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BROOK MINING CO., LLC.
BROOK MINE
VOLUME 6 OF 12
TFN 6 2/025

Brook Mine Permit Application

Volume VI

Appendix D7

DEQ Exhibit 7

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Brook Mine Permit Application Volume VI

VOLUME VI

Appendix D7

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APPENDIX D7

Soil Resources Assessment

Prepared by:
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Certified Professional Soil Scientist

July 2015

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D7 SOIL RESOURCES ASSESSMENT

D7.1 Introduction

This appendix describes the soil resources of the Brook Mine Area which is located in the Sheridan Coal Field of the Powder River Basin near the Montana – Wyoming state line. The proposed permit area is located approximately 6 miles northwest of Sheridan, Wyoming and lies along a portion of the north side of the Interstate 90 corridor between the Acme interchange and Ranchester, Wyoming. This appendix was prepared by James Nyenhuis, Certified Professional Soil Scientist, of Fort Collins, Colorado.

The identification and proper management of the soil resources in the Brook Mine Area is essential for the success of reclamation in the mine area and the achievement of the post-mining land use. The information presented in this soils report is designed to aid in formulating a practical and successful reclamation plan.

The Brook Mine Area comprises approximately 4,548.8 acres and is composed of Parcel 1, about 4,484.4 acres and Parcel 3, about 64.4 acres. The Brook Mine Area is located in portions of Sections 10, 11, 12, 13, 14, T.57N., R.85W., and portions of Sections 7, 8, 9, 10, 15, 17, 18, 20, 21, and 22, T.57N., R.84W. Approximately 1,113.5 acres are proposed for coal mining related disturbance and 2,624.4 acres could be affected by potential subsidence. Please refer to "Appendix 'C' – Right To Mine" Legal Description of the Permit Application for the complete legal descriptions of the proposed permit area.

Figure D7.1-1, Brook Mine Permit Area with Disturbance Boundary, shows the mine permit area as well as projected disturbance areas, potential subsidence areas, and other pertinent information.

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D7.2 Methodology

The soil resources of the Brook Mine Permit Area were investigated by James Nyenhuis, Certified Professional Soil Scientist/Soil Classifier (ARCPACS #2743), during the spring and summer of 2014. Soils mapping, soil profile and map unit description, taxonomic classification, and soil sampling was conducted in accordance with the procedures and standards of the National Cooperative Soil Survey (Soil Survey Staff, 1993, 1997, 1998, 1999, and 2010; and Schoeneberger et al., 2012), and "Guideline No. 1, Soils and Overburden" (WDEQ-LQD,1996). Reference was also made to "Guideline No.1A, Topsoil and Subsoil" (Draft, May 2014) as well as recent University of Wyoming soil and reclamation bulletins (B-1202, B-1204, B-1206, and B-1212). Based on definitions in the Wyoming Rules and Regulations, Topsoil means the A and E Horizons or any combination thereof; Subsoil means the B and C Horizons excluding consolidated bedrock material. The term "soil" refers to both topsoil and subsoil.

Initial mapping units were identified using Natural Resources and Conservation Service (NRCS) Sheridan County Order 3 soil survey map sheets 18, 19, 30, and 31 (Lupcho, 1986), recent air photo images, and the USGS 7.5' Monarch and Acme topographic quadrangle maps and surficial geologic maps (Barnum, 1983). An excellent recent digital orthophoto base map, with topographic contours, of the project area (created by Horizons, Inc., Rapid City, SD, photo date November 2, 2011) was also available and used during the soils field work. The previous soil map units and polygon delineation boundaries were viewed during initial field reconnaissance and observation but were soon determined to be inaccurate in some areas and generally not detailed enough.

Consistent with recommended procedures in Guideline No.1 (WDEQ-LQD, 1996), all areas projected to be disturbed by coal mining activities (affected lands) were mapped at the detailed Order 1-2 level of intensity. All non-to-be-disturbed areas (non-affected lands) were mapped either to the less detailed Order 3 level or to a better, more detailed level (Order 2 or Order 1-2)

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depending on area. The entire Brook Mine Area was traversed by vehicle where possible and generally on foot in most areas. Soil map unit boundaries were delineated by digging soil profiles using a "Montana spade sharpshooter" and six-foot bucket auger as well as observing surface conditions including geology, vegetation, and slope aspect/gradient.

Coal mining will be done primarily "underground" through "highwall mining panels" but will also include some small areas of surface mining. The areas above the highwall mining panels could have possible "subsidence" features and these areas are clearly delineated on the Brook Mine Area base map. The potential subsidence areas did not require the detailed Order 1-2 soils mapping as noted in a WDEQ memorandum to the project file (RAMACO Preliminary Permit Correspondence, TFN 6 2/025) and attached to this report as Exhibit D7.2-1, Soil Sampling Protocol (RAMACO, TFN 6 2/025). As stated in the memorandum, "Soils on surfaces underlain by mining without surface disturbance (potential subsidence areas) require a minimum Class 3 mapping" (WDEQ-LQD, 2014b). "Class 3" (an archaeological survey level of investigation term) is meant to mean "Order 3" (a soil survey level of investigation term).

For mapping units on affected (to-be-disturbed) lands, if soils were similar (low contrasting in physical and/or chemical properties and/or depth), consociations of a minimum size of five acres were delineated. Similar soils could be mapped as complexes or associations provided their physical and chemical properties would allow for the same salvage depth recommendation. If soils are dissimilar (highly contrasting in physical and/or chemical properties and/or depth), individual soil series (consociations) of a minimum size of two acres were delineated.

Soils on non-affected areas were not required to be sampled for laboratory analysis. Soils on affected (to-be-disturbed) lands were described and sampled for laboratory analysis according to recommended minimum intensities (WDEQ, 1996) as follows: 1 sample pedon was collected and analyzed in the laboratory if the soil series comprised up to 40 acres in size or

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was up to 2% of the affected mine area, 2 sample pedons were collected and analyzed in the laboratory if the soil series comprised between 40 and 160 acres or was at least 2 to 5% of the affected mine area, and 3 sample pedons were collected and analyzed in the laboratory if the soil series comprised greater than 160 acres or was greater than 5% of the affected mine area. Rock Outcrop, Disturbed Land, and Water, either as a consociation or part of a map unit complex, was not sampled for laboratory analysis but was carefully mapped for accurate geographic location and acreage determination.

As such, all soils, regardless of soil depth, were fully described and sampled by major horizons at representative sites at least the minimum required times. In addition, soil resource information for the adjacent and previously permitted Big Horn Coal Mine (Big Horn Coal Company, 1983), now reclaimed, was reviewed to determine whether soils and their recommended salvage depths were similar to those within the currently proposed Brook Mine Area.

Soil series names are based on site-specific characteristics and current NRCS soil series criteria as obtained from consultation with NRCS personnel and information from the official NRCS soils web site. Current Sheridan County soils information for the project area is available and was obtained and reviewed during the field survey (Lupcho, 1986). Any hydric soil indicators (NRCS, 2010), if present, in the freshly dug soil auger holes, would be described on the soil profile description forms filled out at the sample sites.

Following soil mapping, representative locations were selected for all mapped soils within the project area and these sites were fully described and sampled from freshly dug soil auger holes. Representative sample locations were selected to most accurately represent the soil series and to provide for adequate sample site distribution across the study area. Transition zones between map unit delineations, road edges, or previously disturbed areas were avoided. Representative profiles were selected on the basis of medial

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characteristics for physical and chemical soil parameters, parent material, landscape position, and vegetation.

Soil samples were collected from each major horizon and subhorizon at the sample sites. Approximately 1.5 to 2 quarts of soil material per sample was collected into clean Ziploc plastic bags. Sample material was field screened over a 2-mm (0.078 inch), U.S.A. Standard Testing #10 soil screen to determine coarse fragment content (percent by volume). A few samples with hard soil clods were not field screened, although estimated coarse fragment rock content was recorded based on visual determination.

Standard NRCS (Soil Survey Staff, 1994) "232" profile description forms were completed in the field at each sample site and are included with this report. The following data were recorded: sample site number, date, soil series name, map unit number, location, soil classification, vegetation, parent material, physiography, slope gradient and aspect, erosion condition, moisture status at time of sampling, drainage class, depth to groundwater if encountered, salts or alkali if present, permeability, horizon designations and depths, soil color (dry and moist), texture, coarse fragment content, structure, consistence, roots, effervescence (presence of carbonates), and horizon boundary.

A total of one hundred and eleven soil samples (111) were collected from twenty-seven (27) representative soil sample locations (sites "R1" through "R27"). The soil samples were delivered to Inter-Mountain Laboratories (IML) in Sheridan, Wyoming for standard soils analysis (WDEQ, 1996). The soil laboratory analyses included: pH, electrical conductivity (EC, dS/m); saturation percent; organic matter percent (Walkley Black method); calcium, magnesium, and sodium (meq/l); calculation of Sodium Adsorption Ratio (SAR); soil texture by hydrometer (percent sand, not including very fine sands fractionation; silt; and clay), Boron (ppm by Hot Water Boron method); and Selenium (ppm by Extractable Selenium method).

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Percent coarse fragments, by volume estimate, for each sample (sand >2mm, pebbles, gravel, and cobbles), as well as soil effervescence (EO, noneffervescent; SE, slightly effervescent; EM, moderately effervescent; ES, strongly effervescent; or EV, violently effervescent) were determined in the field at the time of sampling. Effervescence in dilute hydrochloric acid (.1N) is one measure of calcium carbonate content of the soil. IML maintains its own QA/QC laboratory procedures. The results of the IML soil laboratory analysis are included with this report.

The results of the soils field mapping, profile descriptions, and soils laboratory analysis were used to evaluate soil suitability and generate project-specific soil salvage recommendations. The suitability evaluation and salvage recommendation was completed for all component soils of survey map units. The evaluation followed parameters and threshold values contained in Table I-2 "Criteria to establish suitability of topsoil (or topsoil substitutes)" of Guideline No.1 "Topsoil and Overburden" (WDEQ, 1996).

Unsuitability threshold values include: pH <5.0 or > 9.0; electrical conductivity (EC) >12; sodium adsorption ratio (SAR) >15, or >12 for soils with greater than 40% clay; coarse fragment (rock) content >35%; saturation percent <25% or >80% (marginal rated); sand, clay, or silty clay texture (marginal rated); Boron (>5.0 ppm), and Selenium (<0.3 ppm = suitable, 0.3 to 0.8 ppm = marginal).

The recommended soil salvage depths are listed and discussed in the various soil mapping unit descriptions in the results section of this report. Topsoil volumes for salvaged soils are included in the project mine and reclamation plan.

D7.3 Results

D7.3.1 General Soils Information

The Brook Mine permit area is within a "mesic" soil temperature regime (average annual temperature about 45 to 47 degrees F.), an "ustic-aridic" soil

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moisture regime (average annual precipitation about 12 to 14 inches), and the average frost-free period is about 110 to 120 days (Lupcho, 1986). Surface elevations within the permit area range from 3,590 feet where the Tongue River crosses the permit in the east portion of the permit area in Section 15 of Township 57N Range 84W to the highest of 4,110 feet above mean sea level (amsl) in Section 7 of Township 57N Range 84W.

The Tongue River is the principal drainage in the permit area and generally flows along the southern edge of the area. Additional drainages in the permit area include Hidden Water and Slater Creek, both tributaries of the Tongue River. Hidden Water traverses northwest to southeast along the northeast part of the permit area. Slater Creek also traverses northwest to southeast and is in the west central part of the permit area. Both have narrow valley floors, Hidden Water more so than Slater Creek. Some mine subsidence features from previous underground coal mining are present on the land surface in a few areas. Some reclaimed land from Big Horn Coal (Permit No. 213 T7) is also present in the southeast portion of the Brook Mine permit area.

Soils in the permit area are forming in claystone, siltstone, shale, and sandstone of the Fort Union Formation of Paleocence age. Coal seams, including thin local seams as well as the Carney and Masters seams of mining interest, are interbedded within the formation. The permit and adjacent area is characterized by the presence of sixteen map units with ten dominant soils and four miscellaneous units: Cambria loam (Map Unit A), Zigweid loam (Map Unit B), Forkwood loam (Map Unit C), Shingle channery loam (Map Unit D), Samday clay loam (Map Units E and F), Bauxson loam (Map Unit G), Haverdad loam (Map Unit H), Wibaux channery loam (Map Units Wx and Wx-Bx-RO), Ulm clay loam (Map Unit U), and Worthenton clay loam (Map Unit Wo). Additional map units include: Reclaimed Land (Map Unit RL), Rock Outcrop (Map Unit RO), Disturbed Land (Map Unit DL), and Water (Map Unit W).

Cambria, Forkwood, Zigweid, and Haverdad soils are all deep, well-drained, nonsaline and nonsodic loamy soils mapped across the permit area.

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Haverdad is mapped on drainages. Worthenton is a deep, poorly-drained, fine textured hydric soil but is not mapped within the permit area. Ulm is also deep, well-drained, nonsaline and nonsodic but is fine textured rather than loamy. Shingle and Samday soils are both shallow, well drained, nonsaline and nonsodic upland soils. Shingle is loamy whereas Samday is clayey. Wibaux and Bauxson are both well-drained soils mapped on the extensive scoria landscape within the permit area. Wibaux is effectively a well-drained shallow soil with 7 to 20 inches of channery to very channery sandy loam to loam to the fragmental contact which has as high as 95% fractured scoria (porcelanite). Bauxson is similar to Wibaux but has slightly deeper loamy soil before the fractured scoria contact.

Since 1980, NRCS has revised its thinking concerning soil climate characteristics and subsequently soil series names. Certain soils were considered to be within a 10 to 14 inch precipitation zone, and others were in a 15 to 17 inch zone. Furthermore, some soils were put into a colder temperature and shorter growing season group (to be consistent with the climate of the northern PRB), and others were grouped with warmer and longer growing season soils mapped further south into northeastern Colorado.

As a result, there have been several name changes since 1980 (the time of the Big Horn Coal soil survey) for soils mapped in the general Brook Mine Area. For example, Samday replaces Samsil, Haverdad replaces Haverson, Forkwood replaces Fort Collins, Bauxson replaces Spearman, and Worthenton replaces Worthing taxajunct. These are the same soils morphologically, they just represent slightly different climatic and/or other taxonomic conditions. These changes were made by NRCS as part of recent northern Wyoming soil surveys including Sheridan County, Northern and Southern Campbell County, and Northern Johnson County (Westerman and Prink, 2004). The former soil names are no longer recognized as present in the survey area, and the new names replace them. These are not new soils, just renamed soils.

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Concerning Prime Farmland, none of the soils in the Brook Mine Area are listed by NRCS as meeting criteria for Prime Farmland status (NRCS, 2006a; NRCS, 2014). None of the soils on the adjacent, previous Big Horn Coal Mine area meet Prime Farmland status as well (Lupcho, 1980).

Exhibit D7.3-1, Brook Mine Area Soils Map, is attached to this report. It was compiled on a RAMACO ortho-photo base map at a scale of 1″=400′, and digitized and produced by WWC Engineering of Sheridan, Wyoming. Base map details: Photo date November 2, 2011; Fugro Geospatial Inc. (Horizons Inc., Rapid City, South Dakota); details provided in email from David Holm to Jeff Baron, 6/27/2014. The Exhibit includes soil map unit delineations and sample site locations. Some soils mapping is also provided for areas outside of but immediately adjacent to the Brook Mine Area boundary. The map unit legend provides map unit symbols and names, including slope percentages, and recommended soil salvage depths.

Table D7.3-1, Brook Mine Area List of Soil Map Units and Acreages, provides a list of soil map units and acreages for both to-be-disturbed and non-affected areas within the Brook Mine Area.

Addendum D7-1, Soil Profile Descriptions, provides the legible, field soil profile description forms for all 27 soil series descriptions completed during the soil survey.

Addendum D7-2, Soil Laboratory Results, provides the results of the IML laboratory analysis of the 111 soil samples collected during the soil survey.

D7.3.2 Soil Suitability and Salvage Depth Recommendation

Soil suitability has been evaluated and soil salvage depths recommended for each component of all soil map units for the Brook Mine Area. Table D7.3-2, Criteria to Establish Topsoil and Overburden Suitability, lists parameter criteria and threshold values for this evaluation. Table D7.3-3, Brook Mine Area List of Soil Map Units and Salvage Depth Recommendations lists the soil map units within the permit area, their soil sample site numbers, and

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summarizes their estimated salvage depths and limitations to deeper salvage. The soils map for the Brook Mine Area also lists the recommended soil salvage depths by map unit. Projected disturbance acreage for each map unit, as well as estimated cubic yard volumes of recommended salvageable soil, will be contained in the Brook Mine mine and reclamation plan. An estimated weight-average suitable soil salvage depth of 20.2 inches, including both topsoil and subsoil, was calculated for the 1,113.5-acre Brook Mine Area proposed disturbance area. The mine plan will calculate the site-specific topsoil salvage and replacement depths and topsoil volumes for each projected mine disturbance area. The average salvage depth for individual disturbance areas may differ from that of the soils study area as a whole.

Results indicate that many map units (A, C, D, E, G, H, and RL) have both moderate acreage and a deep recommended soil salvage depth. These map units contain the best soils from a soil suitability perspective – Cambria, Forkwood, Shingle, Samday, Bauxson, Haverdad, and Reclaimed Land. Wibaux, Wibaux-Rock Outcrop, and Samday-Rock Outcrop have limited suitable soil for salvage. Disturbed Land, Rock Outcrop, and Water have no soil for salvage.

Based on the physical and chemical soil characteristics, and the topsoil suitability evaluation, it is apparent that sufficient suitable topsoil and subsoil, if properly salvaged, exists across the Brook Mine Area for the successful reclamation of any subsequent mining related disturbance areas.

D7.3.3 Soil Series and Map Unit Descriptions

The following text is a description of the sixteen soil map units on the Brook Mine Area and their component soil series, as well as an evaluation of their topsoil suitability and recommended estimated salvage depths. All soil sample sites are plotted on the soils map. Photographs of all soil sample sites are on file. The descriptions are presented below.

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D7.3.3.1 Map Unit A: Cambria loam, 2 to 8% slopes

Cambria loam (Map Unit A) is mapped in many map delineations scattered across the permit area and is located primarily on gently sloping alluvial fans, terraces, and lower sideslopes. Cambria loam is a deep (40+ inches to bedrock), well-drained soil developing in medium-textured to moderately fine-textured local alluvium from interbedded sedimentary rock including sandstone and shale.

In a typical profile, Cambria has a light brownish gray sandy loam to loam "A" horizon surface layer about 5 inches thick. The upper 5 inches of the "Bt" argillic subsoil horizon is a brown silty clay loam. The next 5 inches is a pale brown clay loam. The lower part of the profile to 40 inches or deeper is a pale brown loam. The soil is nonsaline and nonsodic and has slightly acid to neutral reaction (pH) in the upper horizons and slightly alkaline to moderately alkaline reaction throughout the rest of the profile.

Cambria loam has moderate permeability and high available water capacity. The effective rooting depth is greater than 40 inches, the depth to the underlying bedrock contact. Surface runoff is medium and the erosion hazard from water is moderate and severe from wind. The erosion "K Factor" is 0.32, the "T Factor" is 5, the Wind Erodibility Group is 3, and the Hydrologic Group is B. The Cambria soil is in the "Loamy, 10 to 14-inch precipitation zone, Northern Plains" range site.

The Cambria soil is classified as a "fine-loamy, mixed, superactive, mesic Ustic Haplargid", and is an established soil series of moderate extent mapped in Wyoming. The most recent NRCS official soil series description for Cambria, dated 11/2005 is on file at RAMACO.

Cambria loam was described and sampled at three representative sites on the Brook Mine permit area (R5, R6, and R10), and the profile descriptions are contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R5 is located in a portion of the NW1/4 of the SW1/4 of the

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SW1/4 of Section12, T.57N., R.85W. GPS coordinates: 44 degrees, 55′, 31″ North; 107 degrees, 4′, 10″ West. Sample site R6 is located in a portion of the SE1/4 of the NE1/4 of the NW1/4 of Section13, T.57N., R.85W. GPS coordinates: 44 degrees, 53′, 40″ North; 107 degrees, 1′, 54″ West. Sample site R10 is located in a portion of the SE1/4 of the NE1/4 of the NW1/4 of Section17, T.57N., R.84W. GPS coordinates: 44 degrees, 40′, 24″ North; 106 degrees, 51′, 59″ West.

Map Unit A (Cambria loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 10″, Subsoil 15″

The upper 25 inches of Cambria loam (Map Unit A) is entirely "suitable" and recommended for salvage. The electrical conductivity (EC) in the three sampled Cambria pedons (R5, R6, and R10) increased below about 25 inches to values ranging from 6.19 to 6.81 (sample site R10), to 7.03 (sample site R5), and to 8.60 and then 9.49 (sample site R6). EC values above 8 are considered "marginal". Sodium Adsorption Ratio (SAR) values also increased below about 25 inches but not enough to be considered "marginal". Organic matter content in Cambria sample site R10 decreased significantly below 18 inches with values from 0.2 to <0.1 percent. As a result, 25 inches is a good cutoff for salvage in order to not dilute the higher quality of the upper soil material. It makes good sense to separately salvage Topsoil and Subsoil for Cambria (WDEQ-LQD, 2014, p.3). Therefore, the upper 10 inches of Cambria is recommended for salvage as Topsoil and the underlying 15 inches as Subsoil. Deeper Cambria marginal soil material could be salvaged if needed.

D7.3.3.2 Map Unit B: Zigweid loam, 0 to 3% slopes

Zigweid loam (Map Unit B) was mapped in five small delineations located on a low terrace of the Tongue River in an area of Section 13 (T.57N., R.85W.) immediately south of Interstate 90 that is now adjacent to but not within the Brook Mine Permit Area. The soils report retains Map Unit B and provides the following descriptive information. Zigweid loam is a deep (40+ inches to

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bedrock), well-drained soil developing in medium-textured to moderately fine-textured local alluvium from interbedded sedimentary rock including sandstone and shale. Zigweid was previously mapped in the Big Horn Coal soil survey as Map Unit a37A (Zigweid loam, 0 to 3% slopes).

In a typical profile, Zigweid has a brown loam "A" horizon surface layer about 4 inches thick. The upper part of the "Bw" cambic subsoil horizon is a brown loam to clay loam about 12 inches thick. The lower part of the "Bw" cambic subsoil horizon is a pale brown loam to clay loam about 12 inches thick. The underlying "C" horizon substratum is a pale brown to yellowish brown clay loam to loam to a depth of 40 inches to 72 inches. The soil is nonsaline and nonsodic and has neutral reaction (pH) in the surface layer and neutral to slightly alkaline reaction throughout the rest of the soil profile.

Zigweid loam has moderate permeability and high available water capacity. The effective rooting depth is greater than 40 inches, the depth to the underlying bedrock contact. Surface runoff is medium and the erosion hazard from water is slight and moderate from wind. The erosion "K Factor" is 0.32, the "T Factor" is 5, the Wind Erodibility Group is 4L, and the Hydrologic Group is B. The Zigweid soil is in the "Loamy, 10 to 14-inch precipitation zone, Northern Plains" range site.

The Zigweid soil is classified as a "fine-loamy, mixed, superactive, mesic Ustic Haplocambid", and is an established soil series of moderate extent mapped in northeastern and central Wyoming. The most recent NRCS official soil series description for Zigweid, dated 03/2003 is on file at RAMACO.

Zigweid loam was described and sampled at one representative site (R26) located just outside the Brook Mine permit area. The soil profile description for R26 is contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R26 is located in a portion of the SW1/4 of the SW1/4 of Section13, T.57N., R.85W. GPS coordinates: 44 degrees, 54′, 58″ North; 107 degrees, 5′, 52″ West.

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Map Unit B (Zigweid loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 16" (1.3'), Subsoil 56" (4.7')

The entire soil profile to 72 inches (6 feet) in depth is suitable and recommended for soil salvage. All soil parameters are suitable. It makes good sense to separately salvage Topsoil and Subsoil for Zigweid (WDEQ-LQD, 2014, p.3). The upper 16 inches of Zigweid are recommended for salvage as Topsoil and the underlying 56 inches as Subsoil.

D7.3.3.3 Map Unit C: Forkwood loam, 4 to 25% slopes

Forkwood loam (Map Unit C) is mapped in many delineations scattered across the permit area and is located primarily on hill slopes, alluvial fans, terraces, and lower sideslopes. Forkwood loam is a deep (40+ inches to bedrock), well-drained soil developing in medium-textured to moderately fine-textured local alluvium from interbedded sedimentary rock including sandstone and shale. Forkwood was previously mapped in the Big Horn Coal soil survey as Map Unit 88A (Fort Collins loam, 0 to 3% slopes) and Map Unit 88B (Fort Collins loam, 3 to 6% slopes).

In a typical profile, Forkwood has a light brownish gray loam "A" horizon surface layer about 4 inches thick. The upper 8 inches of the "Bt" argillic subsoil horizon is a grayish brown clay loam. The lower 12 inches of the "Bt" argillic subsoil horizon is a light brownish gray clay loam. The lower part of the profile, the "C" horizon substratum, to 40 inches or deeper is a pale brown loam to clay loam. The soil is nonsaline and nonsodic and has slightly acid to neutral reaction (pH) in the upper horizons and slightly alkaline to moderately alkaline reaction throughout the rest of the profile.

Forkwood loam has moderate permeability and high available water capacity. The effective rooting depth is greater than 40 inches, the depth to the underlying bedrock contact. Surface runoff is slow and the erosion hazard from water is slight and moderate from wind. The erosion "K Factor" is 0.32, the "T Factor" is 5, the Wind Erodibility Group is 5, and the Hydrologic Group

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is B. The Forkwood soil is in the "Loamy, 10 to 14-inch precipitation zone, Northern Plains" range site.

The Forkwood soil is classified as a "fine-loamy, mixed, superactive, mesic Ustic Haplargid", and is an established soil series of large extent mapped in central and northern basin areas of Wyoming. It is also the State Soil of Wyoming. The most recent NRCS official soil series description for Forkwood, dated 10/2002 is on file at RAMACO.

Forkwood loam was described and sampled at three representative sites on the Brook Mine permit area (R9, R12, and R14), and the profile descriptions are contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R9 is located in a portion of the NW1/4 of the NW1/4 of the NW1/4 of Section18, T.57N., R.84W. GPS coordinates: 44 degrees, 54′, 31″ North; 107 degrees, 8′, 25″ West. Sample site R12 is located in a portion of the SW1/4 of the SE1/4 of the SW1/4 of Section8, T.57N., R.84W. GPS coordinates: 44 degrees, 55′, 23″ North; 107 degrees, 1′, 35″ West. Sample site R14 is located in a portion of the SE1/4 of the SE1/4 of the NW1/4 of Section14, T.57N., R.85W. GPS coordinates: 44 degrees, 55′, 2″ North; 107 degrees, 4′, 54″ West.

Map Unit C (Forkwood loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 12″ (1′), Subsoil 45″ (3.75′)

Forkwood loam pedons R12 and R14 are entirely suitable throughout their profile depths, 72 and 55 inches, respectively. Forkwood pedon R9, 46 inches deep to bedrock, however, has "marginal" EC (10.6) and "marginal" Selenium (0.37 ppm) from 35 to 46 inches in depth. Neither moderate value is a significant limitation and should dilute upon mixing, and therefore the entire Forkwood profile, an average depth of 57 inches, is recommended for salvage. It makes good sense to separately salvage Topsoil and Subsoil for Forkwood (WDEQ-LQD, 2014, p.3). Therefore, the upper 12 inches of Forkwood is recommended for salvage as Topsoil and the underlying 45 inches as Subsoil.

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D7.3.3.4 Map Unit D: Shingle channery loam, 2 to 25% slopes

Shingle channery loam (Map Unit D) is mapped in several delineations scattered across the permit area and is located primarily on hills and sideslopes. Shingle channery loam is a shallow (10 to 20 inches to bedrock), well-drained soil developing in loamy, medium-textured thin residuum and colluvium from interbedded sedimentary rock including claystone, mudstone, siltstone, and shale. Shingle was previously mapped in the Big Horn Coal soil survey as Map Unit 73 (Shingle clay loam, 0 to 45% slopes).

In a typical profile, Shingle has a light yellowish brown channery loam "A" horizon surface layer about 2 or 3 inches thick. The underlying "C" horizon substratum to 10 to 20 inches in depth is a light yellowish brown loam to clay loam over weathered siltstone, sandstone, or shale. The soil is nonsaline to slightly saline and nonsodic to slightly sodic and has slightly acid to neutral reaction (pH) in the upper horizons and slightly alkaline to moderately alkaline reaction in the lower horizons.

Shingle channery loam has slow permeability and very low available water capacity. The effective rooting depth is 10 to 20 inches, the depth to the underlying bedrock contact. Surface runoff is rapid and the erosion hazard from water is severe and moderate from wind. The erosion "K Factor" is 0.37, the "T Factor" is 1, the Wind Erodibility Group is 4L, and the Hydrologic Group is D. The Shingle soil is in the "Shallow Loamy, 10 to 14-inch precipitation zone, Northern Plains" range site.

The Shingle soil is classified as a "Loamy, mixed, superactive, calcareous, mesic shallow Ustic Torriorthent", and is an established soil series of moderate extensively mapped in northern and eastern Wyoming. The most recent NRCS official soil series description for Shingle, dated 11/2005 is on file at RAMACO.

Shingle channery loam was described and sampled at two representative sites on the Brook Mine permit area (R8 and R16), and the profile descriptions are contained in Addendum D7-1 and the soils laboratory data in Addendum

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D7-2. Sample site R8 is located in a portion of the SE1/4 of the SE1/4 of the NE1/4 of Section13, T.57N., R.85W. GPS coordinates: 44 degrees, 50′, 48″ North; 106 degrees, 59′, 8″ West. Sample site R16 is located in a portion of the NW1/4 of the SE1/4 of the NW1/4 Section13, T.57N., R.85W. GPS coordinates: 44 degrees, 51′, 27″ North; 106 degrees, 59′, 22″ West.

Map Unit D (Shingle channery loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 19″ (1.6′)

Shingle channery loam is entirely "suitable" for soil salvage and has no limiting parameter. The entire soil profile of Shingle is recommended for salvage, an average depth of 19 inches (R8,20″ and R16,18″). The organic matter content of the "C" horizon substratum, the lowest horizon in the soil profile, remains above 0.5 percent across all pedons and therefore the entire profile can be salvaged as one Topsoil lift, an average of 19 inches to the weathered bedrock.

D7.3.3.5 Map Unit E: Samday clay loam, 2 to 25% slopes

Samday clay loam (Map Unit E) is mapped in many delineations scattered across the permit area and is located primarily on hills and sideslopes. Samday clay loam is a shallow (10 to 20 inches to bedrock), well-drained soil developing in fine-textured thin residuum and colluvium from interbedded sedimentary rock including claystone, mudstone, siltstone, and shale. Samday was previously mapped in the Big Horn Coal soil survey as the Samsil soil.

In a typical profile, Samday has a light gray clay loam "A" horizon surface layer about 2 or 3 inches thick. The underlying "C" horizon substratum to 10 to 20 inches in depth is a grayish brown clay over weathered shale. The soil is nonsaline to slightly saline and nonsodic to slightly sodic and has slightly acid to neutral reaction (pH) in the upper horizons and slightly alkaline to moderately alkaline reaction in the lower horizons although it can be moderately acid near to bedrock contact in some profiles.

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Samday clay loam has slow permeability and very low available water capacity. The effective rooting depth is 10 to 20 inches, the depth to the underlying bedrock contact. Surface runoff is rapid and the erosion hazard from water is severe and moderate from wind. The erosion "K Factor" is 0.37, the "T Factor" is 1, the Wind Erodibility Group is 4, and the Hydrologic Group is D. The Samday soil is in the "Shallow Clayey, 10 to 14-inch precipitation zone, Northern Plains" range site.

The Samday soil is classified as a "Clayey, smectitic, calcareous, mesic shallow Ustic Torriorthent", and is an established soil series of moderate extent mapped in northern and northeastern Wyoming. The most recent NRCS official soil series description for Samday, dated 11/2005 is on file at RAMACO.

Samday clay loam was described and sampled at three representative sites on the Brook Mine permit area (R15, R24, and R27), and the profile descriptions are contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R15 is located in a portion of the NE1/4 of the SW1/4 of the NW1/4 of Section14, T.57N., R.85W. GPS coordinates: 44 degrees, 53′, 51″ North; 107 degrees, 3′, 10″ West. Sample site R24 is located in a portion of the SE1/4 of the SW1/4 of Section9, T.57N., R.84W. GPS coordinates: 44 degrees, 54′, 2″ North; 106 degrees, 59′, 47′ West. Sample site R27 is located in a portion of the SE1/4 of the NW1/4 of Section13, T.57N., R.85W. GPS coordinates: 44 degrees, 54′, 52″ North; 107 degrees, 5′, 12″ West.

Map Unit E (Samday clay loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 16″ (1.33′)

Samday clay loam pedon R15 has "marginal" silty clay texture from 3 to 8 inches in depth, otherwise all parameters for Samday are "suitable". The one "marginal" value is not a significant limitation and should dilute upon mixing, and therefore the entire soil profile of Samday is recommended for salvage, an average depth of 16 inches (R15,13″; R24,18″; and R27,18″). The organic matter content of the "C" horizon substratum, the lowest horizon in the soil profile, remains above 0.5 percent across all pedons and therefore the entire

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profile can be salvaged as one Topsoil lift, an average of 16 inches to the weathered bedrock contact.

D7.3.3.6 Map Unit F: Samday-Rock Outcrop Complex

Samday-Rock Outcrop Complex (Map Unit F) is mapped on similar hilly and sideslope topography as Samday clay loam (Map Unit E) except there are scattered Rock Outcrop exposures within the unit. Samday clay loam comprises approximately 75 percent of the unit and Rock Outcrop 25 percent, including a few areas with Samday clay loam less than 3 inches thick. All soil characteristics for Samday are similar in both Map Unit E and Map Unit F. No additional soil sites for Samday were sampled in Map Unit F, three representative sites for the Samday soil series were already described and sampled in Map Unit E. Recommended salvage depth for Samday in Map Unit F is 16 inches Topsoil. Rock Outcrop has no soil available for salvage. The weight-average salvage depth for Map Unit F (Samday 75%, Rock Outcrop 25%) is 12 inches Topsoil.

D7.3.3.7 Map Unit G: Bauxson loam, 4 to 25% slopes

Bauxson loam (Map Unit G) is mapped in several delineations scattered across the Brook Mine Area and is located on porcelanite controlled ridges and hillslopes primarily in the central and eastern parts of the permit area. Bauxson loam is considered by NRCS to be a deep, well-drained soil developing in a thin mantle of colluvial and residual soil material over fractured, displaced red scoria (porcelanite). Bauxson is similar to Wibaux except the soil material to the scoria contact is "fine-loamy" (<35% coarse fragments) rather than "loamy-skeletal" (>35% coarse fragments). Bauxson was previously mapped in the Big Horn Coal soil survey as the Sear soil series in Map Unit 817 (Wibaux-Sear association, rolling).

In a typical profile, the "A" horizon surface layer of Bauxson is a reddish brown loam about 4 inches thick, with about 20 percent fine angular red scoria channers. A "Bt" argillic subsoil horizon, about 6 to 14 inches thick, is a

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reddish brown loam to clay loam with about 10 percent red scoria channers. The underlying material to the fractured scoria contact is a reddish brown very loam to clay loam, about 10 to 15 inches thick, with less than 35 percent red scoria channers. The underlying fractured scoria material is generally red scoria (porcelanite) fragments with little to no soil material (<5% soil fines) in the many voids between the rock fragments.

The fractured scoria substrate is considered by NRCS to be a "fragmental" texture class and part of the soil profile, thus creating a deep soil. However, Bauxson can also be viewed as a shallow to moderately deep soil with only 20 to 40 inches of soil to the fractured scoria contact (up to 95% scoria fragments at and below the contact) below which is not considered a part of the soil profile. Bauxson is considered a moderately deep soil in the current soil survey, and the average depth to the fractured scoria contact in the Brook Mine Area is about 35 inches.

Bauxson loam is nonsaline and nonsodic throughout the upper profile to the fractured scoria contact, and has slightly acid to neutral reaction (pH) in the upper horizons and slightly acid to moderately alkaline reaction in the lower horizons.

Bauxson has moderate permeability in the upper part of the profile and very rapid permeability in the underlying fractured scoria. It has low available water capacity. The effective rooting depth is 20 to 40 inches, the depth to the underlying fractured scoria. Surface runoff is rapid and the erosion hazard from water is severe and slight from wind. The erosion "K Factor" is 0.20, the "T Factor" is 1, the Wind Erodibility Group is 8, and the Hydrologic Group is B. The Bauxson soil is in the "Shallow Loamy, 10 to 14-inch precipitation zone, Northern Plains" range site.

The Bauxson soil is classified as a "Fine-loamy over fragmental, mixed, superactive, mesic Aridic Argiustoll", and is an established soil series of moderate extent mapped in north central and northeastern Wyoming. The

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most recent NRCS official soil series description for Bauxson, dated 11/1998 is on file at RAMACO.

Bauxson loam was described and sampled at three representative sites in Map Unit G (R17, R19, and R22) on the Brook Mine Area, and the profile descriptions are contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R17 is located in a portion of the NE1/4 of the SW1/4 of the SW1/4 of Section 11, T.57N., R.85W. GPS coordinates: 44 degrees, 55′, 29″ North; 107 degrees, 5′, 9″ West. Sample site R19 is located in a portion of the NE1/4 of the SE1/4 of the NW1/4 of Section18, T.57N., R.84W. GPS coordinates: 44 degrees, 55′, 6″ North; 107 degrees, 2′, 42″ West. Sample site R22 is located in a portion of the SW1/4 of the NE1/4 of Section18, T.57N., R.84W. GPS coordinates: 44 degrees, 50', 17" North; 106 degrees, 59′, 38″ West.

Map Unit G (Bauxson loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 14″ (1.2′), Subsoil 18″ (1.5′)

All soil parameters of Bauxson are "suitable" except coarse fragments (channer size and shape scoria fragments) which can range from 10 to 34 percent for the upper soil material to the fractured scoria contact, an average depth of 32 inches. Coarse fragment content below 32 inches (range of 26 to 36 inches) increases above 35 percent and is considered "unsuitable". In addition, Selenium values were "marginal" for the lower depths of Bauxson sample site R19 (Se=0.41 ppm for 22" to 36", and Se=0.37 ppm for 36" to 48"). This limited "marginal" rated material, which would become a small diluted part of the overall salvaged Bauxson subsoil material (from 14" to 32" in depth), is not "unsuitable" and should be salvaged for use in reclamation. It makes good sense to separately salvage Topsoil and Subsoil for Bauxson (WDEQ-LQD, 2014, p.3). Therefore, the upper 14 inches of Bauxson is recommended for salvage as Topsoil and the underlying 18 inches, or the depth to the fractured scoria contact if different, as Subsoil.

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D7.3.3.8 Map Unit H: Haverdad loam, 2 to 15% slopes

Haverdad loam (Map Unit H) is mapped in many elongated delineations scattered across the permit area and is located on low terraces and floodplains in upland drainages including Hidden Water and Slater Creek as well as short segments of minor, unnamed tributary drainages. Haverdad loam is a deep (40+ inches to bedrock), well-drained soil developing in medium-textured to moderately fine-textured local alluvium from interbedded sedimentary rock including sandstone and shale. Haverdad loam was previously mapped in the Big Horn Coal soil survey as Map Unit 19A (Haverson loam, 0 to 3% slopes) and Map Unit 464A (Haverson-Worthing complex, 0 to 3% slopes).

In a typical profile, Haverdad has a light brownish gray loam to very fine sandy loam "A" horizon surface layer about 4 inches thick. The underlying soil to a depth of 40 inches or more is a yellowish brown loam stratified with lenses of silt loam, sandy loam, and clay loam. The soil is nonsaline and nonsodic and has slightly acid to neutral reaction (pH) in the upper horizons and slightly alkaline to moderately alkaline reaction throughout the rest of the profile.

Haverdad loam has moderate permeability and high available water capacity. The effective rooting depth is greater than 40 inches, the depth to the underlying bedrock contact. Surface runoff is slow and the erosion hazard from water is slight and severe from wind. The soil is subject to rare flooding. The erosion "K Factor" is 0.37, the "T Factor" is 5, the Wind Erodibility Group is 3, and the Hydrologic Group is B. The Haverdad soil is in the "Lowland, 10 to 14-inch precipitation zone, Northern Plains" range site.

The Haverdad soil is classified as a "fine-loamy, mixed, superactive, mesic Ustic Torriorthent", and is an established soil series of large extent mapped in Wyoming, Colorado and Utah. The most recent NRCS official soil series description for Haverdad, dated 06/2002 is on file at RAMACO.

Haverdad loam was described and sampled at three representative sites on the Brook Mine permit area (R7, R20, and R23), and the profile descriptions

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are contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R7 is located in a portion of the NE1/4 of the NE1/4 of the NW1/4 of Section13, T.57N., R.85W. GPS coordinates: 44 degrees, 55′, 17″ North; 107 degrees, 3′, 44″ West. Sample site R20 is located in a portion of the NW1/4 of the SE1/4 of the NW1/4 of Section18, T.57N., R.84W. GPS coordinates: 44 degrees, 54′, 46″ North; 107 degrees, 6′, 6″ West. Sample site R23 is located in a portion of the SE1/4 of the SE1/4 of Section9, T.57N., R.84W. GPS coordinates: 44 degrees, 50′, 50″ North; 106 degrees, 58′, 55″ West.

Map Unit H (Haverdad loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 15″ (1.25′), Subsoil 47″ (3.9′)

Haverdad loam pedons R7, R20, and R23 are entirely suitable throughout their profile depths of 72, 72, and 42 inches, respectively. Therefore, the entire Haverdad profile, an average depth of 62 inches, is recommended for salvage. It makes good sense to separately salvage Topsoil and Subsoil for Haverdad (WDEQ-LQD, 2014, p.3). Therefore, the upper 15 inches of Haverdad is recommended for salvage as Topsoil and the underlying 47 inches as Subsoil.

D7.3.3.9 Map Unit Wx: Wibaux channery loam, 2 to 20% slopes

Wibaux channery loam (Map Unit Wx) is mapped in many delineations scattered across the Brook Mine Area and is located on porcelanite controlled ridges and hillslopes primarily in the central and eastern parts of the permit area. Wibaux channery loam is considered by NRCS to be a deep, somewhat excessively drained soil developing in residuum from red scoria (porcelanite). Wibaux was previously mapped in the Big Horn Coal soil survey as Map Unit 218 (Wibaux-Rock Outcrop association, steep) and Map Unit 817 (Wibaux-Sear association, rolling).

In a typical profile, the "A" horizon surface layer of Wibaux is a light reddish brown channery loam about 3 to 5 inches thick, with about 25 percent

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angular red scoria channers. A thin "Bw" subsoil horizon, about 5 to 8 inches thick, exists in some profiles and is a channery to very channery, reddish brown loam to clay loam, with up to 30 percent red scoria channers. The upper part of the "C" horizon substratum is a reddish brown very channery loam, about 7 to 10 inches thick, with about 45 to 55 percent red scoria channers. The lower part of the substratum to 40 inches or deeper is fractured, displaced, generally red scoria (porcelanite) fragments with little to no soil material (<5% soil fines) in the many voids between the rock fragments.

The fractured scoria substrate is considered by NRCS to be a "fragmental" texture class and part of the soil profile, thus creating a deep soil. However, Wibaux can also be viewed as a shallow soil with only 10 to 20 inches of soil to the fractured scoria contact (up to 95% scoria fragments at and below the contact) below which is not considered to be part of the soil profile. Wibaux is considered a shallow soil in the current soil survey. The average soil depth of Wibaux to the fractured scoria contact in the Brook Mine Area is about 14.25 inches.

Wibaux channery loam is nonsaline and nonsodic throughout the upper profile to the fractured scoria contact, and has slightly acid to neutral reaction (pH) in the upper horizons and slightly acid to moderately alkaline reaction in the lower horizons.

Wibaux has moderate permeability in the upper part of the profile and very rapid permeability in the lower part and underlying fractured scoria. It has very low available water capacity. The effective rooting depth is 10 to 20 inches, the depth to the underlying fractured scoria. Surface runoff is medium and the erosion hazard from water and wind is moderate. The erosion "K Factor" is 0.20, the "T Factor" is 1, the Wind Erodibility Group is 6, and the Hydrologic Group is B. The Wibaux soil is in the "Shallow Loamy, 10 to 14-inch precipitation zone, Northern Plains" range site.

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The Wibaux soil is classified as a "Loamy-skeletal over fragmental, mixed, superactive, nonacid, mesic Ustic Torriorthent", and is an established soil series of moderate extent mapped in Wyoming, Montana, and South Dakota. The most recent NRCS official soil series description for Wibaux, dated 02/2000 is on file at RAMACO.

Wibaux channery loam was described and sampled at three representative sites in Map Unit Wx (R11, R13, and R21), and one site in Map Unit Wx-RO (R18) on the Brook Mine permit area, and the profile descriptions are contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R11 is located in a portion of the NW1/4 of the SW1/4 of the SW1/4 of Section 8, T.57N., R.84W. GPS coordinates: 44 degrees, 49′, 2″ North; 106 degrees, 57′, 47″ West. Sample site R13 is located in a portion of the SE1/4 of the NW1/4 of the SE1/4 of Section8, T.57N., R.84W. GPS coordinates: 44 degrees, 49′, 36″ North; 106 degrees, 58′, 17″ West. Sample site R21 is located in a portion of the NE1/4 of the SW1/4 of Section18, T.57N., R.84W. GPS coordinates: 44 degrees, 54′, 18″ North; 107 degrees, 7′, 48″ West. Sample site R18 is located in a portion of the NW1/4 of the SW1/4 of the SW1/4 of Section11, T.57N., R.85W. GPS coordinates: 44 degrees, 55′, 24″ North; 107 degrees, 5′, 19″ West.

Map Unit Wx (Wibaux channery loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 8″ (0.67′)

The upper 8 inches of Wibaux channery loam is recommended for salvage as Topsoil. All soil parameters are "suitable" except coarse fragments (channer size and shape scoria fragments) which can range from 10 to 35 percent for the upper 8 inches of Wibaux. Coarse fragment content for the 8 to 14-inch depth, the average depth to the fractured scoria contact, ranges from 30 to 70 percent and is considered "unsuitable". In addition, both EC and SAR of the 8 to 15-inch depth of R13 was "unsuitable" with values of 12.8 and 17.3, respectively. These values were unexpected, all other EC and SAR values for Wibaux are entirely "suitable", but were confirmed through a rerun of the two

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analyses. The rerun data, 12.1 and 21.8 respectively, are contained in Addendum D7-2, Soils Laboratory Results. All 8 inches of the recommended salvage depth should be salvaged as one lift, 8 inches Topsoil. Material below 8 inches in depth is not recommended for salvage as soil.

D7.3.3.10 Map Unit Wx-RO: Wibaux-Rock Outcrop Complex, steep

Wibaux-Rock Outcrop Complex, steep (Map Unit Wx-RO) is mapped on similar ridge, hill, and sideslope topography as Wibaux channery loam (Map Unit Wx) except there are scattered Rock Outcrop exposures (red scoria outcrops) within the unit. Wibaux channery loam comprises approximately 75 percent of the unit and Rock Outcrop 25 percent, including a few areas with Wibaux channery loam less than 3 inches thick. All soil characteristics for Wibaux are similar in both Map Unit Wx and Map Unit Wx-RO. One additional soil site for Wibaux, R18, was sampled in Map Unit Wx-RO, and it was noted in the Wx Map Unit Description. Recommended salvage depth for Wibaux in Map Unit Wx-RO is 8 inches Topsoil. Any material below 8 inches in depth in Wibaux areas is not recommended for salvage as soil. Rock Outcrop has no soil available for salvage. The weight-average salvage depth for Map Unit F (Wibaux 75%, Rock Outcrop 25%) is 6 inches Topsoil.

D7.3.3.11 Map Unit U: Ulm clay loam, 0 to 3% slopes

Ulm clay loam (Map Unit U) was mapped in a couple of small delineations in a portion of the NE1/4 of the SE1/4 of Section 14, T57N, R85W. The mapped area is south of Interstate 90 in the former Parcel 2, a 97.3-acre area that has now been dropped from the Brook Mine Area. The soils report retains Ulm clay loam (Map Unit U) because it was part of the original survey and because it is mapped in the future Brook Mine, Phase 2 Area. Ulm was previously projected to be disturbed by mining activities and was sampled for laboratory characterization at representative site R25. Ulm was previously mapped in the Big Horn Coal soil survey as Map Unit 81AB (Bidman loam, 0 to 6% slopes).

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Ulm clay loam is a deep (40+ inches to bedrock), well-drained soil developing in local alluvium from interbedded sedimentary rock including sandstone and shale. In a typical profile, Ulm has an "A" horizon surface layer that is a grayish brown clay loam about 3 to 5 inches thick. The upper part of the "Bt" argillic subsoil layer is a grayish brown clay loam to clay about 5 inches thick. The lower part of the "Bt" to "Btk" argillic subsoil layer is a brown clay loam to clay about 15 inches thick. The underlying "Bk" calcic horizon is a light olive brown clay loam to clay to a depth of 40 inches or more. The soil is nonsaline to slightly saline and nonsodic. Soil reaction (pH) is slightly acid to neutral in the upper part and neutral to slightly alkaline in the lower part of the soil profile.

Ulm clay loam has slow permeability and high available water capacity. The effective rooting depth is greater than 40 inches, the depth to the underlying bedrock. Surface runoff is slow and the erosion hazard from water is slight and moderate from wind. The erosion "K Factor" is 0.32, the "T Factor" is 5, the Wind Erodibility Group is 6, and the Hydrologic Group is C. The Ulm soil is in the "Clayey, 15 to 19-inch precipitation zone, Northern Plains" range site.

The Ulm soil is classified as a "fine, smectitic, mesic Ustollic Haplargid", and is an established soil series mapped extensively in northern and northeastern Wyoming. The most recent NRCS official soil series description for Ulm, dated 12/2005 is on file at RAMACO.

Due to very small mapped acreage (<40 aces), Ulm clay loam was described and sampled at one representative site, R25, on Parcel 2, now not part of the Brook Mine permit area, and the profile description is contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2. Sample site R25 is located in a portion of the SE1/4 of the NE1/4 of the SE1/4 of Section14, T.57N., R.85W. GPS coordinates: 44 degrees, 52′, 52″ North; 107 degrees, 4′, 24″ West.

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Map Unit U (Ulm clay loam) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 16" (1.3'), Subsoil 56" (4.7')

If Ulm was in the Brook Mine Area and projected for disturbance, the entire soil profile to 72 inches (6 feet) in depth is suitable and recommended for soil salvage. All soil parameters are suitable except some horizons have silty clay texture which is "marginal" rated but not a significant limitation. It makes good sense to separately salvage Topsoil and Subsoil for Ulm (WDEQ-LQD, 2014, p.3). The upper 16 inches of Ulm are recommended for salvage as Topsoil and the underlying 56 inches as Subsoil.

D7.3.3.12 Map Unit Wo: Worthenton clay loam, 0 to 3% slopes

Worthenton clay loam (Map Unit Wo) was mapped in one small delineation, a former oxbow – now filled in with sediment – of the Tongue River in a portion of the SW1/4 of the SE1/4 of Section 13, T57N, R85W. The mapped area is south of Interstate 90 in the former Parcel 2, a 97.3-acre area that has now been dropped from the Brook Mine Area. The soils report retains Worthenton clay loam (Map Unit Wo) because it was part of the original survey and because it is mapped in the future Brook Mine, Phase 2 Area. Worthenton was not projected to be disturbed by mining activities and was not sampled for laboratory characterization. The soil was mapped as Worthing Taxajunct (Map Unit 96) in the Big Horn Coal soil survey (Big Horn Coal, 1983).

Worthenton clay loam is a deep (40+ inches to bedrock), poorly-drained soil developing in local alluvium from interbedded sedimentary rock including sandstone and shale. In a typical profile, Worthenton has an organic mat about 3 inches thick. The "A" horizon surface layer is a very dark gray silty clay about 8 inches thick. The "Btg" gleyed argillic subsoil layer is a dark grayish brown silty clay about 14 inches thick. The underlying "Bkg" gleyed cambic horizon is an olive gray silty clay and clay to a depth of 40 inches or more. The soil has prominent to distinct mottles (redoximorphic features) throughout the profile and has a fluctuating water table at a depth of 0.5 to 1.5

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feet from March through July and from 1.5 to 3.0 feet the remainder of the year. The soil is nonsaline and nonsodic and has moderately alkaline to strongly alkaline reaction (pH). Worthenton clay loam meets criteria "2B3" (poorly drained, Aquic suborder, with a water table at a depth of 1.0 foot or less during the growing season if permeability is less than 6.0 in/hr in any layer within a depth of 20 inches) for "hydric soil" status and is on the current list of hydric soils for Sheridan County (NRCS, 2006).

Worthenton clay loam has slow permeability and high available water capacity. The effective rooting depth is greater than 40 inches for water-tolerant plants and 6 to 18 inches for plants that are not water tolerant. Surface runoff is slow and the erosion hazard from water is slight and moderate from wind. The erosion "K Factor" is 0.43, the "T Factor" is 5, the Wind Erodibility Group is 4L, and the Hydrologic Group is D. The Worthenton soil is in the "Wetland, 15 to 19-inch precipitation zone, Northern Plains" range site.

The Worthenton soil is classified as a "fine, smectitic, mesic Typic Argiaquoll", and is an established soil series of very limited extent mapped in north-central Wyoming. The most recent NRCS official soil series description for Worthenton, dated 02/1997 is on file at RAMACO.

As stated above, Worthenton clay loam was not sampled for laboratory characterization because it was not projected to be disturbed, and it was not evaluated for soil suitability and salvage depth recommendation. If Worthenton were projected to be disturbed, salvage operations would need to follow specifications for hydric soil salvage as detailed in Appendix F – Hydric Soils of DEQ Guideline 1A (DEQ, 2014).

D7.3.3.13 Map Unit RL: Reclaimed Land

Reclaimed Land (Map Unit RL) is mapped primarily in the Big Horn Coal permit area where most of the previously disturbed land has been reclaimed. Big Horn Coal Company "Exhibit RH-4, Topsoil Verification Sites", details the

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verified depth of reapplied topsoil across the former mine area (Big Horn Coal Company, 2004). A few very small areas of RL are located on other areas where older previous mining activity has been reclaimed, most of it as part of the Abandoned Mine Land (AML) program.

Portions of Reclaimed Land are projected to be re-disturbed as part of the Brook Mine activity and four soil sample sites (R1, R2, R3, and R4) were located on Big Horn Coal reclaimed land. The soil profile descriptions for these sites are contained in Addendum D7-1 and the soils laboratory data in Addendum D7-2.

Sample site R1 is located near previous Big Horn Coal topsoil depth verification site "P4-3" in a portion of the SW1/4 of the NW1/4 of the NW1/4 of Section 15, T.57N., R.84W. GPS coordinates: 44 degrees, 53′ 50″ North; 106 degrees, 59′, 17″ West. Sample site R2 is located in a portion of the NE1/4 of the SW1/4 of the NW1/4 of Section15, T.57N., R.84W. GPS coordinates: 44 degrees, 53′, 17″ North; 106 degrees, 59′, 8″ West. Sample site R3 is located in a portion of the SE1/4 of the SW1/4 of the SE1/4 of Section15, T.57N., R.84W. GPS coordinates: 44 degrees, 54′, 25″ North; 106 degrees, 58′, 39″ West. Sample site R4 is located in a portion of the NW1/4 of the NE1/4 of the NE1/4 of Section22, T.57N., R.84W. GPS coordinates: 44 degrees, 54′, 24″ North; 106 degrees, 58′, 33″ West.

The Big Horn Coal reapplied topsoil material is nonsaline to slightly saline and nonsodic with clay loam, loam, and silt loam textures, in frequency order. Coarse fragment content ranged from about 5 to 20 percent with most samples about 10 percent. Reclaimed Land topsoil depth ranged from 12 inches for sites R3 and R4, to 30 and 32 inches for sites R2 and R1, respectively. The average reapplied topsoil depth was 21.5 inches and the currently sampled depth at each site was very similar to that noted for each area on Big Horn Coal's "Exhibit RH-4". At each site, even when soil sampling with a bucket auger, it was evident when the reapplied topsoil ended and the regraded spoil began and therefore the depth of reapplied topsoil.

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Map Unit RL (Reclaimed Land) Soil Suitability Evaluation and Salvage Depth Recommendation: Topsoil 22" (1.8')

All soil parameters are suitable and the reapplied topsoil can be resalvaged if disturbed. The average reapplied topsoil depth was 21.5 inches (rounded to 22 inches) and all of this material is best salvaged as one Topsoil lift. In each area, the guidance is to resalvage the soil material to the underlying regarded overburden spoil contact, a very visible contact at depth.

D7.3.3.14 Map Unit RO: Rock Outcrop

A few small delineations of Rock Outcrop Water (Map Unit RO), mostly red scoris outcrops, have been carefully mapped across the Brook Mine Area. There is no soil available for salvage from Map Unit RO and therefore the recommended soil salvage depth is 0 inches Topsoil.

D7.3.3.15 Map Unit W: Water

A few small delineations of Water (Map Unit W) have been carefully mapped across the Brook Mine Area. There is no soil available for salvage from Map Unit W and therefore the recommended soil salvage depth is 0 inches Topsoil.

D7.3.3.16 Map Unit DL: Disturbed Land

Various Disturbed Land (Map Unit DL) delineations (roads, pond embankments, non-reclaimed land, etc.) have been carefully mapped across the Brook Mine Area. There is no soil available for salvage from Map Unit DL and therefore the recommended soil salvage depth is 0 inches Topsoil.

D7.4 References

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RECD JUL 30,2015

DEQ 7-039

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TFN 6 2/025
RECD DEC 18, 2015

DEQ 7-042

APPENDIX D7 TABLES

Table D7.3-1. Brook Mine Area List of Soil Map Units and Acreages*

Map Unit	Soil Type	Acreage
A	Cambria loam	337.1
B	Zigweid loam	0.0
C	Forkwood loam	408.2
D	Shingle channery loam	354.1
E	Samday clay loam	257.4
F	Samday-Rock Outcrop Complex	184.2
G	Bauxson loam	315.3
H	Haverdad loam	181.9
Wx	Wibaux channery loam	479.0
Wx-RO	Wibaux-Rock Outcrop Complex	1280.1
U	Ulm clay loam	0.0
Wo	Worthenton clay loam	0.0
RL	Reclaimed Land	615.5
RO	Rock Outcrop	19.4
W	Water	11.9
DL	Disturbed Land	104.7

*Total acreage within surveyed permit boundary is 4,548.8 acres. All calculations, including map unit total, by WWC Engineering, 10-28-2014.

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DEQ 7-044

Table D7.3-2. Criteria to Establish Topsoil and Overburden Suitability Adapted from WDEQ/LQD Guideline No. 1 Table I-2 and I-4

		Surface (potential root zone) and Topsoil		Aquifer Restoration
Parameter	**Suitable**	**Marginal 1/**	**Unsuitable**	**Unsuitable**
pH	5.5-8.5	5.0-5.5; 8.5-9.0	<5.0; >9.0	<5.0
EC (Conductivity) mmhos/cm	0-8	8-12	>12	Depends on premine levels
Saturation Percentage	25-80	<25; >80		
Texture		c,sic,s		
SAR 2/	0-10	10-12; 3/; 10-15	>12 3/; >15	Depends on premine levels
Selenium	<0.3 ppm	>0.3-0.8 ppm	>0.8 ppm	Depends on premine levels
Boron	<5.0 ppm		>5.0ppm	Depends on premine levels
Nitrate/Nitrogen				>50ppm
Molybdenum	<1.0ppm	>1.0ppm		
Acid/base Pot. 4/	>-5		<-5	<-5
Arsenic	<2.0ppm	>2.0ppm		
Organic Carbon	<10%		>10%	

1/ Evaluated on an individual basis for suitability.
2/ As an alternative to SAR calculations, ESP (exchangeable sodium percentage) can be determined. ESP should be determined if suitable SAR value is exceeded.
3/ For fine textured soils (Clay >40%).
4/ Record as Acid pot., Neutralization pot. and acid-base potential in + tons $CaCO_3$ equivalent/1000 tons.

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RECD JUL 30,2015

DEQ 7-045

Table D7.3-3. Brook Mine Area List of Soil Map Units and Salvage Depth Recommendations

Map Unit	Soil Type	Salvage Depth Recommendations
A	Cambria loam	Topsoil 10″, Subsoil 15″
B	Zigweid loam	Topsoil 16″ (1.3′), Subsoil 56″ (4.7′)
C	Forkwood loam	Topsoil 12″ (1′), Subsoil 45″ (3.75′)
D	Shingle channery loam	Topsoil 19″ (1.6′)
E	Samday clay loam	Topsoil 16″ (1.33′)
F	Samday-Rock Outcrop Complex	Topsoil 12” (1.0’)*
G	Bauxson loam	Topsoil 14″ (1.2′), Subsoil 18″ (1.5′)
H	Haverdad loam	Topsoil 15″ (1.25′), Subsoil 47″ (3.9′)
Wx	Wibaux channery loam	Topsoil 8″ (0.67′)
Wx-RO	Wibaux-Rock Outcrop Complex	Topsoil 6” (0.5’)**
U	Ulm clay loam	Topsoil 16″ (1.3′), Subsoil 56″ (4.7′)
Wo	Worthenton clay loam	0
RL	Reclaimed Land	Topsoil 22″ (1.8′)
RO	Rock Outcrop	0
W	Water	0
DL	Disturbed Land	0

- Map Unit F is 75% Samday clay loam with a recommended salvage depth of 16” Topsoil and 25% Rock Outcrop with a recommended salvage depth of 0”. The weight-average soil salvage depth for the map unit is 12” Topsoil. This assumes salvage equipment can maneuver around rock outcrops when salvaging Samday clay loam.
- Map Unit Wx-RO is 75% Wibaux channery loam with a recommended salvage depth of 8” Topsoil and 25% Rock Outcrop with a recommended salvage depth of 0”. The weight-average soil salvage depth for the map unit is 6” Topsoil. This assumes salvage equipment can maneuver around rock outcrops when salvaging Wibaux channery loam.

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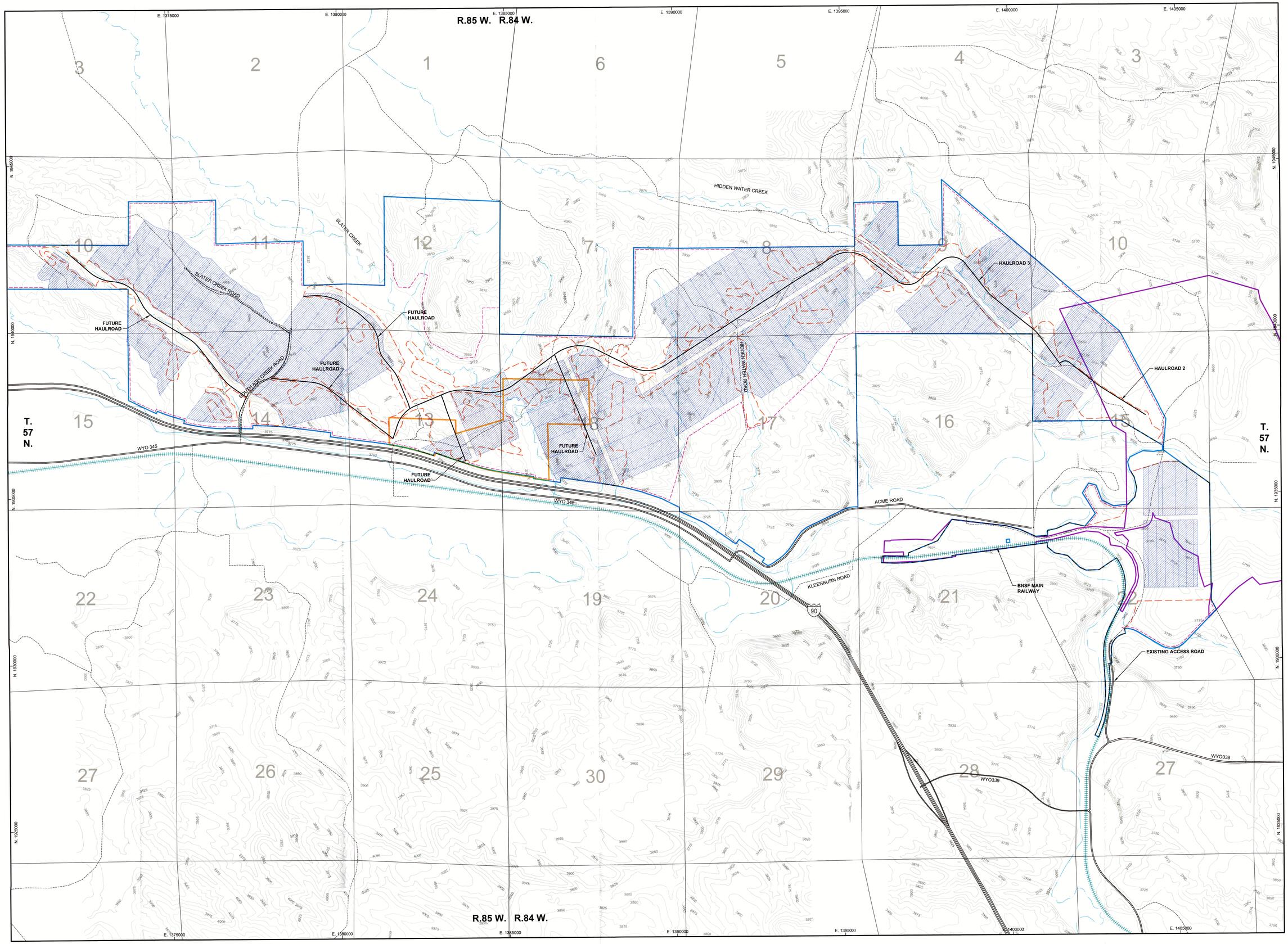
RECD JUL 30, 2015

DEQ 7-046

APPENDIX D7 FIGURES



NOTE: MAP COORDINATE PROJECTION IS WY 83 EC

LEGEND

- BROOK MINE PERMIT BOUNDARY
- BIG HORN COAL PERMIT BOUNDARY (PERMIT NO. 213-T7)
- TAYLOR QUARRY PERMIT BOUNDARY (PERMIT NO. SP-757)
- AFFECTED AREA BOUNDARY (AREA OF POTENTIAL SUBSIDENCE)
- DISTURBANCE BOUNDARY
- STATE HIGHWAY
- INTERSTATE
- UNIMPROVED ROADS
- RAILROAD
- SURFACE MINING
- HIGHWALL MINING PANELS

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
06/15	ROUND 1 COMMENTS
10/15	ROUND 2 COMMENTS
12/15	ROUND 3 COMMENTS

FIGURE D7.1-1

TFN 6 2/025
RECD DEC 18,2015

BROOK MINE PERMIT AREA WITH DISTURBANCE BOUNDARY

Drawn By: DCJ
Checked By: JGB
Date: 10/17/14

WWC ENGINEERING
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FILE: FIG_D7-1_SOIL_DIST_R3.dwg

Date: Thu, 30 Oct 2014 14:10:29 -0600
From: "Jeff Barron, P.E." <jbarron@wwcengineering.com>
Organization: WWC Engineering

To: andrew.cassiday@wy.usda.gov
CC: oakley.ingersoll@wy.usda.gov
Subject: Negative Prime Farm Land Declaration Letter

Andrew,

I understand you are out of the office today and I spoke with Oakley about providing a letter stating a negative declaration of prime farmland for the boundary provided as a shape file in this email. Please review the materials at your earliest convenience and provide a letter of your findings.

Thanks
--

Jeff Barron, P.E. | Project Manager

1849 Terra Avenue | Sheridan, WY 82801

Tel 307-672-0761 | Cell 307-751-1427

www.wwcengineering.com

RC_PERMIT_100314.prj

USDA

United States Department of Agriculture

NRCS
Natural Resources Conservation Service

Sheridan Field Office

1949 Sugarland Dr,
Suite 102
Sheridan, WY 82801

Phone 307.672.5820
Fax 866.574.1366

31 October 2014

Jeff Barron, PE
Project Manager
WWC Engineering
1849 Terra Avenue
Sheridan, WY 82801

Mr. Barron,

I have reviewed the RC Permit Area shapefile you sent. There are no designated Prime Farmland soils mapped within the RC Permit boundary. I have enclosed a map of the area showing the soils map units in the area of the PC Permit with designated Prime Farmland soils shown in green as well as a list of the map units designated as Prime Farmland.

Please let me know if I can assist further.

Thanks very much,

Andrew Cassiday
District Conservationist

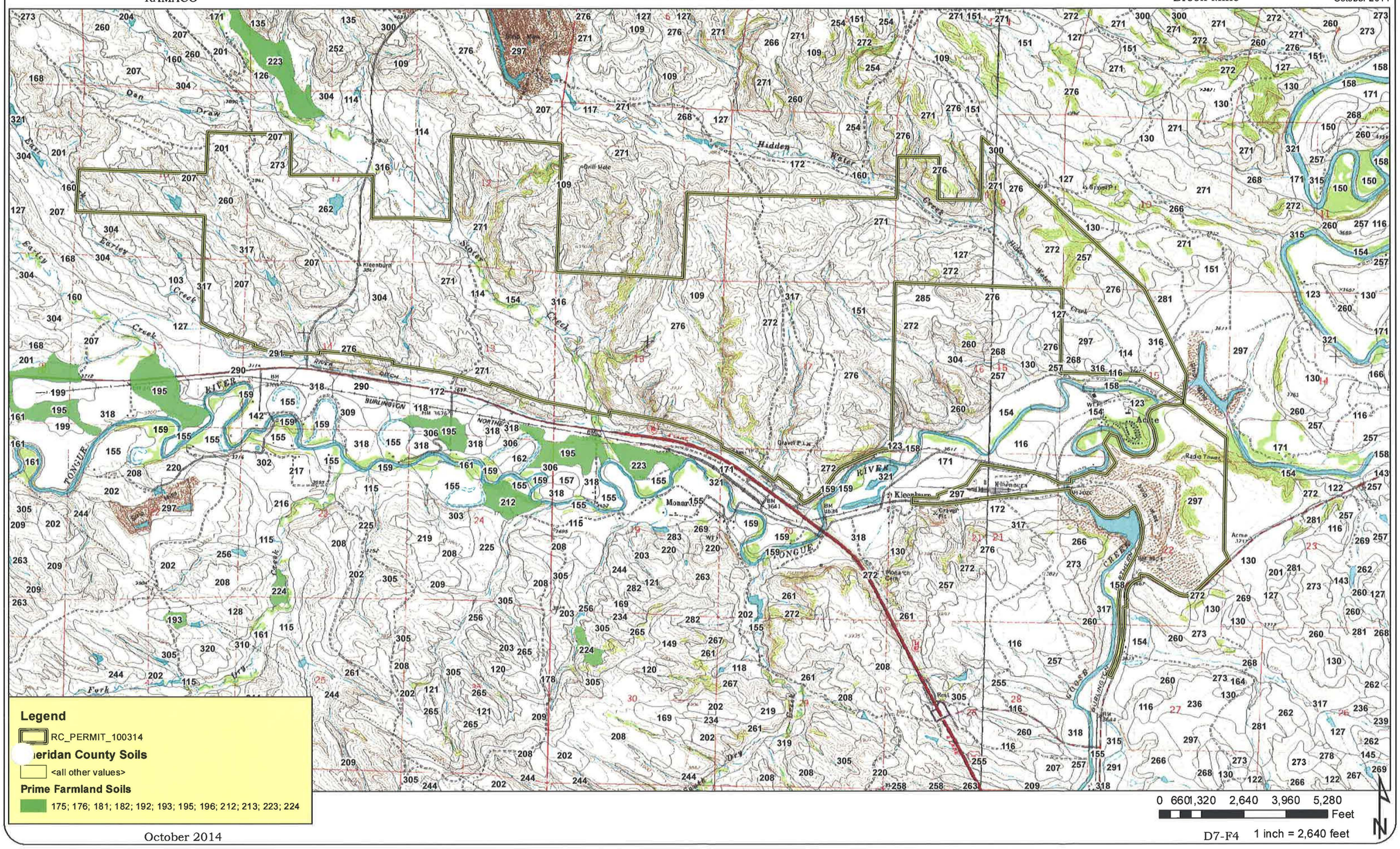
An Equal Opportunity Provider and Employer

Sheridan County Conservation District
Sheridan County, Wyoming

WWC Engineering
RC Permit Map

TFN 6 2/025
RECD NOV 14, 2014

USDA--NRCS
Sheridan Field Office
Prepared by: A. Cassiday
October 2014



October 2014

D7-F4

DEQ 7-051

Prime and Other Important Farmlands

Sheridan County Area, Wyoming

Map symbol	Map unit name	Farmland classification
175	Moskee sandy loam, 0 to 3 percent slopes	Prime farmland if irrigated
176	Moskee sandy loam, 3 to 6 percent slopes	Prime farmland if irrigated
181	Moskee-Nuncho complex, 0 to 3 percent slopes	Prime farmland if irrigated
182	Moskee-Nuncho complex, 3 to 6 percent slopes	Prime farmland if irrigated
192	Nuncho loam, 0 to 3 percent slopes	Prime farmland if irrigated
193	Nuncho loam, 3 to 6 percent slopes	Prime farmland if irrigated
195	Nuncho clay loam, 0 to 3 percent slopes	Prime farmland if irrigated
196	Nuncho clay loam, 3 to 6 percent slopes	Prime farmland if irrigated
212	Platmak loam, 0 to 3 percent slopes	Prime farmland if irrigated
213	Platmak loam, 3 to 6 percent slopes	Prime farmland if irrigated
223	Recluse loam, 0 to 3 percent slopes	Prime farmland if irrigated
224	Recluse loam, 3 to 6 percent slopes	Prime farmland if irrigated

TFN 6 2/025
RECD NOV 14,2014

APPENDIX D7 EXHIBITS

APPENDIX D7

Exhibit D7.2-1 Soil Sampling Protocol, RAMACO, TFN 6 2/025

TFN 6 2/025
RECD NOV 14, 2014

DEQ 7-054

October 2014

RAMACO

From: David Schellinger <david.schellinger@wyo.gov>
To: Jim Nyenhuis <jameshnyenhuis@aol.com>; jbarron <jbarron@wwcengineering.com>; Bj Kristiansen <bj.kristiansen@wyo.gov>
Subject: Soil Sampling Protocol, RAMACO, TFN 6 2/025
Date: Wed, Jun 4, 2014 10:31 am
Attachments: 6_2_025MM060414ds.doc (34K)

In order to properly document the LQD accepted sampling protocol for the proposed RAMACO permit, I have prepared the attached Memorandum summarizing the LQD District 3 soil sampling requirements for this project. Please let me know if you have further questions.

--
David Schellinger
Natural Resources Analyst
WDEQ/LQD District III
2100 W. 5th Street
Sheridan, WY 82801
Phone: (307)675-5611

E-Mail to and from me, in connection with the transaction
of public business, is subject to the Wyoming Public Records
Act and may be disclosed to third parties.

TFN 6 2/025
RECD NOV 14, 2014

D7-E2

Brook Mine

MEMORANDUM

To: File, RAMACO Preliminary Permit Correspondence, TFN 6 2/025

From: David Schellinger, Soils Specialist

Date: June 14, 2014

RE: Soil Baseline Requirements on Potential Subsidence Permit Areas

In a telephone message received on May 22, 2014 Mr. James Nyenhuis, a soils consultant collecting the RAMACO project soils baseline data, asked for clarification about sampling of soils on potential subsidence areas of the proposed permit acreage. After consultation with LQD in other District Offices, we concluded that only those areas proposed to have surface disturbance require sampling and analysis for suitability characterization. Soils on surfaces underlain by mining without surface disturbance (potential subsidence areas) require a minimum Class 3 mapping. If additional disturbance not currently planned is to occur in the future, additional sampling and analysis for suitability characterization will be required.

/DS
cc: Cheyenne File

TFN 6 2/025
RECD NOV 14, 2014

APPENDIX D7

Exhibit D7.3-1 Brook Mine Area Soils Map (Two Sheets)

TFN 6 2/025
RECD NOV 14, 2014

DEQ 7-057

LEGEND

- BROOK MINE PERMIT BOUNDARY
- SOIL BOUNDARY
- SOIL COLLECTION POINT (R11)

MAP UNIT A: CAMBRIA LOAM, 2 TO 8% SLOPES
MAP UNIT B: ZIGWEID LOAM, IRRIGATED, 0 TO 3% SLOPES
MAP UNIT C: FORKWOOD LOAM, 4 TO 25% SLOPES
MAP UNIT D: SHINGLE CHANNERY LOAM, 2 TO 25% SLOPES
MAP UNIT E: SAMDAY CLAY LOAM, 2 TO 25% SLOPES
MAP UNIT F: SAMDAY-ROCK OUTCROP COMPLEX
MAP UNIT G: BAUXSON LOAM, 4 TO 25% SLOPES
MAP UNIT H: HAVERDAD LOAM, 2 TO 15% SLOPES
MAP UNIT U: ULM CLAY LOAM, IRRIGATED, 0 TO 3% SLOPES
MAP UNIT WO: WORTHENTON CLAY LOAM, 0 TO 3% SLOPES
MAP UNIT WX: WIBAUX CHANNERY LOAM, 2 TO 20% SLOPES
MAP UNIT WX-RO: WIBAUX-ROCK OUTCROP COMPLEX, STEEP
MAP UNIT RL: RECLAIMED LAND
MAP UNIT RO: ROCK OUTCROP
MAP UNIT W: WATER
MAP UNIT DL: DISTURBED LAND
MAP UNIT XXX: UNCLASSIFIED SOIL TYPE

N

0 500 1,000 1,500 2,000
GRAPHIC SCALE (FEET)

RAMACO

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

REVISIONS	
Date	Description

EXHIBIT D7.3-1 SHEET 1 OF 2

TFN 6 2/025
RECD NOV 14, 2014

BROOK MINE AREA SOILS MAP

Drawn By: DCJ
Checked By: JGB
Date: 10/28/14

WWC ENGINEERING
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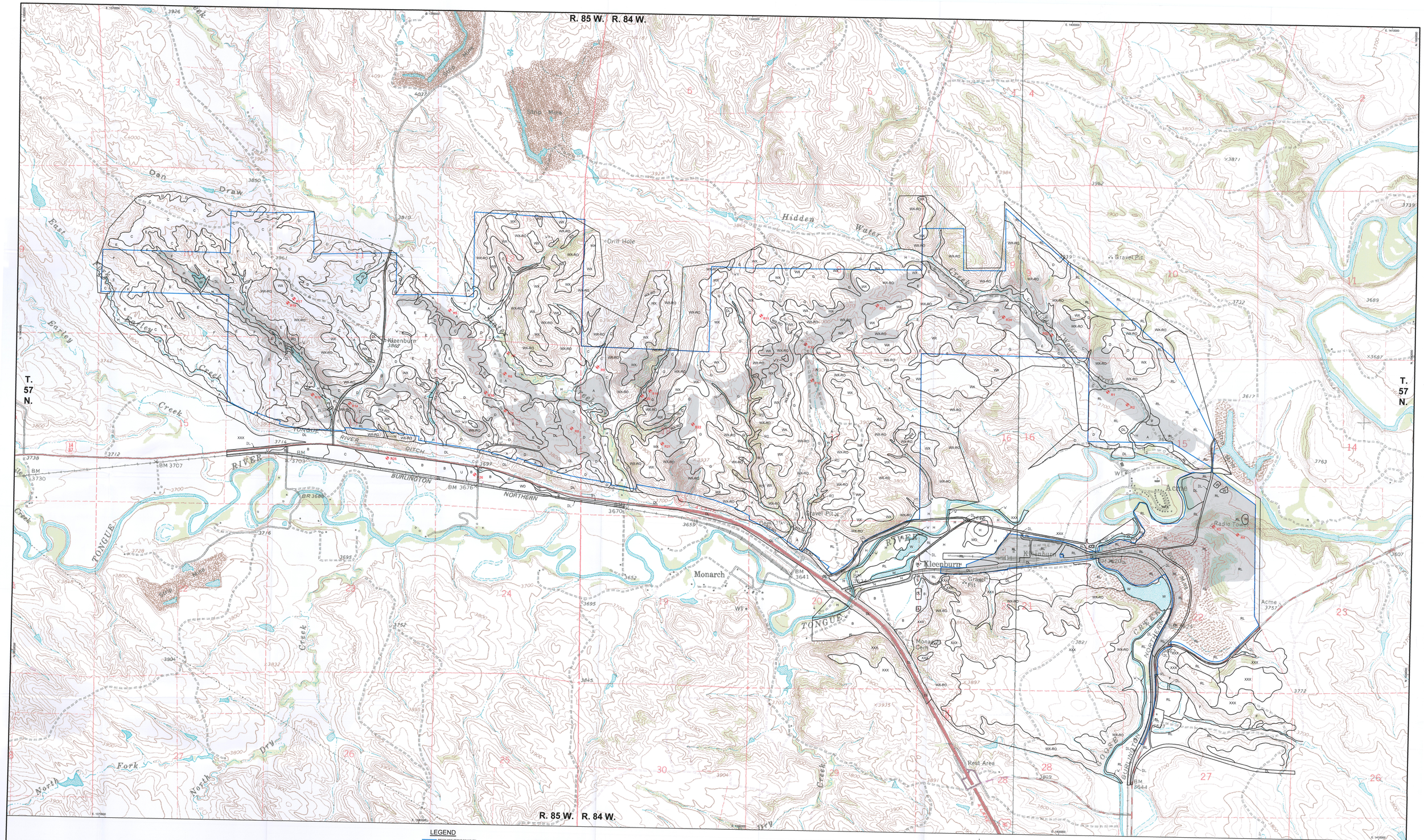
FILE: D7_3-1_SOILS.dwg



LEGEND

- BROOK MINE PERMIT BOUNDARY
- SOIL BOUNDARY
- SOIL COLLECTION POINT
- AREA OF DISTURBANCE

MAP UNIT A: CAMBRIA LOAM, 2 TO 6% SLOPES
MAP UNIT B: ZIGWEED LOAM, IRRIGATED, 0 TO 3% SLOPES
MAP UNIT C: FORKWOOD LOAM, 4 TO 25% SLOPES
MAP UNIT D: SHINGLE CHANNERY LOAM, 2 TO 25% SLOPES
MAP UNIT E: SAMDAY CLAY LOAM, 2 TO 25% SLOPES
MAP UNIT F: SAMDAY-ROCK OUTCROP COMPLEX
MAP UNIT G: BAUKSON LOAM, 4 TO 35% SLOPES
MAP UNIT H: HRUBESKO LOAM, 2 TO 15% SLOPES
MAP UNIT U: UCM CLAY LOAM, IRRIGATED, 0 TO 3% SLOPES
MAP UNIT WO: WORTHINGTON CLAY LOAM, 0 TO 3% SLOPES
MAP UNIT WR: WIBAUX CHANNERY LOAM, 2 TO 25% SLOPES
MAP UNIT WR-RO: WIBAUX-ROCK OUTCROP COMPLEX, STEEP
MAP UNIT RL: RECLAIMED LAND
MAP UNIT RO: ROCK OUTCROP
MAP UNIT W: WATER
MAP UNIT DL: DISTURBED LAND
MAP UNIT XXX: UNCLASSIFIED SOIL TYPE

GRAPHIC SCALE (FEET)
0 500 1000 1,500 1,400
C1 = 20'

RAMACO

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

REVISIONS

Date	Description
09/15	ROUND 1 COMMENTS

EXHIBIT D7.3-1

TFR 6 2/2025
RECD JUL 30.2015

SHEET 2 OF 2

BROOK MINE AREA
SOILS MAP

Drawn By: DCJ
Checked By: JGB
Date: 10/28/14

WWC ENGINEERING
www.wwcengineering.com

FILE: ADD_D7_3-1_SOILS_R1.dwg

DEQ 7-059

ADDENDUM D7-1

ADDENDUM D7-1
SOIL PROFILE DESCRIPTIONS

- **R1 Reclaimed Land, Map Unit RL**
- **R2 Reclaimed land, Map Unit RL**
- **R3 Reclaimed Land, Map Unit RL**
- **R4 Reclaimed Land, Map Unit RL**
- **R5 Cambria, Map Unit A**
- **R6 Cambria, Map Unit A**
- **R7 Haverdad, Map Unit H**
- **R8 Shingle, Map Unit D**
- **R9 Forkwood, Map Unit C,**
- **R10 Cambria, Map Unit A**
- **R11 Wibaux, Map Unit Wx**
- **R12 Forkwood, Map Unit C**
- **R13 Wibaux, Map Unit Wx**
- **R14 Forkwood, Map Unit C**
- **R15 Samday, Map Unit E**
- **R16 Shingle, Map Unit D**
- **R17 Bauxson, Map Unit G**
- **R18 Wibaux, Map Unit Wx-RO**
- **R19 Bauxson, Map Unit G**
- **R20 Haverdad, Map Unit H**
- **R21 Wibaux, Map Unit Wx**
- **R22 Bauxson, Map Unit G**
- **R23 Haverdad, Map Unit H**
- **R24 Samday, Map Unit E**
- **R25 Ulm, Map Unit U**
- **R26 Zigweid, Map Unit B**
- **R27 Samday, Map Unit E**

TFN 6 2/025
RECD NOV 14,2014

DEQ 7-061

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R1

Soil type Reclaimed Land RL J. NYENHUIS, RN File No.

Area Ramaco Brook Mine, north of Sheridan WY Date 5-26-14 Stop No.

Classification SW¼, NW¼, NW¼ Sect 15 T 57N, R 84W

Location near "P4-3" (2:1 "soil reapplied") 44°53'50"N, 106°59'17"W (iPhone 4S)

N. veg. (or crop) reclaimed grasses, very sparse. w/o Big Sage Climate mesic soil temp, ustic aridic soil moisture

Parent material mixed soil and spoil

Physiography regraded & reclaimed upland sideslope

Relief —	Drainage well	Salt or alkali —
Elevation	Gr. water deep (not encountered)	Stoniness —
Slope 6%	Moisture sl. moist to 20"	
Aspect N15°	Root distrib. Major Rooting Depth "MRD"	% Clay *
Erosion none w. slight spots	% Coarse fragments * see below 0-12" many F, VF com M	% Coarser than V.F.S. *
Permeability mod slow		

Additional notes

Scattered prairie dog holes - active
Digital photos taken of sample site with sign and landscape
Sampled in "To Be Affected Area" Disturbance Area

4 Samples: 0-6, 6-12, 12-20, 20-32"

* Control section average

Horizon	Depth Inches	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-6	10YR 5/3	10YR 4/3	Loam	VM GR	SO	FR	SS/SP	ES	GW		5%	mixed Frags
BC	6-12	10YR 5/3	10YR 4/3	Clay loam	VM SBK, Mass	SH	FR FI	S/P	ES	GW		25%	mixed Frags
C	12-20	10YR 5/2	10YR 4/2	Clay loam	Massive	H	FI	S/P	ES+	GW		5%	mixed Frags
C/spoil	20-32	10YR 5/2	10YR 4/2	Clay loam	Massive	H	FI	S/P	EV	GW		10%	mixed Frags
OB	32+ spoil (not sampled)												

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

Soil type: Reclaimed Land RL J. NYENHUIS, RN File No. R2

Area: Ramaco Brook Mine, north of Sheridan Wy | Date: 5-26-14 | Stop No.

Classification: Sec 15 T57N R84W

Location: NE¼ of SW¼ of NW¼ 44°53'17" N 106°59'8" W

N. veg. (or crop): reclaimed grasses, sc.c. Wyo Big Sagebrush | Climate: mesic

Parent material: mixed soil grading down to spoil

Physiography: reclaimed sideslope

Relief: – | Drainage: well | Salt or alkali: –

Elevation | Gr. water: deep | Stoniness: –

Slope: 20% | Moisture: sl. moist to

Aspect: 42° NE | Root distrib.: max 0-12" | % Clay *

Erosion: none | % Coarse fragments *: see below | % Coarser than V.F.S. *

Permeability: slow

Additional notes

Sampled in "To be Affected Area" Disturbance Area
Digital photos taken of sample site with sign and landscape

4 Samples: 0-6, 6-12, 12-21, 21-30"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-6	10YR 5/3	10YR 4/3	Loam	MM GR	SH	FR	SS/SP	ES	GW		5%	mixed Frags.
BC	6-12	10YR 5/4	10YR 4/4	Clay Loam	WM SBK	H	FR	S/P	ES+	GW		15%	mixed Frags
C	12-21	10YR 6/4	10YR 5/4	Clay Loam	Massive	H	FI	S/P	ES+	GW		10%	"
C/spoil	21-30	10YR 5/4	10YR 4/4	Clay Loam	Massive	H	FI	S/P	EV	GW		10%	"
OB	30+	spoil (not sampled)											

TFN 6 2/025
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R3

Soil type: Reclaimed RL J. NYENHUIS, RN File No.

Area: RAMACO BROOK MINE, north of Sheridan Wy Date: 5-28-14 Stop No.

Classification: SE¼ of SW¼ of SE¼ Sect 15 T57N R84W

Location: Big Horn Coal reclaimed area 44° 54' 25" N, 106° 58' 39" W

N. veg. (or crop): reclamation grasses Climate: mesic

Parent material: reapplied Topsoil

Physiography: reclaimed area - gently sloping upland

Relief: Drainage: well Salt or alkali: —

Elevation: Gr. water: deep (not encountered) Stoniness: —

Slope: 3% Moisture: all moist

Aspect: 73° E Root distrib.: MRD 0-12" Common F VF fom M 0-12" % Clay *

Erosion: none % Coarse fragments * see below % Coarser than V.F.S. *

Permeability: moderate

Additional notes

Digital photos taken of sample site with sign and landscape
Sampled in "To Be Affected Area" Disturbance Area

2 Samples: 0-6, 6-12"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
Ap	0-6"	10YR 5/4	10YR 4/4	clay loam	mm SBK	SH	FR	S/P	ES	GW		5%	mixed frags
C	6-12	10YR 5/4	10YR 4/4	clay loam	mm SBK > mac	H	FR	S/P	ES+	GW		5%	mixed frags
OB	12+	regraded spoil (not sampled)											

TFN 6 2/025
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R4

Soil type: Reclaimed Land RL — I NYENHUIS, RN — File No.

Area: Ramaco Brook Mine, north of Sheridan WY — Date: 5-28-14 — Stop No.

Classification: NW 1/4 of NE 1/4 of NE 1/4 of Sect 22 T57N R84W

Location: Big Horn Coal Reclaimed Area 44°54'24" N 106° 58' 33" W

N. veg. (or crop): reclamation grasses — Climate: mesic

Parent material: reapplied topsoil

Physiography: reclaimed area - gently sloping upland

Relief — Drainage: well — Salt or alkali: —

Elevation — Gr. water: deep — Stoniness: —

Slope: 2% — Moisture: all moist

Aspect: 70° E — Root distrib.: MRD 0-12" Com. F, VF — % Clay *

Erosion: none — % Coarse fragments *: few M 0-12" — % Coarser than V.F.S. *

Permeability: moderate — see below

Additional notes

Digital photos taken of sample site with sign and landscape
Sampled in "To Be Affected Area" Disturbance Area

2 Samples: 0-6, 6-12"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
AC	0-6	10YR 5/3	10YR 4/3	Clay Loam	MM SBK	SH	FR	S/P	EV	GW		15%	mixed frags
C	6-12	10YR 5/4	10YR 4/4	Clay Loam	Massive	H	FR	S/P	EV	GW		20%	mixed frags
OB	12+	regraded spoil (not sampled)											

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R5

Soil type: Cambria Mag Unit A J. NYENHUIS, RN File No.

Area: Ramaco Brook Mine, north of Sheridan, WYO | Date: 5-27-14 | Stop No.

Classification: Mod-deep, sectil, fine-loamy, mesic Ustic Haplargid

Location: NW¼, SW¼, SW¼ T57N R85W 44°55'31" N, 107°4'10" W

N. veg. (or crop): prairie dog, mixed grasses | Climate: mesic

Parent material: mixed slopewash alluv. over residuum from scoria

Physiography: valley side slope - alluvial fan

Relief | Drainage: well | Salt or alkali: –

Elevation | Gr. water: deep (not encountered) | Stoniness: –

Slope: 5% | Moisture: sl. moist to 10"

Aspect: 36° NE | Root distrib.: MRD 0-22" Com F vF Few M 022" | % Clay *

Erosion: slight w/ mod. spots | % Coarse fragments *: see below | % Coarser than V.F.S. *

Permeability: moderate

Additional notes

Digital photos taken of sample site with sign and landscape

Sampled in "To Be Affected Area" Disturbance Area

4 Samples: 0-4, 4-10, 10-22, 22-36"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	10YR 6/3	10YR 5/3	Loam	WF GR	SH	VFR	SS/SP	EO	GS		5%	mixed fragments
Bt	4-10	10YR 5/3	10YR 4/3	Loam	WM SBK	SH	FR	SS/SP	EO	GW		7%	"
C1	10-22	10YR 4/3	10YR 3/3	Clay Loam	Massive	H	FI	S/SP	EO	GW		15%	"
C2	22-36	10YR 5/4	10YR 4/4	Clay Loam	Massive	H	FI	SS/SP	SE	GW		20%	
	36+	stopped by scoria coarse fragments (probably not bedrock)											

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R6

Soil type: Cambria Map Unit A J. NYENHUIS, RN File No.

Area: RAMACO Brook Mine, north of Sheridan Date: 5-27-14 Stop No.

Classification: Deep Fine-loamy, mesic Ustic Haplargid

Location: SE¼ NE¼ NW¼ Sect 13 T57N R85W 44° 53' 40" N, 109° 1' 54" W

N. veg. (or crop): mixed grasses prairie dog Climate: mesic

Parent material: slopewash alluvium

Physiography: alluvial fan

Relief –	Drainage: well	Salt or alkali: –
Elevation	Gr. water: deep	Stoniness: –
Slope: 4%	Moisture: sl. moist 0-20" moist + 20-72"	
Aspect: 76° East	Root distrib.: MRO 0-20"	% Clay*
Erosion: Slight w Mod spots	% Coarse fragments* see below	% Coarser than V.F.S.*
Permeability: mod slow		

Additional notes: Common F, VF; Few M } 0-20"

Digital photo taken of sample site with sign and landscape
Sampled in "To Be Affected Area" Disturbance Area

6 Samples: 0-4, 4-12, 12-20, 20-36, 36-52, 52-72"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	10YR 6/3	10YR 5/3	Loam	MM PL	SO	VFR	SS/SP	EO	GS		29	small mixed Frags
Bt1	4-12	10YR 5/3	10YR 4/3	Loam	MM SBK	SH	FR	SS/SP	EO	GW		39	"
Bt2	12-20	10YR 5/4	10YR 4/4	Loam	MM SBK	H	FR	S/P	EO	GW		–	
C1	20-36	10YR 6/4	10YR 5/4	Loam	Mass.	H	FI	S/P	EM	GW		–	
C2 v. moist	36-52	10YR 6/4	10YR 5/4	Clay Loam	Mass.	H	FI	S/P	ES	GW		–	
C v. moist	52-72+	10YR 5/4	10YR 4/4	Clay Loam	Mass.	H	FI	S/P	ES	GW		–	

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R7

Soil type Haverdad Mapunit H J. NIENHUIS, RN File No.

Area RAMACO Brook Mine, north of Sheridan Wy Date 5-27-14 Stop No.

Classification deep Fine-loamy, mesic (R55W) Ustic Torrifluvent

Location NE¼ NE¼ NW¼ Sect 13 T57N ↓ 44° 55'17" N, 107° 3'44" W

N. veg. (or crop) Riparian Wooded: Cottonwood, big Sage, grasses Climate mesic

Parent material streamlain alluvium

Physiography Slater Creek bottomland low Terrace

Relief	Drainage well	Salt or alkali –
Elevation	Gr. water deep	Stoniness –
Slope 0%	Moisture moist to 30", dry 30-46, moist to 58", very moist below 58	
Aspect 140° SE	Root distrib. MRD 0-30"	% Clay *
Erosion none	% Coarse fragments * –	% Coarser than V.F.S. *

Permeability moderate

Additional notes

Digital photos of sample site and landscape
Sampled in "To be Affected Area" Disturbance Area

6 Samples: 0-4, 4-16, 16-30, 30-46, 46-58, 58-72"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	10YR 4/3	10YR 3/3	Loam	sod cover	SO	VFR	SS/SP	SE	GS		–	
BC1	4-16	10YR 5/4	10YR 4/4	Loam	MM SBK	SH	FR	SS/SP	SE	GW		–	
BC2	16-30	10YR 6/3	10YR 5/3	Loam	WM SBK	SH	FR	SS/SP	EM	GW		–	
C1	30-46	10YR 6/4	10YR 5/4	Loam	Mass	H	FI	SS/SP	SE	GW		–	
C2	46-58	salts - white 10YR 5/4	10YR 4/4	Loam	Mass	H	FI	SS/SP	SE	GW		–	
C3	58-72	10YR 5/3	10YR 4/3	Loam	Mass	SH	FR	S/P	SE	GW		<1% small frags	

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

Soil type: Shingle Map Unit D

R8
File No.

J. NYENHUIS, RN

Area	RAMACO BROOK MINE north of Sheridan WY	Date 5-28-14	Stop No.
Classification	Shallow mesic Lamy Ustic TO R85W		
Location	SE¼ SE¼ NE¼ Section 13, T57N 44°50'48"N, 106°59'8"W		
N. veg. (or crop)	Wyoming Big Sage, mixed grasses, forbs	Climate	mesic
Parent material	thin residuum from underlying bedrock		
Physiography	upland		
Relief	Drainage well	Salt or alkali	–
Elevation	Gr. water deep (not encountered)	Stoniness	–
Slope 4%	Moisture dry		
Aspect 49° NE	Root distrib. MRD 0-20" Com M, F, VF few CO 0-20"	% Clay *	
Erosion none	% Coarse fragments *	% Coarser than V.F.S. *	
Permeability moderate			

Additional notes

Digital photos taken of sample site and landscape
Sampled in "To Be Affected Area" Disturbance Area

3 Samples: 0-3, 3-10, 10-20"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-3	10YR 5/3	10YR 4/3	Loam	MM GR	SH	FR	SS/SP	EO	GS		5%	small frags
Bw	3-10	10YR 4/3	10YR 3/3	Loam	MM SBK	H	FR	SS/SP	EO	GW		3%	small frags
Ck	10-20	10YR 6/4	10YR 5/4	Clay Loam	Mpas.	H	FR	S/SP	EV	GW		10%	small frags
	20+	R coarse frags											

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R9

Soil type: Forkwood Mapunit C — J. NYENHUIS, RN — File No.

Area: RAMACO BROOK MINE, north of Sheridan Wy — Date: 5-28-14 — Stop No.

Classification: Deep mesic Ustic Haplargid 44° 54' 31" N, 107° 8' 25"

Location: NW¼ NW¼ NW¼ Sect 18 T57N, R84W

N. veg. (or crop): mixed grasses w/ Big Sage scattered — Climate: mesic

Parent material: slopewash alluv.

Physiography: valley sideslope - alluvial fan, bowl

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness: —
Slope: 7%	Moisture: dry to 6", moist below	
Aspect: 202° S	Root distrib.: MAD 0-18"	% Clay *
Erosion: none	% Coarse fragments *: see below	% Coarser than V.F.S. *

Permeability: m slow

Additional notes

Digital photos taken of sample site and landscape
Sampled in "To Be Affected Area" Disturbance Area

5 Samples: 0-4, 4-12, 12-23, 23-35, 35-46"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %		
A	0-4	10YR 5/3	10YR 4/3	Loam	MM GR	SH	VFR	SS/SP	EO	GS		58	mixed frags	
Bt	4-12	10YR 5/3 5/4	10YR 4/3 4/4	Loam	MM SBK	SH	FR	SS/SP	EO	GW		59	"	
Btk	12-23	7.5YR 6/4	7.5YR 4/4	Clay Loam	Massive	H	FR	S/P	EM	GW		152	"	
C1	23-35	7.5YR 6/4	7.5YR 4/4	Loam	Mass.	H	FI	S/P	ES	GW		187	"	
C2	35-46	7.5YR 6/6	7.5YR 5/6	Loam	Mass.	H	FI	S/P	EM	GW		209	"	
	46+	hard dense layer coarse fragments												

TFN 6 2/025
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R10

Soil type: Cambria Map Unit A J. NYENHUIS RN File No.

Area RAMACO BROOK Mine northeast Sheridan Wy. Date 5-29-14 Stop No.

Classification Deep Fine-loamy, mixed, superactive, mesic Ustic Haplargid

Location SE¼ NE¼ NW¼ Sect 17 T57N R84W 44° 40' 24" N, 106° 51' 59" W

N. veg. (or crop) mtn cheat grass forbs Climate mesic

Parent material slopewash alluvium

Physiography upland valley

Relief	Drainage well	Salt or alkali —
Elevation	Gr. water deep (not encountered)	Stoniness —
Slope 5%	Moisture dry	
Aspect 149° SE	Root distrib. MRD 0-18" Few m com F VF 0-18"	% Clay *
Erosion moderate	% Coarse fragments * see below	% Coarser than V.F.S. *
Permeability moderate		

Additional notes

Digital photos of sample site and landscape taken

Sampled in "To Be Affected Area" Disturbance Area

6 Samples: 0-4, 4-10, 10-18, 18-32, 32-48, 48-72"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4"	7.5YR 10YR 5/3	7.5YR 10YR 4/3	Loam	WM GR	SO	VFR	SS/SP	VN GS	VN EO		10%	mixed scoria gravels
Bt1	4-10	7.5YR 5/4	7.5YR 4/4	Clay Loam	WM SBK	SH	FR	SS/SP	GW	EO		15%	"
Bt2	10-18	7.5YR 5/4	7.5YR 4/4	Clay Loam	Massive	SH	FR	SS/SP	GW	SE		20%	"
C	18-32	7.5YR 6/4	7.5YR 4/4	Loam	Mass	H	FR	SS/SP	GW	EM		15%	"
C	32-48	7.5YR 6/4	7.5YR 4/4	SL	Mass	H	FR	SS/SP	GW	ES		45%	"
C	48-72+	7.5YR 5/4	7.5YR 4/4	SL	Mass	H	FR	SS/SP	GW	ES		50%	

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R11

Soil type: WIBAUX Map Unit Wx J. NYENHUIS, RN File No.

Area: Ramaco Brook Mine, north of Sheridan WY | Date: 5-29-14 | Stop No.

Classification: Shallow Loamy-skeletal over fragmental mixed, nonacid, mesic Lithic Torriorthent

Location: NW¼ SW¼ SW¼ Sec 8 T57N R84W 44° 49' 2" N 106° 57' 47" W

N. veg. (or crop): Wyo. Big sage, mixed grasses, forbs, prickly pear | Climate: mesic

Parent material: thin residuum from scoria bedrock

Physiography: upland ridge crest

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness
Slope: 4%	Moisture: all dry to 4, then sl. moist	
Aspect: 208° SW	Root distrib.: MRD 0-8" Many F, VF Few M, CO 0-8"	% Clay *
Erosion: none to slight	% Coarse fragments *: see below	% Coarser than V.F.S. *
Permeability: moderately rapid		

Additional notes

Digital photos taken of sample site and landscape

Sampled in Potential Subsidence Area

3 Samples: 0-4, 4-8, 8-14"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	7.5YR 5/4	7.5YR 4/4	Channery Loam	MM GR	SO	VFR	SS/SP	EO	GS		15% 20% frags	scoria
Bw	4-8	7.5YR 5/4	7.5YR 4/4	Very Channery Loam	MM SBK	SH	FR	SS/SP	EO	GW		55%	scoria Channers
2C	8-14	7.5YR 6/4	7.5YR 5/4	EXT. CHANNERY Clay Loam	Mass.	H	FR	SS/SP	EO	GW		70% frags	scoria

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R12

Soil type Forkwood Map Unit Co J. NUENHUIS, RN File No.

Area RAMACO Brook Mine, north of Sheridan, Wyo. Date 5-29-14 Stop No.

Classification deep mesic Ustic Haplargid

Location SW1/4 SE1/4 SW1/4 Sec 8 T57N R84W 44° 55' 23" N 107° 1' 35" W

N. veg. (or crop) WYO Big sage, mixed grasses, forbs, prickly pear Climate mesic

Parent material alluvium, colluvium from Fort Union

Physiography fan off ridge

Relief Drainage well Salt or alkali —

Elevation Gr. water deep (not encountered) Stoniness channers surface

Slope 10% Moisture

Aspect 119° SE Root distrib. MRD % Clay *

Erosion none to slight % Coarse fragments * % Coarser than V.F.S. *

Permeability moderate see below

Additional notes

Digital photos taken of sample site and landscape

Sampled in "To Be Affected Area" Disturbance Area

6 Samples: 0-4, 4-13, 13-24, 24-40, 40-57, 57-72"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	7.5YR 5/4	7.5YR 4/4	Loam	WM GR	SO	VFR	SS/SP	EO	GS		15%	some channers
Bt1	4-13	7.5YR 5/4	7.5YR 4/4	Loam	WM SBK	SH	FR	SS/SP	SE	GW		20%	"
Btk	13-24	7.5YR 7/4	7.5YR 6/4	Loam	WM SBK	SH	FR	SS/SP	EV	GW		15%	"
C1	24-40	7.5YR 5/4	7.5YR 4/4	Loam	Mass	H	FR	SS/SP	ES	GW		10%	"
C2	40-57	7.5YR 5/4	7.5YR 4/4	Loam	Mass	H	FR	SS/SP	EM	GW		10%	"
C3	57-72+	10YR 6/4	10YR 4/4	Loam	Mass	H	FR	SS/SP	SE	GW		10%	"

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R13

Soil type: WIBAUX Mag Unit Wx J. NYENHUIS, RN — File No.

Area: RAMACO BROOK MINE north of Sheridan WY — Date: 5-29-14 — Stop No.

Classification: Shallow Loamy-skeletal over fragmental, mixed, nonacid Ustic Torriorthent

Location: SE¼ NW¼ NE¼ T57N, R84W 44°49'36" N, 106°58'17" W

N. veg. (or crop): Upland Grassland — Climate: mesic

Parent material: thin residuum from scoria bedrock

Physiography: upland

Relief	Drainage: well	Salt or alkali: –
Elevation	Gr. water: deep (not encountered)	Stoniness: –
Slope: 6%	Moisture: 8-15" sl. moist	
Aspect: 91° E	Root distrib.: MRT 0-8 Com F VF Few M	% Clay *
Erosion: slight	% Coarse fragments * 0-8"	% Coarser than V.F.S. *
Permeability: moderate	see below	

Additional notes

Digital photos taken of sample site and landscape
Sampled in "To Be Affected Area" Disturbance Area

3 Samples: 0-4, 4-8, 8-15"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	5YR 6/2	5YR 5/2	Loam	MM GR	SH	FR	SS/SP	EO	GS		15%	scoria channels
B	4-8	7.5YR 5/3	7.5YR 4/3	Clay	MS ABR	H	FI	S/P	EO	GW		10%	"
BK	8-15	7.5YR 6/4	7.5YR 5/4	Very channery Loam	Massive	H	FR	S/SP	EM+ ES	GW		30%	"
2C	15+	Scoria (not sampled)										70+	"

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R14

Soil type: Forkwood Map Unit C J. NYENHUIS RN File No.

Area: Ramaco Brook Mine, north of Sheridan WY Date: 5-30-14 Stop No.

Classification: Deep Fine-loamy, mixed, superactive, mesic Ustic Haplargid

Location: SE¼ SE¼ NW¼ Sec 14, T57NR85W 44°55'2"N, 107°4'54"W

N. veg. (or crop): cottonwoods & Big sage, mixed grasses, cactus Climate: mesic temp.

Parent material: slopewash

Physiography: sideslope

Relief	Drainage: well	Salt or alkali: –
Elevation	Gr. water: deep (not encountered)	Stoniness: –
Slope: 18%	Moisture: moist to 36"	
Aspect: 11° N	Root distrib.: MRD 0-24"	% Clay *
Erosion: none to slight	% Coarse fragments *: see below	% Coarser than V.F.S. *

Permeability: moderate

Additional notes:

Digital photos taken of sample site and landscape.

5 Samples: 0-4, 4-12, 12-24, 24-42, 42-55"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4"	10YR 5/3	10YR 4/3	SL	MM GR	SH	FR	S/SP	Eo	GS		2%	some charcoal
Bt1	4-12	10YR 5/3	10YR 4/3	Loam	MM SBK	SH	FR	S/SP	Eo	GW		5%	"
Bt2	12-24	7.5YR 5/4 10YR 5/4	7.5YR 4/4 10YR 4/4	SCL	MM SBK	H	FR	S/P	Eo	GW		10%	"
Ck1	24-42	10YR 6/4	10YR 5/4	SCL	Mass	H	FR	S/P	ES	GW		2%	"
Ck2	42-55	10YR	10YR	Loam	Mass	H	FI	S/P	ES	GW		15%	frags
	Stopped by rock												

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R15

Soil type: SAMDAY Map Unit E J. NYENHUIS, RAI File No.

Area: RAMACO BROOK MINE, northeast Sheridan WY | Date: 5-30-14 | Stop No.

Classification: shallow, clayey, smectitic, mesic Ustic Torriorthent

Location: NE/4 SW/4 NW/4 Sec 14 T57N, R85W 44°53'51" N, 107°3'10" W

N. veg. (or crop): Big sage, mixed grasses, cactus, forbs | Climate: mesic temp

Parent material: colluvium & slopewash over shale

Physiography: sideslope

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness: —
Slope: 20%	Moisture: all moist	
Aspect: 20° NE	Root distrib.: MRD 0-8" Com F, VF	% Clay *
Erosion: slight	% Coarse fragments * Few M, CO 0-8"	% Coarser than V.F.S. *
Permeability: slow		

Additional notes

Digital photos taken of sample site and landscape

3 Samples: 0-3, 3-8, 8-13"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %		
A	0-3"	10YR 6/2	10YR 4/2	Clay Loam	MM GR	SH	FR	SS/SP	EO	GS		10%	frags	
Bw	3-8	10YR 5/2	10YR 4/2	clay	MM SBK	H	FI	S/P	EO	GW		1%	"	
C	8-13	10YR 3/2	10YR 2/2	Sandy Clay	w Mass	SH	FR	SS/SP	EO	GW		25%	carb. shale chips	
		w carbonaceous shale-coaly material												

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R16

Soil type: Shingle Mag Unit D J. NYENHUIS, RN — File No.

Area: RAMACO BROOK Mine, north of Sheridan WY — Date: 5-30-14 — Stop No.

Classification: Shallow, Loamy mesic Ustic Torriorthent

Location: NW¼ SE¼ NW¼ Sect 13 T57N R85W 44° 51' 27" N 106° 59' 22" W

N. veg. (or crop): Wyo Big sage, mixed grasses, cactus, forbs — Climate

Parent material: slopewash alluv. over residuum

Physiography: rolling upland sideslope

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness: —
Slope: 18%	Moisture: dry 0-4, moist below	
Aspect: 37° NE	Root distrib.: MRD 0-12 com F, VF	% Clay *
Erosion: none to slight	% Coarse fragments * see below; few M, CO 0-12"	% Coarser than V.F.S. *
Permeability		

Additional notes

Digital photos taken of sample site and landscape

3 Samples: 0-4, 4-12, 12-18"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4"	10YR 5/3	10YR 4/3	SL loam	MM GR	SO	VFR	SS/SP	EO	GS		5%	scoria frags
Bw	4-12	10YR 5/4	10YR 4/3	SL loam	MM SBK	SH	FR	SS/SP	EO	GW		10%	scoria frags
C	12-18	10YR 6/4	10YR 5/4	SL loam	mass	H	FR	S/SP	EM	GW		15%	rock frags
	18+ stopped by rock												

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R17

Soil type: Bauxson Mag Unit G J. NIENHUIS, RN File No.

Area RAMACO BROOK Mine, north of Sheridan W4 Date 5-31-14 Stop No.

Classification deep Fine-loamy over fragmental, mixed, superactive, mesic Aridic Argiustoll

Location NE1/4 SW1/4 SW1/4 Sec 11 T57N R85W 44° 55' 29" N 107° 5' 9" W

N. veg. (or crop) Upland Grassland mixed grasses cactus, sagebrush Climate mesic temp

Parent material residuum from scoria bedrock

Physiography upland ridge crest - bench

Relief	Drainage well	Salt or alkali —
Elevation	Gr. water deep (not encountered)	Stoniness
Slope 3%	Moisture all moist	
Aspect 79° E	Root distrib. MAR 12	% Clay *
Erosion none	% Coarse fragments * see below	% Coarser than V.F.S. *

Permeability moderate

Additional notes

Digital photos taken of sample site and landscape

5 Samples: 0-4, 4-12, 12-23, 23-34, 34-42"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	10YR 4/3	10YR 3/3	Loam	MM GR	SO	VFR	SS/SP	EO	GS		2%	mixed frags
Bt	4-12	7.5YR 5/4 10YR	7.5YR 4/4 10YR	Clay Loam	MM SBK	SH	FR	SS/SP	EM	GW		10-15%	"
Bk	12-23	7.5YR 6/4 10YR	7.5YR 4/4 10YR	Chan. Loam	MM SBK	SH H	FR	SS/SP	EV	GW		20%	small scoria frags
ck	23-34	7.5YR 6/4	7.5YR 5/4	V. Chan. SL	Massive	H	FR	SS/SP	EV	GW		30%	"
c	34-42	7.5YR 5/4	7.5YR 4/4	V. Chan SL	Massive	H	FR	SS/SP	ES	GW		55%	"
2c	42+	stopped by rock (not sampled)										>70%	scoria frags

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - 501 - Rev. 2 -

R.18.

Soil type: WIBAUX Mag Unit Wx-RD J. NYENHUIS, RN — File No.

Area: RAMACO BROOK MINE, north of Sheridan WY — Date: 5-31-14 — Stop No.

Classification: Shallow Loamy-skeletal over fragmental mixed nonacid mesic Ustic Torriorthent

Location: NW 1/4 SW 1/4 SW 1/4 Sect 11 T57N R85W 44° 55' 24" N 107° 5' 19" W

N. veg. (or crop): woody shrubs, mixed grasses, rough forbs — Climate: mesic temp

Parent material: thin residuum from scoria bedrock (porcellanite)

Physiography: upper scoria sides/ridges

Relief — Drainage: well - somewhat excessive — Salt or alkali: —

Elevation — Gr. water: deep (not encountered) — Stoniness: channery surface

Slope: 37% — Moisture: all moist

Aspect: 194° S — Root distrib.: MAD 0-8" — % Clay *

Erosion: none to sl. spots — % Coarse fragments *: see below — % Coarser than V.F.S. *

Permeability: moderately rapid

Additional notes

Digital photos taken of sample site and landscape

3 Samples: 0-3, 3-8, 8-18"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-3	7.5YR 4/3	7.5YR 3/3	Chan. Loam	WM GR	SH	FR	SS/SP	EO	GS		20%	scoria channers
Bw	3-8	7.5YR 4/2	7.5YR 3/2	V. chan. Loam	WM SBK	SH	FR	SS/SP	SE	GW		30%	"
C	8-18	7.5YR 4/2 skeletal	7.5YR 3/2	V. chan. Loam	Massive	LO	LO	NS/NP	SE	GW		55%	"
	18-40+	fragmental (not sampled)											

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R19

Soil type: Bauxson Map Unit G J. NYENHUIS, RN File No.

Area: RAMACO Brook Mine, north of Sheridan WY Date: 5-31-14 Stop No.

Classification: Mod deep-deep Fine-loamy to Fine mesic Aridic Argiustoll

Location: NE1/4 SE1/4 NW1/4 Sect 18 T57N, R84W 44° 55' 6" N, 107° 2' 42" W

N. veg. (or crop): W40 big sage, mixed grasses, cactus Climate: mesic temp

Parent material: slopewash, alluv. and colluvium

Physiography: Lower sideslope - upper bajada

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness
Slope: 18%	Moisture: surface dry, moist	
Aspect: 252° W	Root distrib.: MRD 0-22"	% Clay *
Erosion: none	% Coarse fragments * see below	% Coarser than V.F.S. *
Permeability: mod. slow		

Additional notes

Digital photos taken of sample site and landscape.

5 Samples: 0-4, 4-10, 10-22, 22-36, 36-48"

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-4	10YR 5/3	10YR 4/3	Loam	MM GR	SH	FR	SS/SP	EO	GS		10%	mixed channers
Bt	4-10	5YR 5/3	5YR 4/3	clay loam	SM ABK	H	FR	S/P	SE	GW		10-15%	"
Bta	10-22	5YR 5/4	5YR 4/4	Clay loam	WM SBK	H	FR	S/P	ES	GW		2%	
C	22-36	2.5YR 5/6 5YR	2.5YR 4/6 5YR	clay	Mass	VH	FI	S/P	EM	GW		20%	clay rx chips
C/Cr	36-48	2.5YR 5/6 5YR	2.5YR 4/6 5YR	clay	Mass	VH	FI	S/P	EO	GW		45%	+ geof. clay cloth angular

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R20

Soil type: Haverdad Map Unit H J. NYENHUIS, RN File No.

Area: RAMACO Brook Mine, north of Sheridan WY | Date: 5-31-14 | Stop No.

Classification: deep Fine-loamy mixed superactive mesic Ustic Torrifluvent

Location: NW¼ SE¼ NW¼ Sec 19 T57N R84W 44°54'46"N 107°6'6" W

N. veg. (or crop): Riparian woodland, mixed grasses | Climate: mesic-temp.

Parent material: Fine-loamy streamlain alluv.

Physiography: drainage bottomland

Relief	Drainage: well	Salt or alkali: –
Elevation	Gr. water: deep (not encountered)	Stoniness: –
Slope: 4%	Moisture: all moist, very moist 42+	
Aspect: 195° South	Root distrib.: MBD 0-26"	% Clay *
Erosion: none	% Coarse fragments * see below	% Coarser than V.F.S. *
Permeability: moderate		

Additional notes

Digital photos taken of sample site and landscape

6 Samples: 0-5, 5-14, 14-26, 26-42, 42-58, 58-72

* Control section average

Horizon	Depth	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-5	10YR 5/3	10YR 4/3	Loam	MM GR	SO	FR	SS/SP	EO	GS		2%	mixed scoria frags
Bw	5-14	10YR 5/3	10YR 4/3	Loam	WM SBK	SH	FR	SS/SP	EO	GW		1%	"
BC	14-26	10YR 5/4	10YR 4/4	Loam	WM SBK	SH	FR	SS/SP	SE	GW		10-15%	
C1	26-42	10YR 4/2	10YR 3/2	Loam	Mass	H	FE	SS/SP	SE	GW		2%	mixed frags
C2	42-58	10YR 4/2	10YR 3/2	Loam	Mass	SH	FR	SS/SP	SE+	GW		3%	"
C3	58-72+	10YR 4/3	10YR 3/3	Loam	Mass	SH	FR	SS/SP	EM	GW		3%	"
	did not hit bedrock												

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R21

Soil type: WIBAUX Mapping Wx J. NYENHUIS File No.

Area: RAMACO BROOK MINE, north of SHERIDAN, WY Date: 6-30-14 Stop No.

Classification: shallow Lo-shal over fragmental mesic Ustic Torriorthent 44° 54' 18" N 107° 7' 48" W

Location: NE¼ of SW¼ Sect. 18 T57N, R84W

N. veg. (or crop): wyo. big sage, mixed grasses, prickly pear cactus Climate: mesic temp

Parent material: Lin residuum from interbedded sedimentary (ustic-mesic precip) scoria

Physiography: upland ridge crest

Relief	Drainage: well	Salt or alkali
Elevation	Gr. water: deep (not encountered)	Stoniness: channery surface
Slope: 8%	Moisture: sl. moist 0-10"	
Aspect: 220° SW	Root distrib.: MRD 0-10" Many F VF	% Clay *
Erosion: slight in spots	% Coarse fragments * see below Few M Co 0-10"	% Coarser than V.F.S. *
Permeability: moderately rapid		

Additional notes

Digital photos taken of sample site and landscape
Located sample site in a "To Be Affected Area" Disturbance Area

2 Samples: 0-3, 3-10"

all samples screened No. 10 screen

* Control section average

Horizon	Depth IN.	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary		CF %	
A	0-3	7.5YR 5/4	7.5YR 4/4	channery Loam	WF GR	SO	FR	SS/SP	SE	GS		20% scoria Channers	
C	3-10	7.5YR 6/4	7.5YR 4/4	v chan. Loam	WF SBK	SO	FR	SS/SP	SE	GW		35% scoria Fragments	
RC	10-40+	"Fragmental" displaced scoria fragments with many voids larger than 2 mm without any soil (NOT Sampled)											

TFN 6 2/025
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - Rev. 2 -

R22

Soil type: Banxson Map Unit G — J. NYENHUIS — File No.

Area: RAMACO BROOK MINE north of Sheridan WY — Date: 6-30-14 — Stop No.

Classification: see R17

Location: SW¼ of NE¼ Sect. 18, T57N, R84W

N. veg. (or crop): Wyo. Big Sage, mixed grasses, prickly pear — Climate: mosic soil temp, xeric aridic

Parent material: local alluvium over residuum from scoria ppt

Physiography: upland Gowl

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness: —
Slope: 8%	Moisture: Sl. moist to 14"	
Aspect: 189° South	Root distrib.: MRD 0-14"	% Clay *
Erosion: none	% Coarse fragments *: see below	% Coarser than V.F.S. *

Permeability: moderately rapid

Additional notes:

All samples screened No. 10 screen
Digital photos taken of sample site and landscape
Sample site located in "To Be Affected Area" Disturbance Area

3 Samples: 0-4, 4-14, 14-26"

* Control section average

Horizon	Depth IN.	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	CF %		
A	0-4	10YR 4/3 7.5YR 4/2	10YR 3/3 7.5YR 3/2	Channery Loam	WM GR	SO	FR	SS/SP	SE	G-S	15%	scoria channers	
B	4-14	10YR 5/3 7.5YR 5/4	10YR 4/3 7.5YR 4/4	Loam	MM SBK	SO	FR	SS/SP	EM	GW +	20%	"	
C	14-21+	10YR 5/3 7.5YR 5/4	10YR 4/3 7.5YR 4/4	Loam	Mass	SO	FR	SS/SP	EM	GW	25%	"	

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - 2
Rev. 2 - 8

R23

Soil type: HAVERDAD Map Unit H J. NYENHUIS File No.

Area: RAMACO BROOK MINE, north of Sheridan WY Date: 7-1-2014 Stop No.

Classification: deep see R20 44° 50' 50" N, 106° 58' 55" W

Location: SE 1/4 of SE 1/4 Sect 9 T57N R84W

N. veg. (or crop): mixed grasses, silver sage Climate: mesic temp ustic aridic moist.

Parent material: drainage and slopewash alluvium

Physiography: Hidden Waters Creek bottomland & low terraces

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness: —
Slope: 2 %	Moisture: sl. moist to 14"	
Aspect: 132° SE	Root distrib.: MRD 0-14"	% Clay *
Erosion: none	% Coarse fragments * see below	% Coarser than V.F.S. *
Permeability: moderate		

Additional notes

Digital photos taken of sample site and landscape
Located in "To be Affected Area" Disturbance Area

4 Samples: 0-4, 4-15, 15-26, 26-42"

* Control section average

Horizon	Depth IN	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	CF %		
A	0-4	10YR 4/3	10YR 3/3	Loam	MM GR	SO	FR	SS/SP	SE	GS	—		
BC	4-15	10YR 5/3	10YR 4/3	Loam	WM SBK	SH	FR	SS/SP	EM	GW	—		
C1	15-26	10YR 6/3	10YR 5/3	Loam	Massive	SH	FR	SS/SP	EM	GW	34%	mixed channers	
C2	26-42+	7.5YR 5/4	7.5YR 4/4	Loam	Massive	H	FR	SS/SP	EM	GW	34%	mixed channers	

stopped by sedimentary channers - could not auger dig any deeper

TFN 6 2/025
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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - 2
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R24

Soil type: Samday Map Unit E J. NYENHUIS File No.

Area: RAMACO BROOK Mine, north of Sheridan WY | Date: 7-1-2014 | Stop No.

Classification: see R15 GPS: 44°54'2"N, 106°59'47"W

Location: SE¼ of SW¼ Sect. 9, T57N R84W

N. veg. (or crop): mixed grasses (no sage) | Climate: ustic-aridic precip (mesic soil temp)

Parent material: slopewash, alluvium over residuum from sedimentary beds

Physiography: erosion surface - bench

Relief | Drainage: well | Salt or alkali: —

Elevation | Gr. water: deep (not encountered) | Stoniness: —

Slope: 3% | Moisture: 0-3" sl. moist

Aspect: 357° N | Root distrib.: MRX 0-10" | % Clay *

Erosion: none | % Coarse fragments *: see below | % Coarser than V.F.S. *

Permeability: moderately slow

Additional notes

Digital photos taken of sample site and landscape
Located in "To be affected area" Disturbance Area
Accessed 0-3"
not screened 3-10"
10-18"
3 Samples: 0-3, 3-10, 10-18"

* Control section average

Horizon	Depth IN	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	CF %			
A	0-3	10YR 5/3	10YR 4/3	Silt Loam	mm GR	SO	FR	S/SP	SE-	GS	—			
Bw	3-10	10YR 6/2	10YR 5/3	Clay Loam	wm SBK	SH	FR	S/P	SE-	GW	3%	small scoria & shale chips		
C	10-18	10YR 5/3	10YR 4/2	Clay Loam	Massive	VH	FR	S/P	SE-	GW	15%	small hard shale chips		
Cr	18+	weathered	10YR 7/3	clay shale	(not sampled)									

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U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - 2
Rev. 2 - 8

R25
File No.

Soil type: Ulm Map Unit 11 J. NYENHUIS

Area: RAMACO BROOK MINE, north of Sheridan WY | Date: 7-2-2014 | Stop No.

Classification: very deep Fine mesic Ustic Haplargid

Location: 44° 52' 52" N, 107° 4' 24" W

N. veg. (or crop): Rangeland mixed grasses | Climate: mesic temp ustic aridic moisture

Parent material: local alluvium (fine Textured

Physiography: irrigated hay Field Tongue River bottomland floodplain

Relief	Drainage: somewhat well	Salt or alkali: —
Elevation	Gr. water: deep	Stoniness: —
Slope: 0-2%	Moisture: moist to 40" then very moist below	
Aspect: 163° S	Root distrib.: MRP 0-14"	% Clay *
Erosion: none	% Coarse fragments *: see below	% Coarser than V.F.S. *

Permeability: moderately slow

Additional notes:

checked hole one day later - very moist - wet at 72" but No free water
Located in proposed Facilities Area
Digital photos taken of sample site and landscape

7 Samples 0-5, 5-14, 14-27, 27-40, 40-52, 52-62, 62-72"

* Control section average

Horizon	Depth IN.	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	CF %		
A_p	0-5	10YR 5/2	10YR 4/2	clay	MM GR	SH	FR	S/P	SE-	GS	-		
Bt1	5-14	10YR 5/3	10YR 4/3	clay	MM SBK	H	FR	VS/P	SE	GS.	-		
Bt2	14-27	10YR 6/3	10YR 5/3	Silty clay	MM SBK	H	FI	VS/P	SE	GW	-	few small flake carb strata chips	
C1	27-40	10YR 5/3	10YR 4/3	Silty clay	Massive	H	FI	VS/P	SE	GW	-	"	
C2	40-52	10YR 6/4	10YR 5/4	thin strata - VFS silty clay	carbon. chips Massive	H	FR	S/SP	SE-	GW	-	5% small scria chips and coaly chips start at 48"	
C3	52-62	Common redoximorphic colors at 52"+ 10YR 5/3	10YR 4/3	Silty clay	Massive	Both	Low	& high	chrome SE-	GW	-	5%	
C4	62-72+	10YR 5/4	10YR 4/4	clay loam	stratified Massive	SH	FR	S/SP	SE-	GW	-	5%	

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - 2
Rev. 2 - 8.

Soil type: ZIGWEID Map Unit B loam

J. NYENHUIS

R26

File No.

Area: RAMACO BROOK MINE, north of Sheridan WY | Date: 7-2-2014 | Stop No.

Classification: deep Fine loamy mesic Ustic Haplocambid (SW 1/4 of SW 1/4 of Sect 13 T57N, R85W)

Location: Facilities Area, test road and RR tracks 44° 54' 58" N 107° 5' 52" W

N. veg. (or crop): Mixed grasses hayland, including alfalfa | Climate: mesic soil temp, ustic aridic soil moist.

Parent material: Qal local alluvium

Physiography: irrigated hay field terrace of Tongue River

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness: —
Slope: 0-2%	Moisture: moist to	
Aspect: 184° S	Root distrib.: MBD 0-16"	% Clay *
Erosion: none	% Coarse fragments *: see below	% Coarser than V.F.S. *

Permeability: moderate

Additional notes

Digital photos taken of sample site and landscape

2" fine gravelly lense at 16-18"; also gravel lense w. scoria chips at 52-54"

7 Samples: 0-4, 4-16; 16-28, 28-40, 40-52, 52-62, 62-72"

* Control section average

Horizon	Depth ±N	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	CF %		
Ap	0-4	10YR 5/2	10YR 4/2	Loam	SCO GR	SH	FR	S/SP	EO	GS	—		
Bw	4-16	10YR 5/3	10YR 4/3	Loam	WM SBK	H	FR	S/P	EO	GW	—		
BC	16-28	10YR 6/3	10YR 5/3	Loam	Massive	H	FR	S/P	SE	GW	5% small gravel and clasnners		
C1	28-40	10YR 5/3	10YR 4/3	Clay Loam	Mass.	H	FI	S/P	SE	GW	—		
C2	40-52	10YR 5/3	10YR 4/3	Clay Loam	Mass	SH	FR	SH/SP	SE EM-	GW	—		
C3	52-62	few high chroma redox 10YR 5/4	10YR 4/4	Loam	Mass.	SH	FR	SH/SP	EM	GW	5% small gravels and scoria clasnes		
C4	62-72+	few high chroma redox 10YR 5/4	10YR 4/4	Loam	Mass.	H	FR	S/P	ES-	GW	"	"	"
	did not hit bedrock												

TFN 6 2/025
RECD NOV 14, 2014

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL DESCRIPTION

SCS - SOI - 2
Rev. 2 - 6

R27

Soil type: Samday Map Unit E — J. NYENHUIS — File No.

Area: RAMACO BROOK Mine, north of Sheridan WY — Date: 7-2-2014 — Stop No.

Classification: Shallow see R15

Location: SE 1/4 of NW 1/4 Sect 13 T57N R85W / 44° 54' 52" N, 107° 5' 12" W

N. veg. (or crop): Wyo big sage, mixed grasses, prickly pear — Climate: mesic soil temp ustic aridic moist

Parent material: thin residuum from clay shale (no scoria)

Physiography: upland hillslope

Relief	Drainage: well	Salt or alkali: —
Elevation	Gr. water: deep (not encountered)	Stoniness: —
Slope: 5%	Moisture: 9-18" sl. moist	
Aspect: 209° SW	Root distrib.: MRD 0-9"	% Clay *
Erosion: slight	% Coarse fragments *: —	% Coarser than V.F.S. *

Permeability: moderately slow

Additional notes:

Digital photos taken of sample site and landscape located in "to be affected area" Disturbance Area

3 Samples: 0-3, 3-9, 9-18"

* Control section average

Horizon	Depth IN.	Color Dry	Color Moist	Texture	Structure	Consistence Dry	Consistence Moist	Consistence Wet	Reaction	Boundary	CF %			
A	0-3	10YR 7/3	10YR 6/3	Clay Loam	mco PL	SH	FR	S/P	SE	GW	2%	mixed channers		
B	3-9	10YR 7/3	10YR 5/3	Silty Clay Loam	SM ABK/ MMGR	H	FR	S/P	SE	GW	—			
C	9-18	2.5Y 7/4 10YR 7/4	2.5Y 6/4 10YR 6/4	Silty Clay Loam	Mpas.	H	FR FI	S/P	EM	GW	—			
Cr	18+	weathered clay shale bedrock (not sampled)												

TFN 6 2/025
RECD NOV 14, 2014

ADDENDUM D7-2

ADDENDUM D7-2
SOILS LABORATORY RESULTS
SOIL SAMPLE SITES R1 – R27

TFN 6 2/025
RECD NOV 14,2014

DEQ 7-090

Inter-Mountain Labs

Your Environmental Monitoring Partner

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

Date: 6/18/2014

CLIENT: RAMACO
Project: Brook Mine Topsoil
Lab Order: S1405494

CASE NARRATIVE

Report ID: S1405494001

Samples R1, R2, R3, R4, R5, R6, R7, R8, and R9 were received on May 29, 2014.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

TFN 6 2/025
RECD NOV 14,2014

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

May 29, 2014

RAMACO, BROOK MINE, SHERIDAN WYO.

LIST OF SOIL SAMPLES: 36 Total Samples
sampled by JAMES NYENHUIS, CPSS-CPSC
Parameters: "Wyoming Topsoil"
pH, EC, sat%, OM, SAR, TEXTURE (hydrometer)
Boron & Selenium (hot water)
Coarse frags done in the field - don't do in the lab

R1	R2	R3	R4
0-6"	0-6"	0-6"	0-6"
6-12	6-12	6-12	6-12
12-20	12-21		
20-32	21-30		

R5	R6	R7	R8	R9
0-4"	0-4"	0-4"	0-3"	0-4"
4-10	4-12	4-16	3-10	4-12
10-22	12-20	16-30	10-20	12-23
22-36	20-36	30-46		23-35
	36-52	46-58		35-46
	52-72	58-72		

TFN 6 2/025
RECD NOV 14, 2014

Soil results in 15 business days.
On soil report, please have one blank line separating each sample set

5-29-14
Delivered J. Nyenhuis
Rec'd 5/29/14 Kara Asco
51405494

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

Your Environmental Monitoring Partner

October 2014

RAMACO

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1405494001

Project: Brook Mine Topsoil
Date Received: 5/29/2014

Date Reported: 6/18/2014
Work Order: S1405494

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1405494-001	R1	0-6	7.7	53.5	0.46	2.8	2.47	1.14	0.16	0.12
S1405494-002	R1	6-12	8.0	50.6	0.38	2.1	1.69	1.39	0.19	0.15
S1405494-003	R1	12-20	8.0	50.3	1.79	1.9	8.57	11.7	2.17	0.68
S1405494-004	R1	20-32	8.0	49.1	6.06	2.4	19.1	57.2	20.7	3.34
S1405494-005	R2	0-6	7.9	54.8	0.49	4.1	2.93	2.02	0.63	0.40
S1405494-006	R2	6-12	7.9	48.7	0.38	2.3	2.30	1.17	0.23	0.18
S1405494-007	R2	12-21	8.1	48.8	0.39	1.8	1.84	1.57	0.42	0.32
S1405494-008	R2	21-30	7.8	44.9	3.97	3.0	21.8	31.5	6.66	1.29
S1405494-009	R3	0-6	8.0	55.5	0.38	0.9	1.59	1.52	0.16	0.13
S1405494-010	R3	6-12	8.2	49.1	0.39	0.7	1.75	2.11	0.36	0.26
S1405494-011	R4	0-6	7.9	50.8	0.34	2.6	2.12	0.75	0.09	0.08
S1405494-012	R4	6-12	7.9	55.4	0.34	2.2	1.91	1.15	0.16	0.13
S1405494-013	R5	0-4	6.3	43.0	0.21	4.1	0.75	0.48	0.30	0.38
S1405494-014	R5	4-10	6.2	46.2	0.17	2.7	0.68	0.24	0.15	0.22
S1405494-015	R5	10-22	7.7	53.2	0.69	1.4	1.86	1.37	3.42	2.69
S1405494-016	R5	22-36	8.0	50.4	7.03	1.8	20.5	46.2	50.0	8.65
S1405494-017	R6	0-4	6.2	57.9	0.29	5.8	1.21	0.74	0.21	0.21
S1405494-018	R6	4-12	7.0	45.9	0.22	3.1	1.08	0.70	0.26	0.28
S1405494-019	R6	12-20	8.0	41.8	1.36	2.0	5.27	6.69	3.29	1.35
S1405494-020	R6	20-36	8.2	40.0	8.60	0.7	22.4	99.9	40.8	5.22

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate

Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential

Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Addendum D7-2-4

Brook Mine

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

Your Environmental Monitoring Partner

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1405494001

Project: Brook Mine Topsoil
Date Received: 5/29/2014

Date Reported: 6/18/2014
Work Order: S1405494

Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture	Boron ppm	Selenium ppm
S1405494-001	R1	0-6	36.0	41.0	23.0	Loam	0.39	<0.02
S1405494-002	R1	6-12	28.0	45.0	27.0	Clay Loam	0.45	<0.02
S1405494-003	R1	12-20	34.0	39.0	27.0	Clay Loam	1.75	<0.02
S1405494-004	R1	20-32	28.0	44.0	28.0	Clay Loam	1.74	0.05
S1405494-005	R2	0-6	32.0	42.0	26.0	Loam	0.32	<0.02
S1405494-006	R2	6-12	33.0	39.0	28.0	Clay Loam	0.44	<0.02
S1405494-007	R2	12-21	36.0	35.0	29.0	Clay Loam	0.66	<0.02
S1405494-008	R2	21-30	24.0	50.0	26.0	Silty Loam	1.68	<0.02
S1405494-009	R3	0-6	24.0	46.0	30.0	Clay Loam	0.36	<0.02
S1405494-010	R3	6-12	30.0	42.0	28.0	Clay Loam	0.74	<0.02
S1405494-011	R4	0-6	34.0	35.0	31.0	Clay Loam	0.33	<0.02
S1405494-012	R4	6-12	28.0	40.0	32.0	Clay Loam	0.35	<0.02
S1405494-013	R5	0-4	40.0	47.0	13.0	Loam	0.28	<0.02
S1405494-014	R5	4-10	40.0	43.0	17.0	Loam	0.35	<0.02
S1405494-015	R5	10-22	30.0	41.0	29.0	Clay Loam	0.48	<0.02
S1405494-016	R5	22-36	34.0	32.0	34.0	Clay Loam	0.55	0.10
S1405494-017	R6	0-4	40.0	42.0	18.0	Loam	0.28	<0.02
S1405494-018	R6	4-12	29.0	46.0	25.0	Loam	0.30	<0.02
S1405494-019	R6	12-20	36.0	40.0	24.0	Loam	0.51	<0.02
S1405494-020	R6	20-36	32.0	44.0	24.0	Loam	0.43	0.20

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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

Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1405494001

Project: Brook Mine Topsoil
Date Received: 5/29/2014

Date Reported: 6/18/2014
Work Order: S1405494

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1405494-021	R6	36-52	8.4	45.0	9.49	1.5	19.4	110	54.8	6.81
S1405494-022	R6	52-72	8.4	46.7	8.78	1.1	15.7	82.8	58.6	8.35
S1405494-023	R7	0-4	6.5	70.3	0.33	5.5	1.16	1.08	0.59	0.56
S1405494-024	R7	4-16	8.0	43.2	0.42	2.3	1.58	1.06	0.47	0.41
S1405494-025	R7	16-30	7.9	53.3	3.65	3.2	10.8	23.3	10.0	2.43
S1405494-026	R7	30-46	8.0	49.1	6.41	2.2	22.5	35.8	28.3	5.24
S1405494-027	R7	46-58	8.2	52.9	6.66	2.3	22.8	50.0	38.8	6.43
S1405494-028	R7	58-72	8.2	49.2	6.21	1.8	20.2	46.8	34.7	6.00
S1405494-029	R8	0-3	6.4	53.9	0.26	3.2	1.26	0.61	0.20	0.21
S1405494-030	R8	3-10	6.3	57.4	0.14	1.6	0.82	0.28	0.12	0.16
S1405494-031	R8	10-20	7.8	56.2	0.32	1.9	2.01	0.90	0.23	0.19
S1405494-032	R9	0-4	6.2	51.0	0.21	4.0	0.77	0.59	0.15	0.19
S1405494-033	R9	4-12	6.7	39.1	0.17	1.6	0.54	0.55	0.18	0.24
S1405494-034	R9	12-23	8.0	48.1	0.32	0.8	1.14	1.32	0.38	0.34
S1405494-035	R9	23-35	8.0	44.6	4.92	1.3	19.6	34.2	16.1	3.11
S1405494-036	R9	35-46	8.3	39.1	10.6	<0.1	20.1	96.8	72.1	9.43

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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

Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1405494001
Date Reported: 6/18/2014
Work Order: S1405494

Project: Brook Mine Topsoil
Date Received: 5/29/2014

Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture	Boron ppm	Selenium ppm
S1405494-021	R6	36-52	32.0	38.0	30.0	Clay Loam	0.66	0.20
S1405494-022	R6	52-72	36.0	36.0	28.0	Clay Loam	0.93	0.15
S1405494-023	R7	0-4	36.0	48.0	16.0	Loam	0.62	<0.02
S1405494-024	R7	4-16	36.0	44.0	20.0	Loam	0.52	<0.02
S1405494-025	R7	16-30	26.0	49.0	25.0	Loam	1.21	<0.02
S1405494-026	R7	30-46	28.0	48.0	24.0	Loam	0.71	0.16
S1405494-027	R7	46-58	26.0	48.0	26.0	Loam	0.61	0.13
S1405494-028	R7	58-72	42.0	37.0	21.0	Loam	0.70	0.06
S1405494-029	R8	0-3	48.0	34.0	18.0	Loam	0.29	<0.02
S1405494-030	R8	3-10	40.0	32.0	28.0	Clay Loam	0.18	<0.02
S1405494-031	R8	10-20	38.0	30.0	32.0	Clay Loam	0.19	<0.02
S1405494-032	R9	0-4	50.0	37.0	13.0	Loam	0.27	<0.02
S1405494-033	R9	4-12	44.0	37.0	19.0	Loam	0.21	<0.02
S1405494-034	R9	12-23	48.0	29.0	23.0	Loam	0.22	<0.02
S1405494-035	R9	23-35	40.0	39.0	21.0	Loam	1.56	0.11
S1405494-036	R9	35-46	38.0	41.0	21.0	Loam	2.44	0.37

TFN 62/025
RECD NOV 14, 2014

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Inter-Mountain Labs

Your Environmental Monitoring Partner

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

Date: 6/18/2014

CLIENT: RAMACO
Project: Brook Mine Topsoil
Lab Order: S1406011

CASE NARRATIVE

Report ID: S1406011001

Samples R10, R11, R12, R13, R14, R15, and R16 were received on May 30, 2014.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

TFN 6 2/025
RECD NOV 14,2014

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Brook Mine

May 30, 2014

RAMACO, BROOK MINE, SHERIDAN WYO.

LIST of Soil Samples: 2nd Set
same parameters as 1st Set

R10	R11	R12	R13
0-4"	0-4"	0-4"	0-4"
4-10	4-8	4-13	4-8
10-18	8-14	13-24	8-15
18-32		24-40	
32-48		40-57	
48-72		57-72	

R14	R15	R16
0-4"	0-3"	0-4"
4-12	3-8	4-12
12-24	8-13	12-18
24-42		
42-55		

TFN 6 2/025
RECD NOV 14, 2014

5-30-14

Delivered by Jim Nyenhuis
Rec'd 5/30/14 Kara Sea
51406011

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

Your Environmental Monitoring Partner

October 2014

RAMACO

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1406011001

Project: Brook Mine Topsoil
Date Received: 5/30/2014

Date Reported: 6/18/2014
Work Order: S1406011

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1406011-001	R10	0-4	6.2	51.4	0.36	3.3	1.62	1.11	0.09	0.08
S1406011-002	R10	4-10	6.8	55.1	0.15	1.3	0.77	0.39	0.28	0.37
S1406011-003	R10	10-18	7.8	55.3	0.33	0.6	1.21	0.93	0.30	0.29
S1406011-004	R10	18-32	8.2	46.5	1.25	0.2	2.65	4.91	4.35	2.24
S1406011-005	R10	32-48	8.0	38.4	6.19	<0.1	19.7	46.9	22.9	3.97
S1406011-006	R10	48-72	8.0	39.6	6.81	0.1	17.4	56.2	27.8	4.58
S1406011-007	R11	0-4	6.1	59.3	0.27	4.8	1.11	1.08	0.53	0.50
S1406011-008	R11	4-8	6.3	51.5	0.12	2.3	0.58	0.33	0.24	0.35
S1406011-009	R11	8-14	6.6	57.1	0.19	2.4	0.73	0.40	0.11	0.15
S1406011-010	R12	0-4	6.6	53.5	0.18	2.6	0.68	0.41	0.07	0.10
S1406011-011	R12	4-13	7.8	56.0	0.20	1.5	1.08	0.43	0.07	0.08
S1406011-012	R12	13-24	8.1	50.9	0.23	1.1	0.96	0.70	0.14	0.16
S1406011-013	R12	24-40	8.4	40.7	0.23	0.6	0.50	0.83	0.83	1.02
S1406011-014	R12	40-57	8.2	46.6	0.57	0.4	0.52	0.73	4.05	5.12
S1406011-015	R12	57-72	8.0	51.5	1.88	0.2	3.50	4.26	10.3	5.25
S1406011-016	R13	0-4	6.4	47.1	0.51	4.2	0.48	0.60	3.11	4.23
S1406011-017	R13	4-8	7.6	71.2	1.23	1.7	0.84	1.59	8.06	7.31
S1406011-018	R13	8-15	8.2	71.3	12.8	1.3	20.1	62.6	111	17.3
S1406011-019	R14	0-4	6.9	40.5	0.49	1.9	2.17	1.29	0.28	0.21
S1406011-020	R14	4-12	6.7	37.1	0.17	0.6	0.53	0.44	0.14	0.21

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

Addendum D7-2-10

Brook Mine

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

Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1406011001
Date Reported: 6/18/2014
Work Order: S1406011

Project: Brook Mine Topsoil
Date Received: 5/30/2014

Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture	Boron ppm	Selenium ppm
S1406011-001	R10	0-4	40.0	42.0	18.0	Loam	0.42	<0.02
S1406011-002	R10	4-10	34.0	38.0	28.0	Clay Loam	0.43	<0.02
S1406011-003	R10	10-18	26.0	44.0	30.0	Clay Loam	0.50	<0.02
S1406011-004	R10	18-32	42.0	34.0	24.0	Loam	0.61	<0.02
S1406011-005	R10	32-48	68.0	21.0	11.0	Sandy Loam	0.74	0.08
S1406011-006	R10	48-72	56.0	27.0	17.0	Sandy Loam	0.94	0.21
S1406011-007	R11	0-4	48.0	34.0	18.0	Loam	0.26	<0.02
S1406011-008	R11	4-8	38.0	38.0	24.0	Loam	0.34	<0.02
S1406011-009	R11	8-14	36.0	35.0	29.0	Clay Loam	0.28	<0.02
S1406011-010	R12	0-4	36.0	42.0	22.0	Loam	0.25	<0.02
S1406011-011	R12	4-13	38.0	36.0	26.0	Loam	0.32	<0.02
S1406011-012	R12	13-24	36.0	42.0	22.0	Loam	0.29	<0.02
S1406011-013	R12	24-40	40.0	44.0	16.0	Loam	0.27	<0.02
S1406011-014	R12	40-57	28.0	48.0	24.0	Loam	1.43	<0.02
S1406011-015	R12	57-72	28.0	50.0	22.0	Silty Loam	1.67	0.11
S1406011-016	R13	0-4	34.0	48.0	18.0	Loam	0.44	<0.02
S1406011-017	R13	4-8	26.0	34.0	40.0	Clay	1.37	0.02
S1406011-018	R13	8-15	44.0	44.0	12.0	Loam	1.81	0.09
S1406011-019	R14	0-4	64.0	24.0	12.0	Sandy Loam	0.20	<0.02
S1406011-020	R14	4-12	64.0	18.0	18.0	Sandy Loam	0.17	<0.02

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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

Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1406011001

Project: Brook Mine Topsoil
Date Received: 5/30/2014

Date Reported: 6/18/2014
Work Order: S1406011

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1406011-021	R14	12-24	8.2	41.9	0.26	0.2	1.01	1.05	0.21	0.20
S1406011-022	R14	24-42	8.4	32.0	0.73	0.8	1.35	4.65	1.31	0.75
S1406011-023	R14	42-55	8.0	40.9	5.56	0.9	7.59	77.7	11.8	1.81
S1406011-024	R15	0-3	7.1	54.9	0.30	6.1	1.27	0.99	0.18	0.17
S1406011-025	R15	3-8	7.3	51.0	0.14	2.6	0.58	0.71	0.29	0.37
S1406011-026	R15	8-13	5.9	86.6	0.18	6.5	1.31	1.11	0.33	0.30
S1406011-027	R16	0-4	6.5	50.9	0.25	3.1	0.84	0.61	0.25	0.29
S1406011-028	R16	4-12	6.9	41.4	0.16	1.2	0.66	0.37	0.08	0.12
S1406011-029	R16	12-18	8.0	39.1	0.24	0.8	1.07	0.72	0.30	0.31

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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

Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1406011001
Date Reported: 6/18/2014
Work Order: S1406011

Project: Brook Mine Topsoil
Date Received: 5/30/2014

Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture	Boron ppm	Selenium ppm
S1406011-021	R14	12-24	62.0	12.0	26.0	Sandy Clay Loam	0.17	<0.02
S1406011-022	R14	24-42	64.0	16.0	20.0	Sandy Clay Loam	0.22	<0.02
S1406011-023	R14	42-55	34.0	40.0	26.0	Loam	0.85	0.18
S1406011-024	R15	0-3	30.0	42.0	28.0	Clay Loam	0.44	<0.02
S1406011-025	R15	3-8	8.0	36.0	56.0	Silty Clay	0.39	<0.02
S1406011-026	R15	8-13	76.0	<0.1	49.0	Sandy Clay	0.49	<0.02
S1406011-027	R16	0-4	54.0	31.0	15.0	Sandy Loam	0.30	<0.02
S1406011-028	R16	4-12	52.0	30.0	18.0	Sandy Loam	0.27	<0.02
S1406011-029	R16	12-18	60.0	22.0	18.0	Sandy Loam	0.21	<0.02

TFN 6 2/025
RECD NOV 14, 2014

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

From: Karen Secor <ksecor@imlinc.com>
To: 'Jim Nyenhuis' <jameshnyenhuis@aol.com>
Subject: EC/SAR Rerun for Ramaco
Date: Thu, Jul 3, 2014 2:21 pm

Jim,

I re-analyzed sample R13 (8-15") for EC and SAR and obtained similar results. They are summarized below:

	Ca	Mg	Na	SAR
initial:	20.1	62.6	111	17.3
rerun:	20.5	74.6	150	21.8

Please call or email with any questions. Thanks,

Karen Secor

Soil Lab Manager

Inter-Mountain Labs

Phone 307-672-8945

Fax 307-672-6053

Email: ksecor@imlinc.com

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TFN 6 2/025
RECD NOV 14, 2014

From: Karen Secor <ksecor@imlinc.com>
To: 'Jim Nyenhuis' <jameshnyenhuis@aol.com>
Subject: FW: EC/SAR Rerun for Ramaco
Date: Thu, Jul 3, 2014 2:59 pm

Karen Secor

Soil Lab Manager

Inter-Mountain Labs

Phone 307-672-8945

Fax 307-672-6053

Email:

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From: Karen Secor [ ]
Sent: Thursday, July 03, 2014 2:22 PM
To: 'Jim Nyenhuis'
Subject: EC/SAR Rerun for Ramaco

Jim,

I re-analyzed sample R13 (8-15") for EC and SAR and obtained similar results. They are summarized below:

TFN 6 2/025
RECD NOV 14, 2014

Inter-Mountain Labs

Your Environmental Monitoring Partner

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

Date: 6/18/2014

CLIENT: RAMACO
Project: Brook Mine Topsoil
Lab Order: S1406012

CASE NARRATIVE

Report ID: S1406012001

Samples R17, R18, R19, and R20 were received on June 2, 2014.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

TFN 6 2/025
RECD NOV 14, 2014

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

5-31-14

RAMACO BROOK MINE
LIST OF SOIL SAMPLES 3rd Set (19 Samples)
Sampled by JIM NYENHUIS
970-204-9167

R17	R18	R19	R20
0-4"	0-3"	0-4"	0-5"
4-12	3-8	4-10	5-14
12-23	8-18	10-22	14-26
23-34		22-36	26-42
34-42		36-48	42-58
			58-72

Same parameters as Sets 1 & 2

Delivered by Jim Nyenhuis 5-31-2014
3pm.

Rec'd 6/2/14 Kare Aleco
51406012

TFN 6 2/025
RECD NOV 14, 2014

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

Your Environmental Monitoring Partner

October 2014

RAMACO

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1406012001

Project: Brook Mine Topsoil
Date Received: 6/2/2014

Date Reported: 6/18/2014
Work Order: S1406012

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1406012-001	R17	0-4	7.8	72.4	0.24	5.3	1.12	0.47	0.10	0.11
S1406012-002	R17	4-12	7.7	67.6	0.27	2.1	1.43	0.55	0.11	0.11
S1406012-003	R17	12-23	8.1	61.7	0.35	2.0	1.59	0.99	0.32	0.28
S1406012-004	R17	23-34	8.3	46.1	0.51	0.7	1.79	1.95	0.48	0.35
S1406012-005	R17	34-42	7.9	45.3	3.00	<0.1	25.8	15.6	1.86	0.41
S1406012-006	R18	0-3	6.6	69.8	0.37	5.0	2.33	0.92	0.34	0.27
S1406012-007	R18	3-8	6.8	70.3	0.24	3.1	1.49	0.63	0.32	0.31
S1406012-008	R18	8-18	7.6	63.5	0.26	0.6	1.76	0.62	0.36	0.33
S1406012-009	R19	0-4	6.5	50.1	0.25	3.7	1.29	0.99	0.39	0.37
S1406012-010	R19	4-10	7.7	48.7	0.30	1.5	0.86	1.03	0.51	0.52
S1406012-011	R19	10-22	8.3	47.5	0.33	1.6	0.89	1.03	1.39	1.42
S1406012-012	R19	22-36	8.1	61.6	6.31	0.6	15.0	60.7	25.1	4.09
S1406012-013	R19	36-48	8.0	53.9	7.50	<0.1	14.3	78.4	37.8	5.55
S1406012-014	R20	0-5	6.6	77.7	0.36	6.3	1.56	1.76	0.63	0.49
S1406012-015	R20	5-14	7.2	55.9	0.18	2.6	0.83	0.54	0.30	0.36
S1406012-016	R20	14-26	8.1	55.7	0.28	1.9	1.65	0.84	0.44	0.39
S1406012-017	R20	26-42	7.7	48.6	1.91	1.7	12.8	9.95	2.38	0.71
S1406012-018	R20	42-58	7.9	49.0	3.28	1.7	18.3	21.4	7.17	1.61
S1406012-019	R20	58-72	8.2	49.5	0.57	1.5	2.07	2.28	1.50	1.02

TFN 6 2/025
RECD NOV 14, 2014

Addendum D7-2-18

Brook Mine

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur. Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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

Your Environmental Monitoring Partner

October 2014

RAMACO

Soil Analysis Report

RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1406012001

Project: Brook Mine Topsoil
Date Received: 6/2/2014

Date Reported: 6/18/2014
Work Order: S1406012

Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture	Boron ppm	Selenium ppm
S1406012-001	R17	0-4	40.0	41.0	19.0	Loam	0.26	<0.02
S1406012-002	R17	4-12	36.0	33.0	31.0	Clay Loam	0.23	<0.02
S1406012-003	R17	12-23	36.0	40.0	24.0	Loam	0.71	<0.02
S1406012-004	R17	23-34	62.0	28.0	10.0	Sandy Loam	0.53	<0.02
S1406012-005	R17	34-42	68.0	22.0	10.0	Sandy Loam	0.78	<0.02
S1406012-006	R18	0-3	46.0	36.0	18.0	Loam	0.49	<0.02
S1406012-007	R18	3-8	38.0	40.0	22.0	Loam	0.70	<0.02
S1406012-008	R18	8-18	38.0	40.0	22.0	Loam	0.57	<0.02
S1406012-009	R19	0-4	50.0	34.0	16.0	Loam	0.23	<0.02
S1406012-010	R19	4-10	38.0	30.0	32.0	Clay Loam	0.26	<0.02
S1406012-011	R19	10-22	18.0	46.0	36.0	Silty Clay Loam	0.61	<0.02
S1406012-012	R19	22-36	8.0	55.0	37.0	Silty Clay Loam	1.96	0.41
S1406012-013	R19	36-48	16.0	52.0	32.0	Silty Clay Loam	1.23	0.37
S1406012-014	R20	0-5	34.0	47.0	19.0	Loam	0.56	<0.02
S1406012-015	R20	5-14	36.0	44.0	20.0	Loam	0.50	<0.02
S1406012-016	R20	14-26	44.0	34.0	22.0	Loam	0.48	<0.02
S1406012-017	R20	26-42	36.0	39.0	25.0	Loam	0.56	<0.02
S1406012-018	R20	42-58	34.0	44.0	22.0	Loam	0.65	0.10
S1406012-019	R20	58-72	50.0	30.0	20.0	Loam	0.60	<0.02

TFN 6 2/025
RECD NOV 14, 2014

Addendum D7-2-19

Brook Mine

These results apply only to the samples tested.
Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

RAMACO
Inter-Mountain Labs
Your Environmental Monitoring Partner
1673 Terra Avenue, Sheridan, Wyoming 82801 ph: (307) 672-8945

Date: 7/25/2014

CLIENT: RAMACO
Project: Brook Mine Topsoil
Lab Order: S1407102

CASE NARRATIVE

Report ID: S1407102001

Samples R21, R22, R23, R24, R25, R26, and R27 were received on July 3, 2014.

Samples were analyzed using the methods outlined in the following references:

U.S.E.P.A. 600/2-78-054 "Field and Laboratory Methods Applicable to Overburden and Mining Soils", 1978
American Society of Agronomy, Number 9, Part 2, 1982
USDA Handbook 60 "Diagnosis and Improvement of Saline and Alkali Soils", 1969
Wyoming Department of Environmental Quality, Land Quality Division, Guideline No. 1, 1984
New Mexico Overburden and Soils Inventory and Handling Guideline, March 1987
State of Utah, Division of Oil, Gas, and Mining: Guidelines for Management of Topsoil and Overburden for Underground and Surface Coal Mining, April 1988
Montana Department of State Lands, Reclamation Division: Soil, Overburden, and Regraded Spoil Guidelines, December 1994
State of Nevada Modified Sobek Procedure
Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW846, 3rd Edition

All Quality Control parameters met the acceptance criteria defined by EPA and Inter-Mountain Laboratories except as indicated in this case narrative.

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

TFN 6 2/025
RECD NOV 14, 2014

RAMACO, BROOK MINE, SHERIDAN WYO.

LIST OF SOIL SAMPLES: 29 total Samples

sampled by JAMES NYENHUIS, CPSS

Parameters: pH, EC, Sat %, OM, SAR, TEXTURE (hydrometer)
Boron & Selenium (hot water)
Coarse frags done in the field – don't do in the lab.
Keep remainder of sample material

R21	R22	R23	R24
0-3"	0-4"	0-4"	0-3"
3-10	4-14	4-15	3-10
	14-26	15-26	10-18
		26-42	

R25		R26	R27
0-5"	Add N-P-K per Jim Nyenhuis phone call 7/3/14 KS	0-4"	0-3"
5-14		4-16	3-9
14-27		16-28	9-18
27-40		28-40	
40-52		40-52	
52-62		52-62	
62-72		62-72	

S1407102

Rec'd by Kara Leco 7/3/14

Delivered by Jim Nyenhuis 7-3-14

TFN 6 2/025
RECD NOV 14, 2014

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

Your Environmental Monitoring Partner

Soil Analysis Report
RAMACO
250 West Main Street, Suite 210
Lexington, KY 40507

Report ID: S1407102001

Project: Brook Mine Topsoil
Date Received: 7/3/2014

Date Reported: 7/25/2014
Work Order: S1407102

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1407102-001	R21	0-3	7.8	47.7	0.47	2.9	2.49	0.41	0.27	0.22
S1407102-002	R21	3-10	7.8	55.9	0.32	2.9	2.34	0.36	0.15	0.13
S1407102-003	R22	0-4	7.8	62.0	0.40	3.5	2.76	0.46	0.43	0.34
S1407102-004	R22	4-14	7.8	59.6	0.40	3.0	2.43	0.53	0.44	0.36
S1407102-005	R22	14-26	7.8	59.0	0.44	2.9	2.68	0.85	0.34	0.26
S1407102-006	R23	0-4	7.4	70.9	0.51	6.4	2.24	1.16	0.38	0.29
S1407102-007	R23	4-15	7.7	48.4	0.57	2.9	2.18	1.23	0.37	0.28
S1407102-008	R23	15-26	7.8	45.3	1.06	2.4	3.95	4.14	1.70	0.85
S1407102-009	R23	26-42	7.7	45.0	2.02	2.2	9.52	10.1	2.66	0.85
S[illegible]'02-010	R24	0-3	6.2	56.2	0.26	3.3	0.37	0.47	0.82	1.27
S[illegible]02-011	R24	3-10	6.4	53.9	0.24	2.1	0.55	2.50	1.59	1.29
S1407102-012	R24	10-18	7.6	52.4	4.29	1.6	5.10	18.3	25.2	7.37
S1407102-013	R25	0-5	6.8	78.1	0.65	6.4	3.39	2.30	0.79	0.47
S1407102-014	R25	5-14	6.7	62.5	0.27	5.0	1.11	0.83	0.56	0.57
S1407102-015	R25	14-27	6.9	62.9	0.65	3.8	3.42	2.36	0.74	0.43
S1407102-016	R25	27-40	7.5	61.2	0.56	3.2	2.57	1.78	0.71	0.48
S1407102-017	R25	40-52	7.4	50.3	0.92	3.3	4.96	3.25	1.01	0.50
S1407102-018	R25	52-62	7.5	52.0	0.58	2.6	3.39	2.39	1.01	0.59
S1407102-019	R25	62-72	7.4	50.4	0.78	1.8	4.32	2.99	0.94	0.49
S1407102-020	R26	0-4	6.9	77.0	0.70	5.6	3.76	2.55	0.79	0.45

These results apply only to the samples tested.

Abbreviations for extractants: PE= Saturated Paste Extract, H20Sol= water soluble,AB-DTPA= Ammonium Bicarbonate-DTPA, AAO= Acid Ammonium Oxalate
Abbreviations used in acid base accounting: T.S.= Total Sulfur, AB= Acid Base, ABP= Acid Base Potential, PyrS= Pyritic Sulfur, Pyr+Org= Pyritic Sulfur + Organic Sulfur, Neutral. Pot.= Neutralization Potential
Miscellaneous Abbreviations: SAR= Sodium Adsorption Ratio, CEC= Cation Exchange Capacity, ESP= Exchangeable Sodium Percentage

Reviewed by: Karen A Secor
Karen Secor, Soil Lab Supervisor

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Report ID: S1407102001

Project: Brook Mine Topsoil
Date Received: 7/3/2014

Date Reported: 7/25/2014
Work Order: S1407102

Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture	Boron ppm	Nitrate(as N) ppm	Available Phosphorus ppm	Available Potassium ppm	Selenium ppm
S1407102-001	R21	0-3	52.0	35.0	13.0	Sandy Loam	0.29				<0.02
S1407102-002	R21	3-10	46.0	39.0	15.0	Loam	0.33				<0.02
S1407102-003	R22	0-4	40.0	45.0	15.0	Loam	0.29				<0.02
S1407102-004	R22	4-14	36.0	44.0	20.0	Loam	0.22				<0.02
S1407102-005	R22	14-26	36.0	43.0	21.0	Loam	0.28				<0.02
S1407102-006	R23	0-4	42.0	44.0	14.0	Loam	0.63				<0.02
S1407102-007	R23	4-15	46.0	37.0	17.0	Loam	0.61				<0.02
S1407102-008	R23	15-26	52.0	30.0	18.0	Sandy Loam	0.57				<0.02
S1407102-009	R23	26-42	52.0	29.0	19.0	Sandy Loam	0.56				<0.02
S[illegible]102-010	R24	0-3	24.0	53.0	23.0	Silty Loam	0.30				<0.02
S[illegible]02-011	R24	3-10	22.0	48.0	30.0	Clay Loam	0.31				<0.02
S1407102-012	R24	10-18	20.0	41.0	39.0	Clay Loam	0.44				<0.02
S1407102-013	R25	0-5	18.0	47.0	35.0	Silty Clay Loam	0.38	3.4	25.2	167	<0.02
S1407102-014	R25	5-14	16.0	47.0	37.0	Silty Clay Loam	0.28	4.7	13.6	148	<0.02
S1407102-015	R25	14-27	14.0	45.0	41.0	Silty Clay	0.48	4.2	11.4	157	<0.02
S1407102-016	R25	27-40	14.0	43.0	43.0	Silty Clay	0.42	1.1	9.2	161	<0.02
S1407102-017	R25	40-52	26.0	43.0	31.0	Clay Loam	0.25				<0.02
S1407102-018	R25	52-62	14.0	46.0	40.0	Silty Clay	0.28				<0.02
S1407102-019	R25	62-72	24.0	39.0	37.0	Clay Loam	0.49				<0.02
S1407102-020	R26	0-4	34.0	41.0	25.0	Loam	0.38	2.6	46.6	193	<0.02

These results apply only to the samples tested.

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Karen Secor, Soil Lab Supervisor

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Project: Brook Mine Topsoil
Date Received: 7/3/2014

Date Reported: 7/25/2014
Work Order: S1407102

Lab ID	Sample ID	Depths Inches	pH s.u.	Saturation %	Electrical Conductivity dS/m	Organic Matter %	PE Calcium meq/L	PE Magnesium meq/L	PE Sodium meq/L	SAR
S1407102-021	R26	4-16	7.2	62.2	0.45	4.6	2.61	1.50	0.52	0.36
S1407102-022	R26	16-28	7.8	46.0	0.34	1.4	1.52	0.90	0.56	0.51
S1407102-023	R26	28-40	7.7	61.7	0.33	1.6	1.57	0.94	0.41	0.37
S1407102-024	R26	40-52	7.6	42.5	0.44	1.1	1.77	1.13	0.70	0.58
S1407102-025	R26	52-62	7.8	40.1	0.29	1.3	1.57	1.96	0.44	0.33
S1407102-026	R26	62-72	7.8	45.1	0.53	0.8	2.55	1.49	0.54	0.38
S1407102-027	R27	0-3	6.3	33.1	0.18	1.3	0.41	0.72	0.33	0.44
S1407102-028	R27	3-9	7.8	44.0	0.33	1.1	1.14	2.20	0.46	0.36
S1407102-029	R27	9-18	7.9	50.2	3.70	0.7	23.3	31.7	3.24	0.62

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Lab ID	Sample ID	Depths Inches	Sand %	Silt %	Clay %	Texture	Boron ppm	Nitrate(as N) ppm	Available Phosphorus ppm	Available Potassium ppm	Selenium ppm
S1407102-021	R26	4-16	36.0	41.0	23.0	Loam	0.19	4.6	16.4	92	<0.02
S1407102-022	R26	16-28	42.0	37.0	21.0	Loam	0.15	1.3	6.4	65	<0.02
S1407102-023	R26	28-40	23.0	52.0	25.0	Silty Loam	0.16	0.9	6.1	70	<0.02
S1407102-024	R26	40-52	28.0	42.0	30.0	Clay Loam	0.24				<0.02
S1407102-025	R26	52-62	32.0	42.0	26.0	Loam	0.22				<0.02
S1407102-026	R26	62-72	30.0	45.0	25.0	Loam	0.17				<0.02
S1407102-027	R27	0-3	32.0	46.0	22.0	Loam	0.20				<0.02
S1407102-028	R27	3-9	16.0	47.0	37.0	Silty Clay Loam	0.25				<0.02
S1407102-029	R27	9-18	14.0	52.0	34.0	Silty Clay Loam	0.84				<0.02

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