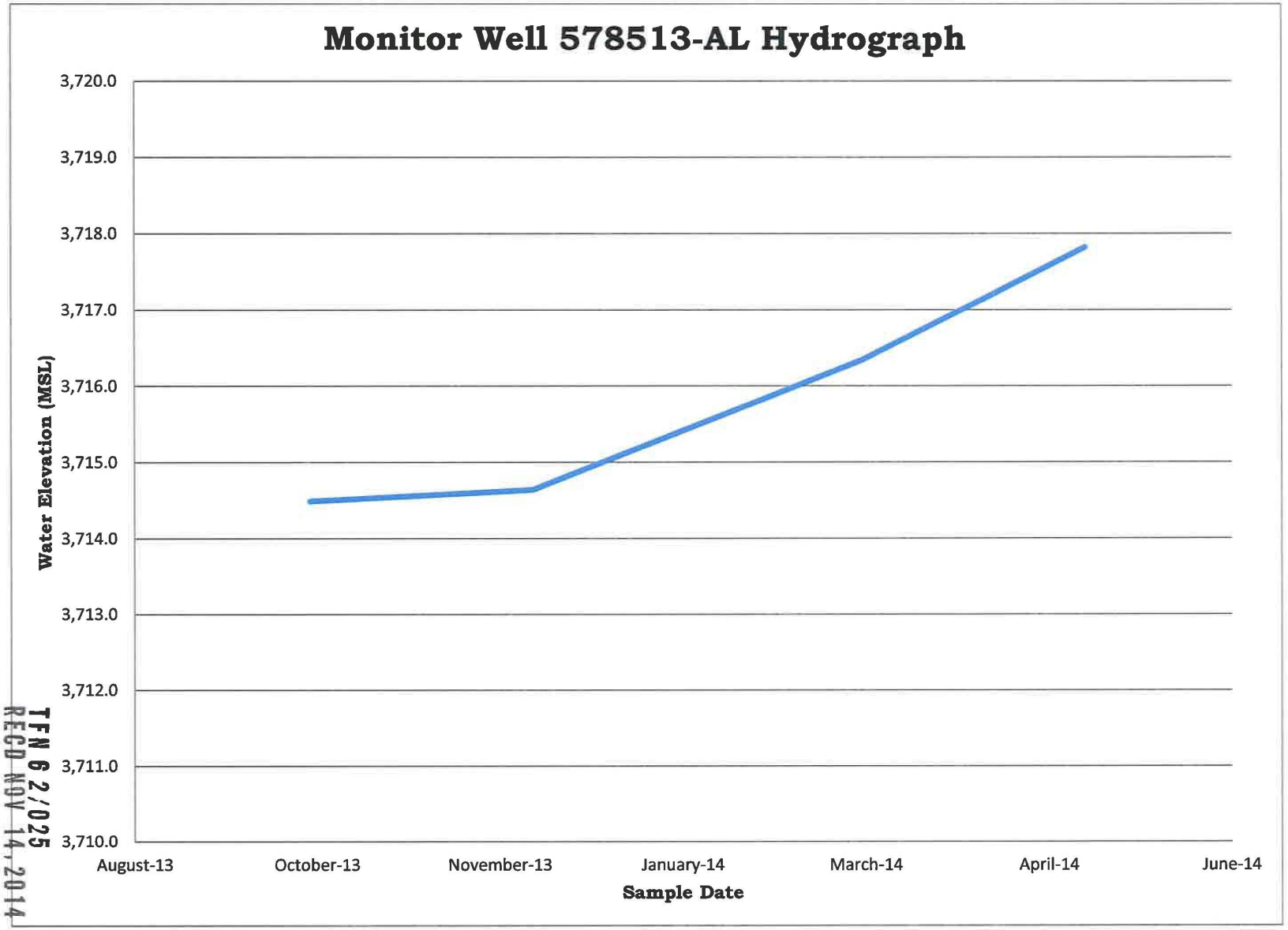


TFN 6 2/025
RECD NOV 14, 2014

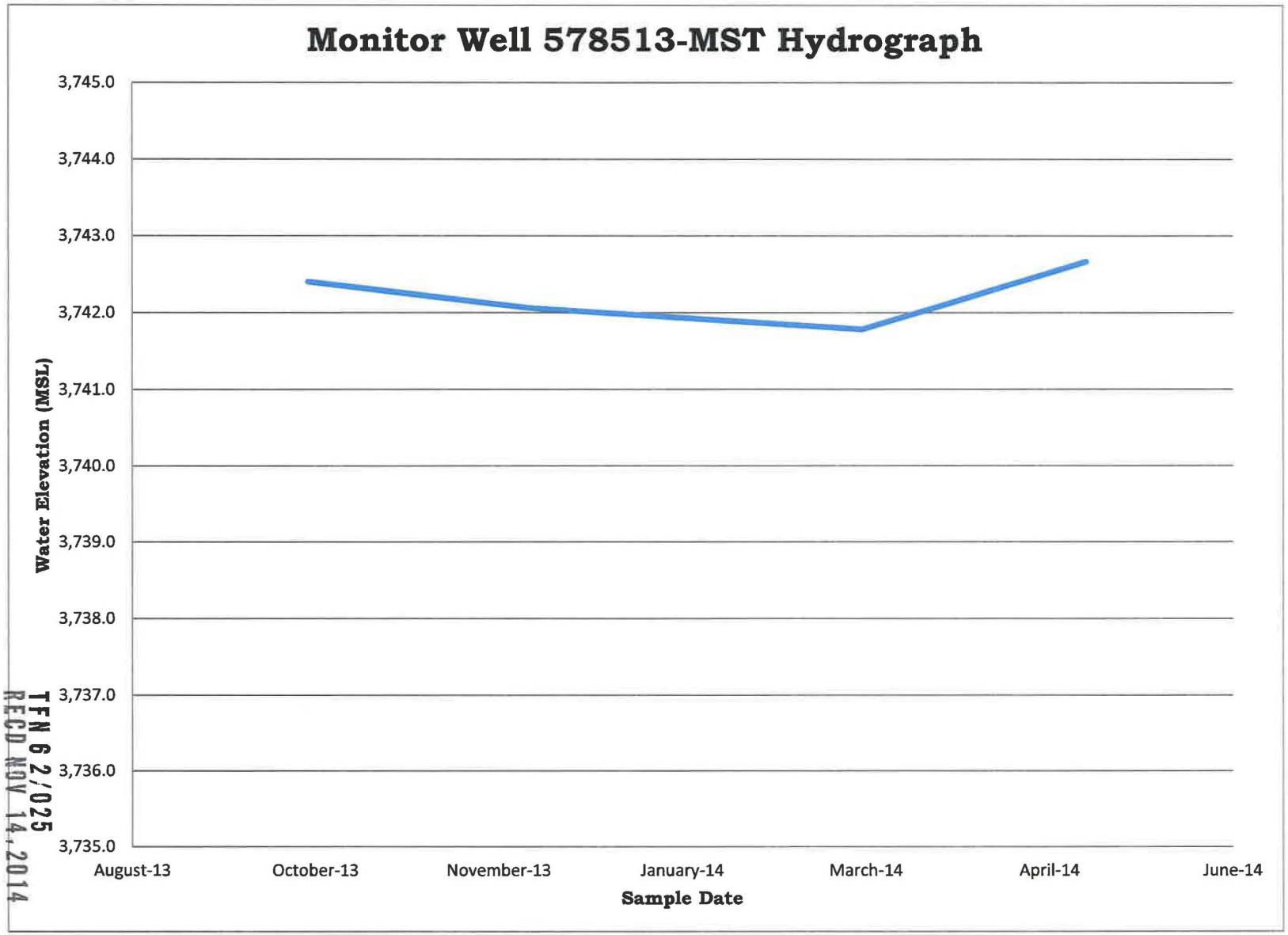
Monitor Well 578512-MST Hydrograph



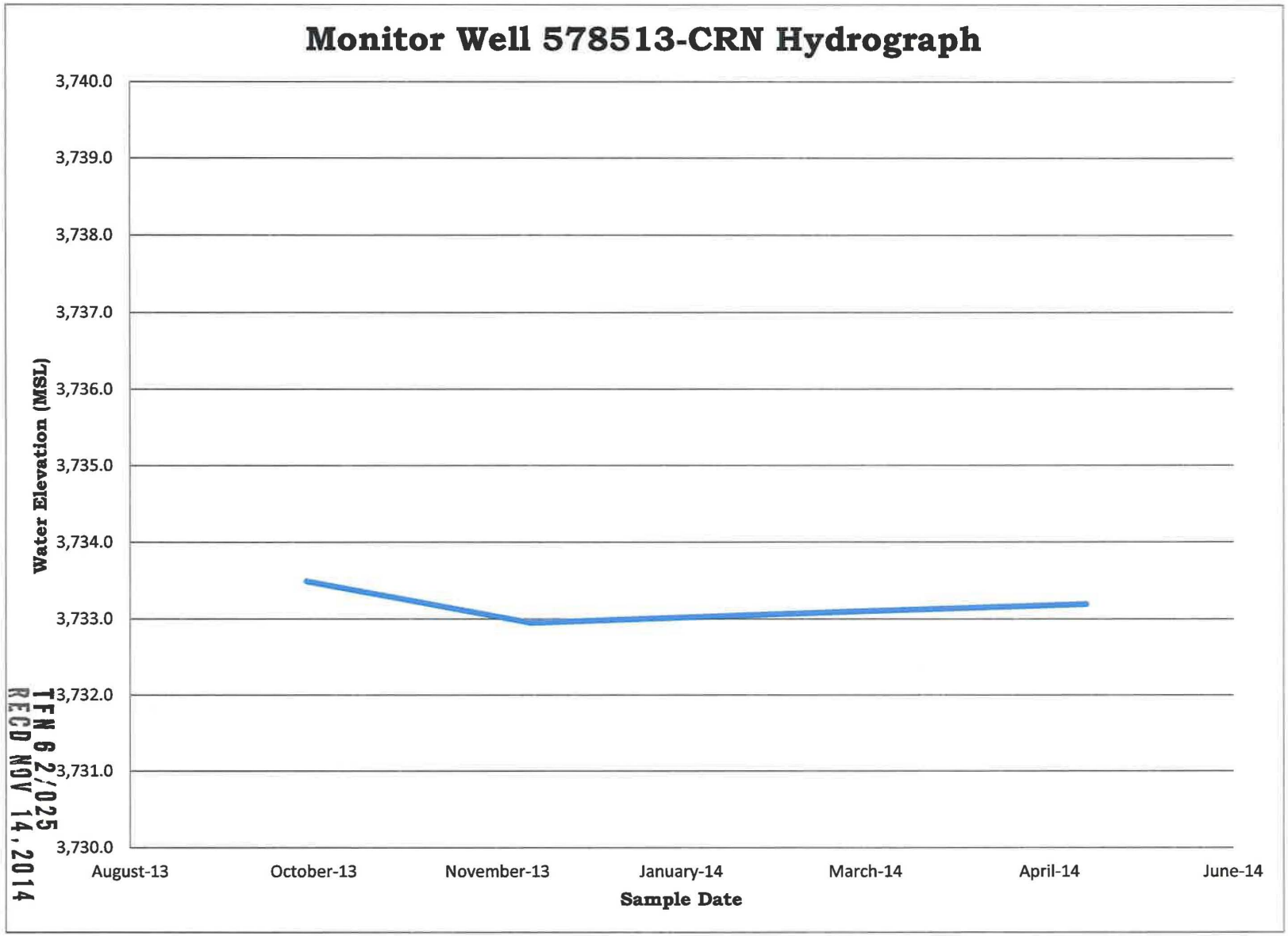
TFN 6 2/025
RECD NOV 14, 2014
Addendum D6-9-22



TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 2014



TFN 6 2/025
RECD NOV 14, 2014

ADDENDUM D6-10

ADDENDUM D6-10

Groundwater Quality

TFN 6 2/025
RECD NOV 14, 2014

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578408-CRN-1 Project Ramaco

Location _____ W.O.# _____

Sample ID# SM578408-CRN-1 Date Sampled 10 / 9 / 13 Time 1540 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 98.27 ft below MP Depth to Water (below MP) 87.66 ft Casing Diameter 2 in

Date 10 / 9 / 13 Time 1415 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' Bladder

' Tap ' Bailer _____

Pump intake or bailer set at 96 ft below MP.

DISCHARGE RATE

_____ gpm

x 0.00223

_____ cfs

ıbing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1530	7.83	2470	13.3	170	—	↓	150 mL/30sec
1540	7.79	2440	13.3	370	—	≈ 3.0	↓

Pumping Start Time 1515 WL _____ Pumping End Time _____ WL _____

Comments: Water turbid - no odor

HCF

COC# 150183

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-2
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RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578408 - MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled 10 / 9 / 13 Time 1500 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 120.20 ft below MP Depth to Water (below MP) 104.49 ft Casing Diameter 2 in

Date 10 / 9 / 13 Time 1410 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Pump intake or bailer set at 116 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1450	7.40	2380	14.2	779	—	↓	150 mL/30 sec
1500	7.38	2380	13.7	552	—	≈ 3.0	↓

Pumping Start Time 1435 WL _____ Pumping End Time _____ WL _____

Comments: Water very turbid - no odor

HCF

COC #

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

RAMACO

* no Sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# [illegible] Date Sampled [illegible] Time _____ am pm

Describe Sampling Point _____

Well Depth 110.55 ft below MP Depth to Water (below MP) 89.77 ft Casing Diameter _____ in

Date 10 / 9 / 13 Time 1620 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

'ubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time [illegible] WL _____ Pumping End Time _____ WL _____

Comments: No Sample - sampled SM578409-CRN-OB-1 Swayne said that the OB well would be better to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-4
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DEQ 6-353

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-CRN-OB-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578409-CRN-OB-1 Date Sampled 10 / 10 / 13 Time ~~1~~ 0935 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 111.33 ft below MP Depth to Water (below MP) 85.99 ft Casing Diameter 5 in

Date 10 / 9 / 13 Time 1625 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 105 ft below MP.

DISCHARGE RATE

_____ gpm

x 0.00223

cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
0925	7.93	1991	10.3	99.7	—	↓	150mL/30sec
0935	8.04	1977	10.3	91.9	—	≈ 3.0	↓

Pumping Start Time 0910 WL _____ Pumping End Time _____ WL _____

Comments: Water turbid - no odor

HCF

COC# 151960

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-5
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RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578409-MST-1 Date Sampled 10 / 9 / 13 Time 1730 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 122.83 ft below MP Depth to Water (below MP) 101.18 ft Casing Diameter 5 in

Date 10 / 9 / 13 Time 1610 am pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' Bladder

' Tap ' Bailer _____

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Pump intake or bailer set at 115 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1720	8.47	2480	14.2	49.2	—	↓	150 mL/30sec
1730	8.49	2450	13.9	78.1	—	43.0	↓

Pumping Start Time 1705 WL _____ Pumping End Time _____ WL _____

Comments: water turbid - no odor

COC # 150183

HCF

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-6
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RAMACO

* No Sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-MST-OB-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# [redacted] Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 123.80 ft below MP Depth to Water (below MP) 101.83 ft Casing Diameter _____ in

Date 10 / 9 / 13 Time 1615 am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

ıbing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: NO Sample - Sampled SM578409-MST-1

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-7
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RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-UBN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578409-UBN-1 Date Sampled 10 / 10 / 13 Time 1030 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 141.20 ft below MP Depth to Water (below MP) 108.44 ft Casing Diameter ~~2~~ 5 in

Date 10 / 9 / 13 Time 1630 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Pump intake or bailer set at 130 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1015	8.72	4140	11.1	5.39	—	↓	150ml/30sec
1030	8.74	4110	10.9	4.61	—	≈3.5	↓

Pumping Start Time 1000 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF

COC# 151960

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578415-MST/CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578415-MST/CRN-1 Date Sampled 10 / 31 / 13 Time 1240 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 143.70 ft below MP Depth to Water (below MP) 122.85 ft Casing Diameter 5 in

Date 10 / 31 / 13 Time 1200 am (pm) Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 140 ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

...bing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1230	8.58	2830	~~14.6~~	+1000	—	↓	150 mL/30sec
1240	8.56	2590	12.8	330	—	23.5	↓

Pumping Start Time 1210 WL _____ Pumping End Time _____ WL _____

Comments: Can hear water bubbling in well (methane gas?)
- water turbid - no odor
HCF
COC# 151965

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578415-MST/CRM-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point _____

Well Depth _____ ft below MP Depth to Water (below MP) _____ ft Casing Diameter _____ in

Date ___/___/___ Time _____ am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

ıbing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Drilling Company just completed this well and has not removed drill rig from over the well, so no monitoring could be done at this time.

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Jodi Fuller Witnessed by: _____

October 2014

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578415-MST/CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578415-MST/CRN-1 Date Sampled 10 / 31 / 13 Time 1240 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 143.70 ft below MP Depth to Water (below MP) 122.85 ft Casing Diameter 5 in

Date 10 / 31 / 13 Time 1200 am (pm) Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 140 ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

ubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1230	8.58	2830	~~12.6~~ 14.6	+1000	—	↓	150 mL/30sec
1240	8.56	2590	12.8	330	—	≈3.5	↓

Pumping Start Time 1210 WL _____ Pumping End Time _____ WL _____

Comments: Can hear water bubbling in well (methane gas?)
- water turbid - no odor
HCF
COC# 151965

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578415-MST/CRA-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578415-MST/CRA-1 Date Sampled 10 / 31 / 13 Time 1240 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 143.70 ft below MP Depth to Water (below MP) 122.85 ft Casing Diameter 5 in

Date 10 / 31 / 13 Time 1200 am (pm) Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 140 ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1230	8.58	2830	~~14.6~~	+1000	—	↓	150 ml/30sec
1240	8.56	2590	12.8	330	—	23.5	↓

Pumping Start Time 1210 WL _____ Pumping End Time _____ WL _____

Comments: Can hear water bubbling in well (methane gas?)
- water turbid - no odor
HCF
COC# 151965

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-12
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DEQ 6-361

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578417-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578417-CRN-1 Date Sampled 10 / 9 / 13 Time 1325 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 142.41 ft below MP Depth to Water (below MP) 133.05 ft Casing Diameter 2 in

Date 10 / 9 / 13 Time 1230 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 140 ft below MP.

DISCHARGE RATE

_____ gpm

x 0.00223

_____ cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for N/A

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1315	8.12	1432	14.8	672	—	↓	150 mL/30 sec
1325	8.16	1421	14.6	302	—	3.0	↓

Pumping Start Time 1300 WL _____ Pumping End Time _____ WL _____

Comments: Water very turbid - no odor

HCF

COC# 150183

TFN 6 2/025
RECD NOV 14, 201

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-13
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RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578417-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 163.82 ft below MP Depth to Water (below MP) 160.80 ft Casing Diameter 2 in

Date 10 / 9 / 13 Time 1225 am (pm) Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
_____	cfs

bing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Well almost dry - not enough water sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-14
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RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SMS78418-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SMS78418-AL-1 Date Sampled 10 / 9 / 13 Time 1040 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 24.50 ft below MP Depth to Water (below MP) 20.65 ft Casing Diameter 5 in

Date 10 / 9 / 13 Time 1010 (am) pm Casing Volume _____ gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' Bladder

' Tap ' Bailer _____

Pump intake or bailer set at 23 ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for N/A

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1030	8.72	1226	12.6	203	—	↓	150ml/30sec
1040	8.72	1179	12.3	257	—	≈3.0	↓

Pumping Start Time 1015 WL _____ Pumping End Time _____ WL _____

Comments: Water turbid - no odor

HCF

COC # 150183

TFN 6 2;025
RECD NOV 14,2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

RAMACO

WWC ENGINEERING

* no Sample

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578418-CRM-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 153.79 ft below MP Depth to Water (below MP) 146.69 ft Casing Diameter 5 in

Date 10 / 9 / 13 Time 1130 am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - Not enough water to Sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-16
K:\WWC\ADM\FORMS\Monitor Well Sample Form.doc

RAMACO

* NO Sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SMS78418-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point _____

Well Depth 185.75 ft below MP Depth to Water (below MP) 184.28 ft Casing Diameter _____ in

Date 10 / 9 / 13 Time 1145 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

ıbing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Well almost dry - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-17
K:\WWC\ADM\FORMS\Monitor Well Sample Form.doc

RAMACO

* no Sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578510-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth ~~[illegible]~~ 92.74' ft below MP Depth to Water (below MP) 92.18 ft Casing Diameter 5 in

Date 10/2/13 Time 1110 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Well almost dry - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2013

Form completed by: Bob Fuller Witnessed by: _____

October 2014

Addendum D6-10-18
K:\WWC\ADM\FORMS\Monitor Well Sample Form.doc

RAMACO

X no Sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578510-MST-1 Project Ramaco

Location _____ W.O.# 2013139 -

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth ~~[illegible]~~ 147.24 ft below MP Depth to Water (below MP) 143.4 ft Casing Diameter 5 in

Date 10/02/13 Time 1100 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

('ubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Well almost dry - not enough water to Sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-19
K:\WWC\ADM\FORMS\Monitor Well Sample Form.doc

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578511-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-

Sample ID# 578511-CRN-1 Date Sampled 10 / 2 / 13 Time 1250 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 128.92 ft below MP Depth to Water (below MP) 119.53 ft Casing Diameter 5 in

Date 10 / 2 / 13 Time 1155 (am) pm Casing Volume N/A gal

At least N/A bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' Bladder

' Tap ' Bailer ~~Bailer~~

Pump intake or bailer set at 127 ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for N/A

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1240	8.24	3290	17.6	200	—		150mL/30sec
1250	8.33	3280	16.8	86.7	—	≈ 3.5	↓

Pumping Start Time 1220 WL _____ Pumping End Time _____ WL _____

Comments: water turbid - no odor

HCF

COC # 150182

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-20
K:\WWC\ADM\FORMS\Monitor Well Sample Form.doc

DEQ 6-369

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578511-MST-1 Project Ramaco

Location _____ W.O.# 2013139

Sample ID# _____ Date Sampled 10 / 2 / 13 Time 1340 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 158.00 ft below MP Depth to Water (below MP) 150.10 ft Casing Diameter 5 in

Date 10 / 2 / 13 Time 1200 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 156 ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1330	8.48	2550	15.8	32.4	—	↓	150ML/30sec
1340	8.57	2300	17.6	35.0	—	≈ 3.5	↓

Pumping Start Time 1310 WL _____ Pumping End Time _____ WL _____

Comments: Water turbid - no odor - Ran out of water at the end of pumping.

HCF

COC# 150182

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578512-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578512-AL-1 Date Sampled 10 / 2 / 13 Time 1720 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 21.21 ft below MP Depth to Water (below MP) 4.03 ft Casing Diameter 5 in

Date 10 / 2 / 13 Time 1640 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Sampling method ' Submersible pump (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 15 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1710	7.95	5220	13.8	3.63	—	↓	150 ML/30Sec
1720	8.02	5180	13.4	3.51	—	≈3.5	↓

Pumping Start Time 1650 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF

COC# 150182

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-22
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DEQ 6-371

RAMACO

X no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578512-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 49.85 ft below MP Depth to Water (below MP) Dry ft Casing Diameter _____ in

Date 10/2/13 Time 1610 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Well dry - no sample

TEN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-23
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RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578512-MST Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 114.96 ft below MP Depth to Water (below MP) 111.91 ft Casing Diameter 5 in

Date 10 / 2 / 13 Time 1615 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

ıbing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Well almost dry - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-24
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RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578513-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# SM578513-AL-1 Date Sampled 10 / 9 / 13 Time 0950 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 20.77 ft below MP Depth to Water (below MP) 9.51 ft Casing Diameter 5 in

Date 10 / 9 / 13 Time 0910 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' Bladder

' Tap ' Bailer _____

Pump intake or bailer set at 18.00 ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
0940	7.87	4770	12.4	4.07	—	↓	150mL/30sec
0950	7.95	4870	12.3	2.05	—	≈3.0	↓

Pumping Start Time 0925 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF

COC # 150183

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

RAMACO

* no sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578513-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 117.28 ft below MP Depth to Water (below MP) 116.51 ft Casing Diameter 5 in

Date 10 / 21 / 13 Time 1435 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' _____

' Tap ' Bailer _____ _____

Pump intake or bailer set at _____ ft below MP.

DISCHARGE RATE	
_____	gpm
x 0.00223	
	cfs

'ubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: Well almost dry - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-26
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RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578513-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578513-MST-1 Date Sampled 10 / 21 / 13 Time 1530 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 144.00 ft below MP Depth to Water (below MP) 108.20 ft Casing Diameter 5 in

Date 10 / 21 / 13 Time 1445 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method ' Submersible pump ' (Bladder)

' Tap ' Bailer _____

Pump intake or bailer set at 135 ft below MP.

DISCHARGE RATE

_____ gpm

x 0.00223

_____ cfs

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temperature (°C)	Turbidity (NTU)	Water Level (nearest 0.01 ft)	Cumulative Volume of Water Removed from Well (gallons)	Pumping Rate (gpm)
1520	7.49	4130	15.0	11.38	—	1	150 mL/30 sec
1530	7.51	4110	14.6	9.82	—	≈3.5	↓

Pumping Start Time 1500 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF
COC# 150182

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

October 2014

Addendum D6-10-27
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DEQ 6-376

Sample Analysis Reports

Premining water quality sampling was conducted in accordance with WDEQ/LQD Guideline No. 8 Hydrology Coal and Non-Coal. Constituents and associated units in these reports can be found in Appendix 1 of the aforementioned Guideline. Sampled zone nomenclature is defined as follows: MST = Masters, CRN = Carney, AL = Alluvium, OB = observation, and UBN = underburden.

TFN 6 2/025
RECD OCT 23, 2015

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-001
Client Sample ID: 578511-CRN-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 12:50:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.33			s.u.	10/02/2013 1250	Field
Conductivity	3280			µmhos/cm	10/02/2013 1250	Field
Turbidity	86.7			NTU	10/02/2013 1250	Field
Temperature	16.8			°C	10/02/2013 1250	Field
Static Water Level	119.53			ft	10/02/2013 1250	Field
General Parameters						
pH	8.2	0.1		s.u.	10/04/2013 0050 KV	SM 4500 H B
Electrical Conductivity	3400	5		µmhos/cm	10/04/2013 0050 KV	SM 2510B
Total Dissolved Solids (180)	2400	10		mg/L	10/03/2013 1329 EC	SM 2540
Solids, Total Dissolved (Calc)	2220	10		mg/L	10/15/2013 1429 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	525	5		mg/L	10/04/2013 0050 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	565	1		mg/L	10/15/2013 1429 JJ	SM 2340B
Nitrogen, Ammonia (As N)	6.8	0.1		mg/L	10/14/2013 1046 RH	EPA 350.1
lium Adsorption Ratio	9.8	0.1			10/15/2013 1429 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	641	5		mg/L	10/04/2013 0050 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/04/2013 0050 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/04/2013 0050 KV	SM 2320B
Chloride	24	1		mg/L	10/05/2013 2230 AMB	EPA 300.0
Fluoride	1.1	0.1		mg/L	10/04/2013 0050 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	7.9	0.1		mg/L	10/08/2013 1304 RH	EPA 353.2
Sulfate	1110	1		mg/L	10/05/2013 2230 AMB	EPA 300.0
Cations						
Calcium	85	1		mg/L	10/03/2013 1808 DG	EPA 200.7
Magnesium	86	1		mg/L	10/03/2013 1808 DG	EPA 200.7
Potassium	26	1		mg/L	10/03/2013 1808 DG	EPA 200.7
Sodium	535	1		mg/L	10/03/2013 1808 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Addendum D6-10-28

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-001
Client Sample ID: 578511-CRN-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 12:50:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	10.50	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Chloride	0.67	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Fluoride	0.05	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Nitrate + Nitrite as N	0.56	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sulfate	23.14	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Calcium	4.23	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Magnesium	7.06	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Potassium	0.66	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sodium	23.28	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	35.74	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion Sum	34.94	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion-Anion Balance	1.12	0.01		%	10/15/2013 1429 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/03/2013 1808 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/03/2013 1417 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/03/2013 1417 MS	EPA 200.8
Boron	0.3	0.1		mg/L	10/03/2013 1808 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/03/2013 1417 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/03/2013 1808 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/03/2013 1417 MS	EPA 200.8
Iron	ND	0.05		mg/L	10/03/2013 1808 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/03/2013 1417 MS	EPA 200.8
Manganese	0.19	0.02		mg/L	10/03/2013 1808 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/04/2013 1345 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/03/2013 1417 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/03/2013 1808 DG	EPA 200.7
Selenium	0.005	0.005		mg/L	10/03/2013 1417 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/03/2013 1808 DG	EPA 200.7
Total Metals						
Iron	0.18	0.05		mg/L	10/08/2013 0246 DG	EPA 200.7
Manganese	0.24	0.02		mg/L	10/08/2013 0246 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-002
Client Sample ID: 578511-MST-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 1:40:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.57			s.u.	10/02/2013 1340	Field
Conductivity	2300			µmhos/cm	10/02/2013 1340	Field
Turbidity	35.0			NTU	10/02/2013 1340	Field
Temperature	17.6			°C	10/02/2013 1340	Field
Static Water Level	150.10			ft	10/02/2013 1340	Field
General Parameters						
pH	8.3	0.1		s.u.	10/04/2013 0100 KV	SM 4500 H B
Electrical Conductivity	2280	5		µmhos/cm	10/04/2013 0100 KV	SM 2510B
Total Dissolved Solids (180)	1500	10		mg/L	10/03/2013 1330 EC	SM 2540
Solids, Total Dissolved (Calc)	1430	10		mg/L	10/15/2013 1429 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	443	5		mg/L	10/09/2013 1313 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	382	1		mg/L	10/15/2013 1429 JJ	SM 2340B
Nitrogen, Ammonia (As N)	4.5	0.1		mg/L	10/14/2013 1047 RH	EPA 350.1
'ium Adsorption Ratio	7.9	0.1			10/15/2013 1429 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	540	5		mg/L	10/09/2013 1313 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/09/2013 1313 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/09/2013 1313 KV	SM 2320B
Chloride	16	1		mg/L	10/09/2013 1626 AMB	EPA 300.0
Fluoride	0.9	0.1		mg/L	10/04/2013 0100 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	8.0	0.1		mg/L	10/08/2013 1305 RH	EPA 353.2
Sulfate	624	1		mg/L	10/09/2013 1626 AMB	EPA 300.0
Cations						
Calcium	59	1		mg/L	10/10/2013 0201 DG	EPA 200.7
Magnesium	57	1		mg/L	10/10/2013 0201 DG	EPA 200.7
Potassium	19	1		mg/L	10/10/2013 0201 DG	EPA 200.7
Sodium	353	1		mg/L	10/10/2013 0201 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-002
Client Sample ID: 578511-MST-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 1:40:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	8.85	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Chloride	0.45	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Fluoride	0.04	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Nitrate + Nitrite as N	0.57	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sulfate	12.98	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Calcium	2.94	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Magnesium	4.69	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Potassium	0.48	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sodium	15.36	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	23.80	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion Sum	22.91	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion-Anion Balance	1.90	0.01		%	10/15/2013 1429 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/03/2013 1810 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/03/2013 1423 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/03/2013 1423 MS	EPA 200.8
Boron	0.3	0.1		mg/L	10/03/2013 1810 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/03/2013 1423 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/03/2013 1810 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/03/2013 1423 MS	EPA 200.8
Iron	ND	0.05		mg/L	10/03/2013 1810 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/03/2013 1423 MS	EPA 200.8
Manganese	0.09	0.02		mg/L	10/03/2013 1810 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/04/2013 1353 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/03/2013 1423 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/03/2013 1810 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/03/2013 1423 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/03/2013 1810 DG	EPA 200.7
Total Metals						
Iron	0.29	0.05		mg/L	10/08/2013 0255 DG	EPA 200.7
Manganese	0.11	0.02		mg/L	10/08/2013 0255 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-004
Client Sample ID: 578512-AL-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 5:20:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.02			s.u.	10/02/2013 1720	Field
Conductivity	5180			µmhos/cm	10/02/2013 1720	Field
Turbidity	3.51			NTU	10/02/2013 1720	Field
Temperature	13.4			°C	10/02/2013 1720	Field
Static Water Level	4.03			ft	10/02/2013 1720	Field
General Parameters						
pH	8.0	0.1		s.u.	10/04/2013 0119 KV	SM 4500 H B
Electrical Conductivity	5650	5		µmhos/cm	10/04/2013 0119 KV	SM 2510B
Total Dissolved Solids (180)	5210	10		mg/L	10/03/2013 1332 EC	SM 2540
Solids, Total Dissolved (Calc)	4740	10		mg/L	10/15/2013 1429 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	638	5		mg/L	10/04/2013 0119 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2840	1		mg/L	10/15/2013 1429 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	10/14/2013 1049 RH	EPA 350.1
'ium Adsorption Ratio	4.0	0.1			10/15/2013 1429 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	778	5		mg/L	10/04/2013 0119 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/04/2013 0119 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/04/2013 0119 KV	SM 2320B
Chloride	17	1		mg/L	10/05/2013 2311 AMB	EPA 300.0
Fluoride	1.0	0.1		mg/L	10/04/2013 0119 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	10/08/2013 1308 RH	EPA 353.2
Sulfate	2990	1		mg/L	10/05/2013 2311 AMB	EPA 300.0
Cations						
Calcium	369	1		mg/L	10/03/2013 1815 DG	EPA 200.7
Magnesium	466	1		mg/L	10/03/2013 1815 DG	EPA 200.7
Potassium	26	1		mg/L	10/03/2013 1815 DG	EPA 200.7
Sodium	490	1		mg/L	10/03/2013 1815 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-004
Client Sample ID: 578512-AL-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 5:20:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.75	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Chloride	0.48	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Fluoride	0.05	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sulfate	62.21	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Calcium	18.40	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Magnesium	38.33	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Potassium	0.65	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sodium	21.32	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	78.72	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion Sum	75.49	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion-Anion Balance	2.09	0.01		%	10/15/2013 1429 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/03/2013 1815 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/03/2013 1434 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/03/2013 1434 MS	EPA 200.8
Boron	0.4	0.1		mg/L	10/03/2013 1815 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/03/2013 1434 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/03/2013 1815 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/03/2013 1434 MS	EPA 200.8
Iron	0.91	0.05		mg/L	10/03/2013 1815 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/03/2013 1434 MS	EPA 200.8
Manganese	2.28	0.02		mg/L	10/03/2013 1815 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/04/2013 1357 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/03/2013 1434 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/03/2013 1815 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/03/2013 1434 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/03/2013 1815 DG	EPA 200.7
Total Metals						
Iron	0.96	0.05		mg/L	10/08/2013 0300 DG	EPA 200.7
Manganese	2.20	0.02		mg/L	10/08/2013 0300 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-003
Client Sample ID: 578513-MST-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 3:30:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.51			s.u.	10/02/2013 1530	Field
Conductivity	4110			µmhos/cm	10/02/2013 1530	Field
Turbidity	9.82			NTU	10/02/2013 1530	Field
Temperature	14.6			°C	10/02/2013 1530	Field
Static Water Level	108.20			ft	10/02/2013 1530	Field
General Parameters						
pH	7.8	0.1		s.u.	10/04/2013 0109 KV	SM 4500 H B
Electrical Conductivity	4290	5		µmhos/cm	10/04/2013 0109 KV	SM 2510B
Total Dissolved Solids (180)	3370	10		mg/L	10/03/2013 1331 EC	SM 2540
Solids, Total Dissolved (Calc)	3070	10		mg/L	10/15/2013 1429 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	604	5		mg/L	10/04/2013 0109 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1040	1		mg/L	10/15/2013 1429 JJ	SM 2340B
Nitrogen, Ammonia (As N)	10.6	0.1		mg/L	10/14/2013 1048 RH	EPA 350.1
ium Adsorption Ratio	8.3	0.1			10/15/2013 1429 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	736	5		mg/L	10/04/2013 0109 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/04/2013 0109 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/04/2013 0109 KV	SM 2320B
Chloride	15	1		mg/L	10/05/2013 2257 AMB	EPA 300.0
Fluoride	0.6	0.1		mg/L	10/04/2013 0109 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	10/08/2013 1307 RH	EPA 353.2
Sulfate	1740	1		mg/L	10/05/2013 2257 AMB	EPA 300.0
Cations						
Calcium	128	1		mg/L	10/03/2013 1813 DG	EPA 200.7
Magnesium	175	1		mg/L	10/03/2013 1813 DG	EPA 200.7
Potassium	32	1		mg/L	10/03/2013 1813 DG	EPA 200.7
Sodium	613	1		mg/L	10/03/2013 1813 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

DEQ 6-384

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/15/2013
Report ID: S1310062001

Project: RAMACO
Lab ID: S1310062-003
Client Sample ID: 578513-MST-1
COC: 150182

Work Order: S1310062
Collection Date: 10/2/2013 3:30:00 PM
Date Received: 10/3/2013 8:28:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.07	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Chloride	0.43	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sulfate	36.31	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Calcium	6.37	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Magnesium	14.39	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Potassium	0.80	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Sodium	26.67	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	48.99	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion Sum	48.85	0.01		meq/L	10/15/2013 1429 JJ	SM 1030E
ion-Anion Balance	0.15	0.01		%	10/15/2013 1429 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/03/2013 1813 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/03/2013 1428 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/03/2013 1428 MS	EPA 200.8
Boron	0.3	0.1		mg/L	10/03/2013 1813 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/03/2013 1428 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/03/2013 1813 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/03/2013 1428 MS	EPA 200.8
Iron	0.19	0.05		mg/L	10/03/2013 1813 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/03/2013 1428 MS	EPA 200.8
Manganese	0.09	0.02		mg/L	10/03/2013 1813 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/04/2013 1355 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/03/2013 1428 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/03/2013 1813 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/03/2013 1428 MS	EPA 200.8
Zinc	0.01	0.01		mg/L	10/03/2013 1813 DG	EPA 200.7
Total Metals						
Iron	0.34	0.05		mg/L	10/08/2013 0258 DG	EPA 200.7
Manganese	0.13	0.02		mg/L	10/08/2013 0258 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-005
Client Sample ID: SM578408-CRN-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 3:40:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.79			s.u.	10/09/2013 1540	Field
Conductivity	2440			µmhos/cm	10/09/2013 1540	Field
Turbidity	370			NTU	10/09/2013 1540	Field
Temperature	13.3			°C	10/09/2013 1540	Field
Static Water Level	87.66			ft	10/09/2013 1540	Field
General Parameters						
pH	7.9	0.1		s.u.	10/11/2013 2016 KV	SM 4500 H B
Electrical Conductivity	2290	5		µmhos/cm	10/11/2013 2016 KV	SM 2510B
Total Dissolved Solids (180)	1870	10		mg/L	10/10/2013 1118 EC	SM 2540
Solids, Total Dissolved (Calc)	1760	10		mg/L	10/16/2013 1109 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	577	5		mg/L	10/11/2013 2016 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1300	1		mg/L	10/16/2013 1109 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	10/14/2013 1149 RH	EPA 350.1
ium Adsorption Ratio	1.0	0.1			10/16/2013 1109 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	705	5		mg/L	10/11/2013 2016 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/11/2013 2016 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/11/2013 2016 KV	SM 2320B
Chloride	8	1		mg/L	10/10/2013 1651 AMB	EPA 300.0
Fluoride	0.7	0.1		mg/L	10/11/2013 2016 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	10/15/2013 1244 RH	EPA 353.2
Sulfate	918	1		mg/L	10/10/2013 1651 AMB	EPA 300.0
Cations						
Calcium	165	1		mg/L	10/10/2013 1613 DG	EPA 200.7
Magnesium	214	1		mg/L	10/10/2013 1613 DG	EPA 200.7
Potassium	27	1		mg/L	10/10/2013 1613 DG	EPA 200.7
Sodium	82	1		mg/L	10/10/2013 1613 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-005
Client Sample ID: SM578408-CRN-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 3:40:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	11.54	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Chloride	0.23	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sulfate	19.11	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Calcium	8.25	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Magnesium	17.64	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Potassium	0.68	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sodium	3.56	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	30.16	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion Sum	30.94	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion-Anion Balance	1.27	0.01		%	10/16/2013 1109 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/10/2013 1613 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 1441 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 1441 MS	EPA 200.8
Boron	0.5	0.1		mg/L	10/10/2013 1613 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 1441 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/10/2013 1613 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 1441 MS	EPA 200.8
Iron	ND	0.05		mg/L	10/10/2013 1613 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 1441 MS	EPA 200.8
Manganese	0.44	0.02		mg/L	10/10/2013 1613 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/11/2013 1237 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/10/2013 1441 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/10/2013 1613 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/10/2013 1441 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/10/2013 1613 DG	EPA 200.7
Total Metals						
Iron	4.57	0.05		mg/L	10/14/2013 1829 DG	EPA 200.7
Manganese	0.54	0.02		mg/L	10/14/2013 1829 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
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Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-004
Client Sample ID: SM578408-MST-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 3:00:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.38			s.u.	10/09/2013 1500	Field
Conductivity	2380			µmhos/cm	10/09/2013 1500	Field
Turbidity	552			NTU	10/09/2013 1500	Field
Temperature	13.7			°C	10/09/2013 1500	Field
Static Water Level	104.49			ft	10/09/2013 1500	Field
General Parameters						
pH	7.6	0.1		s.u.	10/11/2013 2003 KV	SM 4500 H B
Electrical Conductivity	2230	5		µmhos/cm	10/11/2013 2003 KV	SM 2510B
Total Dissolved Solids (180)	1720	10		mg/L	10/10/2013 1117 EC	SM 2540
Solids, Total Dissolved (Calc)	1650	10		mg/L	10/16/2013 1109 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	464	5		mg/L	10/11/2013 2003 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1040	1		mg/L	10/16/2013 1109 JJ	SM 2340B
Nitrogen, Ammonia (As N)	3.1	0.1		mg/L	10/14/2013 1148 RH	EPA 350.1
'ium Adsorption Ratio	1.9	0.1			10/16/2013 1109 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	566	5		mg/L	10/11/2013 2003 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/11/2013 2003 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/11/2013 2003 KV	SM 2320B
Chloride	8	1		mg/L	10/10/2013 1638 AMB	EPA 300.0
Fluoride	0.5	0.1		mg/L	10/11/2013 2003 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	10/15/2013 1243 RH	EPA 353.2
Sulfate	891	1		mg/L	10/10/2013 1638 AMB	EPA 300.0
Cations						
Calcium	129	1		mg/L	10/10/2013 1611 DG	EPA 200.7
Magnesium	174	1		mg/L	10/10/2013 1611 DG	EPA 200.7
Potassium	29	1		mg/L	10/10/2013 1611 DG	EPA 200.7
Sodium	140	1		mg/L	10/10/2013 1611 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

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1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-004
Client Sample ID: SM578408-MST-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 3:00:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.27	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Chloride	0.21	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Fluoride	0.02	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sulfate	18.56	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Calcium	6.45	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Magnesium	14.34	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Potassium	0.74	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sodium	6.10	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	27.86	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
[illegible]ion Sum	28.07	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
[illegible]ion-Anion Balance	0.36	0.01		%	10/16/2013 1109 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.8	0.1		mg/L	10/10/2013 1611 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 1435 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 1435 MS	EPA 200.8
Boron	0.4	0.1		mg/L	10/10/2013 1611 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 1435 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/10/2013 1611 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 1435 MS	EPA 200.8
Iron	0.68	0.05		mg/L	10/10/2013 1611 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 1435 MS	EPA 200.8
Manganese	0.92	0.02		mg/L	10/10/2013 1611 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/11/2013 1235 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/10/2013 1435 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/10/2013 1611 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/10/2013 1435 MS	EPA 200.8
Zinc	0.02	0.01		mg/L	10/10/2013 1611 DG	EPA 200.7
Total Metals						
Iron	5.95	0.05		mg/L	10/14/2013 1826 DG	EPA 200.7
Manganese	0.94	0.02		mg/L	10/14/2013 1826 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

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H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/16/2013
Report ID: S1310172001

Project: Ramaco
Lab ID: S1310172-001
Client Sample ID: SM578409-CRN-OB-1
COC: 151960

Work Order: S1310172
Collection Date: 10/10/2013 9:35:00 AM
Date Received: 10/10/2013 12:00:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.04			s.u.	10/10/2013 0935	Field
Conductivity	1977			µmhos/cm	10/10/2013 0935	Field
Turbidity	91.9			NTU	10/10/2013 0935	Field
Temperature	10.3			°C	10/10/2013 0935	Field
Static Water Level	85.99			ft	10/10/2013 0935	Field
General Parameters						
pH	8.1	0.1		s.u.	10/12/2013 0016 KV	SM 4500 H B
Electrical Conductivity	2020	5		µmhos/cm	10/12/2013 0016 KV	SM 2510B
Total Dissolved Solids (180)	1510	10		mg/L	10/10/2013 1132 EC	SM 2540
Solids, Total Dissolved (Calc)	1480	10		mg/L	10/16/2013 1000 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	421	5		mg/L	10/12/2013 0016 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	879	1		mg/L	10/16/2013 1000 JJ	SM 2340B
Nitrogen, Ammonia (As N)	1.5	0.1		mg/L	10/14/2013 1205 RH	EPA 350.1
ium Adsorption Ratio	2.3	0.1			10/16/2013 1000 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	513	5		mg/L	10/12/2013 0016 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/12/2013 0016 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/12/2013 0016 KV	SM 2320B
Chloride	12	1		mg/L	10/10/2013 2347 AMB	EPA 300.0
Fluoride	0.5	0.1		mg/L	10/12/2013 0016 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	10/15/2013 1306 RH	EPA 353.2
Sulfate	778	1		mg/L	10/10/2013 2347 AMB	EPA 300.0
Cations						
Calcium	127	1		mg/L	10/11/2013 1330 DG	EPA 200.7
Magnesium	136	1		mg/L	10/11/2013 1330 DG	EPA 200.7
Potassium	18	1		mg/L	10/11/2013 1330 DG	EPA 200.7
Sodium	156	1		mg/L	10/11/2013 1330 DG	EPA 200.7

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Qualifiers:

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H	Holding times for preparation or analysis exceeded
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ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
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TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/16/2013
Report ID: S1310172001

Project: Ramaco
Lab ID: S1310172-001
Client Sample ID: SM578409-CRN-OB-1
COC: 151960

Work Order: S1310172
Collection Date: 10/10/2013 9:35:00 AM
Date Received: 10/10/2013 12:00:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	8.41	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Chloride	0.33	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Fluoride	0.02	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Sulfate	16.19	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Calcium	6.34	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Magnesium	11.22	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Potassium	0.46	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Sodium	6.79	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	24.94	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
[illegible]ion Sum	24.97	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
[illegible]ion-Anion Balance	0.05	0.01		%	10/16/2013 1000 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/11/2013 1330 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 2029 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 2029 MS	EPA 200.8
Boron	0.2	0.1		mg/L	10/11/2013 1330 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 2029 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/11/2013 1330 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 2029 MS	EPA 200.8
Iron	ND	0.05		mg/L	10/11/2013 1330 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 2029 MS	EPA 200.8
Manganese	0.09	0.02		mg/L	10/11/2013 1330 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/15/2013 1011 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/10/2013 2029 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/11/2013 1330 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/10/2013 2029 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/11/2013 1330 DG	EPA 200.7
Total Metals						
Iron	1.36	0.05		mg/L	10/14/2013 1835 DG	EPA 200.7
Manganese	0.17	0.02		mg/L	10/14/2013 1835 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-006
Client Sample ID: SM578409-MST-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 5:30:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.49			s.u.	10/09/2013 1730	Field
Conductivity	2450			µmhos/cm	10/09/2013 1730	Field
Turbidity	78.1			NTU	10/09/2013 1730	Field
Temperature	13.9			°C	10/09/2013 1730	Field
Static Water Level	101.18			ft	10/09/2013 1730	Field
General Parameters						
pH	8.4	0.1		s.u.	10/11/2013 2028 KV	SM 4500 H B
Electrical Conductivity	2300	5		µmhos/cm	10/11/2013 2028 KV	SM 2510B
Total Dissolved Solids (180)	1500	10		mg/L	10/10/2013 1119 EC	SM 2540
Solids, Total Dissolved (Calc)	1470	10		mg/L	10/16/2013 1109 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	577	5		mg/L	10/11/2013 2028 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	171	1		mg/L	10/16/2013 1109 JJ	SM 2340B
Nitrogen, Ammonia (As N)	2.0	0.1		mg/L	10/14/2013 1150 RH	EPA 350.1
'ium Adsorption Ratio	16.1	0.1			10/16/2013 1109 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	685	5		mg/L	10/11/2013 2028 KV	SM 2320B
Alkalinity, Carbonate as CO3	9	5		mg/L	10/11/2013 2028 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/11/2013 2028 KV	SM 2320B
Chloride	10	1		mg/L	10/10/2013 1705 AMB	EPA 300.0
Fluoride	1.4	0.1		mg/L	10/11/2013 2028 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	0.4	0.1		mg/L	10/15/2013 1245 RH	EPA 353.2
Sulfate	560	1		mg/L	10/10/2013 1705 AMB	EPA 300.0
Cations						
Calcium	29	1		mg/L	10/10/2013 1615 DG	EPA 200.7
Magnesium	24	1		mg/L	10/10/2013 1615 DG	EPA 200.7
Potassium	15	1		mg/L	10/10/2013 1615 DG	EPA 200.7
Sodium	484	1		mg/L	10/10/2013 1615 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-006
Client Sample ID: SM578409-MST-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 5:30:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	11.22	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Carbonate as CO3	0.31	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Chloride	0.29	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Fluoride	0.07	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Nitrate + Nitrite as N	0.02	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sulfate	11.65	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Calcium	1.44	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Magnesium	1.98	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Potassium	0.38	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sodium	21.05	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	25.01	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion Sum	23.58	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ation-Anion Balance	2.94	0.01		%	10/16/2013 1109 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.3	0.1		mg/L	10/10/2013 1615 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 1446 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 1446 MS	EPA 200.8
Boron	0.2	0.1		mg/L	10/10/2013 1615 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 1446 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/10/2013 1615 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 1446 MS	EPA 200.8
Iron	0.12	0.05		mg/L	10/10/2013 1615 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 1446 MS	EPA 200.8
Manganese	0.08	0.02		mg/L	10/10/2013 1615 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/11/2013 1239 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/10/2013 1446 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/10/2013 1615 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/10/2013 1446 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/10/2013 1615 DG	EPA 200.7
Total Metals						
Iron	1.13	0.05		mg/L	10/14/2013 1831 DG	EPA 200.7
Manganese	0.11	0.02		mg/L	10/14/2013 1831 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/16/2013
Report ID: S1310172001

Project: Ramaco
Lab ID: S1310172-002
Client Sample ID: SM578409-UBN-1
COC: 151960

Work Order: S1310172
Collection Date: 10/10/2013 10:30:00 AM
Date Received: 10/10/2013 12:00:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.74			s.u.	10/10/2013 1030	Field
Conductivity	4110			µmhos/cm	10/10/2013 1030	Field
Turbidity	4.61			NTU	10/10/2013 1030	Field
Temperature	10.9			°C	10/10/2013 1030	Field
Static Water Level	108.44			ft	10/10/2013 1030	Field
General Parameters						
pH	8.5	0.1		s.u.	10/12/2013 0028 KV	SM 4500 H B
Electrical Conductivity	3880	5		µmhos/cm	10/12/2013 0028 KV	SM 2510B
Total Dissolved Solids (180)	2860	10		mg/L	10/10/2013 1133 EC	SM 2540
Solids, Total Dissolved (Calc)	2900	10		mg/L	10/16/2013 1000 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	435	5		mg/L	10/12/2013 0028 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	373	1		mg/L	10/16/2013 1000 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	10/14/2013 1206 RH	EPA 350.1
...lium Adsorption Ratio	18.0	0.1			10/16/2013 1000 JJ	Calculation
A...ons						
Alkalinity, Bicarbonate as HCO3	505	5		mg/L	10/12/2013 0028 KV	SM 2320B
Alkalinity, Carbonate as CO3	13	5		mg/L	10/12/2013 0028 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/12/2013 0028 KV	SM 2320B
Chloride	34	1		mg/L	10/11/2013 0001 AMB	EPA 300.0
Fluoride	1.0	0.1		mg/L	10/12/2013 0028 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	13.6	0.1		mg/L	10/15/2013 1305 RH	EPA 353.2
Sulfate	1620	1		mg/L	10/11/2013 0001 AMB	EPA 300.0
Cations						
Calcium	67	1		mg/L	10/11/2013 1338 DG	EPA 200.7
Magnesium	50	1		mg/L	10/11/2013 1338 DG	EPA 200.7
Potassium	12	1		mg/L	10/11/2013 1338 DG	EPA 200.7
Sodium	801	1		mg/L	10/11/2013 1338 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-44

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/16/2013
Report ID: S1310172001

Project: Ramaco
Lab ID: S1310172-002
Client Sample ID: SM578409-UBN-1
COC: 151960

Work Order: S1310172
Collection Date: 10/10/2013 10:30:00 AM
Date Received: 10/10/2013 12:00:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	8.28	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Carbonate as CO3	0.41	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Chloride	0.94	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Fluoride	0.05	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Nitrate + Nitrite as N	0.97	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Sulfate	33.70	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Calcium	3.33	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Magnesium	4.12	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Potassium	0.31	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Sodium	34.82	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	42.60	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
[illegible]ion Sum	44.37	0.01		meq/L	10/16/2013 1000 JJ	SM 1030E
[illegible]ion-Anion Balance	2.03	0.01		%	10/16/2013 1000 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/11/2013 1338 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 2102 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 2102 MS	EPA 200.8
Boron	0.2	0.1		mg/L	10/11/2013 1338 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 2102 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/11/2013 1338 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 2102 MS	EPA 200.8
Iron	ND	0.05		mg/L	10/11/2013 1338 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 2102 MS	EPA 200.8
Manganese	0.04	0.02		mg/L	10/11/2013 1338 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/15/2013 1019 CS	EPA 245.1
Molybdenum	0.03	0.02		mg/L	10/10/2013 2102 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/11/2013 1338 DG	EPA 200.7
Selenium	0.012	0.005		mg/L	10/10/2013 2102 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/11/2013 1338 DG	EPA 200.7
Total Metals						
Iron	0.09	0.05		mg/L	10/14/2013 1840 DG	EPA 200.7
Manganese	0.05	0.02		mg/L	10/14/2013 1840 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

DEQ 6-395

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 11/11/2013
Report ID: S1310501001

Project: Ramaco
Lab ID: S1310501-001
Client Sample ID: SM578415-MST/CRN-1
COC: 151965

Work Order: S1310501
Collection Date: 10/31/2013 12:40:00 PM
Date Received: 10/31/2013 2:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.56			s.u.	10/31/2013 1240	Field
Conductivity	2590			µmhos/cm	10/31/2013 1240	Field
Turbidity	330			NTU	10/31/2013 1240	Field
Temperature	12.8			°C	10/31/2013 1240	Field
Static Water Level	122.85			ft	10/31/2013 1240	Field
General Parameters						
pH	8.4	0.1		s.u.	11/01/2013 1836 KV	SM 4500 H B
Electrical Conductivity	2720	5		µmhos/cm	11/01/2013 1836 KV	SM 2510B
Total Dissolved Solids (180)	1640	10		mg/L	11/01/2013 1021 EC	SM 2540
Solids, Total Dissolved (Calc)	1580	10		mg/L	11/08/2013 1057 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	958	5		mg/L	11/01/2013 1836 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	72	1		mg/L	11/08/2013 1057 JJ	SM 2340B
Nitrogen, Ammonia (As N)	1.0	0.1		mg/L	11/07/2013 1041 RH	EPA 350.1
lium Adsorption Ratio	29.0	0.1			11/08/2013 1057 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	1110	5		mg/L	11/01/2013 1836 KV	SM 2320B
Alkalinity, Carbonate as CO3	27	5		mg/L	11/01/2013 1836 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	11/01/2013 1836 KV	SM 2320B
Chloride	24	1		mg/L	11/03/2013 0338 AMB	EPA 300.0
Fluoride	1.7	0.1		mg/L	11/01/2013 1836 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	1.2	0.1		mg/L	11/01/2013 1257 RH	EPA 353.2
Sulfate	374	1		mg/L	11/05/2013 1419 AMB	EPA 300.0
Cations						
Calcium	15	1		mg/L	11/04/2013 2020 DG	EPA 200.7
Magnesium	8	1		mg/L	11/04/2013 2020 DG	EPA 200.7
Potassium	9	1		mg/L	11/04/2013 2020 DG	EPA 200.7
Sodium	567	1		mg/L	11/04/2013 2020 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Addendum D6-10-46

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 11/11/2013
Report ID: S1310501001

Project: Ramaco
Lab ID: S1310501-001
Client Sample ID: SM578415-MST/CRN-1
COC: 151965

Work Order: S1310501
Collection Date: 10/31/2013 12:40:00 PM
Date Received: 10/31/2013 2:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	18.25	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Carbonate as CO3	0.89	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Chloride	0.66	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Fluoride	0.09	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Nitrate + Nitrite as N	0.08	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Sulfate	7.79	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Calcium	0.76	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Magnesium	0.67	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Potassium	0.22	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Sodium	24.67	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	26.41	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
ion Sum	27.78	0.01		meq/L	11/08/2013 1057 JJ	SM 1030E
ion-Anion Balance	2.52	0.01		%	11/08/2013 1057 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	11/04/2013 2020 DG	EPA 200.7
Arsenic	0.007	0.005		mg/L	11/01/2013 2128 MS	EPA 200.8
Barium	ND	0.1		mg/L	11/01/2013 2128 MS	EPA 200.8
Boron	0.1	0.1		mg/L	11/04/2013 2020 DG	EPA 200.7
Cadmium	0.001	0.001		mg/L	11/01/2013 2128 MS	EPA 200.8
Chromium	ND	0.01		mg/L	11/04/2013 2020 DG	EPA 200.7
Copper	ND	0.01		mg/L	11/01/2013 2128 MS	EPA 200.8
Iron	ND	0.05		mg/L	11/04/2013 2020 DG	EPA 200.7
Lead	ND	0.02		mg/L	11/05/2013 1836 MS	EPA 200.8
Manganese	0.05	0.02		mg/L	11/04/2013 2020 DG	EPA 200.7
Mercury	ND	0.001		mg/L	11/08/2013 1104 CS	EPA 245.1
Molybdenum	0.03	0.02		mg/L	11/01/2013 2128 MS	EPA 200.8
Nickel	ND	0.01		mg/L	11/04/2013 2020 DG	EPA 200.7
Selenium	0.005	0.005		mg/L	11/01/2013 2128 MS	EPA 200.8
Zinc	ND	0.01		mg/L	11/04/2013 2020 DG	EPA 200.7
Total Metals						
Iron	3.67	0.05		mg/L	11/05/2013 0034 DG	EPA 200.7
Manganese	0.14	0.02		mg/L	11/05/2013 0034 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-003
Client Sample ID: SM578417-CRN-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 1:25:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.16			s.u.	10/09/2013 1325	Field
Conductivity	1421			µmhos/cm	10/09/2013 1325	Field
Turbidity	302			NTU	10/09/2013 1325	Field
Temperature	14.6			°C	10/09/2013 1325	Field
Static Water Level	133.05			ft	10/09/2013 1325	Field
General Parameters						
pH	8.3	0.1		s.u.	10/11/2013 1952 KV	SM 4500 H B
Electrical Conductivity	1420	5		µmhos/cm	10/11/2013 1952 KV	SM 2510B
Total Dissolved Solids (180)	880	10		mg/L	10/10/2013 1116 EC	SM 2540
Solids, Total Dissolved (Calc)	860	10		mg/L	10/16/2013 1109 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	465	5		mg/L	10/11/2013 1952 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	147	1		mg/L	10/16/2013 1109 JJ	SM 2340B
Nitrogen, Ammonia (As N)	2.7	0.1		mg/L	10/14/2013 1147 RH	EPA 350.1
'ium Adsorption Ratio	9.8	0.1			10/16/2013 1109 JJ	Calculation
A...ons						
Alkalinity, Bicarbonate as HCO3	563	5		mg/L	10/11/2013 1952 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/11/2013 1952 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/11/2013 1952 KV	SM 2320B
Chloride	7	1		mg/L	10/10/2013 1624 AMB	EPA 300.0
Fluoride	1.9	0.1		mg/L	10/11/2013 1952 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	10/15/2013 1242 RH	EPA 353.2
Sulfate	242	1		mg/L	10/10/2013 1624 AMB	EPA 300.0
Cations						
Calcium	19	1		mg/L	10/10/2013 1557 DG	EPA 200.7
Magnesium	24	1		mg/L	10/10/2013 1557 DG	EPA 200.7
Potassium	15	1		mg/L	10/10/2013 1557 DG	EPA 200.7
Sodium	272	1		mg/L	10/10/2013 1557 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-003
Client Sample ID: SM578417-CRN-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 1:25:00 PM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.23	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Chloride	0.20	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Fluoride	0.10	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sulfate	5.02	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Calcium	0.93	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Magnesium	2.00	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Potassium	0.39	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sodium	11.85	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	15.37	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion Sum	14.64	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion-Anion Balance	2.42	0.01		%	10/16/2013 1109 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.9	0.1		mg/L	10/10/2013 1557 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 1430 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 1430 MS	EPA 200.8
Boron	0.1	0.1		mg/L	10/10/2013 1557 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 1430 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/10/2013 1557 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 1430 MS	EPA 200.8
Iron	0.21	0.05		mg/L	10/10/2013 1557 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 1430 MS	EPA 200.8
Manganese	0.07	0.02		mg/L	10/10/2013 1557 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/11/2013 1233 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/10/2013 1430 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/10/2013 1557 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/10/2013 1430 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/10/2013 1557 DG	EPA 200.7
Total Metals						
Iron	3.56	0.05		mg/L	10/14/2013 1824 DG	EPA 200.7
Manganese	0.19	0.02		mg/L	10/14/2013 1824 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-002
Client Sample ID: SM578418-AL-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 10:40:00 AM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.72			s.u.	10/09/2013 1040	Field
Conductivity	1179			µmhos/cm	10/09/2013 1040	Field
Turbidity	257			NTU	10/09/2013 1040	Field
Temperature	12.3			°C	10/09/2013 1040	Field
Static Water Level	20.65			ft	10/09/2013 1040	Field
General Parameters						
pH	8.4	0.1		s.u.	10/11/2013 1940 KV	SM 4500 H B
Electrical Conductivity	1160	5		µmhos/cm	10/11/2013 1940 KV	SM 2510B
Total Dissolved Solids (180)	760	10		mg/L	10/10/2013 1115 EC	SM 2540
Solids, Total Dissolved (Calc)	780	10		mg/L	10/16/2013 1109 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	205	5		mg/L	10/11/2013 1940 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	254	1		mg/L	10/16/2013 1109 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	10/14/2013 1146 RH	EPA 350.1
tium Adsorption Ratio	4.3	0.1			10/16/2013 1109 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	242	5		mg/L	10/11/2013 1940 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/11/2013 1940 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/11/2013 1940 KV	SM 2320B
Chloride	9	1		mg/L	10/15/2013 2357 AMB	EPA 300.0
Fluoride	1.1	0.1		mg/L	10/11/2013 1940 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	1.4	0.1		mg/L	10/15/2013 1241 RH	EPA 353.2
Sulfate	393	1		mg/L	10/15/2013 2357 AMB	EPA 300.0
Cations						
Calcium	26	1		mg/L	10/15/2013 1524 DG	EPA 200.7
Magnesium	46	1		mg/L	10/15/2013 1524 DG	EPA 200.7
Potassium	13	1		mg/L	10/10/2013 1552 DG	EPA 200.7
Sodium	159	1		mg/L	10/15/2013 1524 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-002
Client Sample ID: SM578418-AL-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 10:40:00 AM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	3.97	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Chloride	0.24	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Fluoride	0.05	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Nitrate + Nitrite as N	0.09	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sulfate	8.17	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Calcium	1.31	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Magnesium	3.75	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Potassium	0.32	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sodium	6.92	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	12.32	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion Sum	12.67	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion-Anion Balance	1.43	0.01		%	10/16/2013 1109 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/10/2013 1552 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 1358 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 1358 MS	EPA 200.8
Boron	0.2	0.1		mg/L	10/10/2013 1552 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 1358 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/10/2013 1552 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 1358 MS	EPA 200.8
Iron	ND	0.05		mg/L	10/10/2013 1552 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 1358 MS	EPA 200.8
Manganese	ND	0.02		mg/L	10/10/2013 1552 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/11/2013 1231 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/10/2013 1358 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/10/2013 1552 DG	EPA 200.7
Selenium	0.006	0.005		mg/L	10/10/2013 1358 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/10/2013 1552 DG	EPA 200.7
Total Metals						
Iron	2.24	0.05		mg/L	10/14/2013 1822 DG	EPA 200.7
Manganese	0.16	0.02		mg/L	10/14/2013 1822 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-001
Client Sample ID: SM578513-AL-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 9:50:00 AM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.95			s.u.	10/09/2013 0950	Field
Conductivity	4870			µmhos/cm	10/09/2013 0950	Field
Turbidity	2.05			NTU	10/09/2013 0950	Field
Temperature	12.3			°C	10/09/2013 0950	Field
Static Water Level	9.51			ft	10/09/2013 0950	Field
General Parameters						
pH	8.0	0.1		s.u.	10/11/2013 1915 KV	SM 4500 H B
Electrical Conductivity	4800	5		µmhos/cm	10/11/2013 1915 KV	SM 2510B
Total Dissolved Solids (180)	4530	10		mg/L	10/10/2013 1113 EC	SM 2540
Solids, Total Dissolved (Calc)	4500	10		mg/L	10/16/2013 1109 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	636	5		mg/L	10/11/2013 1915 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2340	1		mg/L	10/16/2013 1109 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	10/14/2013 1145 RH	EPA 350.1
'ium Adsorption Ratio	4.3	0.1			10/16/2013 1109 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	776	5		mg/L	10/11/2013 1915 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	10/11/2013 1915 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	10/11/2013 1915 KV	SM 2320B
Chloride	22	1		mg/L	10/10/2013 1556 AMB	EPA 300.0
Fluoride	0.9	0.1		mg/L	10/11/2013 1915 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	10/15/2013 1239 RH	EPA 353.2
Sulfate	2910	1		mg/L	10/10/2013 1556 AMB	EPA 300.0
Cations						
Calcium	275	1		mg/L	10/10/2013 1550 DG	EPA 200.7
Magnesium	401	1		mg/L	10/10/2013 1550 DG	EPA 200.7
Potassium	33	1		mg/L	10/10/2013 1550 DG	EPA 200.7
Sodium	474	1		mg/L	10/10/2013 1550 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14,2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Addendum D6-10-52

DEQ 6-402

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 10/17/2013
Report ID: S1310156001

Project: Ramaco
Lab ID: S1310156-001
Client Sample ID: SM578513-AL-1
COC: 150183

Work Order: S1310156
Collection Date: 10/9/2013 9:50:00 AM
Date Received: 10/10/2013 8:06:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.71	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Chloride	0.62	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Fluoride	0.04	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sulfate	60.54	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Calcium	13.73	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Magnesium	33.03	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Potassium	0.84	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Sodium	20.63	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	68.24	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion Sum	73.93	0.01		meq/L	10/16/2013 1109 JJ	SM 1030E
ion-Anion Balance	4.00	0.01		%	10/16/2013 1109 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	10/10/2013 1550 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	10/10/2013 1352 MS	EPA 200.8
Barium	ND	0.1		mg/L	10/10/2013 1352 MS	EPA 200.8
Boron	0.4	0.1		mg/L	10/10/2013 1550 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	10/10/2013 1352 MS	EPA 200.8
Chromium	ND	0.01		mg/L	10/10/2013 1550 DG	EPA 200.7
Copper	ND	0.01		mg/L	10/10/2013 1352 MS	EPA 200.8
Iron	ND	0.05		mg/L	10/10/2013 1550 DG	EPA 200.7
Lead	ND	0.02		mg/L	10/10/2013 1352 MS	EPA 200.8
Manganese	0.37	0.02		mg/L	10/10/2013 1550 DG	EPA 200.7
Mercury	ND	0.001		mg/L	10/11/2013 1229 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	10/10/2013 1352 MS	EPA 200.8
Nickel	ND	0.01		mg/L	10/10/2013 1550 DG	EPA 200.7
Selenium	ND	0.005		mg/L	10/10/2013 1352 MS	EPA 200.8
Zinc	ND	0.01		mg/L	10/10/2013 1550 DG	EPA 200.7
Total Metals						
Iron	0.10	0.05		mg/L	10/14/2013 1813 DG	EPA 200.7
Manganese	0.62	0.02		mg/L	10/14/2013 1813 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Inter-Mountain Labs

Sheridan, WY and Gillette, WY

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10182

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC / RAMACO	RAMACO	Rod Fuller	

Report Address	Contact Name	Email	Phone
WWC	Jeff Barron		

Invoice Address	Purchase Order #	Quote #
WWC		439

ANALYSES / PARAMETERS: Quote # 439

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers	Quote # 439	REMARKS
1		10/2/13	1250	578511-CRN-1	WT	4	✓	
2				pH = 8.33, EC = 3280, T = 16.8, TUR = 86.7, SWL = 119.53'				
3		10/2/13	1340	578511-MST-1	WT	4	✓	
4				pH = 8.57, EC = 2300, T = 17.6, TUR = 35.0, SWL = 150.10'				
5		10/2/13	1530	578513-MST-1	WT	4	✓	
6				pH = 7.51, EC = 4110, T = 14.6, TUR = 9.82, SWL = 108.20'				
7		10/2/13	1720	578512-AL-1	WT	4	✓	
8				pH = 8.02, EC = 5180, T = 13.4, TUR = 3.51, SWL = 4.03'				
9								
10								
11								
12								
13								
14								

TFN 6 2/025
RECD NOV 14, 201

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
AC	Rod Fuller	10/3/13	0827		10/3/13	8:28

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION		ADDITIONAL REMARKS
☐ UPS	Water	WT	Check desired service	Compliance Monitoring?	Y / N	
☐ Fed Express	Soil	SL	☐ Standard turnaround	Program (SDWA, NPDES,...)		
☐ US Mail	Solid	SD	☐ RUSH - 5 Working Days	PWSID / Permit #		
☐ Hand Carried	Filter	FT	☐ URGENT - < 2 Working Days	Chlorinated?	Y / N	
☐ Other _____	Other	OT	Rush & Urgent Surcharges will be applied	Sample Disposal: Lab	Client	

October 2014

RAMACO

Addendum D6-10-55

Brook Mine

TFN 6 2/025

DEAD NOV 14 2014

Inter-Mountain Labs
Sheridan, WY and Gillette, WY

CHAIN OF CUSTODY RECORD

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Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC	Ramaco	Rod Fuller	

Report Address	Contact Name	Email	Phone
WWC	Jeff Barron - WWC		

Invoice Address	Purchase Order #	Quote #
WWC		439

ANALYSES / PARAMETERS

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers	Quote # 439	REMARKS
1		10/9/13	0950	SM578513-AL-1	WT	4	✓	
2				pH = 7.85, EC = 4870, T = 12.3, TUR = 2.05, SWL = 9.51'				
3		10/9/13	1040	SM578418-AL-1	WT	4	✓	
4				pH = 8.72, EC = 1179, T = 12.3, TUR = 257, SWL = 20.65'				
5		10/9/13	1325	SM578417-CRN-1	WT	4	✓	
6				pH = 8.16, EC = 1421, T = 14.6, TUR = 302, SWL = 133.05'				
7		10/9/13	1500	SM578408-MST-1	WT	4	✓	
8				pH = 7.38, EC = 2380, T = 13.7, TUR = 552, SWL = 104.49				
9		10/9/13	1540	SM578408-CRN-1	WT	4	✓	
10				pH = 7.79, EC = 2440, T = 13.3, TUR = 370, SWL = 87.66'				
11		10/9/13	1730	SM578409-MST-1	WT	4		
12				pH = 8.49, EC = 2450, T = 13.9, TUR = 78.1, SWL = 101.18				
13								
14								

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
3.5 C	Rod Fuller	10/10/13	0852	Kathy Dap	10.10.13	3:0[illegible]

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION		ADDITIONAL REMARKS
☐ UPS	Water	WT	**Check desired service**	Compliance Monitoring?	Y / N	
☐ Fed Express	Soil	SL	☒ Standard turnaround	Program (SDWA, NPDES,...)		
☐ US Mail	Solid	SD	☐ **RUSH - 5 Working Days**	PWSID / Permit #		
☐ Hand Carried	Filter	FT	☐ **URGENT** - < 2 Working Days	Chlorinated?	Y / N	
☐ Other _____	Other	OT	***Rush & Urgent Surcharges will be applied***	Sample Disposal: Lab	Client	

October 2014

RAMACO

Addendum D6-10-56

Brook Mine

Inter-Mountain Labs
Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

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1960

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC	Ramaco	Ed Fuller	

Report Address	Contact Name	Email	Phone
	Jeff Barron - WWC		

Invoice Address

Purchase Order # | Quote # 439

ANALYSES / PARAMETERS

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers		REMARKS
1		10/10/13	0935	SM578409-CRN-OB-1	WT	4	✓	
2				pH = 8.04, EC = 1977, T = 10.3, TUR = 91.9, SWL = 85.99'				
3		10/10/13	1030	SM578409-UBN-1	WT	4	✓	
4				pH = 8.74, EC = 4110, T = 10.9, TUR = 4.61, SWL = 108.44'				
5								
6								
7								
8								
9								
10								
11								
12								
13								
14								

TFN 6 2/025
REC'D NOV 14, 2014

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
	Ed Fuller	10/13	1200	Kathy Bolt	10.10.13	12:00

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION	ADDITIONAL REMARKS
☐ UPS	Water	WT	Standard turnaround	Compliance Monitoring?	
☐ Fed Express	Soil	SL	RUSH - 5 Working Days	Program (SDWA, NPDES,...)	
☐ US Mail	Solid	SD	URGENT - < 2 Working Days	PWSID / Permit #	
☐ Hand Carried	Filter	FT		Chlorinated?	
☐ Other _____	Other	OT	*Rush & Urgent Surcharges will be applied*	Sample Disposal: Lab ☐ Client ☐	

October 2014

RAMACO

Addendum D6-10-57

Brook Mine

Inter-Mountain Labs
Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

Page of

All shaded fields m[illegible]e completed.
This is a legal document: any misrepresentation may be construed as fraud.

1[illegible]1965

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
wwc	Ramaco	[illegible]	

Report Address	Contact Name	Email	Phone	Purchase Order #	Quote #
wwc	Jeff Ramaco wwc				457

Invoice Address
wwc

ANALYSES / PARAMETERS

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers	REMARKS
1		10/31/13	1240	SM578415-MST/CRN-1 WT		4	
2				pH = 8.56, EC = 2590, T = 12.8, TUR = 330, SWL = 122.85'			
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							

TEN 5 2/025
RECD NOV 14, 2014

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
	[illegible]			[illegible]	10-31-13	1430

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION	ADDITIONAL REMARKS
☐ UPS	Water	(WT)		Compliance Monitoring?	
☐ Fed Express	Soil	SL	Standard turnaround	Program (SDWA, NPDES,...)	
☐ US Mail	Solid	SD	RUSH - 5 Working Days	PWSID / Permit #	
☐ Hand Carried	Filter	FT	URGENT - < 2 Working Days	Chlorinated?	
☐ Other _____	Other	OT	*Rush & Urgent Surcharges will be applied*	Sample Disposal: Lab Client	

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578408-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578408-CRN-1 Date Sampled 12 / 15 / 13 Time 1420 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 98.27 ft below MP Depth to Water (below MP) 87.70 ft Casing Diameter 2 in

Date 12 / 15 / 13 Time 1343 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 96 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no)

and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1410	6.88	2640	10.4	217	↓	150 mL/30 sec.
1420	6.88	2650	10.4	355	≈ 3.0	↓

Pumping Start Time 1355 WL _____ Pumping End Time _____ WL _____

Comments: water turbid - no odor

HCF

COC# 150196

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578408-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578408-MST-1 Date Sampled 12/15/13 Time 1600 am (pm)

Describe Sampling Point GW monitoring Well

Well Depth 120.20 ft below MP Depth to Water (below MP) 105.89 ft Casing Diameter 2 in

Date 12/15/13 Time 1430 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 115 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1450	6.56	2410	10.2	537	↓	150 ml/30sec
1500	6.53	2430	10.3	518	≥ 3.0	↓

Pumping Start Time 1435 WL _____ Pumping End Time _____ WL _____

Comments: Water turbid - no odor

HCF

COC # 150196

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

X No Sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578409-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 110.55 ft below MP Depth to Water (below MP) 90.72 ft Casing Diameter _____ in

Date 12/15/13 Time 1230 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No Sample - GW only

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578409-CRM-OB-1 Project Ramaco

Location _____ W.O.# _____

Sample ID# 578409-CRM-OB-1 Date Sampled 12/15/13 Time 1320 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 111.33 ft below MP Depth to Water (below MP) 90.76 ft Casing Diameter 5 in

Date 12/15/13 Time 12:52 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow)) Tap Bailer _____

Pump intake or bailer set at 105 ft below MP.

Tubing (type: Plastic). (New or previously used) was used to collect all samples (yes or no) and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1310	7.23	2370	10.3	10.15	↓	150 mL / 30 sec
1320	7.25	2390	10.2	15.13	≥ 3.0	~~↓~~ ↓

Pumping Start Time 1255 WL _____ Pumping End Time _____ WL _____

Comments: water clear - no odor

2 LCF

COC # 150196

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578409-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578409-MST-1 Date Sampled 12/15/13 Time 1245 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 122.83 ft below MP Depth to Water (below MP) 101.10 ft Casing Diameter 5 in

Date 12/15/13 Time 1215 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 115 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no)

and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1235	7.70	2480	10.7	2.56	↓	150 ML/30 SEC
1245	7.70	2470	10.7	1.45	≈ 3.0	↓

Pumping Start Time 1220 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF

COC# 150196

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no Sample

WWC ENGINEERING

Brook Mine

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Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578409-MST-OB-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 123.80 ft below MP Depth to Water (below MP) 101.73 ft Casing Diameter 5 in

Date 12/19/13 Time ~~1220~~ 1320 am/pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no - sample - water level only

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

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SAMPLING INFORMATION

Sampling Point 578409-UBN-1 Project Ramaco

Location _____ W.O.# _____

Sample ID# 578409-UBN-1 Date Sampled 12 / 15 / 13 Time 1200 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 141.20 ft below MP Depth to Water (below MP) 110.20 ft Casing Diameter 5 in

Date 12 / 15 / 13 Time 1125 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 135 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (umhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1150	7.63	4220	11.6	5.50	↓	150 mL/30 sec
1200	7.76	4220	11.4	3.62	3.0	↓

Pumping Start Time 1135 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF

COC # 150196

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578415-MST/CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578415-MST/CRN-1 Date Sampled 12/15/13 Time 1045 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 143.70 ft below MP Depth to Water (below MP) 122.68 ft Casing Diameter 5 in

Date 12/15/13 Time 1010 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow)) Tap Bailer _____

Pump intake or bailer set at 138 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1035	7.63	2520	10.7	+1000	↓	150 ml/30 sec.
1045	7.68	1952	10.5	225	3.0	↓

Pumping Start Time 1020 WL — Pumping End Time _____ WL _____

Comments: Water turbid - no odor

HCF

COC# 150196

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578417-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-67

Sample ID# 578417-CRN-1 Date Sampled 12 / 15 / 13 Time 1600 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 142.41 ft below MP Depth to Water (below MP) 133.31 ft Casing Diameter 2 in

Date 12 / 15 / 13 Time 1525 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 130 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1545	7.33	1491	10.0	653	↓	150 mL/30 sec
1600	7.39	1483	9.9	615	3.0	↓

Pumping Start Time 1530 WL _____ Pumping End Time _____ WL _____

Comments: Water turbid - no odor

HCF

TFN 6 2/025
RECD NOV 14, 2014

COC# 150196

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

*no sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578417-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 163.82 ft below MP Depth to Water (below MP) 160.47 ft Casing Diameter 2 in

Date 12/15/13 Time 1532 am (pm) Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

Sampling method Submersible pump (Bladder pump (low flow)) Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

STATIC WATER LEVEL OF ASSOCIATED WELLS

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no sample - not enough water to sample. - water level only

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578418-AL-1 Project Ramaco

Location _____ W.O.# _____

Sample ID# 578418-AL-1 Date Sampled 12 / 16 / 13 Time 1505 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 24.50 ft below MP Depth to Water (below MP) 20.78 ft Casing Diameter 5 in

Date 12 / 16 / 13 Time 1436 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 22 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1455	7.62	3050	9.9	64.4	↓	150mL/30sec
1505	7.67	3050	9.6	38.2	3.0	↓

Pumping Start Time 1440 WL _____ Pumping End Time _____ WL _____

Comments: water turbid - no odor

HCF

COC# 150197

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578418-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 153.79 ft below MP Depth to Water (below MP) 146.55 ft Casing Diameter 5 in

Date 12 / 18 / 13 Time 1340 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

STATIC WATER LEVEL OF ASSOCIATED WELLS

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no sample - not enough water to sample - Site has not been reclaimed yet

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO * no sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578418-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 185.75 ft below MP Depth to Water (below MP) 184.45 ft Casing Diameter 5 in

Date 12 / 18 / 13 Time 1345 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no sample - not enough water to sample - site has not been reclaimed yet, and the well shelter has not been set yet.

Form completed by: Rod Fuller Witnessed by: _____

TFN 6 2/025
RECD NOV 14, 2014

RAMACO

X no sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578510 - CRM-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point _____

Well Depth 92.74 ft below MP Depth to Water (below MP) 92.68 ft Casing Diameter 5 in

Date 12/18/13 Time 1130 (am) pm Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no sample - not enough water to sample - Site has not been reclaimed yet

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578510-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 147.24 ft below MP Depth to Water (below MP) 146.12 ft Casing Diameter 5 in

Date 12 / 18 / 13 Time 1125 (am) pm Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample - site has not been reclaimed yet

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578511-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578511-CRN-1 Date Sampled 12/16/13 Time 0940 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 128.92 ft below MP Depth to Water (below MP) 119.63 ft Casing Diameter 5 in

Date 12/16/13 Time 0900 (am) pm Casing Volume _____ gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 125 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
0930	7.31	3830	10.4	124	↓	150ML/30 Sec
0940	7.41	3800	10.0	72.6	≈3.0	↓

Pumping Start Time 0915 WL _____ Pumping End Time _____ WL _____

Comments: water turbid - no odor

HCF

COC# 150197

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578511-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578511-MST-1 Date Sampled 12 / 16 / 13 Time 1035 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 158.00 ft below MP Depth to Water (below MP) 150.12 ft Casing Diameter 5 in

Date 12 / 16 / 13 Time 9:52 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 155 ft below MP.

STATIC WATER LEVEL OF ASSOCIATED WELLS

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1025	7.65	3700	8.6	18.56	↓	150mL/30sec
1035	7.52	4180	9.9	171	≈ 3.0	↓

Pumping Start Time 1010 WL _____ Pumping End Time _____ WL _____

Comments: water was clear but turned turbid - no odor - almost not enough water to sample.

HCF - COC# 150197

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578512-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578512-AL-1 Date Sampled 12/16/13 Time 1300 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 21.2 ft below MP Depth to Water (below MP) 3.81 ft Casing Diameter 5 in

Date 12/16/13 Time 1227 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 15 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1250	7.19	5460	10.7	23.8	↓	150 ml/30sec
1300	7.22	5460	10.5	20.0	≈3.0	↓

Pumping Start Time 1235 WL _____ Pumping End Time _____ WL _____

Comments: Water slightly turbid - no odor

HCF

COC# 150197

TFN 6 2/025
RECD NOV 14.2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

*no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578512-CRM-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 49.85 ft below MP Depth to Water (below MP) Dry ft Casing Diameter 5 in

Date 12 / 18 / 13 Time 1240 am (pm) Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no sample - well dry

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

*no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578512-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 114.96 ft below MP Depth to Water (below MP) 111.92 ft Casing Diameter _____ in

Date 12/18/2013 Time 1250 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578513-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578513-AL-1 Date Sampled 12 / 16 / 13 Time 1415 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 30.77 ft below MP Depth to Water (below MP) 9.36 ft Casing Diameter 5 in

Date 12 / 16 / 13 Time 1:42 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 18 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no).

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1405	7.13	5150	10.5	2.05	↓	150 ML / 30 sec
1415	7.18	5130	10.2	0.57	≥3.0	↓

Pumping Start Time 1350 WL _____ Pumping End Time _____ WL _____

Comments: Water Clear - no odor

LCF

COC # 150197

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578513-CRN-1 Project Ramaco

Location _____ W.O.# 2012139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point _____

Well Depth 117.28 ft below MP Depth to Water (below MP) 117.05 ft Casing Diameter 5 in

Date 12/16/13 Time 1430 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no sample - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point 578513-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578513-MST-1 Date Sampled 12 / 16 / 13 Time 1200 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 144.00 ft below MP Depth to Water (below MP) 108.54 ft Casing Diameter 5 in

Date 12 / 16 / 13 Time 1125 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 140 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1150	6.71	4210	10.9	29.1	↓	150 mL/30sec.
1200	6.77	4230	10.6	2.96	≈3.0	↓

Pumping Start Time 1135 WL _____ Pumping End Time _____ WL _____

Comments: water clear - no odor

LCF

COC # 150197

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-005
Client Sample ID: 578408-CRN-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 2:20:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	6.88			s.u.	12/15/2013 1420	Field
Conductivity	2650			µmhos/cm	12/15/2013 1420	Field
Turbidity	355			NTU	12/15/2013 1420	Field
Temperature	10.4			°C	12/15/2013 1420	Field
Static Water Level	87.70			ft	12/15/2013 1420	Field
General Parameters						
pH	7.9	0.1		s.u.	12/17/2013 2153 KV	SM 4500 H B
Electrical Conductivity	2470	5		µmhos/cm	12/17/2013 2153 KV	SM 2510B
Total Dissolved Solids (180)	2000	10		mg/L	12/16/2013 1208 EC	SM 2540
Solids, Total Dissolved (Calc)	1830	10		mg/L	12/20/2013 1056 BC	SM 1030E
Alkalinity, Total (As CaCO3)	584	5		mg/L	12/17/2013 2153 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1380	1		mg/L	12/20/2013 1056 BC	SM 2340B
Nitrogen, Ammonia (As N)	0.2	0.1		mg/L	12/23/2013 1456 RH	EPA 350.1
dium Adsorption Ratio	0.9	0.1			12/20/2013 1056 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	712	5		mg/L	12/17/2013 2153 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2153 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2153 KV	SM 2320B
Chloride	9	1		mg/L	12/17/2013 2246 AMB	EPA 300.0
Fluoride	0.7	0.1		mg/L	12/17/2013 2153 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1107 RH	EPA 353.2
Sulfate	963	1		mg/L	12/17/2013 2246 AMB	EPA 300.0
Cations						
Calcium	173	1		mg/L	12/16/2013 1904 DG	EPA 200.7
Magnesium	232	1		mg/L	12/16/2013 1904 DG	EPA 200.7
Potassium	30	1		mg/L	12/16/2013 1904 DG	EPA 200.7
Sodium	79	1		mg/L	12/16/2013 1904 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-005
Client Sample ID: 578408-CRN-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 2:20:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	11.67	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Chloride	0.24	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Fluoride	0.03	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sulfate	20.04	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Calcium	8.61	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Magnesium	19.08	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Potassium	0.75	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sodium	3.42	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	31.87	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion Sum	31.99	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion-Anion Balance	0.19	0.01		%	12/20/2013 1056 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/16/2013 1904 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/16/2013 1454 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/16/2013 1454 MS	EPA 200.8
Boron	0.5	0.1		mg/L	12/16/2013 1904 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/16/2013 1454 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/16/2013 1904 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/16/2013 1454 MS	EPA 200.8
Iron	0.05	0.05		mg/L	12/16/2013 1904 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/16/2013 1454 MS	EPA 200.8
Manganese	0.64	0.02		mg/L	12/16/2013 1904 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/17/2013 1418 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/16/2013 1454 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/16/2013 1904 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/16/2013 1454 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/16/2013 1904 DG	EPA 200.7
Total Metals						
Iron	2.85	0.05		mg/L	12/18/2013 1942 DG	EPA 200.7
Manganese	0.81	0.02		mg/L	12/18/2013 1942 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-006
Client Sample ID: 578408-MST-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 3:00:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	6.53			s.u.	12/15/2013 1500	Field
Conductivity	2430			µmhos/cm	12/15/2013 1500	Field
Turbidity	518			NTU	12/15/2013 1500	Field
Temperature	10.3			°C	12/15/2013 1500	Field
Static Water Level	105.89			ft	12/15/2013 1500	Field
General Parameters						
pH	7.8	0.1		s.u.	12/17/2013 2204 KV	SM 4500 H B
Electrical Conductivity	2230	5		µmhos/cm	12/17/2013 2204 KV	SM 2510B
Total Dissolved Solids (180)	1690	10		mg/L	12/16/2013 1209 EC	SM 2540
Solids, Total Dissolved (Calc)	1610	10		mg/L	12/20/2013 1056 BC	SM 1030E
Alkalinity, Total (As CaCO3)	472	5		mg/L	12/17/2013 2204 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1040	1		mg/L	12/20/2013 1056 BC	SM 2340B
Nitrogen, Ammonia (As N)	4.2	0.1		mg/L	12/23/2013 1457 RH	EPA 350.1
[illegible]ium Adsorption Ratio	1.7	0.1			12/20/2013 1056 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	576	5		mg/L	12/17/2013 2204 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2204 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2204 KV	SM 2320B
Chloride	7	1		mg/L	12/17/2013 2259 AMB	EPA 300.0
Fluoride	0.5	0.1		mg/L	12/17/2013 2204 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1108 RH	EPA 353.2
Sulfate	858	1		mg/L	12/17/2013 2259 AMB	EPA 300.0
Cations						
Calcium	124	1		mg/L	12/16/2013 1917 DG	EPA 200.7
Magnesium	177	1		mg/L	12/16/2013 1917 DG	EPA 200.7
Potassium	30	1		mg/L	12/16/2013 1917 DG	EPA 200.7
Sodium	129	1		mg/L	12/16/2013 1917 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-006
Client Sample ID: 578408-MST-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 3:00:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.44	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Chloride	0.20	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Fluoride	0.02	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sulfate	17.85	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Calcium	6.17	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Magnesium	14.53	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Potassium	0.77	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sodium	5.59	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	27.07	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
[illegible]ion Sum	27.54	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
[illegible]ion-Anion Balance	0.85	0.01		%	12/20/2013 1056 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/16/2013 1917 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/16/2013 1459 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/16/2013 1459 MS	EPA 200.8
Boron	0.4	0.1		mg/L	12/16/2013 1917 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/16/2013 1459 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/16/2013 1917 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/16/2013 1459 MS	EPA 200.8
Iron	0.61	0.05		mg/L	12/16/2013 1917 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/16/2013 1459 MS	EPA 200.8
Manganese	0.29	0.02		mg/L	12/16/2013 1917 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/17/2013 1426 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/16/2013 1459 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/16/2013 1917 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/16/2013 1459 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/16/2013 1917 DG	EPA 200.7
Total Metals						
Iron	3.53	0.05		mg/L	12/18/2013 1944 DG	EPA 200.7
Manganese	0.36	0.02		mg/L	12/18/2013 1944 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-004
Client Sample ID: 578409-CRN-OB-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 1:20:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.25			s.u.	12/15/2013 1320	Field
Conductivity	2390			µmhos/cm	12/15/2013 1320	Field
Turbidity	15.13			NTU	12/15/2013 1320	Field
Temperature	10.2			°C	12/15/2013 1320	Field
Static Water Level	90.76			ft	12/15/2013 1320	Field
General Parameters						
pH	8.2	0.1		s.u.	12/17/2013 2130 KV	SM 4500 H B
Electrical Conductivity	2200	5		µmhos/cm	12/17/2013 2130 KV	SM 2510B
Total Dissolved Solids (180)	1560	10		mg/L	12/16/2013 1207 EC	SM 2540
Solids, Total Dissolved (Calc)	1540	10		mg/L	12/20/2013 1056 BC	SM 1030E
Alkalinity, Total (As CaCO3)	509	5		mg/L	12/17/2013 2130 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	730	1		mg/L	12/20/2013 1056 BC	SM 2340B
Nitrogen, Ammonia (As N)	4.2	0.1		mg/L	12/23/2013 1455 RH	EPA 350.1
'ium Adsorption Ratio	3.6	0.1			12/20/2013 1056 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	621	5		mg/L	12/17/2013 2130 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2130 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2130 KV	SM 2320B
Chloride	11	1		mg/L	12/17/2013 2232 AMB	EPA 300.0
Fluoride	0.6	0.1		mg/L	12/17/2013 2130 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1106 RH	EPA 353.2
Sulfate	753	1		mg/L	12/17/2013 2232 AMB	EPA 300.0
Cations						
Calcium	110	1		mg/L	12/16/2013 1859 DG	EPA 200.7
Magnesium	111	1		mg/L	12/16/2013 1859 DG	EPA 200.7
Potassium	22	1		mg/L	12/16/2013 1859 DG	EPA 200.7
Sodium	226	1		mg/L	12/16/2013 1859 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-004
Client Sample ID: 578409-CRN-OB-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 1:20:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	10.18	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Chloride	0.30	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Fluoride	0.03	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sulfate	15.67	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Calcium	5.49	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Magnesium	9.09	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Potassium	0.55	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sodium	9.83	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	24.97	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion Sum	26.19	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion-Anion Balance	2.38	0.01		%	12/20/2013 1056 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/16/2013 1859 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/16/2013 1448 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/16/2013 1448 MS	EPA 200.8
Boron	0.2	0.1		mg/L	12/16/2013 1859 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/16/2013 1448 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/16/2013 1859 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/16/2013 1448 MS	EPA 200.8
Iron	ND	0.05		mg/L	12/16/2013 1859 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/16/2013 1448 MS	EPA 200.8
Manganese	0.19	0.02		mg/L	12/16/2013 1859 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/17/2013 1409 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/16/2013 1448 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/16/2013 1859 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/16/2013 1448 MS	EPA 200.8
Zinc	0.01	0.01		mg/L	12/16/2013 1859 DG	EPA 200.7
Total Metals						
Iron	0.19	0.05		mg/L	12/18/2013 1939 DG	EPA 200.7
Manganese	0.23	0.02		mg/L	12/18/2013 1939 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-003
Client Sample ID: 578409-MST-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 12:45:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.70			s.u.	12/15/2013 1245	Field
Conductivity	2470			µmhos/cm	12/15/2013 1245	Field
Turbidity	1.45			NTU	12/15/2013 1245	Field
Temperature	10.7			°C	12/15/2013 1245	Field
Static Water Level	101.10			ft	12/15/2013 1245	Field
General Parameters						
pH	8.4	0.1		s.u.	12/17/2013 2116 KV	SM 4500 H B
Electrical Conductivity	2260	5		µmhos/cm	12/17/2013 2116 KV	SM 2510B
Total Dissolved Solids (180)	1510	10		mg/L	12/16/2013 1206 EC	SM 2540
Solids, Total Dissolved (Calc)	1430	10		mg/L	12/20/2013 1056 BC	SM 1030E
Alkalinity, Total (As CaCO3)	655	5		mg/L	12/17/2013 2116 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	91	1		mg/L	12/20/2013 1056 BC	SM 2340B
Nitrogen, Ammonia (As N)	4.0	0.1		mg/L	12/23/2013 1454 RH	EPA 350.1
ium Adsorption Ratio	22.0	0.1			12/20/2013 1056 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	773	5		mg/L	12/17/2013 2116 KV	SM 2320B
Alkalinity, Carbonate as CO3	12	5		mg/L	12/17/2013 2116 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2116 KV	SM 2320B
Chloride	9	1		mg/L	12/17/2013 2219 AMB	EPA 300.0
Fluoride	1.5	0.1		mg/L	12/17/2013 2116 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1058 RH	EPA 353.2
Sulfate	497	1		mg/L	12/17/2013 2219 AMB	EPA 300.0
Cations						
Calcium	16	1		mg/L	12/16/2013 1857 DG	EPA 200.7
Magnesium	12	1		mg/L	12/16/2013 1857 DG	EPA 200.7
Potassium	16	1		mg/L	12/16/2013 1857 DG	EPA 200.7
Sodium	484	1		mg/L	12/16/2013 1857 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-003
Client Sample ID: 578409-MST-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 12:45:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.67	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Carbonate as CO3	0.41	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Chloride	0.26	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Fluoride	0.07	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sulfate	10.35	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Calcium	0.80	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Magnesium	1.01	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Potassium	0.40	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sodium	21.06	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	23.29	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion Sum	23.78	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion-Anion Balance	1.04	0.01		%	12/20/2013 1056 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/16/2013 1857 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/16/2013 1443 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/16/2013 1443 MS	EPA 200.8
Boron	0.1	0.1		mg/L	12/16/2013 1857 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/16/2013 1443 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/16/2013 1857 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/16/2013 1443 MS	EPA 200.8
Iron	ND	0.05		mg/L	12/16/2013 1857 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/16/2013 1443 MS	EPA 200.8
Manganese	0.21	0.02		mg/L	12/16/2013 1857 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/17/2013 1407 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/16/2013 1443 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/16/2013 1857 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/16/2013 1443 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/16/2013 1857 DG	EPA 200.7
Total Metals						
Iron	0.06	0.05		mg/L	12/18/2013 1937 DG	EPA 200.7
Manganese	0.22	0.02		mg/L	12/18/2013 1937 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-002
Client Sample ID: 578409-UBN-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 12:00:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.76			s.u.	12/15/2013 1200	Field
Conductivity	4220			µmhos/cm	12/15/2013 1200	Field
Turbidity	3.62			NTU	12/15/2013 1200	Field
Temperature	11.4			°C	12/15/2013 1200	Field
Static Water Level	110.20			ft	12/15/2013 1200	Field
General Parameters						
pH	8.3	0.1		s.u.	12/17/2013 2104 KV	SM 4500 H B
Electrical Conductivity	4010	5		µmhos/cm	12/17/2013 2104 KV	SM 2510B
Total Dissolved Solids (180)	2820	10		mg/L	12/16/2013 1205 EC	SM 2540
Solids, Total Dissolved (Calc)	2850	10		mg/L	12/20/2013 1056 BC	SM 1030E
Alkalinity, Total (As CaCO3)	459	5		mg/L	12/17/2013 2104 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	395	1		mg/L	12/20/2013 1056 BC	SM 2340B
Nitrogen, Ammonia (As N)	0.7	0.1		mg/L	12/23/2013 1453 RH	EPA 350.1
'ium Adsorption Ratio	16.9	0.1			12/20/2013 1056 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	553	5		mg/L	12/17/2013 2104 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2104 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2104 KV	SM 2320B
Chloride	32	1		mg/L	12/17/2013 2206 AMB	EPA 300.0
Fluoride	1.0	0.1		mg/L	12/17/2013 2104 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	7.5	0.1		mg/L	12/19/2013 1057 RH	EPA 353.2
Sulfate	1600	1		mg/L	12/17/2013 2206 AMB	EPA 300.0
Cations						
Calcium	70	1		mg/L	12/16/2013 1855 DG	EPA 200.7
Magnesium	53	1		mg/L	12/16/2013 1855 DG	EPA 200.7
Potassium	14	1		mg/L	12/16/2013 1855 DG	EPA 200.7
Sodium	771	1		mg/L	12/16/2013 1855 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14,2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager

October 2014

Addendum D6-10-89

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-002
Client Sample ID: 578409-UBN-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 12:00:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.06	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Chloride	0.91	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Fluoride	0.05	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Nitrate + Nitrite as N	0.53	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sulfate	33.31	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Calcium	3.49	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Magnesium	4.39	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Potassium	0.35	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sodium	33.54	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	41.79	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion Sum	44.01	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion-Anion Balance	2.58	0.01		%	12/20/2013 1056 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/16/2013 1855 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/16/2013 1427 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/16/2013 1427 MS	EPA 200.8
Boron	0.3	0.1		mg/L	12/16/2013 1855 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/16/2013 1427 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/16/2013 1855 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/16/2013 1427 MS	EPA 200.8
Iron	ND	0.05		mg/L	12/16/2013 1855 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/16/2013 1427 MS	EPA 200.8
Manganese	0.16	0.02		mg/L	12/16/2013 1855 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/17/2013 1405 CS	EPA 245.1
Molybdenum	0.03	0.02		mg/L	12/16/2013 1427 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/16/2013 1855 DG	EPA 200.7
Selenium	0.010	0.005		mg/L	12/16/2013 1427 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/16/2013 1855 DG	EPA 200.7
Total Metals						
Iron	ND	0.05		mg/L	12/18/2013 1923 DG	EPA 200.7
Manganese	0.19	0.02		mg/L	12/18/2013 1923 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-001
Client Sample ID: 578415-MST/CRN-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 10:45:00 AM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.68			s.u.	12/15/2013 1045	Field
Conductivity	1952			µmhos/cm	12/15/2013 1045	Field
Turbidity	225			NTU	12/15/2013 1045	Field
Temperature	10.5			°C	12/15/2013 1045	Field
Static Water Level	122.68			ft	12/15/2013 1045	Field
General Parameters						
pH	8.4	0.1		s.u.	12/17/2013 2052 KV	SM 4500 H B
Electrical Conductivity	1950	5		µmhos/cm	12/17/2013 2052 KV	SM 2510B
Total Dissolved Solids (180)	1180	10		mg/L	12/16/2013 1204 EC	SM 2540
Solids, Total Dissolved (Calc)	1180	10		mg/L	12/20/2013 1056 BC	SM 1030E
Alkalinity, Total (As CaCO3)	707	5		mg/L	12/17/2013 2052 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	56	1		mg/L	12/20/2013 1056 BC	SM 2340B
Nitrogen, Ammonia (As N)	1.6	0.1		mg/L	12/23/2013 1452 RH	EPA 350.1
ium Adsorption Ratio	25.1	0.1			12/20/2013 1056 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	831	5		mg/L	12/17/2013 2052 KV	SM 2320B
Alkalinity, Carbonate as CO3	16	5		mg/L	12/17/2013 2052 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2052 KV	SM 2320B
Chloride	13	1		mg/L	12/17/2013 2152 AMB	EPA 300.0
Fluoride	1.9	0.1		mg/L	12/17/2013 2052 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1056 RH	EPA 353.2
Sulfate	280	1		mg/L	12/17/2013 2152 AMB	EPA 300.0
Cations						
Calcium	12	1		mg/L	12/16/2013 1852 DG	EPA 200.7
Magnesium	6	1		mg/L	12/16/2013 1852 DG	EPA 200.7
Potassium	10	1		mg/L	12/16/2013 1852 DG	EPA 200.7
Sodium	431	1		mg/L	12/16/2013 1852 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-91

DEQ 6-441

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Work Order: S1312200
Project: Ramaco
Collection Date: 12/15/2013 10:45:00 AM
Lab ID: S1312200-001
Date Received: 12/16/2013 8:16:00 AM
Client Sample ID: 578415-MST/CRN-1
Sampler: RF
COC: 150196
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.62	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Carbonate as CO3	0.52	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Chloride	0.36	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Fluoride	0.09	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sulfate	5.82	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Calcium	0.60	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Magnesium	0.51	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Potassium	0.25	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sodium	18.74	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	20.12	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion Sum	20.43	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
ion-Anion Balance	0.77	0.01		%	12/20/2013 1056 BC	SM 1030E
Dissolved Metals						
Aluminum	0.7	0.1		mg/L	12/16/2013 1852 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/16/2013 1406 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/16/2013 1406 MS	EPA 200.8
Boron	0.1	0.1		mg/L	12/16/2013 1852 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/16/2013 1406 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/16/2013 1852 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/16/2013 1406 MS	EPA 200.8
Iron	0.21	0.05		mg/L	12/16/2013 1852 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/16/2013 1406 MS	EPA 200.8
Manganese	0.10	0.02		mg/L	12/16/2013 1852 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/17/2013 1403 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/16/2013 1406 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/16/2013 1852 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/16/2013 1406 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/16/2013 1852 DG	EPA 200.7
Total Metals						
Iron	0.95	0.05		mg/L	12/18/2013 1919 DG	EPA 200.7
Manganese	0.17	0.02		mg/L	12/18/2013 1919 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-007
Client Sample ID: 578417-CRN-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 4:00:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.39			s.u.	12/15/2013 1600	Field
Conductivity	1483			µmhos/cm	12/15/2013 1600	Field
Turbidity	615			NTU	12/15/2013 1600	Field
Temperature	9.9			°C	12/15/2013 1600	Field
Static Water Level	133.31			ft	12/15/2013 1600	Field
General Parameters						
pH	8.3	0.1		s.u.	12/17/2013 2218 KV	SM 4500 H B
Electrical Conductivity	1450	5		µmhos/cm	12/17/2013 2218 KV	SM 2510B
Total Dissolved Solids (180)	880	10		mg/L	12/16/2013 1210 EC	SM 2540
Solids, Total Dissolved (Calc)	890	10		mg/L	12/20/2013 1056 BC	SM 1030E
Alkalinity, Total (As CaCO3)	508	5		mg/L	12/17/2013 2218 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	150	1		mg/L	12/20/2013 1056 BC	SM 2340B
Nitrogen, Ammonia (As N)	3.6	0.1		mg/L	12/23/2013 1458 RH	EPA 350.1
ium Adsorption Ratio	9.2	0.1			12/20/2013 1056 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	607	5		mg/L	12/17/2013 2218 KV	SM 2320B
Alkalinity, Carbonate as CO3	6	5		mg/L	12/17/2013 2218 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2218 KV	SM 2320B
Chloride	8	1		mg/L	12/17/2013 2312 AMB	EPA 300.0
Fluoride	1.9	0.1		mg/L	12/17/2013 2218 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1110 RH	EPA 353.2
Sulfate	255	1		mg/L	12/17/2013 2312 AMB	EPA 300.0
Cations						
Calcium	19	1		mg/L	12/16/2013 1920 DG	EPA 200.7
Magnesium	25	1		mg/L	12/16/2013 1920 DG	EPA 200.7
Potassium	17	1		mg/L	12/16/2013 1920 DG	EPA 200.7
Sodium	258	1		mg/L	12/16/2013 1920 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312200001

Project: Ramaco
Lab ID: S1312200-007
Client Sample ID: 578417-CRN-1
COC: 150196

Work Order: S1312200
Collection Date: 12/15/2013 4:00:00 PM
Date Received: 12/16/2013 8:16:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.95	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Carbonate as CO3	0.19	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Chloride	0.21	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Fluoride	0.09	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sulfate	5.30	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Calcium	0.92	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Magnesium	2.08	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Potassium	0.42	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Sodium	11.23	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	14.66	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
[illegible]ion Sum	15.76	0.01		meq/L	12/20/2013 1056 BC	SM 1030E
[illegible]ion-Anion Balance	3.60	0.01		%	12/20/2013 1056 BC	SM 1030E
Dissolved Metals						
Aluminum	0.4	0.1		mg/L	12/16/2013 1920 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/16/2013 1504 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/16/2013 1504 MS	EPA 200.8
Boron	0.1	0.1		mg/L	12/16/2013 1920 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/16/2013 1504 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/16/2013 1920 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/16/2013 1504 MS	EPA 200.8
Iron	0.22	0.05		mg/L	12/16/2013 1920 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/16/2013 1504 MS	EPA 200.8
Manganese	0.06	0.02		mg/L	12/16/2013 1920 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/17/2013 1428 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/16/2013 1504 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/16/2013 1920 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/16/2013 1504 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/16/2013 1920 DG	EPA 200.7
Total Metals						
Iron	12.7	0.05		mg/L	12/18/2013 1946 DG	EPA 200.7
Manganese	0.18	0.02		mg/L	12/18/2013 1946 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-006
Client Sample ID: 578418-AL-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 3:05:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.67			s.u.	12/16/2013 1505	Field
Conductivity	3050			µmhos/cm	12/16/2013 1505	Field
Turbidity	38.2			NTU	12/16/2013 1505	Field
Temperature	9.6			°C	12/16/2013 1505	Field
Static Water Level	20.78			ft	12/16/2013 1505	Field
General Parameters						
pH	8.3	0.1		s.u.	12/18/2013 0007 KV	SM 4500 H B
Electrical Conductivity	2800	5		µmhos/cm	12/18/2013 0007 KV	SM 2510B
Total Dissolved Solids (180)	2220	10		mg/L	12/17/2013 1209 EC	SM 2540
Solids, Total Dissolved (Calc)	2080	10		mg/L	12/20/2013 0811 BC	SM 1030E
Alkalinity, Total (As CaCO3)	411	5		mg/L	12/18/2013 0007 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	909	1		mg/L	12/20/2013 0811 BC	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	12/23/2013 1510 RH	EPA 350.1
lium Adsorption Ratio	4.8	0.1			12/20/2013 0811 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	501	5		mg/L	12/18/2013 0007 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/18/2013 0007 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/18/2013 0007 KV	SM 2320B
Chloride	14	1		mg/L	12/18/2013 0233 AMB	EPA 300.0
Fluoride	1.2	0.1		mg/L	12/18/2013 0007 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	0.2	0.1		mg/L	12/19/2013 1117 RH	EPA 353.2
Sulfate	1200	1		mg/L	12/18/2013 0233 AMB	EPA 300.0
Cations						
Calcium	114	1		mg/L	12/17/2013 1533 DG	EPA 200.7
Magnesium	152	1		mg/L	12/17/2013 1533 DG	EPA 200.7
Potassium	22	1		mg/L	12/17/2013 1533 DG	EPA 200.7
Sodium	332	1		mg/L	12/17/2013 1533 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-006
Client Sample ID: 578418-AL-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 3:05:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	8.21	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Chloride	0.39	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Fluoride	0.06	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Nitrate + Nitrite as N	0.01	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sulfate	25.03	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Calcium	5.68	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Magnesium	12.49	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Potassium	0.57	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sodium	14.44	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	33.20	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion Sum	33.73	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion-Anion Balance	0.79	0.01		%	12/20/2013 0811 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/17/2013 1533 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/17/2013 1340 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/17/2013 1340 MS	EPA 200.8
Boron	0.3	0.1		mg/L	12/17/2013 1533 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/17/2013 1340 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/17/2013 1533 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/17/2013 1340 MS	EPA 200.8
Iron	ND	0.05		mg/L	12/17/2013 1533 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/17/2013 1340 MS	EPA 200.8
Manganese	0.03	0.02		mg/L	12/17/2013 1533 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/23/2013 0915 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/17/2013 1340 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/17/2013 1533 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/17/2013 1340 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/17/2013 1533 DG	EPA 200.7
Total Metals						
Iron	0.80	0.05		mg/L	12/20/2013 1255 DG	EPA 200.7
Manganese	0.07	0.02		mg/L	12/20/2013 1255 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-001
Client Sample ID: 578511-CRN-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 9:40:00 AM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.41			s.u.	12/16/2013 0940	Field
Conductivity	3800			µmhos/cm	12/16/2013 0940	Field
Turbidity	72.6			NTU	12/16/2013 0940	Field
Temperature	10.0			°C	12/16/2013 0940	Field
Static Water Level	119.63			ft	12/16/2013 0940	Field
General Parameters						
pH	8.2	0.1		s.u.	12/17/2013 2253 KV	SM 4500 H B
Electrical Conductivity	3570	5		µmhos/cm	12/17/2013 2253 KV	SM 2510B
Total Dissolved Solids (180)	2910	10		mg/L	12/17/2013 1204 EC	SM 2540
Solids, Total Dissolved (Calc)	2530	10		mg/L	12/20/2013 0811 BC	SM 1030E
Alkalinity, Total (As CaCO3)	678	5		mg/L	12/17/2013 2253 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	552	1		mg/L	12/20/2013 0811 BC	SM 2340B
Nitrogen, Ammonia (As N)	6.7	0.1		mg/L	12/23/2013 1459 RH	EPA 350.1
[illegible]lium Adsorption Ratio	11.6	0.1			12/20/2013 0811 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	827	5		mg/L	12/17/2013 2253 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2253 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2253 KV	SM 2320B
Chloride	26	1		mg/L	12/18/2013 0126 AMB	EPA 300.0
Fluoride	1.1	0.1		mg/L	12/17/2013 2253 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	1.7	0.1		mg/L	12/19/2013 1111 RH	EPA 353.2
Sulfate	1270	1		mg/L	12/18/2013 0126 AMB	EPA 300.0
Cations						
Calcium	79	1		mg/L	12/17/2013 1509 DG	EPA 200.7
Magnesium	86	1		mg/L	12/17/2013 1509 DG	EPA 200.7
Potassium	28	1		mg/L	12/17/2013 1509 DG	EPA 200.7
Sodium	625	1		mg/L	12/17/2013 1509 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Addendum D6-10-97

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-001
Client Sample ID: 578511-CRN-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 9:40:00 AM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.56	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Chloride	0.74	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Fluoride	0.05	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Nitrate + Nitrite as N	0.12	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sulfate	26.50	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Calcium	3.92	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Magnesium	7.11	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Potassium	0.71	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sodium	27.17	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	38.92	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion Sum	40.99	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion-Anion Balance	2.58	0.01		%	12/20/2013 0811 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/17/2013 1509 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/17/2013 1247 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/17/2013 1247 MS	EPA 200.8
Boron	0.2	0.1		mg/L	12/17/2013 1509 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/17/2013 1247 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/17/2013 1509 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/17/2013 1247 MS	EPA 200.8
Iron	ND	0.05		mg/L	12/17/2013 1509 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/17/2013 1247 MS	EPA 200.8
Manganese	0.48	0.02		mg/L	12/17/2013 1509 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/23/2013 0855 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/17/2013 1247 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/17/2013 1509 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/17/2013 1247 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/17/2013 1509 DG	EPA 200.7
Total Metals						
Iron	1.03	0.05		mg/L	12/20/2013 1230 DG	EPA 200.7
Manganese	0.66	0.02		mg/L	12/20/2013 1230 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-002
Client Sample ID: 578511-MST-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 10:35:00 AM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.52			s.u.	12/16/2013 1035	Field
Conductivity	4180			µmhos/cm	12/16/2013 1035	Field
Turbidity	171			NTU	12/16/2013 1035	Field
Temperature	9.9			°C	12/16/2013 1035	Field
Static Water Level	150.12			ft	12/16/2013 1035	Field
General Parameters						
pH	8.3	0.1		s.u.	12/17/2013 2307 KV	SM 4500 H B
Electrical Conductivity	3970	5		µmhos/cm	12/17/2013 2307 KV	SM 2510B
Total Dissolved Solids (180)	2740	10		mg/L	12/17/2013 1205 EC	SM 2540
Solids, Total Dissolved (Calc)	2790	10		mg/L	12/20/2013 0811 BC	SM 1030E
Alkalinity, Total (As CaCO3)	1230	5		mg/L	12/17/2013 2307 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	506	1		mg/L	12/20/2013 0811 BC	SM 2340B
Nitrogen, Ammonia (As N)	6.9	0.1		mg/L	12/23/2013 1500 RH	EPA 350.1
tium Adsorption Ratio	15.3	0.1			12/20/2013 0811 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	1470	5		mg/L	12/17/2013 2307 KV	SM 2320B
Alkalinity, Carbonate as CO3	11	5		mg/L	12/17/2013 2307 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2307 KV	SM 2320B
Chloride	30	1		mg/L	12/18/2013 0139 AMB	EPA 300.0
Fluoride	1.1	0.1		mg/L	12/17/2013 2307 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1112 RH	EPA 353.2
Sulfate	1050	1		mg/L	12/18/2013 0139 AMB	EPA 300.0
Cations						
Calcium	74	1		mg/L	12/17/2013 1511 DG	EPA 200.7
Magnesium	78	1		mg/L	12/17/2013 1511 DG	EPA 200.7
Potassium	29	1		mg/L	12/17/2013 1511 DG	EPA 200.7
Sodium	793	1		mg/L	12/17/2013 1511 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-002
Client Sample ID: 578511-MST-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 10:35:00 AM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	24.17	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Carbonate as CO3	0.35	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Chloride	0.84	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Fluoride	0.05	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sulfate	21.82	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Calcium	3.71	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Magnesium	6.40	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Potassium	0.74	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sodium	34.47	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	45.33	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion Sum	47.25	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion-Anion Balance	2.06	0.01		%	12/20/2013 0811 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/17/2013 1511 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/17/2013 1308 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/17/2013 1308 MS	EPA 200.8
Boron	0.2	0.1		mg/L	12/17/2013 1511 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/17/2013 1308 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/17/2013 1511 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/17/2013 1308 MS	EPA 200.8
Iron	0.47	0.05		mg/L	12/17/2013 1511 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/17/2013 1308 MS	EPA 200.8
Manganese	0.23	0.02		mg/L	12/17/2013 1511 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/23/2013 0903 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/17/2013 1308 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/17/2013 1511 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/17/2013 1308 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/17/2013 1511 DG	EPA 200.7
Total Metals						
Iron	25.6	0.05		mg/L	12/20/2013 1232 DG	EPA 200.7
Manganese	0.68	0.02		mg/L	12/20/2013 1232 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-004
Client Sample ID: 578512-AL-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 1:00:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.22			s.u.	12/16/2013 1300	Field
Conductivity	5460			µmhos/cm	12/16/2013 1300	Field
Turbidity	20.0			NTU	12/16/2013 1300	Field
Temperature	10.5			°C	12/16/2013 1300	Field
Static Water Level	3.81			ft	12/16/2013 1300	Field
General Parameters						
pH	8.0	0.1		s.u.	12/17/2013 2330 KV	SM 4500 H B
Electrical Conductivity	5370	5		µmhos/cm	12/17/2013 2330 KV	SM 2510B
Total Dissolved Solids (180)	5150	10		mg/L	12/17/2013 1207 EC	SM 2540
Solids, Total Dissolved (Calc)	4780	10		mg/L	12/20/2013 0811 BC	SM 1030E
Alkalinity, Total (As CaCO3)	662	5		mg/L	12/17/2013 2330 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2560	1		mg/L	12/20/2013 0811 BC	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	12/23/2013 1508 RH	EPA 350.1
ium Adsorption Ratio	4.0	0.1			12/20/2013 0811 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	807	5		mg/L	12/17/2013 2330 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2330 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2330 KV	SM 2320B
Chloride	17	1		mg/L	12/18/2013 0206 AMB	EPA 300.0
Fluoride	1.0	0.1		mg/L	12/17/2013 2330 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1114 RH	EPA 353.2
Sulfate	3130	1		mg/L	12/18/2013 0206 AMB	EPA 300.0
Cations						
Calcium	322	1		mg/L	12/17/2013 1529 DG	EPA 200.7
Magnesium	427	1		mg/L	12/17/2013 1529 DG	EPA 200.7
Potassium	23	1		mg/L	12/17/2013 1529 DG	EPA 200.7
Sodium	465	1		mg/L	12/17/2013 1529 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14,2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-004
Client Sample ID: 578512-AL-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 1:00:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.23	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Chloride	0.48	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Fluoride	0.05	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sulfate	65.18	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Calcium	16.08	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Magnesium	35.12	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Potassium	0.57	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sodium	20.20	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	71.99	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion Sum	78.95	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion-Anion Balance	4.60	0.01		%	12/20/2013 0811 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/17/2013 1529 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/17/2013 1329 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/17/2013 1329 MS	EPA 200.8
Boron	0.4	0.1		mg/L	12/17/2013 1529 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/17/2013 1329 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/17/2013 1529 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/17/2013 1329 MS	EPA 200.8
Iron	0.92	0.05		mg/L	12/17/2013 1529 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/17/2013 1329 MS	EPA 200.8
Manganese	1.92	0.02		mg/L	12/17/2013 1529 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/23/2013 0907 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/17/2013 1329 MS	EPA 200.8
Nickel	0.01	0.01		mg/L	12/17/2013 1529 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/17/2013 1329 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/17/2013 1529 DG	EPA 200.7
Total Metals						
Iron	5.29	0.05		mg/L	12/20/2013 1246 DG	EPA 200.7
Manganese	2.69	0.02		mg/L	12/20/2013 1246 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-005
Client Sample ID: 578513-AL-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 2:15:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.18			s.u.	12/16/2013 1415	Field
Conductivity	5130			µmhos/cm	12/16/2013 1415	Field
Turbidity	0.57			NTU	12/16/2013 1415	Field
Temperature	10.2			°C	12/16/2013 1415	Field
Static Water Level	9.36			ft	12/16/2013 1415	Field
General Parameters						
pH	8.0	0.1		s.u.	12/17/2013 2343 KV	SM 4500 H B
Electrical Conductivity	4980	5		µmhos/cm	12/17/2013 2343 KV	SM 2510B
Total Dissolved Solids (180)	4790	10		mg/L	12/17/2013 1208 EC	SM 2540
Solids, Total Dissolved (Calc)	4290	10		mg/L	12/20/2013 0811 BC	SM 1030E
Alkalinity, Total (As CaCO3)	674	5		mg/L	12/17/2013 2343 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2240	1		mg/L	12/20/2013 0811 BC	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	12/23/2013 1509 RH	EPA 350.1
ium Adsorption Ratio	4.1	0.1			12/20/2013 0811 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	823	5		mg/L	12/17/2013 2343 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2343 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2343 KV	SM 2320B
Chloride	22	1		mg/L	12/18/2013 0220 AMB	EPA 300.0
Fluoride	0.8	0.1		mg/L	12/17/2013 2343 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1116 RH	EPA 353.2
Sulfate	2740	1		mg/L	12/18/2013 0220 AMB	EPA 300.0
Cations						
Calcium	267	1		mg/L	12/17/2013 1531 DG	EPA 200.7
Magnesium	383	1		mg/L	12/17/2013 1531 DG	EPA 200.7
Potassium	26	1		mg/L	12/17/2013 1531 DG	EPA 200.7
Sodium	448	1		mg/L	12/17/2013 1531 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-005
Client Sample ID: 578513-AL-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 2:15:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.48	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Chloride	0.60	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Fluoride	0.04	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sulfate	57.07	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Calcium	13.34	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Magnesium	31.53	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Potassium	0.67	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sodium	19.49	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	65.04	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion Sum	71.21	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion-Anion Balance	4.52	0.01		%	12/20/2013 0811 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/17/2013 1531 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/17/2013 1335 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/17/2013 1335 MS	EPA 200.8
Boron	0.4	0.1		mg/L	12/17/2013 1531 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/17/2013 1335 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/17/2013 1531 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/17/2013 1335 MS	EPA 200.8
Iron	ND	0.05		mg/L	12/17/2013 1531 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/17/2013 1335 MS	EPA 200.8
Manganese	0.35	0.02		mg/L	12/17/2013 1531 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/23/2013 0909 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/17/2013 1335 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/17/2013 1531 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/17/2013 1335 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/17/2013 1531 DG	EPA 200.7
Total Metals						
Iron	0.08	0.05		mg/L	12/20/2013 1253 DG	EPA 200.7
Manganese	0.47	0.02		mg/L	12/20/2013 1253 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-003
Client Sample ID: 578513-MST-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 12:00:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	6.77			s.u.	12/16/2013 1200	Field
Conductivity	4230			µmhos/cm	12/16/2013 1200	Field
Turbidity	2.96			NTU	12/16/2013 1200	Field
Temperature	10.6			°C	12/16/2013 1200	Field
Static Water Level	108.54			ft	12/16/2013 1200	Field
General Parameters						
pH	7.8	0.1		s.u.	12/17/2013 2319 KV	SM 4500 H B
Electrical Conductivity	4010	5		µmhos/cm	12/17/2013 2319 KV	SM 2510B
Total Dissolved Solids (180)	3120	10		mg/L	12/17/2013 1206 EC	SM 2540
Solids, Total Dissolved (Calc)	3080	10		mg/L	12/20/2013 0811 BC	SM 1030E
Alkalinity, Total (As CaCO3)	611	5		mg/L	12/17/2013 2319 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1030	1		mg/L	12/20/2013 0811 BC	SM 2340B
Nitrogen, Ammonia (As N)	9.1	0.1		mg/L	12/23/2013 1507 RH	EPA 350.1
ium Adsorption Ratio	7.9	0.1			12/20/2013 0811 BC	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	745	5		mg/L	12/17/2013 2319 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	12/17/2013 2319 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	12/17/2013 2319 KV	SM 2320B
Chloride	16	1		mg/L	12/18/2013 0153 AMB	EPA 300.0
Fluoride	0.7	0.1		mg/L	12/17/2013 2319 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	12/19/2013 1113 RH	EPA 353.2
Sulfate	1780	1		mg/L	12/18/2013 0153 AMB	EPA 300.0
Cations						
Calcium	124	1		mg/L	12/17/2013 1516 DG	EPA 200.7
Magnesium	175	1		mg/L	12/17/2013 1516 DG	EPA 200.7
Potassium	34	1		mg/L	12/17/2013 1516 DG	EPA 200.7
Sodium	586	1		mg/L	12/17/2013 1516 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 12/24/2013
Report ID: S1312211001

Project: Ramaco
Lab ID: S1312211-003
Client Sample ID: 578513-MST-1
COC: 150197

Work Order: S1312211
Collection Date: 12/16/2013 12:00:00 PM
Date Received: 12/16/2013 3:50:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.21	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Chloride	0.44	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Fluoride	0.03	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sulfate	37.10	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Calcium	6.19	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Magnesium	14.42	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Potassium	0.87	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Sodium	25.47	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
Cation / Anion Balance						
Cation Sum	46.96	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion Sum	49.79	0.01		meq/L	12/20/2013 0811 BC	SM 1030E
ion-Anion Balance	2.92	0.01		%	12/20/2013 0811 BC	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	12/17/2013 1516 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	12/17/2013 1324 MS	EPA 200.8
Barium	ND	0.1		mg/L	12/17/2013 1324 MS	EPA 200.8
Boron	0.3	0.1		mg/L	12/17/2013 1516 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	12/17/2013 1324 MS	EPA 200.8
Chromium	ND	0.01		mg/L	12/17/2013 1516 DG	EPA 200.7
Copper	ND	0.01		mg/L	12/17/2013 1324 MS	EPA 200.8
Iron	0.40	0.05		mg/L	12/17/2013 1516 DG	EPA 200.7
Lead	ND	0.02		mg/L	12/17/2013 1324 MS	EPA 200.8
Manganese	0.08	0.02		mg/L	12/17/2013 1516 DG	EPA 200.7
Mercury	ND	0.001		mg/L	12/23/2013 0905 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	12/17/2013 1324 MS	EPA 200.8
Nickel	ND	0.01		mg/L	12/17/2013 1516 DG	EPA 200.7
Selenium	ND	0.005		mg/L	12/17/2013 1324 MS	EPA 200.8
Zinc	ND	0.01		mg/L	12/17/2013 1516 DG	EPA 200.7
Total Metals						
Iron	0.51	0.05		mg/L	12/20/2013 1241 DG	EPA 200.7
Manganese	0.09	0.02		mg/L	12/20/2013 1241 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

October 2014

TFN 6 27025
RECD NOV 14, 2014 Addendum D6-10-107

RAMACO

Inter-Mountain Labs

Sheridan, WY and Gillette, WY

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Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC	RAMACO	Lod Fulkerson	

Report Address	Contact Name	Email	Phone
WWC	Jeff Barron - WWC		

Invoice Address	Purchase Order #	Quote #
WWC		439

ANALYSES / PARAMETERS

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME	SAMPLE IDENTIFICATION	Matrix	# of Containers	SEE H.T.	REMARKS
1		2/15/13	1045	578415-MST/CRN-1	WT	4	✓	
2				PH=7.68, EC=1952, T=10.5, TUR=225, SWL=122.68'				
3		2/15/13	1200	578409-UBN-1	WT	4	✓	
4				PH=7.76, EC=4220, T=11.4, TUR=3.62, SWL=110.20'				
5		2/15/13	1245	578409-MST-1	WT	4	✓	
6				PH=7.70, EC=2470, T=10.7, TUR=1.45, SWL=101.10'				
7		2/15/13	1320	578409-CRN-OB-1	WT	4	✓	
8				PH=7.25, EC=2390, T=10.2, TUR=15.13, SWL=90.76'				
9		2/15/13	1420	578408-CRN-1	WT	4	✓	
10				PH=6.88, EC=2650, T=10.4, TUR=355, SWL=87.70'				
11		2/15/13	1500	578408-MST-1	WT	4	✓	
12				PH=6.53, EC=2430, T=10.3, TUR=518, SWL=105.89				
13		2/15/13	1600	578417-CRN-1	WT	4	✓	
14				PH=7.39, EC=1483, T=9.9, TUR=615, SWL=				133.31'

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
1-4	Lod Fulkerson	12/16/13	0816	Kathy Boyd	12.16.13	8:16

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION	ADDITIONAL REMARKS
☐ UPS	Water	(WT)	Check desired service	Compliance Monitoring? Y / N	
☐ Fed Express	Soil	SL	☒ Standard turnaround	Program (SDWA, NPDES,...)	
☐ US Mail	Solid	SD	☐ RUSH - 5 Working Days	PWSID / Permit #	
☐ Hand Carried	Filter	FT	☐ URGENT - < 2 Working Days	Chlorinated? Y / N	
☐ Other _____	Other	OT	*Rush & Urgent Surcharges will be applied*	Sample Disposal: Lab Client	

DEQ 6-457

Inter-Mountain Labs
Sheridan, WY and Gillette, WY

CHAIN OF CUSTODY RECORD

Page of

All shaded fields must be completed.
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Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC	RAMACO	Rod Fuller	

Report Address	Contact Name	Email	Phone
WWC	Jeff Barron - WWC		

Invoice Address	Purchase Order #	Quote #
WWC		439

ANALYSES / PARAMETERS

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers	Grab #	REMARKS
1		12/16/13	0940	578511 - CRN - 1	WT	4	✓	
2				pH = 7.41, EC = 3800, T = 10.0, TUR = 72.6, SWL = 119.63'				
3		12/16/13	1035	578511 - MST - 1	WT	4		
4				pH = 7.52, EC = 4180, T = 9.9, TUR = 171, SWL = 150.12'				
5		12/16/13	1200	578513 - MST - 1	WT	4		
6				pH = 6.77, EC = 4230, T = 10.6, TUR = 2.96, SWL = 108.54'				
7		12/16/13	1300	578512 - AL - 1	WT	4		
8				pH = 7.22, EC = 5460 T = 10.5, TUR = 20.0, SWL = 3.81'				
9		12/16/13	1415	578513 - AL - 1	WT	4		
10				pH = 7.18, EC = 5130, T = 10.2, TUR = 0.57, SWL =				9.36'
11		12/16/13	1505	578418 - AL - 1	WT	4		
12				pH = 7.67, EC = 3050, T = 9.6, TUR = 38.2, SWL =				20.78'
13								
14								

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
2.7°C	Rod Fuller	12/16/13	1547	Tom Patton	12/16/13	15:50

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION		ADDITIONAL REMARKS
☐ UPS	Water	WT	Check desired service	Compliance Monitoring?	Y / N	
☐ Fed Express	Soil	SL	☑ Standard turnaround	Program (SDWA, NPDES,...)		
☐ US Mail	Solid	SD	☐ RUSH - 5 Working Days	PWSID / Permit #		
☐ Hand Carried	Filter	FT	☐ URGENT - < 2 Working Days	Chlorinated?	Y / N	
☐ Other _____	Other	OT	Rush & Urgent Surcharges will be applied	Sample Disposal: Lab	Client	

October 2014

TFN 6 2/025
RECD NOV 14, 2014
Addendum D6-10-108

RAMACO

BROOK MILLIC

DEQ 6-458

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SW1578408-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578408-CRN-1 Date Sampled 3/6/14 Time 0940 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 98.27 ft below MP Depth to Water (below MP) 87.70 ft Casing Diameter 2 in

Date 3/6/14 Time 0925 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at NA ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
0930	7.26	2600	9.4	66.0	↓	150 mL/30 sec
0940	7.22	2600	9.1	65.9	3.0	↓

Pumping Start Time 0915 WL _____ Pumping End Time _____ WL _____

Comments:

HCF

CCC# 151519

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578408-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled 3 / 6 / 14 Time 0855 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 120.26 ft below MP Depth to Water (below MP) 102.93 ft Casing Diameter 2 in

Date 3 / 6 / 14 Time 0822 (am) pm Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 115 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
0845	6.84	1976	9.5	45.6	↓	150mL/30sec
0855	6.87	1984	9.4	53.7	3.0	↓

Pumping Start Time 0830 WL _____ Pumping End Time _____ WL _____

Comments:

HCF

CCC# 151519

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fulker Witnessed by: _____

RAMACO

* No Sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SW578409-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 110.55 ft below MP Depth to Water (below MP) 90.71 ft Casing Diameter 5 in

Date 3/5/14 Time 1025 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: GW Sample

TEN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-CRN-OB-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578409-CRN-OB-1 Date Sampled 3/5/14 Time 1220 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 111.33 ft below MP Depth to Water (below MP) 70.78 ft Casing Diameter 5 in

Date 3/5/14 Time 1070 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 105 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1210	7.64	1956	12.4	3.30	↓	150mL/30sec
1220	7.62	1960	11.9	4.36	3.0	↓

Pumping Start Time 1155 WL _____ Pumping End Time _____ WL _____

Comments: LCF

CCC# 151518

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578409-MST-1 Date Sampled 3 / 5 / 14 Time 1135 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 122.83 ft below MP Depth to Water (below MP) 101.21 ft Casing Diameter 5 in

Date 3 / 5 / 14 Time 1035 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 115 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1125	8.05	2330	13.1	4.78	↓	150ML/30 sec.
1135	8.05	2310	12.8	1.86	3.0	↓

Pumping Start Time 1110 WL _____ Pumping End Time _____ WL _____

Comments:

LCF

CCC# 151518

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fulton Witnessed by: _____

RAMACO

* No sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM1578409-MST-OB-1 Project Ramaco

Location _____ W.O.# 203139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 123.80 ft below MP Depth to Water (below MP) 102.11 ft Casing Diameter 5 in

Date 3/5/14 Time 1030 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-UBN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578409-UBN-1 Date Sampled 3/5/14 Time 1050 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 141.20 ft below MP Depth to Water (below MP) 110.25 ft Casing Diameter 5 in

Date 3/5/14 Time 1015 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 135 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1040	8.03	3910	12.4	73.3	↓	150mL/30sec
1050	8.04	3920	12.9	59.7	3.0	↓

Pumping Start Time 1025 WL _____ Pumping End Time _____ WL _____

Comments:

HCF

CCC# 151518

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578415-MST/CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578415-MST/CRN-1 Date Sampled 3 / 5 / 14 Time 0930 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 143.70 ft below MP Depth to Water (below MP) 122.01 ft Casing Diameter 5 in

Date 3 / 5 / 14 Time 0855 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 135 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for N/A

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
0920	8.04	1746	10.6	11.21	↓	150 ml/30sec
0930	8.11	1936	10.5	8.38	~~3.0~~ 3.0	↓

Pumping Start Time 0905 WL _____ Pumping End Time _____ WL _____

Comments: LCF

COC# 151518

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578417-CRAL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578417-CRAL-1 Date Sampled 3/6/14 Time 1040 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 142.4 ft below MP Depth to Water (below MP) 133.13 ft Casing Diameter 2 in

Date 3/6/14 Time 1008 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 138 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1030	7.70	1363	9.5	956	↓	150 ML/30 sec
1040	7.76	1347	9.5	971	3.0	↓

Pumping Start Time 1015 WL _____ Pumping End Time _____ WL _____

Comments: HCF

COC# 151519

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578417-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point _____

Well Depth 163.82 ft below MP Depth to Water (below MP) 160.17 ft Casing Diameter 2 in

Date 3/6/14 Time 1045 (am) pm Casing Volume ---- gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578418-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point _____

Well Depth 24.50 ft below MP Depth to Water (below MP) 20.60 ft Casing Diameter 5 in

Date 3 / 4 / 14 Time 1520 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time 1525 WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample - Pumped for five minutes and ran out of water. Slow recovery

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No Sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578418-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 153.79 ft below MP Depth to Water (below MP) 146.64 ft Casing Diameter 5 in

Date 3/6/14 Time _____ am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No Sample - not enough water to sample - Site still needs reclaimed.

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578418-MST-1 Project Ramaco

Location _____ W.O.# 20131.39-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 185.75 ft below MP Depth to Water (below MP) / 84.43 ft Casing Diameter _____ in

Date 3/6/14 Time _____ am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample - well shelter still needs set and site still needs reclaimed.

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

× no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578510-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 92.74 ft below MP Depth to Water (below MP) Dry ft Casing Diameter _____ in

Date 3/6/14 Time _____ am pm Casing Volume _____ gal

STATIC WATER LEVEL OF ASSOCIATED WELLS

At least _____ bore volumes have been evacuated before sampling

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample - Dry - site still needs reclaimed

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578510-MST-1 Project Ramaco

Location _____ W.O.# 2013139-17

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 147.24 ft below MP Depth to Water (below MP) 146.31 ft Casing Diameter 5 in

Date 3/6/14 Time _____ am pm Casing Volume _____ gal

STATIC WATER LEVEL OF ASSOCIATED WELLS

At least _____ bore volumes have been evacuated before sampling

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample - Site still needs reclaimed

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578511-CRM-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578511-CRM-1 Date Sampled 3 / 4 / 14 Time 1030 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 128.92 ft below MP Depth to Water (below MP) 119.59 ft Casing Diameter 5 in

Date 3 / 4 / 14 Time 0905 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 125 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1020	7.66	3730	12.0	32.9	↓	150 mL/30 sec
1030	7.66	3690	12.3	28.3	≈ 3.0	↓

Pumping Start Time 1005 WL _____ Pumping End Time _____ WL _____

Comments: HCF, COC # 151517

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM5785II-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point _____

Well Depth 158 ft below MP Depth to Water (below MP) 150.08 ft Casing Diameter 5 in

Date 3/4/14 Time 1048 (am) pm Casing Volume NA gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample - pumped for ± 15 min. and ran out of water - slow recharge.

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578512-AL-1 Project Ramaco

Location _____ W.O.# 2013139-C7

Sample ID# 578512-AL-1 Date Sampled 3 / 4 / 14 Time 1355 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 21.21 ft below MP Depth to Water (below MP) 3.67 ft Casing Diameter 5 in

Date 3 / 4 / 14 Time 1325 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 15 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1345	7.50	5440	9.6	252	↓	150 mL/30 sec
1355	7.59	5370	9.6	173	≈ 3.0	↓

Pumping Start Time 1330 WL _____ Pumping End Time _____ WL _____

Comments: Water rust colored

HCF

COC# 151517

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No Sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578512-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 49.85 ft below MP Depth to Water (below MP) Dry ft Casing Diameter 5 in

Date 3/6/14 Time _____ am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No Sample - Dry

TEN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SMS78512-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring wells

Well Depth 114.96 ft below MP Depth to Water (below MP) 111.95 ft Casing Diameter 5 in

Date ___/___/___ Time _____ am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water # samples

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578513-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578513-AL-1 Date Sampled 3/4/14 Time 1450 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 20.77 ft below MP Depth to Water (below MP) 7.66 ft Casing Diameter 5 in

Date 3/4/14 Time 1420 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 15 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1440	7.54	4910	10.0	3.35	↓	150mL/30sec
1450	7.57	4900	9.9	0.93	≈ 3.0	↓

Pumping Start Time 1425 WL _____ Pumping End Time _____ WL _____

Comments:

LCF

COC# 151517

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no Sample

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point Sm 578513-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-01

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring Well

Well Depth 117.28 ft below MP Depth to Water (below MP) 116.90 ft Casing Diameter 5 in

Date 3/4/14 Time 1215 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578513-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578513-MST-1 Date Sampled 3 / 4 / 14 Time 1255 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 144 ft below MP Depth to Water (below MP) 108.82 ft Casing Diameter 5 in

Date 3 / 4 / 13 Time 1220 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 140 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1245	7.11	4080	10.9	4.02	↓	150ML/30 sec
1255	7.12	3920	10.7	2.06	≈3.0	↓

Pumping Start Time 1230 WL _____ Pumping End Time _____ WL _____

Comments: LCF, CCC# 151517

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/17/2014
Report ID: S1403082001

Project: Ramaco
Lab ID: S1403082-001
Client Sample ID: 578408-MST-1
COC: 151519

Work Order: S1403082
Collection Date: 3/6/2014 8:55:00 AM
Date Received: 3/6/2014 11:35:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	6.87			s.u.	03/06/2014 0855	Field
Conductivity	1984			µmhos/cm	03/06/2014 0855	Field
Turbidity	53.7			NTU	03/06/2014 0855	Field
Temperature	9.4			°C	03/06/2014 0855	Field
Static Water Level	102.93			ft	03/06/2014 0855	Field
General Parameters						
pH	7.6	0.1		s.u.	03/10/2014 1956 KV	SM 4500 H B
Electrical Conductivity	2120	5		µmhos/cm	03/10/2014 1956 KV	SM 2510B
Total Dissolved Solids (180)	1650	10		mg/L	03/07/2014 1312 EC	SM 2540
Solids, Total Dissolved (Calc)	1510	10		mg/L	03/13/2014 1443 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	496	5		mg/L	03/10/2014 1956 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1020	1		mg/L	03/13/2014 1443 JJ	SM 2340B
Nitrogen, Ammonia (As N)	5.4	0.1		mg/L	03/13/2014 0850 RH	EPA 350.1
[illegible]ium Adsorption Ratio	1.6	0.1			03/13/2014 1443 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	605	5		mg/L	03/10/2014 1956 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/10/2014 1956 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/10/2014 1956 KV	SM 2320B
Chloride	7	1		mg/L	03/10/2014 2149 AMB	EPA 300.0
Fluoride	0.5	0.1		mg/L	03/10/2014 1956 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/12/2014 0754 RH	EPA 353.2
Sulfate	767	1		mg/L	03/10/2014 2149 AMB	EPA 300.0
Cations						
Calcium	120	1		mg/L	03/07/2014 2005 DG	EPA 200.7
Magnesium	175	1		mg/L	03/07/2014 2005 DG	EPA 200.7
Potassium	28	1		mg/L	03/07/2014 2005 DG	EPA 200.7
Sodium	114	1		mg/L	03/07/2014 2005 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/17/2014
Report ID: S1403082001

Project: Ramaco
Lab ID: S1403082-001
Client Sample ID: 578408-MST-1
COC: 151519

Work Order: S1403082
Collection Date: 3/6/2014 8:55:00 AM
Date Received: 3/6/2014 11:35:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.91	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Chloride	0.18	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Fluoride	0.02	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Sulfate	15.96	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Calcium	5.98	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Magnesium	14.38	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Potassium	0.72	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Sodium	4.95	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	26.43	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
[illegible]ion Sum	26.09	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
[illegible]ion-Anion Balance	0.64	0.01		%	03/13/2014 1443 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	03/07/2014 2005 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 1500 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 1500 MS	EPA 200.8
Boron	0.4	0.1		mg/L	03/07/2014 2005 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 1500 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 2005 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 1500 MS	EPA 200.8
Iron	0.59	0.05		mg/L	03/07/2014 2005 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 1500 MS	EPA 200.8
Manganese	0.15	0.02		mg/L	03/07/2014 2005 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/14/2014 1034 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 1500 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 2005 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 1500 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 2005 DG	EPA 200.7
Total Metals						
Iron	1.41	0.05		mg/L	03/11/2014 1529 DG	EPA 200.7
Manganese	0.16	0.02		mg/L	03/11/2014 1529 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14,2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/17/2014
Report ID: S1403082001

Project: Ramaco
Lab ID: S1403082-002
Client Sample ID: 578408-CRN-1
COC: 151519

Work Order: S1403082
Collection Date: 3/6/2014 9:40:00 AM
Date Received: 3/6/2014 11:35:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.22			s.u.	03/06/2014 0940	Field
Conductivity	2600			µmhos/cm	03/06/2014 0940	Field
Turbidity	65.9			NTU	03/06/2014 0940	Field
Temperature	9.1			°C	03/06/2014 0940	Field
Static Water Level	87.70			ft	03/06/2014 0940	Field
General Parameters						
pH	7.9	0.1		s.u.	03/10/2014 2007 KV	SM 4500 H B
Electrical Conductivity	2480	5		µmhos/cm	03/10/2014 2007 KV	SM 2510B
Total Dissolved Solids (180)	2040	10		mg/L	03/07/2014 1313 EC	SM 2540
Solids, Total Dissolved (Calc)	1870	10		mg/L	03/13/2014 1443 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	605	5		mg/L	03/10/2014 2007 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1430	1		mg/L	03/13/2014 1443 JJ	SM 2340B
Nitrogen, Ammonia (As N)	0.4	0.1		mg/L	03/13/2014 0851 RH	EPA 350.1
lium Adsorption Ratio	0.9	0.1			03/13/2014 1443 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	738	5		mg/L	03/10/2014 2007 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/10/2014 2007 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/10/2014 2007 KV	SM 2320B
Chloride	8	1		mg/L	03/10/2014 2202 AMB	EPA 300.0
Fluoride	0.7	0.1		mg/L	03/10/2014 2007 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/12/2014 0755 RH	EPA 353.2
Sulfate	973	1		mg/L	03/10/2014 2202 AMB	EPA 300.0
Cations						
Calcium	177	1		mg/L	03/07/2014 2007 DG	EPA 200.7
Magnesium	240	1		mg/L	03/07/2014 2007 DG	EPA 200.7
Potassium	29	1		mg/L	03/07/2014 2007 DG	EPA 200.7
Sodium	82	1		mg/L	03/07/2014 2007 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/17/2014
Report ID: S1403082001

Project: Ramaco
Lab ID: S1403082-002
Client Sample ID: 578408-CRN-1
COC: 151519

Work Order: S1403082
Collection Date: 3/6/2014 9:40:00 AM
Date Received: 3/6/2014 11:35:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.10	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Chloride	0.23	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Sulfate	20.26	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Calcium	8.81	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Magnesium	19.74	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Potassium	0.74	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Sodium	3.57	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	32.90	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
ion Sum	32.63	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
ion-Anion Balance	0.40	0.01		%	03/13/2014 1443 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.2	0.1		mg/L	03/07/2014 2007 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 1516 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 1516 MS	EPA 200.8
Boron	0.5	0.1		mg/L	03/07/2014 2007 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 1516 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 2007 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 1516 MS	EPA 200.8
Iron	0.14	0.05		mg/L	03/07/2014 2007 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 1516 MS	EPA 200.8
Manganese	0.51	0.02		mg/L	03/07/2014 2007 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/14/2014 1036 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 1516 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 2007 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 1516 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 2007 DG	EPA 200.7
Total Metals						
Iron	1.05	0.05		mg/L	03/11/2014 1533 DG	EPA 200.7
Manganese	0.50	0.02		mg/L	03/11/2014 1533 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-004
Client Sample ID: 578409-CRN-OB-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 12:20:00 PM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.62			s.u.	03/05/2014 1220	Field
Conductivity	1960			µmhos/cm	03/05/2014 1220	Field
Turbidity	4.36			NTU	03/05/2014 1220	Field
Temperature	11.9			°C	03/05/2014 1220	Field
Static Water Level	90.78			ft	03/05/2014 1220	Field
General Parameters						
pH	8.1	0.1		s.u.	03/06/2014 2058 KV	SM 4500 H B
Electrical Conductivity	2100	5		µmhos/cm	03/06/2014 2058 KV	SM 2510B
Total Dissolved Solids (180)	1450	10		mg/L	03/06/2014 1613 EC	SM 2540
Solids, Total Dissolved (Calc)	1430	10		mg/L	03/10/2014 1211 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	473	5		mg/L	03/06/2014 2058 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	665	1		mg/L	03/10/2014 1211 JJ	SM 2340B
Nitrogen, Ammonia (As N)	5.1	0.1		mg/L	03/07/2014 0921 RH	EPA 350.1
ium Adsorption Ratio	4.3	0.1			03/10/2014 1211 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	577	5		mg/L	03/06/2014 2058 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/06/2014 2058 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 2058 KV	SM 2320B
Chloride	12	1		mg/L	03/09/2014 0338 AMB	EPA 300.0
Fluoride	0.6	0.1		mg/L	03/06/2014 2058 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/07/2014 1130 RH	EPA 353.2
Sulfate	655	1		mg/L	03/09/2014 0338 AMB	EPA 300.0
Cations						
Calcium	101	1		mg/L	03/07/2014 1809 DG	EPA 200.7
Magnesium	100	1		mg/L	03/07/2014 1809 DG	EPA 200.7
Potassium	21	1		mg/L	03/07/2014 1809 DG	EPA 200.7
Sodium	253	1		mg/L	03/07/2014 1809 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-136

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-004
Client Sample ID: 578409-CRN-OB-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 12:20:00 PM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.46	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Chloride	0.33	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sulfate	13.63	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Calcium	5.03	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Magnesium	8.26	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Potassium	0.53	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sodium	10.99	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	25.19	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion Sum	23.47	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion-Anion Balance	3.53	0.01		%	03/10/2014 1211 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	03/07/2014 1809 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0500 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0500 MS	EPA 200.8
Boron	0.2	0.1		mg/L	03/07/2014 1809 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0500 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1809 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 0500 MS	EPA 200.8
Iron	ND	0.05		mg/L	03/07/2014 1809 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0500 MS	EPA 200.8
Manganese	0.14	0.02		mg/L	03/07/2014 1809 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1251 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 0500 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 1809 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 0500 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1809 DG	EPA 200.7
Total Metals						
Iron	0.12	0.05		mg/L	03/10/2014 2038 DG	EPA 200.7
Manganese	0.15	0.02		mg/L	03/10/2014 2038 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-003
Client Sample ID: 578409-MST-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 11:35:00 AM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.05			s.u.	03/05/2014 1135	Field
Conductivity	2310			µmhos/cm	03/05/2014 1135	Field
Turbidity	1.86			NTU	03/05/2014 1135	Field
Temperature	12.8			°C	03/05/2014 1135	Field
Static Water Level	101.21			ft	03/05/2014 1135	Field
General Parameters						
pH	8.4	0.1		s.u.	03/06/2014 2047 KV	SM 4500 H B
Electrical Conductivity	2230	5		µmhos/cm	03/06/2014 2047 KV	SM 2510B
Total Dissolved Solids (180)	1430	10		mg/L	03/06/2014 1612 EC	SM 2540
Solids, Total Dissolved (Calc)	1420	10		mg/L	03/10/2014 1211 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	658	5		mg/L	03/06/2014 2047 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	89	1		mg/L	03/10/2014 1211 JJ	SM 2340B
Nitrogen, Ammonia (As N)	3.3	0.1		mg/L	03/07/2014 0920 RH	EPA 350.1
lium Adsorption Ratio	24.2	0.1			03/10/2014 1211 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	775	5		mg/L	03/06/2014 2047 KV	SM 2320B
Alkalinity, Carbonate as CO3	13	5		mg/L	03/06/2014 2047 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 2047 KV	SM 2320B
Chloride	9	1		mg/L	03/09/2014 0325 AMB	EPA 300.0
Fluoride	1.5	0.1		mg/L	03/06/2014 2047 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/07/2014 1128 RH	EPA 353.2
Sulfate	449	1		mg/L	03/09/2014 0325 AMB	EPA 300.0
Cations						
Calcium	16	1		mg/L	03/07/2014 1807 DG	EPA 200.7
Magnesium	12	1		mg/L	03/07/2014 1807 DG	EPA 200.7
Potassium	15	1		mg/L	03/07/2014 1807 DG	EPA 200.7
Sodium	525	1		mg/L	03/07/2014 1807 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-003
Client Sample ID: 578409-MST-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 11:35:00 AM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.70	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Carbonate as CO3	0.44	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Chloride	0.26	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Fluoride	0.07	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sulfate	9.34	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Calcium	0.78	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Magnesium	0.98	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Potassium	0.37	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sodium	22.82	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	25.21	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion Sum	22.83	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion-Anion Balance	4.94	0.01		%	03/10/2014 1211 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	03/07/2014 1807 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0455 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0455 MS	EPA 200.8
Boron	0.1	0.1		mg/L	03/07/2014 1807 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0455 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1807 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 0455 MS	EPA 200.8
Iron	ND	0.05		mg/L	03/07/2014 1807 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0455 MS	EPA 200.8
Manganese	0.23	0.02		mg/L	03/07/2014 1807 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1249 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 0455 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 1807 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 0455 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1807 DG	EPA 200.7
Total Metals						
Iron	ND	0.05		mg/L	03/10/2014 2036 DG	EPA 200.7
Manganese	0.24	0.02		mg/L	03/10/2014 2036 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-002
Client Sample ID: 578409-UBN-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 10:50:00 AM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.04			s.u.	03/05/2014 1050	Field
Conductivity	3920			µmhos/cm	03/05/2014 1050	Field
Turbidity	59.7			NTU	03/05/2014 1050	Field
Temperature	12.9			°C	03/05/2014 1050	Field
Static Water Level	110.25			ft	03/05/2014 1050	Field
General Parameters						
pH	8.2	0.1		s.u.	03/06/2014 2011 KV	SM 4500 H B
Electrical Conductivity	3840	5		µmhos/cm	03/06/2014 2011 KV	SM 2510B
Total Dissolved Solids (180)	2760	10		mg/L	03/06/2014 1611 EC	SM 2540
Solids, Total Dissolved (Calc)	2810	10		mg/L	03/10/2014 1211 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	460	5		mg/L	03/06/2014 2011 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	479	1		mg/L	03/10/2014 1211 JJ	SM 2340B
Nitrogen, Ammonia (As N)	1.7	0.1		mg/L	03/07/2014 0919 RH	EPA 350.1
'ium Adsorption Ratio	15.6	0.1			03/10/2014 1211 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	561	5		mg/L	03/06/2014 2011 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/06/2014 2011 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 2011 KV	SM 2320B
Chloride	30	1		mg/L	03/09/2014 0312 AMB	EPA 300.0
Fluoride	1.1	0.1		mg/L	03/06/2014 2011 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	4.9	0.1		mg/L	03/07/2014 1127 RH	EPA 353.2
Sulfate	1530	1		mg/L	03/09/2014 0312 AMB	EPA 300.0
Cations						
Calcium	80	1		mg/L	03/07/2014 1804 DG	EPA 200.7
Magnesium	68	1		mg/L	03/07/2014 1804 DG	EPA 200.7
Potassium	15	1		mg/L	03/07/2014 1804 DG	EPA 200.7
Sodium	784	1		mg/L	03/07/2014 1804 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-002
Client Sample ID: 578409-UBN-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 10:50:00 AM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.19	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Chloride	0.84	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Fluoride	0.05	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Nitrate + Nitrite as N	0.34	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sulfate	31.89	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Calcium	3.99	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Magnesium	5.58	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Potassium	0.37	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sodium	34.09	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	44.17	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion Sum	42.33	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion-Anion Balance	2.12	0.01		%	03/10/2014 1211 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.2	0.1		mg/L	03/07/2014 1804 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0449 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0449 MS	EPA 200.8
Boron	0.3	0.1		mg/L	03/07/2014 1804 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0449 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1804 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 0449 MS	EPA 200.8
Iron	0.30	0.05		mg/L	03/07/2014 1804 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0449 MS	EPA 200.8
Manganese	0.41	0.02		mg/L	03/07/2014 1804 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1247 CS	EPA 245.1
Molybdenum	0.04	0.02		mg/L	03/07/2014 0449 MS	EPA 200.8
Nickel	0.01	0.01		mg/L	03/07/2014 1804 DG	EPA 200.7
Selenium	0.006	0.005		mg/L	03/07/2014 0449 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1804 DG	EPA 200.7
Total Metals						
Iron	1.88	0.05		mg/L	03/10/2014 2034 DG	EPA 200.7
Manganese	1.00	0.02		mg/L	03/10/2014 2034 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-001
Client Sample ID: 578415-MST/CRN-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 9:30:00 AM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	8.11			s.u.	03/05/2014 0930	Field
Conductivity	1930			µmhos/cm	03/05/2014 0930	Field
Turbidity	8.38			NTU	03/05/2014 0930	Field
Temperature	10.5			°C	03/05/2014 0930	Field
Static Water Level	122.01			ft	03/05/2014 0930	Field
General Parameters						
pH	8.4	0.1		s.u.	03/06/2014 1947 KV	SM 4500 H B
Electrical Conductivity	1850	5		µmhos/cm	03/06/2014 1947 KV	SM 2510B
Total Dissolved Solids (180)	1140	10		mg/L	03/06/2014 1610 EC	SM 2540
Solids, Total Dissolved (Calc)	1140	10		mg/L	03/10/2014 1211 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	679	5		mg/L	03/06/2014 1947 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	48	1		mg/L	03/10/2014 1211 JJ	SM 2340B
Nitrogen, Ammonia (As N)	2.1	0.1		mg/L	03/07/2014 0918 RH	EPA 350.1
lium Adsorption Ratio	28.1	0.1			03/10/2014 1211 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	805	5		mg/L	03/06/2014 1947 KV	SM 2320B
Alkalinity, Carbonate as CO3	12	5		mg/L	03/06/2014 1947 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 1947 KV	SM 2320B
Chloride	14	1		mg/L	03/09/2014 0158 AMB	EPA 300.0
Fluoride	2.0	0.1		mg/L	03/06/2014 1947 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/07/2014 1126 RH	EPA 353.2
Sulfate	249	1		mg/L	03/09/2014 0158 AMB	EPA 300.0
Cations						
Calcium	10	1		mg/L	03/07/2014 1751 DG	EPA 200.7
Magnesium	6	1		mg/L	03/07/2014 1751 DG	EPA 200.7
Potassium	9	1		mg/L	03/07/2014 1751 DG	EPA 200.7
Sodium	449	1		mg/L	03/07/2014 1751 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: Bill Courtney
Bill Courtney, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-142

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/11/2014
Report ID: S1403049001

Project: Ramaco
Lab ID: S1403049-001
Client Sample ID: 578415-MST/CRN-1
COC: 151518

Work Order: S1403049
Collection Date: 3/5/2014 9:30:00 AM
Date Received: 3/5/2014 2:07:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.20	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Carbonate as CO3	0.38	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Chloride	0.39	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Fluoride	0.10	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sulfate	5.18	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Calcium	0.49	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Magnesium	0.47	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Potassium	0.24	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Sodium	19.51	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	20.86	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion Sum	19.27	0.01		meq/L	03/10/2014 1211 JJ	SM 1030E
ion-Anion Balance	3.97	0.01		%	03/10/2014 1211 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	03/07/2014 1751 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0428 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0428 MS	EPA 200.8
Boron	ND	0.1		mg/L	03/07/2014 1751 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0428 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1751 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 0428 MS	EPA 200.8
Iron	0.06	0.05		mg/L	03/07/2014 1751 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0428 MS	EPA 200.8
Manganese	0.09	0.02		mg/L	03/07/2014 1751 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1245 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 0428 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 1751 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 0428 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1751 DG	EPA 200.7
Total Metals						
Iron	0.29	0.05		mg/L	03/10/2014 2032 DG	EPA 200.7
Manganese	0.10	0.02		mg/L	03/10/2014 2032 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/17/2014
Report ID: S1403082001

Project: Ramaco
Lab ID: S1403082-003
Client Sample ID: 578417-CRN-1
COC: 151519

Work Order: S1403082
Collection Date: 3/6/2014 10:40:00 AM
Date Received: 3/6/2014 11:35:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.76			s.u.	03/06/2014 1040	Field
Conductivity	1347			µmhos/cm	03/06/2014 1040	Field
Turbidity	971			NTU	03/06/2014 1040	Field
Temperature	9.5			°C	03/06/2014 1040	Field
Static Water Level	133.13			ft	03/06/2014 1040	Field
General Parameters						
pH	8.2	0.1		s.u.	03/10/2014 2019 KV	SM 4500 H B
Electrical Conductivity	1400	5		µmhos/cm	03/10/2014 2019 KV	SM 2510B
Total Dissolved Solids (180)	890	10		mg/L	03/07/2014 1315 EC	SM 2540
Solids, Total Dissolved (Calc)	880	10		mg/L	03/13/2014 1443 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	449	5		mg/L	03/10/2014 2019 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	151	1		mg/L	03/13/2014 1443 JJ	SM 2340B
Nitrogen, Ammonia (As N)	1.7	0.1		mg/L	03/13/2014 0852 RH	EPA 350.1
'ium Adsorption Ratio	10	0.1			03/13/2014 1443 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	548	5		mg/L	03/10/2014 2019 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/10/2014 2019 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/10/2014 2019 KV	SM 2320B
Chloride	8	1		mg/L	03/10/2014 2216 AMB	EPA 300.0
Fluoride	1.9	0.1		mg/L	03/10/2014 2019 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	2.3	0.1		mg/L	03/12/2014 0757 RH	EPA 353.2
Sulfate	250	1		mg/L	03/10/2014 2216 AMB	EPA 300.0
Cations						
Calcium	18	1		mg/L	03/07/2014 2010 DG	EPA 200.7
Magnesium	26	1		mg/L	03/07/2014 2010 DG	EPA 200.7
Potassium	16	1		mg/L	03/07/2014 2010 DG	EPA 200.7
Sodium	282	1		mg/L	03/07/2014 2010 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/17/2014
Report ID: S1403082001

Project: Ramaco
Lab ID: S1403082-003
Client Sample ID: 578417-CRN-1
COC: 151519

Work Order: S1403082
Collection Date: 3/6/2014 10:40:00 AM
Date Received: 3/6/2014 11:35:00 AM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	8.98	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Chloride	0.21	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Fluoride	0.10	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Nitrate + Nitrite as N	0.16	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Sulfate	5.21	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Calcium	0.91	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Magnesium	2.11	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Potassium	0.41	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Sodium	12.25	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	15.81	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
ion Sum	14.67	0.01		meq/L	03/13/2014 1443 JJ	SM 1030E
ion-Anion Balance	3.74	0.01		%	03/13/2014 1443 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.3	0.1		mg/L	03/07/2014 2010 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 1521 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 1521 MS	EPA 200.8
Boron	0.1	0.1		mg/L	03/07/2014 2010 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 1521 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 2010 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 1521 MS	EPA 200.8
Iron	0.08	0.05		mg/L	03/07/2014 2010 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 1521 MS	EPA 200.8
Manganese	0.02	0.02		mg/L	03/07/2014 2010 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/14/2014 1038 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 1521 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 2010 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 1521 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 2010 DG	EPA 200.7
Total Metals						
Iron	11.3	0.05		mg/L	03/11/2014 1547 DG	EPA 200.7
Manganese	0.11	0.02		mg/L	03/11/2014 1547 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Bill Courtney

Bill Courtney, Project Manager
October 2014

RAMACO
Inter-Mountain Labs
INTER-MOUNTAIN LABS
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-001
Client Sample ID: 578511-CRN-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 10:30:00 AM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.66			s.u.	03/04/2014 1030	Field
Conductivity	3690			µmhos/cm	03/04/2014 1030	Field
Turbidity	28.3			NTU	03/04/2014 1030	Field
Temperature	12.3			°C	03/04/2014 1030	Field
Static Water Level	119.59			ft	03/04/2014 1030	Field
General Parameters						
pH	8.0	0.1		s.u.	03/06/2014 1456 KV	SM 4500 H B
Electrical Conductivity	3660	5		µmhos/cm	03/06/2014 1456 KV	SM 2510B
Total Dissolved Solids (180)	3150	10		mg/L	03/05/2014 1306 EC	SM 2540
Solids, Total Dissolved (Calc)	2560	10		mg/L	03/14/2014 0819 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	737	5		mg/L	03/06/2014 1456 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	542	1		mg/L	03/14/2014 0819 JJ	SM 2340B
Nitrogen, Ammonia (As N)	7.6	0.1		mg/L	03/07/2014 0901 RH	EPA 350.1
dium Adsorption Ratio	12.6	0.1			03/14/2014 0819 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	899	5		mg/L	03/06/2014 1456 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/06/2014 1456 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 1456 KV	SM 2320B
Chloride	27	1		mg/L	03/07/2014 2105 AMB	EPA 300.0
Fluoride	1.0	0.1		mg/L	03/06/2014 1456 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/07/2014 1100 RH	EPA 353.2
Sulfate	1230	1		mg/L	03/07/2014 2105 AMB	EPA 300.0
Cations						
Calcium	76	1		mg/L	03/07/2014 1614 DG	EPA 200.7
Magnesium	86	1		mg/L	03/07/2014 1614 DG	EPA 200.7
Potassium	24	1		mg/L	03/07/2014 1614 DG	EPA 200.7
Sodium	675	1		mg/L	03/07/2014 1614 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Addendum D6-10-146

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-001
Client Sample ID: 578511-CRN-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 10:30:00 AM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	14.73	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Chloride	0.77	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Fluoride	0.05	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sulfate	25.66	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Calcium	3.77	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Magnesium	7.07	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Potassium	0.61	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sodium	29.37	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	41.37	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
[illegible]ion Sum	41.22	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
[illegible]ion-Anion Balance	0.18	0.01		%	03/14/2014 0819 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	03/07/2014 1614 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0147 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0147 MS	EPA 200.8
Boron	0.2	0.1		mg/L	03/07/2014 1614 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0147 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1614 DG	EPA 200.7
Copper	0.02	0.01		mg/L	03/07/2014 0147 MS	EPA 200.8
Iron	0.07	0.05		mg/L	03/07/2014 1614 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0147 MS	EPA 200.8
Manganese	0.53	0.02		mg/L	03/07/2014 1614 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1151 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 0147 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 1614 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 0147 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1614 DG	EPA 200.7
Total Metals						
Iron	0.38	0.05		mg/L	03/07/2014 2117 DG	EPA 200.7
Manganese	0.70	0.02		mg/L	03/07/2014 2117 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-003
Client Sample ID: 578512-AL-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 1:55:00 PM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.59			s.u.	03/04/2014 1355	Field
Conductivity	5370			µmhos/cm	03/04/2014 1355	Field
Turbidity	173			NTU	03/04/2014 1355	Field
Temperature	9.6			°C	03/04/2014 1355	Field
Static Water Level	3.67			ft	03/04/2014 1355	Field
General Parameters						
pH	7.9	0.1		s.u.	03/06/2014 1519 KV	SM 4500 H B
Electrical Conductivity	5340	5		µmhos/cm	03/06/2014 1519 KV	SM 2510B
Total Dissolved Solids (180)	4590	10		mg/L	03/05/2014 1308 EC	SM 2540
Solids, Total Dissolved (Calc)	4760	10		mg/L	03/14/2014 0819 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	652	5		mg/L	03/06/2014 1519 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2920	1		mg/L	03/14/2014 0819 JJ	SM 2340B
Nitrogen, Ammonia (As N)	0.2	0.1		mg/L	03/07/2014 0903 RH	EPA 350.1
'ium Adsorption Ratio	3.9	0.1			03/14/2014 0819 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	795	5		mg/L	03/06/2014 1519 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/06/2014 1519 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 1519 KV	SM 2320B
Chloride	22	1		mg/L	03/07/2014 2238 AMB	EPA 300.0
Fluoride	0.9	0.1		mg/L	03/06/2014 1519 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/07/2014 1103 RH	EPA 353.2
Sulfate	2990	1		mg/L	03/07/2014 2238 AMB	EPA 300.0
Cations						
Calcium	360	1		mg/L	03/07/2014 1621 DG	EPA 200.7
Magnesium	490	1		mg/L	03/07/2014 1621 DG	EPA 200.7
Potassium	23	1		mg/L	03/07/2014 1621 DG	EPA 200.7
Sodium	488	1		mg/L	03/07/2014 1621 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14,2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-003
Client Sample ID: 578512-AL-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 1:55:00 PM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.03	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Chloride	0.62	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Fluoride	0.04	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sulfate	62.18	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Calcium	17.95	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Magnesium	40.34	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Potassium	0.59	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sodium	21.22	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	80.14	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
[illegible]ion Sum	75.89	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
[illegible]ion-Anion Balance	2.72	0.01		%	03/14/2014 0819 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.1	0.1		mg/L	03/07/2014 1621 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0224 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0224 MS	EPA 200.8
Boron	0.3	0.1		mg/L	03/07/2014 1621 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0224 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1621 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 0224 MS	EPA 200.8
Iron	1.04	0.05		mg/L	03/07/2014 1621 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0224 MS	EPA 200.8
Manganese	2.13	0.02		mg/L	03/07/2014 1621 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1159 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 0224 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 1621 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 0224 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1621 DG	EPA 200.7
Total Metals						
Iron	25.4	0.05		mg/L	03/07/2014 2122 DG	EPA 200.7
Manganese	2.71	0.02		mg/L	03/07/2014 2122 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-149

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-004
Client Sample ID: 578513-AL-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 2:50:00 PM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.57			s.u.	03/04/2014 1450	Field
Conductivity	4900			µmhos/cm	03/04/2014 1450	Field
Turbidity	0.93			NTU	03/04/2014 1450	Field
Temperature	9.9			°C	03/04/2014 1450	Field
Static Water Level	7.66			ft	03/04/2014 1450	Field
General Parameters						
pH	7.9	0.1		s.u.	03/06/2014 1530 KV	SM 4500 H B
Electrical Conductivity	4670	5		µmhos/cm	03/10/2014 1703 KV	SM 2510B
Total Dissolved Solids (180)	4610	10		mg/L	03/10/2014 1405 EC	SM 2540
Solids, Total Dissolved (Calc)	4340	10		mg/L	03/14/2014 0819 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	651	5		mg/L	03/06/2014 1530 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2350	1		mg/L	03/14/2014 0819 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	03/07/2014 0904 RH	EPA 350.1
ium Adsorption Ratio	3.9	0.1			03/14/2014 0819 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	794	5		mg/L	03/06/2014 1530 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/06/2014 1530 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 1530 KV	SM 2320B
Chloride	24	1		mg/L	03/07/2014 2251 AMB	EPA 300.0
Fluoride	0.8	0.1		mg/L	03/06/2014 1530 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/07/2014 1104 RH	EPA 353.2
Sulfate	2790	1		mg/L	03/07/2014 2251 AMB	EPA 300.0
Cations						
Calcium	272	1		mg/L	03/07/2014 1635 DG	EPA 200.7
Magnesium	406	1		mg/L	03/07/2014 1635 DG	EPA 200.7
Potassium	25	1		mg/L	03/07/2014 1635 DG	EPA 200.7
Sodium	435	1		mg/L	03/07/2014 1635 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-004
Client Sample ID: 578513-AL-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 2:50:00 PM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.02	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Chloride	0.66	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Fluoride	0.04	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sulfate	58.07	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Calcium	13.59	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Magnesium	33.39	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Potassium	0.63	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sodium	18.90	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	66.52	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
ion Sum	71.79	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
ion-Anion Balance	3.80	0.01		%	03/14/2014 0819 JJ	SM 1030E
Dissolved Metals						
Aluminum	0.1	0.1		mg/L	03/07/2014 1635 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0230 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0230 MS	EPA 200.8
Boron	0.5	0.1		mg/L	03/07/2014 1635 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0230 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1635 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 0230 MS	EPA 200.8
Iron	0.09	0.05		mg/L	03/07/2014 1635 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0230 MS	EPA 200.8
Manganese	0.31	0.02		mg/L	03/07/2014 1635 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1200 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 0230 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 1635 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 0230 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1635 DG	EPA 200.7
Total Metals						
Iron	0.11	0.05		mg/L	03/07/2014 2124 DG	EPA 200.7
Manganese	0.39	0.02		mg/L	03/07/2014 2124 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits
B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Addendum D6-10-151

DEQ 6-501

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-002
Client Sample ID: 578513-MST-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 12:55:00 PM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.12			s.u.	03/04/2014 1255	Field
Conductivity	3920			µmhos/cm	03/04/2014 1255	Field
Turbidity	2.06			NTU	03/04/2014 1255	Field
Temperature	10.7			°C	03/04/2014 1255	Field
Static Water Level	108.82			ft	03/04/2014 1255	Field
General Parameters						
pH	7.6	0.1		s.u.	03/06/2014 1508 KV	SM 4500 H B
Electrical Conductivity	3900	5		µmhos/cm	03/10/2014 1659 KV	SM 2510B
Total Dissolved Solids (180)	3090	10		mg/L	03/10/2014 1404 EC	SM 2540
Solids, Total Dissolved (Calc)	3040	10		mg/L	03/14/2014 0819 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	605	5		mg/L	03/06/2014 1508 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1080	1		mg/L	03/14/2014 0819 JJ	SM 2340B
Nitrogen, Ammonia (As N)	10.4	0.1		mg/L	03/07/2014 0902 RH	EPA 350.1
'ium Adsorption Ratio	8.2	0.1			03/14/2014 0819 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	738	5		mg/L	03/06/2014 1508 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	03/06/2014 1508 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	03/06/2014 1508 KV	SM 2320B
Chloride	18	1		mg/L	03/07/2014 2225 AMB	EPA 300.0
Fluoride	0.6	0.1		mg/L	03/06/2014 1508 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	03/07/2014 1102 RH	EPA 353.2
Sulfate	1700	1		mg/L	03/07/2014 2225 AMB	EPA 300.0
Cations						
Calcium	129	1		mg/L	03/07/2014 1617 DG	EPA 200.7
Magnesium	184	1		mg/L	03/07/2014 1617 DG	EPA 200.7
Potassium	32	1		mg/L	03/07/2014 1617 DG	EPA 200.7
Sodium	622	1		mg/L	03/07/2014 1617 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 3/14/2014
Report ID: S1403028001

Project: Ramaco
Lab ID: S1403028-002
Client Sample ID: 578513-MST-1
COC: 151517

Work Order: S1403028
Collection Date: 3/4/2014 12:55:00 PM
Date Received: 3/4/2014 4:44:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.09	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Chloride	0.50	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sulfate	35.32	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Calcium	6.41	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Magnesium	15.15	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Potassium	0.82	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Sodium	27.05	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	50.18	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Anion Sum	47.95	0.01		meq/L	03/14/2014 0819 JJ	SM 1030E
Cation-Anion Balance	2.27	0.01		%	03/14/2014 0819 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	03/07/2014 1617 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	03/07/2014 0219 MS	EPA 200.8
Barium	ND	0.1		mg/L	03/07/2014 0219 MS	EPA 200.8
Boron	0.3	0.1		mg/L	03/07/2014 1617 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	03/07/2014 0219 MS	EPA 200.8
Chromium	ND	0.01		mg/L	03/07/2014 1617 DG	EPA 200.7
Copper	ND	0.01		mg/L	03/07/2014 0219 MS	EPA 200.8
Iron	0.55	0.05		mg/L	03/07/2014 1617 DG	EPA 200.7
Lead	ND	0.02		mg/L	03/07/2014 0219 MS	EPA 200.8
Manganese	0.07	0.02		mg/L	03/07/2014 1617 DG	EPA 200.7
Mercury	ND	0.001		mg/L	03/11/2014 1153 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	03/07/2014 0219 MS	EPA 200.8
Nickel	ND	0.01		mg/L	03/07/2014 1617 DG	EPA 200.7
Selenium	ND	0.005		mg/L	03/07/2014 0219 MS	EPA 200.8
Zinc	ND	0.01		mg/L	03/07/2014 1617 DG	EPA 200.7
Total Metals						
Iron	0.74	0.05		mg/L	03/07/2014 2120 DG	EPA 200.7
Manganese	0.08	0.02		mg/L	03/07/2014 2120 DG	EPA 200.7

These results apply only to the samples tested.

Qualifiers:

*	Value exceeds Maximum Contaminant Level
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

RL - Reporting Limit

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL
O	Outside the Range of Dilutions

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Inter-Mountain Labs
Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

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131517

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC	RAMACO		

Report Address	Contact Name	ANALYSES / PARAMETERS
	Jedd Burnham	
Invoice Address	Email	
	Phone	
	Purchase Order # / Quote # 439	

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME	SAMPLE IDENTIFICATION	Matrix	# of Containers	Quote 439	REMARKS
1		3/4/14	1030	578511-CRN-1	WT	4	✓	
2				PH = 7.66, EC = 3670, T = 12.3, TUR = 28.3, SWL = 119.59'				
3		3/4/14	1255	578513-MST-1	WT	4	✓	
4				PH = 7.12, EC = 5430, T = 10.7, TUR = 2.06, SWL = 108.82'				
5		3/4/14	1355	578512-AL-1	WT	4	✓	
6				PH = 7.59, EC = 5370, T = 9.6, TUR = 173, SWL = 3.67'				
7		3/4/14	1450	578513-AL-1	WT	4	✓	
8				PH = 7.57, EC = 4900, T = 9.9, TUR = 0.93, SWL = 7.66'				
9								
10								
11								
12								
13								
14								

TFN 6 2/025
RECD NOV 14, 2014

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
2.8 C		3/4/14	1643		3/4/14	16:44

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION		ADDITIONAL REMARKS
❑ UPS	Water	WT	Check desired service	Compliance Monitoring?	Y / N	
❑ Fed Express	Soil	SL	❑ Standard turnaround	Program (SDWA, NPDES,...)		
❑ US Mail	Solid	SD	❑ RUSH - 5 Working Days	PWSID / Permit #		
❑ Hand Carried	Filter	FT	❑ URGENT - < 2 Working Days	Chlorinated?	Y / N	
❑ Other _____	Other	OT	Rush & Urgent Surcharges will be applied	Sample Disposal: Lab	Client	

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October 2014 RAMACO Addendum D6-10154 Brook Mine

DEQ 6-504

Inter-Mountain Labs
Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

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151518

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Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWE	Ramaco	Rod Fuller	

Report Address	Contact Name	Email	Phone	Purchase Order #	Quote #
	Jeff Barron				439

Invoice Address

ANALYSES / PARAMETERS: Dunde 439

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME	SAMPLE IDENTIFICATION	Matrix	# of Containers	REMARKS
1		3/5/14	~~1050~~	578415-MST/OBN-1	WT	4	
2			0930	PH: 8.11, EC: 1930, T: 10.5, TUR: 8.38, SWL: 122.01'			
3		3/5/14	1050	578409-UBN-1	WT	4	
4				PH: 8.04, EC: 3920, T: 12.9, TUR: 59.7, SWL: 110.25'			
5		3/5/14	1135	578409-MST-1	WT	4	
6				PH: 8.05, EC: 2310, T: 12.8, TUR: 1.86, SWL: 101.21'			
7		3/5/14	1220	578409-CRN-OB-1	WT	4	
8				PH: 7.62, EC: 1960, T: 11.9, TUR: 4.36, SWL: 90.78'			
9							
10							
11							
12							
13							
14							

TFN 6 2/025
RECD NOV 14, 2014

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
1.2°C	Rod Fuller	3/5/14	1453	Bill Courtney	3-05-14	14:07PM

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION		ADDITIONAL REMARKS
❑ UPS	Water	WT	Check desired service	Compliance Monitoring?	Y / N	
❑ Fed Express	Soil	SL	❑ Standard turnaround	Program (SDWA, NPDES,...)		
❑ US Mail	Solid	SD	❑ RUSH - 5 Working Days	PWSID / Permit #		
❑ Hand Carried	Filter	FT	❑ URGENT - < 2 Working Days	Chlorinated?	Y / N	
❑ Other _____	Other	OT	*Rush & Urgent Surcharges will be applied*	Sample Disposal: Lab	Client	

RAMACO
October 2014
Addendum D6-10153
Brook Mine

DEQ 6-505

October 2014

RAMACO

Addendum D6-10-156

Brook Mine

Inter-Mountain Labs
Sheridan, WY and Gillette, WY

CHAIN OF CUSTODY RECORD -

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151519

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WMC	Ramaco	Rod Fuller	

Report Address	Contact Name	Email	Phone
	Jeff Barron		

Invoice Address	Purchase Order #	Quote #
		439

ANALYSES / PARAMETERS: Quote 439

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers	REMARKS
1	3140 3082 001	3/6/14	0855	578408-MST-1	WT	4	✓
2				pH=6.87, EC=1984, T=9.4, TUR=53.7,			SWL=102.93'
3	002	3/6/14	0940	578408-CRN-1	WT	4	✓
4				pH=7.22, EC=2600, T=9.1, TUR=65.9,			SWL=87.70'
5	003	3/6/14	1040	578417-CRN-1	WT	4	✓
6				pH=7.76, EC=1347, T=9.5, TUR=971,			SWL=133.13'
7							
8							
9							
10							
11							
12							
13							
14							

TEN 6 2,025
RECD NOV 14, 2014

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
6.8°C	Rod Fuller	3/6/14	1135	Kathy Bopp	3/6/14	11:35

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION	ADDITIONAL REMARKS
☐ UPS	Water	WT	Check desired service	Compliance Monitoring? Y / N	
☐ Fed Express	Soil	SL	☐ Standard turnaround	Program (SDWA, NPDES,...)	
☐ US Mail	Solid	SD	☐ RUSH - 5 Working Days	PWSID / Permit #	
☐ Hand Carried	Filter	FT	☐ URGENT - < 2 Working Days	Chlorinated? Y / N	
☐ Other _____	Other	OT	*Rush & Urgent Surcharges will be applied*	Sample Disposal: Lab Client	

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578408-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578408-CRN-1 Date Sampled 5 / 20 / 14 Time 1530 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 98.27 ft below MP Depth to Water (below MP) 87.71 ft Casing Diameter 5 in

Date 5 / 20 / 14 Time 1455 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 95 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

STATIC WATER LEVEL OF ASSOCIATED WELLS

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1520	6.97	2710	13.5	44.2	↓	150 mL/30 sec
1530	6.91	2700	13.7	64.7	3.0	↓

Pumping Start Time 1505 WL _____ Pumping End Time _____ WL _____

Comments: Water turbid (Black in color) - no odor

HCF

COC # 151524

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SMW578408-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578408-MST-1 Date Sampled 5 / 22 / 14 Time 0830 am pm

Describe Sampling Point GW monitoring well

Well Depth 142.41 ft below MP Depth to Water (below MP) 99.82 ft Casing Diameter 2 in

Date 5 / 22 / 14 Time 0755 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 135 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no)

and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
0820	6.65	1974	14.5	28.6	↓	150mL/30sec
0830	6.62	~~1950~~ 1982	14.5	26.3	3.0	↓

Pumping Start Time 0805 WL _____ Pumping End Time _____ WL _____

Comments: water slightly turbid - no odor

HCF

COC # 151525

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 110.55 ft below MP Depth to Water (below MP) 89.85 ft Casing Diameter 5 in

Date 5 / 20 / 14 Time 1150 am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

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Sheridan, Wyoming 82801
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SAMPLING INFORMATION

Sampling Point SM578409-CRN-OB-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578409-CRN-OB-1 Date Sampled 5 / 20 / 14 Time 1400 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 111.33 ft below MP Depth to Water (below MP) 89.87 ft Casing Diameter 5 in

Date 5 / 20 / 14 Time 1140 (am) pm Casing Volume _____ gal

At least NA bore volumes have been evacuated before sampling

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 108 ft below MP.

STATIC WATER LEVEL OF ASSOCIATED WELLS

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1350	7.40	1944	15.5	5.15	↓	150ML/30 sec.
1400	7.38	1944	14.6	3.90	3.0	↓

Pumping Start Time 1335 WL _____ Pumping End Time _____ WL _____

Comments: water clear - no odor

LCF

COC# 151524

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-MST-1 Project Ramaco

Location _____ W.O.# 2014139-07

Sample ID# 578409-MST-1 Date Sampled 5 / 20 / 14 Time 1310 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 122.83 ft below MP Depth to Water (below MP) 100.95 ft Casing Diameter 5 in

Date 5 / 20 / 14 Time 1135 (am) pm Casing Volume _____ gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 115 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no)

and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1300	7.85	2390	16.0	0.21	↓	150 ml / 30 sec.
1310	7.82	2390	17.2	0.36	3.0	↓

Pumping Start Time 1245 WL _____ Pumping End Time _____ WL _____

Comments: water clear - no odor

LCF

COC# 151524

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No Sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-MST-OB-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 123.80 ft below MP Depth to Water (below MP) 101.55 ft Casing Diameter 5 in

Date 5 / 20 / 14 Time 1145 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - Water level only

TFN 6 2;025
RECD NOV 14,2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

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Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578409-UBN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578409-UBN-1 Date Sampled 5 / 20 / 14 Time 1225 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 141.20 ft below MP Depth to Water (below MP) 110.40 ft Casing Diameter 5 in

Date 5 / 20 / 14 Time 1130 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 135 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no)

and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1215	7.80	3980	14.7	0.88	↓	150 ml/30 sec
1225	7.79	3990	14.5	1.01	3.0	↓

Pumping Start Time 1200 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF

COC# 151524

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578415-MST/CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578415-MST/CRN-1 Date Sampled 5 / 20 / 14 Time 1030 (am) pm

Describe Sampling Point Groundwater monitoring well

Well Depth 143.70 ft below MP Depth to Water (below MP) 121.23 ft Casing Diameter 5 in

Date 5 / 20 / 14 Time 0945 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

Sampling method Submersible pump (Bladder pump (low flow)) Tap Bailer _____

Pump intake or bailer set at 135 ft below MP.

STATIC WATER LEVEL OF ASSOCIATED WELLS

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1015	7.91	1773	15.3	5.24	↓	150 ml / 30 sec
1030	7.91	1778	15.1	3.55	3.5	↓

Pumping Start Time 1000 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor - water in well bubbling from CBNG

LCF - COC # 151524

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578417-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578417-CRN-1 Date Sampled 5 / 22 / 14 Time 0950 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 142.41 ft below MP Depth to Water (below MP) 133.55 ft Casing Diameter 2 in

Date 5 / 22 / 14 Time 0910 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 138 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no)

and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
0940	7.60	1372	17.2	990	↓	150ML/30Sec
0950	7.56	1375	18.0	998	3.0	↓

Pumping Start Time 0925 WL _____ Pumping End Time _____ WL _____

Comments: Water very turbid - no odor - well site still needs reclaimed.

HCF - COC# 151525

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

* No Sample

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578417-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled -- / / Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 163.82' ft below MP Depth to Water (below MP) 160.55 ft Casing Diameter 2 in

Date 5 / 22 / 14 Time 0905 am pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only. - not enough water to sample - Site still needs reclaimed.

Form completed by: Rod Fuller Witnessed by: _____

TEN 6 2/025
RECD NOV 14, 2014

RAMACO

WWC ENGINEERING

* No sample

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM67841B-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 24.50 ft below MP Depth to Water (below MP) 20.15 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1520 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* No sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578418-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 153.79 ft below MP Depth to Water (below MP) 146.63 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1030 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only - not enough water to sample - Site still needs reclaimed

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

* No sample

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578418-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 185.75 ft below MP Depth to Water (below MP) 184.49 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1035 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - Water level only - not enough water to sample - site needs reclaimed

TEN 6 2/025
RECD NOV 14, 2014

Form completed by: Bob Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

* No sample

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578510-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 92.74 ft below MP Depth to Water (below MP) Dry ft Casing Diameter 5 in

Date 5 / 23 / 14 Time 0920 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only - not enough water to sample - Site still needs reclaimed

TEN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578510-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 147.24 ft below MP Depth to Water (below MP) 146.34 ft Casing Diameter 5 in

Date 5 / 23 / 14 Time 0915 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - Water level only - not enough water to sample - site still needs reclaimed

Form completed by: Rod Fuller Witnessed by: _____

TFN 6 2/025
RECD NOV 14, 2014

RAMACO

WWC ENGINEERING

Brook Mine

1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578511-CRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578511-CRN-1 Date Sampled 5/23/14 Time 1110 (am) pm

Describe Sampling Point GW monitoring well

Well Depth 128.92 ft below MP Depth to Water (below MP) 119.58 ft Casing Diameter 5 in

Date 5/23/14 Time 1020 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow)) Tap Bailer

Pump intake or bailer set at 125 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes) or no)

and all field measurements (yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1100	7.45	4120	18.8	131	↓	150 mL/30 sec.
1110	7.42	4050	18.2	88.5	3.0	↓

Pumping Start Time 1045 WL _____ Pumping End Time _____ WL _____

Comments: water turbid - no odor

HCF

COC# 151525

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

* No sample

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM5785M - MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___/___/___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 158.00 ft below MP Depth to Water (below MP) 149.91 ft Casing Diameter 5 in

Date 5 / 23 / 14 Time 1015 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: no sample - water level only - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578512-AL-1 Project Ramaco

Location _____ W.O.# 2012139-07

Sample ID# 578512-AL-1 Date Sampled 5 / 22 / 14 Time 1335 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 21.21 ft below MP Depth to Water (below MP) 3.61 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1300 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow)) Tap Bailer _____

Pump intake or bailer set at 15 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no) and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1325	7.36	5540	16.8	32.3	↓	150ML/30sec
1335	7.33	5530	16.3	21.6	3.0	↓

Pumping Start Time 1310 WL _____ Pumping End Time _____ WL _____

Comments: water slightly turbid - no odor

LCF

COC # 151525

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

* no sample

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578512-CRM-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 49.85 ft below MP Depth to Water (below MP) Dry ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1240 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only - well is dry

Form completed by: Rod Fuller Witnessed by: _____

TEN 6 2/025
RECD NOV 14, 2014

RAMACO

WWC ENGINEERING

* NO sample

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578512-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 114.96 ft below MP Depth to Water (below MP) 111.93 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1245 am (pm) Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

STATIC WATER LEVEL OF ASSOCIATED WELLS

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only - not enough water to sample

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rob Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578513-AL-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578513-AL-1 Date Sampled 5 / 22 / 14 Time 1500 am pm

Describe Sampling Point GW monitoring Well

Well Depth 20.77 ft below MP Depth to Water (below MP) 6.18 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1420 am (pm) Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 15 ft below MP.

Tubing (type: Plastic). (New or (previously used)) was used to collect all samples ((yes) or no)

and all field measurements ((yes) or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1450	7.29	4690	17.6	0.69	↓	150 mL / 30 sec.
1500	7.26	4686	17.5	0.17	3.0	↓

Pumping Start Time 1435 WL _____ Pumping End Time _____ WL _____

Comments: Water clear - no odor

LCF

COC # 151525

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

RAMACO

WWC ENGINEERING

* no sample

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM578513-GRN-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# _____ Date Sampled ___ / ___ / ___ Time _____ am pm

Describe Sampling Point GW monitoring well

Well Depth 117.28 ft below MP Depth to Water (below MP) 116.81 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1125 (am) pm Casing Volume _____ gal

At least _____ bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump Bladder pump (low flow)

Tap Bailer _____

Pump intake or bailer set at _____ ft below MP.

Tubing (type: _____). (New or previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for _____

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)

Pumping Start Time _____ WL _____ Pumping End Time _____ WL _____

Comments: No sample - water level only - not enough water to sample

Form completed by: Rod Fuller Witnessed by: _____

TFN 6 2/025
RECD NOV 14, 2014

RAMACO

WWC ENGINEERING

Brook Mine
1849 Terra Avenue
Sheridan, Wyoming 82801
(307) 672-0761

SAMPLING INFORMATION

Sampling Point SM 578513-MST-1 Project Ramaco

Location _____ W.O.# 2013139-07

Sample ID# 578513-MST-1 Date Sampled 5 / 22 / 14 Time 1205 am (pm)

Describe Sampling Point GW monitoring well

Well Depth 144.00 ft below MP Depth to Water (below MP) 107.94 ft Casing Diameter 5 in

Date 5 / 22 / 14 Time 1130 (am) pm Casing Volume NA gal

At least NA bore volumes have been evacuated before sampling

STATIC WATER LEVEL OF ASSOCIATED WELLS

Sampling method Submersible pump (Bladder pump (low flow))

Tap Bailer _____

Pump intake or bailer set at 135 ft below MP.

Tubing (type: Plastic). (New or (previously used) was used to collect all samples (yes or no)

and all field measurements (yes or no). Tubing used only for NA

EVACUATION / STABILIZATION TEST DATA

Time	PH (units)	Temperature Corrected Conductance (µmhos/cm)	Temp. (°C)	Turbidity (NTU)	Volume of Water Removed (gallons)	Pumping Rate (gpm)
1155	6.89	4130	17.5	8.01	↓	150 mL / 30 sec
1205	6.87	4130	17.2	2.22	3.0	↓

Pumping Start Time 1140 WL _____ Pumping End Time _____ WL _____

Comments: water clear - no odor

LCT

COC # 151525

TFN 6 2/025
RECD NOV 14, 2014

Form completed by: Rod Fuller Witnessed by: _____

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-005
Client Sample ID: 578408-CRN-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 3:30:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	6.91			s.u.	05/20/2014 1530	Field
Conductivity	2700			µmhos/cm	05/20/2014 1530	Field
Turbidity	64.7			NTU	05/20/2014 1530	Field
Temperature	13.7			°C	05/20/2014 1530	Field
Static Water Level	87.71			ft	05/20/2014 1530	Field
General Parameters						
pH	7.6	0.1		s.u.	05/21/2014 1734 KV	SM 4500 H B
Electrical Conductivity	2440	5		µmhos/cm	05/21/2014 1734 KV	SM 2510B
Total Dissolved Solids (180)	2190	10		mg/L	05/21/2014 0414 BT	SM 2540
Solids, Total Dissolved (Calc)	1870	10		mg/L	05/29/2014 0955 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	613	5		mg/L	05/21/2014 1734 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	1420	1		mg/L	05/29/2014 0955 JJ	SM 2340B
Nitrogen, Ammonia (As N)	0.6	0.1		mg/L	05/21/2014 1437 CA	EPA 350.1
lium Adsorption Ratio	0.9	0.1			05/29/2014 0955 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	748	5		mg/L	05/21/2014 1734 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/21/2014 1734 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/21/2014 1734 KV	SM 2320B
Chloride	9	1		mg/L	05/22/2014 2023 AMB	EPA 300.0
Fluoride	0.7	0.1		mg/L	05/21/2014 1734 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	05/22/2014 1321 CA	EPA 353.2
Sulfate	969	1		mg/L	05/22/2014 2023 AMB	EPA 300.0
Cations						
Calcium	175	1		mg/L	05/22/2014 2141 DG	EPA 200.7
Magnesium	238	1		mg/L	05/22/2014 2141 DG	EPA 200.7
Potassium	29	1		mg/L	05/22/2014 2141 DG	EPA 200.7
Sodium	79	1		mg/L	05/22/2014 2141 DG	EPA 200.7

TFN 6 2/025
RECD NOV 14,2014

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

- B Analyte detected in the associated Method Blank
- C Calculated Value
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- J Analyte detected below quantitation limits
- L Analyzed by a contract laboratory
- M Value exceeds Monthly Ave or MCL or is less than LCL
- ND Not Detected at the Reporting Limit
- O Outside the Range of Dilutions
- S Spike Recovery outside accepted recovery limits
- X Matrix Effect

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-005
Client Sample ID: 578408-CRN-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 3:30:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.26	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Chloride	0.24	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sulfate	20.17	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Calcium	8.73	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Magnesium	19.58	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Potassium	0.74	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sodium	3.43	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	32.52	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion Sum	32.71	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion-Anion Balance	0.28	0.01		%	05/29/2014 0955 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/22/2014 2141 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/21/2014 1504 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/21/2014 1504 MS	EPA 200.8
Boron	0.5	0.1		mg/L	05/22/2014 2141 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/21/2014 1504 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/22/2014 2141 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/21/2014 1504 MS	EPA 200.8
Iron	0.13	0.05		mg/L	05/22/2014 2141 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/21/2014 1504 MS	EPA 200.8
Manganese	0.40	0.02		mg/L	05/22/2014 2141 DG	EPA 200.7
Mercury	ND	0.001		mg/L	05/28/2014 1035 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/21/2014 1504 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/22/2014 2141 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/21/2014 1504 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/22/2014 2141 DG	EPA 200.7
Total Metals						
Iron	0.96	0.05		mg/L	05/23/2014 1308 DG	EPA 200.7
Manganese	0.43	0.02		mg/L	05/23/2014 1308 DG	EPA 200.7

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested. **RL - Reporting Limit**

Qualifiers:

- B Analyte detected in the associated Method Blank
- C Calculated Value
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- J Analyte detected below quantitation limits
- L Analyzed by a contract laboratory
- M Value exceeds Monthly Ave or MCL or is less than LCL
- ND Not Detected at the Reporting Limit
- O Outside the Range of Dilutions
- S Spike Recovery outside accepted recovery limits
- X Matrix Effect

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-001
Client Sample ID: 578408-MST-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 8:30:00 AM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	6.62			s.u.	05/22/2014 0830	Field
Conductivity	1982			µmhos/cm	05/22/2014 0830	Field
Turbidity	20.3			NTU	05/22/2014 0830	Field
Temperature	14.5			°C	05/22/2014 0830	Field
Static Water Level	99.82			ft	05/22/2014 0830	Field
General Parameters						
pH	7.8	0.1		s.u.	05/28/2014 0002 KV	SM 4500 H B
Electrical Conductivity	1980	5		µmhos/cm	05/28/2014 0002 KV	SM 2510B
Total Dissolved Solids (180)	1570	10		mg/L	05/27/2014 1400 BT	SM 2540
Solids, Total Dissolved (Calc)	1430	10		mg/L	06/05/2014 1609 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	462	5		mg/L	05/28/2014 0002 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	950	1		mg/L	06/05/2014 1609 JJ	SM 2340B
Nitrogen, Ammonia (As N)	5.0	0.1		mg/L	05/27/2014 1640 CA	EPA 350.1
'ium Adsorption Ratio	1.4	0.1			06/05/2014 1609 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	563	5		mg/L	05/28/2014 0002 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/28/2014 0002 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/28/2014 0002 KV	SM 2320B
Chloride	7	1		mg/L	05/27/2014 2049 AMB	EPA 300.0
Fluoride	0.5	0.1		mg/L	05/28/2014 0002 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	05/28/2014 1251 CA	EPA 353.2
Sulfate	742	1		mg/L	05/27/2014 2049 AMB	EPA 300.0
Cations						
Calcium	112	1		mg/L	05/27/2014 1253 DG	EPA 200.7
Magnesium	163	1		mg/L	05/27/2014 1253 DG	EPA 200.7
Potassium	27	1		mg/L	05/27/2014 1253 DG	EPA 200.7
Sodium	101	1		mg/L	05/27/2014 1253 DG	EPA 200.7

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Addendum D6-10-182

DEQ 6-532

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-001
Client Sample ID: 578408-MST-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 8:30:00 AM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.23	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Chloride	0.19	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Fluoride	0.02	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sulfate	15.45	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Calcium	5.60	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Magnesium	13.40	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Potassium	0.68	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sodium	4.40	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	24.45	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion Sum	24.90	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion-Anion Balance	0.91	0.01		%	06/05/2014 1609 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/27/2014 1253 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/24/2014 0507 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/24/2014 0507 MS	EPA 200.8
Boron	0.4	0.1		mg/L	05/27/2014 1253 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/24/2014 0507 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/27/2014 1253 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/24/2014 0507 MS	EPA 200.8
Iron	0.37	0.05		mg/L	05/27/2014 1253 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/24/2014 0507 MS	EPA 200.8
Manganese	0.07	0.02		mg/L	05/27/2014 1253 DG	EPA 200.7
Mercury	ND	0.001		mg/L	06/05/2014 1006 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/24/2014 0507 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/27/2014 1253 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/24/2014 0507 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/27/2014 1253 DG	EPA 200.7
Total Metals						
Iron	0.77	0.05		mg/L	05/28/2014 2003 DG	EPA 200.7
Manganese	0.07	0.02		mg/L	05/28/2014 2003 DG	EPA 200.7

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested. **RL - Reporting Limit**

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-004
Client Sample ID: 578409-CRN-OB-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 2:00:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.38			s.u.	05/20/2014 1400	Field
Conductivity	1944			µmhos/cm	05/20/2014 1400	Field
Turbidity	3.90			NTU	05/20/2014 1400	Field
Temperature	14.6			°C	05/20/2014 1400	Field
Static Water Level	89.87			ft	05/20/2014 1400	Field
General Parameters						
pH	7.9	0.1		s.u.	05/21/2014 1723 KV	SM 4500 H B
Electrical Conductivity	1950	5		µmhos/cm	05/21/2014 1723 KV	SM 2510B
Total Dissolved Solids (180)	1410	10		mg/L	05/21/2014 0413 BT	SM 2540
Solids, Total Dissolved (Calc)	1390	10		mg/L	05/29/2014 0955 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	510	5		mg/L	05/21/2014 1723 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	588	1		mg/L	05/29/2014 0955 JJ	SM 2340B
Nitrogen, Ammonia (As N)	5.2	0.1		mg/L	05/21/2014 1436 CA	EPA 350.1
ium Adsorption Ratio	4.2	0.1			05/29/2014 0955 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	622	5		mg/L	05/21/2014 1723 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/21/2014 1723 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/21/2014 1723 KV	SM 2320B
Chloride	10	1		mg/L	05/22/2014 2009 AMB	EPA 300.0
Fluoride	0.6	0.1		mg/L	05/21/2014 1723 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	05/22/2014 1319 CA	EPA 353.2
Sulfate	637	1		mg/L	05/22/2014 2009 AMB	EPA 300.0
Cations						
Calcium	91	1		mg/L	05/22/2014 2128 DG	EPA 200.7
Magnesium	88	1		mg/L	05/22/2014 2128 DG	EPA 200.7
Potassium	20	1		mg/L	05/22/2014 2128 DG	EPA 200.7
Sodium	235	1		mg/L	05/22/2014 2128 DG	EPA 200.7

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested. **RL - Reporting Limit**

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-004
Client Sample ID: 578409-CRN-OB-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 2:00:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	10.19	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Chloride	0.26	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sulfate	13.26	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Calcium	4.54	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Magnesium	7.20	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Potassium	0.50	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sodium	10.20	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	22.83	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion Sum	23.75	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion-Anion Balance	1.98	0.01		%	05/29/2014 0955 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/22/2014 2128 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/21/2014 1459 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/21/2014 1459 MS	EPA 200.8
Boron	0.2	0.1		mg/L	05/22/2014 2128 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/21/2014 1459 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/22/2014 2128 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/21/2014 1459 MS	EPA 200.8
Iron	ND	0.05		mg/L	05/22/2014 2128 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/21/2014 1459 MS	EPA 200.8
Manganese	0.11	0.02		mg/L	05/22/2014 2128 DG	EPA 200.7
Mercury	ND	0.001		mg/L	05/28/2014 1028 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/21/2014 1459 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/22/2014 2128 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/21/2014 1459 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/22/2014 2128 DG	EPA 200.7
Total Metals						
Iron	0.33	0.05		mg/L	05/23/2014 1259 DG	EPA 200.7
Manganese	0.12	0.02		mg/L	05/23/2014 1259 DG	EPA 200.7

These results apply only to the samples tested. **RL - Reporting Limit**

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TEN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-185

DEQ 6-535

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-003
Client Sample ID: 578409-MST-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 1:10:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.82			s.u.	05/20/2014 1310	Field
Conductivity	2390			µmhos/cm	05/20/2014 1310	Field
Turbidity	0.36			NTU	05/20/2014 1310	Field
Temperature	17.2			°C	05/20/2014 1310	Field
Static Water Level	100.95			ft	05/20/2014 1310	Field
General Parameters						
pH	8.2	0.1		s.u.	05/21/2014 1710 KV	SM 4500 H B
Electrical Conductivity	2150	5		µmhos/cm	05/21/2014 1710 KV	SM 2510B
Total Dissolved Solids (180)	1520	10		mg/L	05/21/2014 0412 BT	SM 2540
Solids, Total Dissolved (Calc)	1440	10		mg/L	05/29/2014 0955 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	655	5		mg/L	05/21/2014 1710 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	86	1		mg/L	05/29/2014 0955 JJ	SM 2340B
Nitrogen, Ammonia (As N)	3.1	0.1		mg/L	05/21/2014 1435 CA	EPA 350.1
ium Adsorption Ratio	24.2	0.1			05/29/2014 0955 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	799	5		mg/L	05/21/2014 1710 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/21/2014 1710 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/21/2014 1710 KV	SM 2320B
Chloride	9	1		mg/L	05/22/2014 1827 AMB	EPA 300.0
Fluoride	1.4	0.1		mg/L	05/21/2014 1710 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	0.5	0.1		mg/L	05/22/2014 1318 CA	EPA 353.2
Sulfate	477	1		mg/L	05/22/2014 1827 AMB	EPA 300.0
Cations						
Calcium	15	1		mg/L	05/22/2014 2123 DG	EPA 200.7
Magnesium	12	1		mg/L	05/22/2014 2123 DG	EPA 200.7
Potassium	14	1		mg/L	05/22/2014 2123 DG	EPA 200.7
Sodium	516	1		mg/L	05/22/2014 2123 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

- B Analyte detected in the associated Method Blank
- C Calculated Value
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- J Analyte detected below quantitation limits
- L Analyzed by a contract laboratory
- M Value exceeds Monthly Ave or MCL or is less than LCL
- ND Not Detected at the Reporting Limit
- O Outside the Range of Dilutions
- S Spike Recovery outside accepted recovery limits
- X Matrix Effect

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-186

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-003
Client Sample ID: 578409-MST-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 1:10:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.09	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Chloride	0.25	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Fluoride	0.07	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Nitrate + Nitrite as N	0.03	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sulfate	9.92	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Calcium	0.77	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Magnesium	0.94	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Potassium	0.36	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sodium	22.43	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	24.74	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion Sum	23.37	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion-Anion Balance	2.83	0.01		%	05/29/2014 0955 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/22/2014 2123 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/21/2014 1453 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/21/2014 1453 MS	EPA 200.8
Boron	0.1	0.1		mg/L	05/22/2014 2123 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/21/2014 1453 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/22/2014 2123 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/21/2014 1453 MS	EPA 200.8
Iron	ND	0.05		mg/L	05/22/2014 2123 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/21/2014 1453 MS	EPA 200.8
Manganese	0.20	0.02		mg/L	05/22/2014 2123 DG	EPA 200.7
Mercury	ND	0.001		mg/L	05/28/2014 1022 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/21/2014 1453 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/22/2014 2123 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/21/2014 1453 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/22/2014 2123 DG	EPA 200.7
Total Metals						
Iron	ND	0.05		mg/L	05/23/2014 1257 DG	EPA 200.7
Manganese	0.23	0.02		mg/L	05/23/2014 1257 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-187

DEQ 6-537

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-002
Client Sample ID: 578409-UBN-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 12:25:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.79			s.u.	05/20/2014 1225	Field
Conductivity	3990			µmhos/cm	05/20/2014 1225	Field
Turbidity	1.01			NTU	05/20/2014 1225	Field
Temperature	14.5			°C	05/20/2014 1225	Field
Static Water Level	110.40			ft	05/20/2014 1225	Field
General Parameters						
pH	8.1	0.1		s.u.	05/21/2014 1659 KV	SM 4500 H B
Electrical Conductivity	3620	5		µmhos/cm	05/21/2014 1659 KV	SM 2510B
Total Dissolved Solids (180)	2830	10		mg/L	05/21/2014 0411 BT	SM 2540
Solids, Total Dissolved (Calc)	2790	10		mg/L	05/29/2014 0955 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	466	5		mg/L	05/27/2014 1528 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	522	1		mg/L	05/29/2014 0955 JJ	SM 2340B
Nitrogen, Ammonia (As N)	2.2	0.1		mg/L	05/21/2014 1434 CA	EPA 350.1
ium Adsorption Ratio	13.5	0.1			05/29/2014 0955 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	569	5		mg/L	05/27/2014 1528 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/27/2014 1528 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/27/2014 1528 KV	SM 2320B
Chloride	28	1		mg/L	05/28/2014 0358 AMB	EPA 300.0
Fluoride	1.0	0.1		mg/L	05/21/2014 1659 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	3.2	0.1		mg/L	05/22/2014 1317 CA	EPA 353.2
Sulfate	1560	1		mg/L	05/22/2014 1813 AMB	EPA 300.0
Cations						
Calcium	85	1		mg/L	05/28/2014 1158 DG	EPA 200.7
Magnesium	75	1		mg/L	05/28/2014 1158 DG	EPA 200.7
Potassium	35	1		mg/L	05/22/2014 2121 DG	EPA 200.7
Sodium	707	1		mg/L	05/28/2014 1158 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

- B Analyte detected in the associated Method Blank
- C Calculated Value
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- J Analyte detected below quantitation limits
- L Analyzed by a contract laboratory
- M Value exceeds Monthly Ave or MCL or is less than LCL
- ND Not Detected at the Reporting Limit
- O Outside the Range of Dilutions
- S Spike Recovery outside accepted recovery limits
- X Matrix Effect

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-188

DEQ 6-538

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-002
Client Sample ID: 578409-UBN-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 12:25:00 PM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	9.32	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Chloride	0.77	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Fluoride	0.05	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Nitrate + Nitrite as N	0.22	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sulfate	32.53	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Calcium	4.24	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Magnesium	6.18	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Potassium	0.88	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sodium	30.77	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	42.24	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion Sum	42.92	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion-Anion Balance	0.79	0.01		%	05/29/2014 0955 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/22/2014 2121 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/21/2014 1437 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/21/2014 1437 MS	EPA 200.8
Boron	0.5	0.1		mg/L	05/22/2014 2121 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/21/2014 1437 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/22/2014 2121 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/21/2014 1437 MS	EPA 200.8
Iron	ND	0.05		mg/L	05/22/2014 2121 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/21/2014 1437 MS	EPA 200.8
Manganese	0.36	0.02		mg/L	05/27/2014 1149 DG	EPA 200.7
Mercury	ND	0.001		mg/L	05/28/2014 1020 CS	EPA 245.1
Molybdenum	0.03	0.02		mg/L	05/21/2014 1437 MS	EPA 200.8
Nickel	0.03	0.01		mg/L	05/22/2014 2121 DG	EPA 200.7
Selenium	0.005	0.005		mg/L	05/21/2014 1437 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/22/2014 2121 DG	EPA 200.7
Total Metals						
Iron	ND	0.05		mg/L	05/23/2014 1250 DG	EPA 200.7
Manganese	0.58	0.02		mg/L	05/23/2014 1250 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

- B Analyte detected in the associated Method Blank
- C Calculated Value
- E Value above quantitation range
- H Holding times for preparation or analysis exceeded
- J Analyte detected below quantitation limits
- L Analyzed by a contract laboratory
- M Value exceeds Monthly Ave or MCL or is less than LCL
- ND Not Detected at the Reporting Limit
- O Outside the Range of Dilutions
- S Spike Recovery outside accepted recovery limits
- X Matrix Effect

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

RAMACO
Inter-Mountain Labs
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Brook Mine
Your Environmental Monitoring Partner

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-001
Client Sample ID: 578415-MST/CRN-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 10:30:00 AM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.91			s.u.	05/20/2014 1030	Field
Conductivity	1778			µmhos/cm	05/20/2014 1030	Field
Turbidity	3.55			NTU	05/20/2014 1030	Field
Temperature	15.1			°C	05/20/2014 1030	Field
Static Water Level	121.23			ft	05/20/2014 1030	Field
General Parameters						
pH	8.3	0.1		s.u.	05/21/2014 1647 KV	SM 4500 H B
Electrical Conductivity	1750	5		µmhos/cm	05/21/2014 1647 KV	SM 2510B
Total Dissolved Solids (180)	1210	10		mg/L	05/21/2014 0410 BT	SM 2540
Solids, Total Dissolved (Calc)	1160	10		mg/L	05/29/2014 0955 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	710	5		mg/L	05/21/2014 1647 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	43	1		mg/L	05/29/2014 0955 JJ	SM 2340B
Nitrogen, Ammonia (As N)	2.3	0.1		mg/L	05/21/2014 1433 CA	EPA 350.1
'ium Adsorption Ratio	29.0	0.1			05/29/2014 0955 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	859	5		mg/L	05/21/2014 1647 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/21/2014 1647 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/21/2014 1647 KV	SM 2320B
Chloride	11	1		mg/L	05/22/2014 1758 AMB	EPA 300.0
Fluoride	2.0	0.1		mg/L	05/21/2014 1647 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	05/21/2014 1058 CA	EPA 353.2
Sulfate	263	1		mg/L	05/22/2014 1758 AMB	EPA 300.0
Cations						
Calcium	9	1		mg/L	05/22/2014 2119 DG	EPA 200.7
Magnesium	5	1		mg/L	05/22/2014 2119 DG	EPA 200.7
Potassium	9	1		mg/L	05/22/2014 2119 DG	EPA 200.7
Sodium	434	1		mg/L	05/22/2014 2119 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-190

DEQ 6-540

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 5/29/2014
Report ID: S1405349001

Project: Ramaco
Lab ID: S1405349-001
Client Sample ID: 578415-MST/CRN-1
COC: 151524

Work Order: S1405349
Collection Date: 5/20/2014 10:30:00 AM
Date Received: 5/20/2014 4:30:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	14.07	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Chloride	0.31	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Fluoride	0.10	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sulfate	5.47	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Calcium	0.45	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Magnesium	0.39	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Potassium	0.23	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Sodium	18.88	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	20.13	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion Sum	20.10	0.01		meq/L	05/29/2014 0955 JJ	SM 1030E
ion-Anion Balance	0.07	0.01		%	05/29/2014 0955 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/22/2014 2119 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/21/2014 1416 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/21/2014 1416 MS	EPA 200.8
Boron	ND	0.1		mg/L	05/22/2014 2119 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/21/2014 1416 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/22/2014 2119 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/21/2014 1416 MS	EPA 200.8
Iron	0.15	0.05		mg/L	05/22/2014 2119 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/21/2014 1416 MS	EPA 200.8
Manganese	0.07	0.02		mg/L	05/22/2014 2119 DG	EPA 200.7
Mercury	ND	0.001		mg/L	05/28/2014 1018 CS	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/21/2014 1416 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/22/2014 2119 DG	EPA 200.7
Selenium	0.005	0.005		mg/L	05/21/2014 1416 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/22/2014 2119 DG	EPA 200.7
Total Metals						
Iron	0.35	0.05		mg/L	05/23/2014 1246 DG	EPA 200.7
Manganese	0.08	0.02		mg/L	05/23/2014 1246 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-191

DEQ 6-541

1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-002
Client Sample ID: 578417-CRN-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 9:50:00 AM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.56			s.u.	05/22/2014 0950	Field
Conductivity	1375			µmhos/cm	05/22/2014 0950	Field
Turbidity	998			NTU	05/22/2014 0950	Field
Temperature	18.0			°C	05/22/2014 0950	Field
Static Water Level	133.55			ft	05/22/2014 0950	Field
General Parameters						
pH	8.3	0.1		s.u.	05/28/2014 0014 KV	SM 4500 H B
Electrical Conductivity	1370	5		µmhos/cm	05/28/2014 0014 KV	SM 2510B
Total Dissolved Solids (180)	870	10		mg/L	05/27/2014 1401 BT	SM 2540
Solids, Total Dissolved (Calc)	850	10		mg/L	06/05/2014 1609 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	430	5		mg/L	05/28/2014 0014 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	143	1		mg/L	06/05/2014 1609 JJ	SM 2340B
Nitrogen, Ammonia (As N)	0.5	0.1		mg/L	05/27/2014 1641 CA	EPA 350.1
ium Adsorption Ratio	8.9	0.1			06/05/2014 1609 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	513	5		mg/L	05/28/2014 0014 KV	SM 2320B
Alkalinity, Carbonate as CO3	6	5		mg/L	05/28/2014 0014 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/28/2014 0014 KV	SM 2320B
Chloride	7	1		mg/L	05/27/2014 2102 AMB	EPA 300.0
Fluoride	1.8	0.1		mg/L	05/28/2014 0014 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	4.6	0.1		mg/L	05/28/2014 1252 CA	EPA 353.2
Sulfate	258	1		mg/L	05/27/2014 2102 AMB	EPA 300.0
Cations						
Calcium	17	1		mg/L	05/27/2014 1255 DG	EPA 200.7
Magnesium	24	1		mg/L	05/27/2014 1255 DG	EPA 200.7
Potassium	15	1		mg/L	05/27/2014 1255 DG	EPA 200.7
Sodium	245	1		mg/L	05/27/2014 1255 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-192

DEQ 6-542

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-002
Client Sample ID: 578417-CRN-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 9:50:00 AM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	8.40	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Carbonate as CO3	0.19	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Chloride	0.20	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Fluoride	0.09	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Nitrate + Nitrite as N	0.33	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sulfate	5.37	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Calcium	0.87	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Magnesium	1.99	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Potassium	0.37	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sodium	10.67	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	13.95	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion Sum	14.61	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion-Anion Balance	2.29	0.01		%	06/05/2014 1609 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/27/2014 1255 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/24/2014 0523 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/24/2014 0523 MS	EPA 200.8
Boron	ND	0.1		mg/L	05/27/2014 1255 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/24/2014 0523 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/27/2014 1255 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/24/2014 0523 MS	EPA 200.8
Iron	ND	0.05		mg/L	05/27/2014 1255 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/24/2014 0523 MS	EPA 200.8
Manganese	ND	0.02		mg/L	05/27/2014 1255 DG	EPA 200.7
Mercury	ND	0.001		mg/L	06/05/2014 1008 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/24/2014 0523 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/27/2014 1255 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/24/2014 0523 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/27/2014 1255 DG	EPA 200.7
Total Metals						
Iron	12.9	0.05		mg/L	05/28/2014 2005 DG	EPA 200.7
Manganese	0.10	0.02		mg/L	05/28/2014 2005 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-193

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-006
Client Sample ID: 578511-CRN-1
COC: 151525

Work Order: S1405432
Collection Date: 5/23/2014 11:10:00 AM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.42			s.u.	05/23/2014 1110	Field
Conductivity	4050			µmhos/cm	05/23/2014 1110	Field
Turbidity	88.5			NTU	05/23/2014 1110	Field
Temperature	18.2			°C	05/23/2014 1110	Field
Static Water Level	119.58			ft	05/23/2014 1110	Field
General Parameters						
pH	8.2	0.1		s.u.	05/28/2014 0103 KV	SM 4500 H B
Electrical Conductivity	3810	5		µmhos/cm	05/28/2014 0103 KV	SM 2510B
Total Dissolved Solids (180)	2650	10		mg/L	05/27/2014 1406 BT	SM 2540
Solids, Total Dissolved (Calc)	2740	10		mg/L	06/05/2014 1609 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	823	5		mg/L	05/28/2014 0103 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	581	1		mg/L	06/05/2014 1609 JJ	SM 2340B
Nitrogen, Ammonia (As N)	6.4	0.1		mg/L	05/27/2014 1645 CA	EPA 350.1
'ium Adsorption Ratio	12.4	0.1			06/05/2014 1609 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	1000	5		mg/L	05/28/2014 0103 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/28/2014 0103 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/28/2014 0103 KV	SM 2320B
Chloride	27	1		mg/L	05/27/2014 2158 AMB	EPA 300.0
Fluoride	0.9	0.1		mg/L	05/28/2014 0103 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	05/28/2014 1151 CA	EPA 353.2
Sulfate	1340	1		mg/L	05/27/2014 2158 AMB	EPA 300.0
Cations						
Calcium	78	1		mg/L	05/27/2014 1325 DG	EPA 200.7
Magnesium	94	1		mg/L	05/27/2014 1325 DG	EPA 200.7
Potassium	25	1		mg/L	05/27/2014 1325 DG	EPA 200.7
Sodium	690	1		mg/L	05/27/2014 1325 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-006
Client Sample ID: 578511-CRN-1
COC: 151525

Work Order: S1405432
Collection Date: 5/23/2014 11:10:00 AM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	16.46	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Chloride	0.74	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Fluoride	0.04	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sulfate	27.80	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Calcium	3.87	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Magnesium	7.74	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Potassium	0.64	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sodium	30.00	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	42.72	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion Sum	45.05	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion-Anion Balance	2.65	0.01		%	06/05/2014 1609 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/27/2014 1325 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/24/2014 0545 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/24/2014 0545 MS	EPA 200.8
Boron	0.2	0.1		mg/L	05/27/2014 1325 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/24/2014 0545 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/27/2014 1325 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/24/2014 0545 MS	EPA 200.8
Iron	0.18	0.05		mg/L	05/27/2014 1325 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/24/2014 0545 MS	EPA 200.8
Manganese	0.47	0.02		mg/L	05/27/2014 1325 DG	EPA 200.7
Mercury	ND	0.001		mg/L	06/05/2014 1019 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/24/2014 0545 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/27/2014 1325 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/24/2014 0545 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/27/2014 1325 DG	EPA 200.7
Total Metals						
Iron	1.63	0.05		mg/L	05/28/2014 2014 DG	EPA 200.7
Manganese	0.51	0.02		mg/L	05/28/2014 2014 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-004
Client Sample ID: 578512-AL-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 1:35:00 PM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.33			s.u.	05/22/2014 1335	Field
Conductivity	5530			µmhos/cm	05/22/2014 1335	Field
Turbidity	21.6			NTU	05/22/2014 1335	Field
Temperature	16.3			°C	05/22/2014 1335	Field
Static Water Level	3.61			ft	05/22/2014 1335	Field
General Parameters						
pH	8.1	0.1		s.u.	05/28/2014 0038 KV	SM 4500 H B
Electrical Conductivity	5190	5		µmhos/cm	05/28/2014 0038 KV	SM 2510B
Total Dissolved Solids (180)	5300	10		mg/L	05/27/2014 1403 BT	SM 2540
Solids, Total Dissolved (Calc)	4680	10		mg/L	06/05/2014 1609 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	655	5		mg/L	05/29/2014 1506 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2640	1		mg/L	06/05/2014 1609 JJ	SM 2340B
Nitrogen, Ammonia (As N)	0.2	0.1		mg/L	05/27/2014 1643 CA	EPA 350.1
ium Adsorption Ratio	3.6	0.1			06/05/2014 1609 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	799	5		mg/L	05/29/2014 1506 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/29/2014 1506 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/29/2014 1506 KV	SM 2320B
Chloride	16	1		mg/L	05/29/2014 1205 AMB	EPA 300.0
Fluoride	0.8	0.1		mg/L	05/28/2014 0038 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	05/28/2014 1149 CA	EPA 353.2
Sulfate	3050	1		mg/L	05/29/2014 1205 AMB	EPA 300.0
Cations						
Calcium	324	1		mg/L	05/29/2014 1713 DG	EPA 200.7
Magnesium	444	1		mg/L	05/29/2014 1713 DG	EPA 200.7
Potassium	20	1		mg/L	05/29/2014 1713 DG	EPA 200.7
Sodium	431	1		mg/L	05/29/2014 1713 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-004
Client Sample ID: 578512-AL-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 1:35:00 PM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.09	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Chloride	0.46	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Fluoride	0.04	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sulfate	63.46	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Calcium	16.18	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Magnesium	36.54	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Potassium	0.51	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sodium	18.73	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	71.97	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion Sum	77.06	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion-Anion Balance	3.41	0.01		%	06/05/2014 1609 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/27/2014 1320 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/24/2014 0534 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/24/2014 0534 MS	EPA 200.8
Boron	0.4	0.1		mg/L	05/27/2014 1320 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/24/2014 0534 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/27/2014 1320 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/24/2014 0534 MS	EPA 200.8
Iron	0.86	0.05		mg/L	05/27/2014 1320 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/24/2014 0534 MS	EPA 200.8
Manganese	1.72	0.02		mg/L	05/27/2014 1320 DG	EPA 200.7
Mercury	ND	0.001		mg/L	06/05/2014 1012 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/24/2014 0534 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/27/2014 1320 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/24/2014 0534 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/27/2014 1320 DG	EPA 200.7
Total Metals						
Iron	5.17	0.05		mg/L	05/28/2014 2010 DG	EPA 200.7
Manganese	2.34	0.02		mg/L	05/28/2014 2010 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-197

DEQ 6-547

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-005
Client Sample ID: 578513-AL-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 3:00:00 PM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	7.26			s.u.	05/22/2014 1500	Field
Conductivity	4686			µmhos/cm	05/22/2014 1500	Field
Turbidity	0.17			NTU	05/22/2014 1500	Field
Temperature	17.5			°C	05/22/2014 1500	Field
Static Water Level	6.18			ft	05/22/2014 1500	Field
General Parameters						
pH	8.1	0.1		s.u.	05/28/2014 0050 KV	SM 4500 H B
Electrical Conductivity	4380	5		µmhos/cm	05/28/2014 0050 KV	SM 2510B
Total Dissolved Solids (180)	3730	10		mg/L	05/27/2014 1405 BT	SM 2540
Solids, Total Dissolved (Calc)	3920	10		mg/L	06/05/2014 1609 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	661	5		mg/L	05/28/2014 0050 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	2030	1		mg/L	06/05/2014 1609 JJ	SM 2340B
Nitrogen, Ammonia (As N)	ND	0.1		mg/L	05/27/2014 1644 CA	EPA 350.1
'ium Adsorption Ratio	4.1	0.1			06/05/2014 1609 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	806	5		mg/L	05/28/2014 0050 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/28/2014 0050 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/28/2014 0050 KV	SM 2320B
Chloride	17	1		mg/L	05/27/2014 2144 AMB	EPA 300.0
Fluoride	0.7	0.1		mg/L	05/28/2014 0050 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	ND	0.1		mg/L	05/28/2014 1150 CA	EPA 353.2
Sulfate	2460	1		mg/L	05/27/2014 2144 AMB	EPA 300.0
Cations						
Calcium	235	1		mg/L	05/27/2014 1323 DG	EPA 200.7
Magnesium	352	1		mg/L	05/27/2014 1323 DG	EPA 200.7
Potassium	29	1		mg/L	05/27/2014 1323 DG	EPA 200.7
Sodium	426	1		mg/L	05/27/2014 1323 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Addendum D6-10-198

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-005
Client Sample ID: 578513-AL-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 3:00:00 PM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	13.21	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Chloride	0.46	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Nitrate + Nitrite as N	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sulfate	51.25	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Calcium	11.70	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Magnesium	28.98	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Potassium	0.74	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sodium	18.52	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	59.95	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion Sum	64.97	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion-Anion Balance	4.02	0.01		%	06/05/2014 1609 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/27/2014 1323 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/24/2014 0540 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/24/2014 0540 MS	EPA 200.8
Boron	0.3	0.1		mg/L	05/27/2014 1323 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/24/2014 0540 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/27/2014 1323 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/24/2014 0540 MS	EPA 200.8
Iron	ND	0.05		mg/L	05/27/2014 1323 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/24/2014 0540 MS	EPA 200.8
Manganese	0.23	0.02		mg/L	05/27/2014 1323 DG	EPA 200.7
Mercury	ND	0.001		mg/L	06/05/2014 1017 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/24/2014 0540 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/27/2014 1323 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/24/2014 0540 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/27/2014 1323 DG	EPA 200.7
Total Metals						
Iron	0.06	0.05		mg/L	05/28/2014 2012 DG	EPA 200.7
Manganese	0.29	0.02		mg/L	05/28/2014 2012 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

DEQ 6-549

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-003
Client Sample ID: 578513-MST-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 12:05:00 PM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Field						
pH	6.87			s.u.	05/22/2014 1205	Field
Conductivity	4130			µmhos/cm	05/22/2014 1205	Field
Turbidity	2.22			NTU	05/22/2014 1205	Field
Temperature	17.2			°C	05/22/2014 1205	Field
Static Water Level	107.94			ft	05/22/2014 1205	Field
General Parameters						
pH	8.0	0.1		s.u.	05/28/2014 0025 KV	SM 4500 H B
Electrical Conductivity	3820	5		µmhos/cm	05/28/2014 0025 KV	SM 2510B
Total Dissolved Solids (180)	2970	10		mg/L	05/27/2014 1402 BT	SM 2540
Solids, Total Dissolved (Calc)	2920	10		mg/L	06/05/2014 1609 JJ	SM 1030E
Alkalinity, Total (As CaCO3)	607	5		mg/L	05/28/2014 0025 KV	SM 2320B
Hardness, Calcium/Magnesium (As CaCO3)	974	1		mg/L	06/05/2014 1609 JJ	SM 2340B
Nitrogen, Ammonia (As N)	9.4	0.1		mg/L	05/27/2014 1642 CA	EPA 350.1
'ium Adsorption Ratio	7.4	0.1			06/05/2014 1609 JJ	Calculation
Anions						
Alkalinity, Bicarbonate as HCO3	740	5		mg/L	05/28/2014 0025 KV	SM 2320B
Alkalinity, Carbonate as CO3	ND	5		mg/L	05/28/2014 0025 KV	SM 2320B
Alkalinity, Hydroxide as OH	ND	5		mg/L	05/28/2014 0025 KV	SM 2320B
Chloride	15	1		mg/L	05/27/2014 2116 AMB	EPA 300.0
Fluoride	0.6	0.1		mg/L	05/28/2014 0025 KV	SM 4500FC
Nitrogen, Nitrate-Nitrite (as N)	0.3	0.1		mg/L	05/28/2014 1148 CA	EPA 353.2
Sulfate	1690	1		mg/L	05/27/2014 2116 AMB	EPA 300.0
Cations						
Calcium	117	1		mg/L	05/27/2014 1300 DG	EPA 200.7
Magnesium	166	1		mg/L	05/27/2014 1300 DG	EPA 200.7
Potassium	30	1		mg/L	05/27/2014 1300 DG	EPA 200.7
Sodium	533	1		mg/L	05/27/2014 1300 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank
E	Value above quantitation range
J	Analyte detected below quantitation limits
M	Value exceeds Monthly Ave or MCL or is less than LCL
O	Outside the Range of Dilutions
X	Matrix Effect
C	Calculated Value
H	Holding times for preparation or analysis exceeded
L	Analyzed by a contract laboratory
ND	Not Detected at the Reporting Limit
S	Spike Recovery outside accepted recovery limits

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

Sample Analysis Report

CLIENT: Western Water Consultants
1849 Terra
Sheridan, WY 82801

Date Reported: 6/6/2014
Report ID: S1405432001

Project: Ramaco
Lab ID: S1405432-003
Client Sample ID: 578513-MST-1
COC: 151525

Work Order: S1405432
Collection Date: 5/22/2014 12:05:00 PM
Date Received: 5/23/2014 12:15:00 PM
Sampler: RF
Matrix: Water

Analyses	Result	RL	Qual	Units	Date Analyzed/Init	Method
Cation/Anion-Milliequivalents						
Bicarbonate as HCO3	12.13	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Carbonate as CO3	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Hydroxide as OH	ND	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Chloride	0.42	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Fluoride	0.03	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Nitrate + Nitrite as N	0.01	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sulfate	35.22	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Calcium	5.84	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Magnesium	13.64	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Potassium	0.75	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Sodium	23.20	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
Cation / Anion Balance						
Cation Sum	44.11	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion Sum	47.84	0.01		meq/L	06/05/2014 1609 JJ	SM 1030E
ion-Anion Balance	4.05	0.01		%	06/05/2014 1609 JJ	SM 1030E
Dissolved Metals						
Aluminum	ND	0.1		mg/L	05/27/2014 1300 DG	EPA 200.7
Arsenic	ND	0.005		mg/L	05/24/2014 0529 MS	EPA 200.8
Barium	ND	0.1		mg/L	05/24/2014 0529 MS	EPA 200.8
Boron	0.3	0.1		mg/L	05/27/2014 1300 DG	EPA 200.7
Cadmium	ND	0.001		mg/L	05/24/2014 0529 MS	EPA 200.8
Chromium	ND	0.01		mg/L	05/27/2014 1300 DG	EPA 200.7
Copper	ND	0.01		mg/L	05/24/2014 0529 MS	EPA 200.8
Iron	0.05	0.05		mg/L	05/27/2014 1300 DG	EPA 200.7
Lead	ND	0.02		mg/L	05/24/2014 0529 MS	EPA 200.8
Manganese	0.05	0.02		mg/L	05/27/2014 1300 DG	EPA 200.7
Mercury	ND	0.001		mg/L	06/05/2014 1010 CJB	EPA 245.1
Molybdenum	ND	0.02		mg/L	05/24/2014 0529 MS	EPA 200.8
Nickel	ND	0.01		mg/L	05/27/2014 1300 DG	EPA 200.7
Selenium	ND	0.005		mg/L	05/24/2014 0529 MS	EPA 200.8
Zinc	ND	0.01		mg/L	05/27/2014 1300 DG	EPA 200.7
Total Metals						
Iron	0.18	0.05		mg/L	05/28/2014 2007 DG	EPA 200.7
Manganese	0.05	0.02		mg/L	05/28/2014 2007 DG	EPA 200.7

These results apply only to the samples tested.

RL - Reporting Limit

Qualifiers:

B	Analyte detected in the associated Method Blank	C	Calculated Value
E	Value above quantitation range	H	Holding times for preparation or analysis exceeded
J	Analyte detected below quantitation limits	L	Analyzed by a contract laboratory
M	Value exceeds Monthly Ave or MCL or is less than LCL	ND	Not Detected at the Reporting Limit
O	Outside the Range of Dilutions	S	Spike Recovery outside accepted recovery limits
X	Matrix Effect		

Reviewed by: John M. Jacobs
John Jacobs, Project Manager
October 2014

TFN 6 2/025
RECD NOV 14, 2014

Inter-Mountain Labs

Sheridan, WY and Gillette, WY

- CHAIN OF CUSTODY RECORD -

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All shaded fields must be completed.
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151524

Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC	Ramaco	Rod Fuller	

Report Address	Contact Name	Email	Phone
	Jeff Barron - WWC		

Invoice Address

Purchase Order #

Quote # 439

ANALYSES / PARAMETERS: Quote 439

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME	SAMPLE IDENTIFICATION	Matrix	# of Containers	REMARKS
1	1405349-001	5/20/14	1030	578415-MST/CRN-1	WT	4	✓
2				pH= 7.91, EC= 1778, T= 15.1, TUR = 3.55, SWL = 121.23'			
3	002	5/20/14	1225	578409-UBN-1	WT	4	✓
4				pH= 7.79, EC= 3990, T= 14.5, TUR = 1.01, SWL = 110.40'			
5	003	5/20/14	1310	578409-MST-1	WT	4	✓
6				pH= 7.82, EC= 2390, T= 17.2, TUR = 0.36, SWL = 100.95'			
7	004	5/20/14	1400	578409-CRN-OB-1	WT	4	✓
8				pH= 7.38, EC= 1944, T= 14.6, TUR = 3.90, SWL = 89.87'			
9	005	5/20/14	1530	578408-CRN-1	WT	4	✓
10				pH= 6.91, EC= 2700, T= 13.7, TUR= 64.7, SWL= 87.71'			
11							
12							
13							
14							

TFN 6 2'025 RECD NOV 14, 2014

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
2.8°C	Rod Fuller	5/20/14	1628	S Stadler	5/20/14	16:30

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION		ADDITIONAL REMARKS
❑ UPS	Water	(WT)	**Check desired service**	Compliance Monitoring?	Y / N	
❑ Fed Express	Soil	SL	☒ Standard turnaround	Program (SDWA, NPDES,...)		
❑ US Mail	Solid	SD	❑ **RUSH - 5 Working Days**	PWSID / Permit #		
❑ Hand Carried	Filter	FT	❑ **URGENT** - < 2 Working Days	Chlorinated?	Y / N	
❑ Other _____	Other	OT	***Rush & Urgent Surcharges will be applied***	Sample Disposal: Lab	Client	

October 2014 RAMACO Addendum D6-10-202 Brook Mine

DEQ 6-552

Inter-Mountain Labs

Sheridan, WY and Gillette, WY

CHAIN OF CUSTODY RECORD -

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Client Name	Project Identification	Sampler (Signature/Attestation of Authenticity)	Telephone #
WWC	Ramaco	Rod Fuller	

Report Address	Contact Name	Email	Phone
WWC	Jeff Barron - WWC		

Invoice Address	Purchase Order #	Quote #
WWC		439

ANALYSES / PARAMETERS: Q# 439

ITEM	LAB ID (Lab Use Only)	DATE SAMPLED	TIME SAMPLED	SAMPLE IDENTIFICATION	Matrix	# of Containers	REMARKS
1	S1405432-001	5/22/14	0830	578408-MST-1	WT	4	✓
2				pH=6.62, EC=1982, T=14.5, TUR=20.3, SWL=99.82'			
3	002	5/22/14	0950	578417-CRN-1	WT	4	✓
4				pH=7.56, EC=1375, T=18.0, TUR=998, SWL=133.55'			
5	003	5/22/14	1205	578513-MST-1	WT	4	✓
6				pH=6.87, EC=4130, T=17.2, TUR=2.22, SWL=107.94'			
7	004	5/22/14	1335	578512-AL-1	WT	4	✓
8				pH=7.33, EC=5530, T=16.3, TUR=21.6, SWL=3.61'			
9	005	5/22/14	1500	578513-AL-1	WT	4	✓
10				pH=7.26, EC=4686, T=17.5, TUR=0.17, SWL=6.18'			
11	006	5/23/14	1110	578511-CRN-1	WT	4	✓
12				pH=7.42, EC=4050, T=18.2, TUR=88.5, SWL=119.58'			
13							
14							

RECD NOV 14, 2014 TFN 6 2/025

LAB COMMENTS	Relinquished By (Signature/Printed)	DATE	TIME	Received By (Signature/Printed)	DATE	TIME
0.4°C	Rod Fuller	5/23/14	1214	Kathy Boyd	5.23.14	12:15

SHIPPING INFO	MATRIX CODES		TURNAROUND TIMES	COMPLIANCE INFORMATION		ADDITIONAL REMARKS
☐ UPS	Water	WT	Check desired service	Compliance Monitoring?	Y / N	
☐ Fed Express	Soil	SL	☒ Standard turnaround	Program (SDWA, NPDES,...)		
☐ US Mail	Solid	SD	☐ RUSH - 5 Working Days	PWSID / Permit #		
☐ Hand Carried	Filter	FT	☐ URGENT - < 2 Working Days	Chlorinated?	Y / N	
☐ Other _____	Other	OT	*Rush & Urgent Surcharges will be applied*	Sample Disposal: Lab	Client	

October 2014 — Addendum D6-10-203 — RAMACO — Brook Mine

DEQ 6-553