SAMPLING AND ANALYSIS PLAN

Section 6.0

Topsoil

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&
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6.1 Introduction and Background

A successful reclamation program is dependent, in part, upon the quantity and quality of topsoil available for use during the reclamation process. RHR is assessing the quantity and suitability of topsoil present at the permit area in two ways. First, current literature concerning soil characteristics was reviewed and is summarized in this section. Second, a determination of site-specific soil characteristics was made and is summarized in this section of the SAP.

The term "topsoil" in this section refers to the A, B and C soil horizon or soil material that is salvageable from the areas to be disturbed and capable of supporting vegetation. In semi-arid climates, good suitable materials such as these may be available. As such, a more accurate term for such materials is "suitable top dressing." However, in the interest of conforming to the requirements of the Mine Act regulations, the term "topsoil" is used to describe this material. General information about the soils present on the Roca Honda permit area was obtained from two separate soil surveys. The level of detail varies in the two surveys; however, both contain a recommendation on topsoil suitability. Both studies use the nomenclature "good," "fair," and "poor". The first survey was conducted by the USFS (Strenger et al., 2007) and covered Sections 9 and 10 of the permit area. The second survey covered Section 16 of the permit area and was conducted by the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) in cooperation with BLM, the Bureau of Indian Affairs (BIA), and the New Mexico Agricultural Experiment Station (NRCS 2006). The results of the two surveys and their respective areas are shown in Figure 6–1. The soil types appear disconnected on the Section 9 and Section 16 line. This is due to the two separate surveys conducted by the two different agencies. The USFS uses observational soil identifications while the NRCS uses defined soil complex identifications.

Not all materials identified as suitable will be salvageable. Such materials located on steep slopes will be avoided. Appropriate allowances for some losses during handling, storage, etc, will be made in calculating needed material quantities. Additional detailed soils mapping will be performed in proposed disturbance areas as described later herein.

The majority of Section 9 and some of the northwest and southwest portions of Section 10 are covered by Typic and Lithic Haplustepts (identified in Figure 6-1 as 166) that are poorly developed, coarse-loamy to fine soils on steep slopes of about 55 percent. Soil depth to sandstone bedrock typically varies from 20 to 40 inches. The potential for soil erosion in this area is severe because of the steep slopes. Topsoil suitability is rated "poor" due to steep slopes.

The main area of Section 10 and a large portion of Section 9 are covered by shallow Typic and Lithic Haplustalfs (165) on slopes of about 2 to 4 percent. Bedrock in this area is within 10 to 40 inches of the surface. These soils have particle size classes of fine, fine-loamy, loamy, and coarse-loamy, and have moderate erosion potential. Topsoil suitability is rated "poor" to "fair" due to soil being too clayey or too thin a layer.

Small areas throughout Sections 9 and 10 are covered by Inceptic, Typic, and Lithic Haplustalfs (34). Particle size classes range from fine-loamy, coarse-loamy, to sandy. These soils are primarily in valleys on low slopes of 4 to 6 percent and are highly susceptible to wind erosion

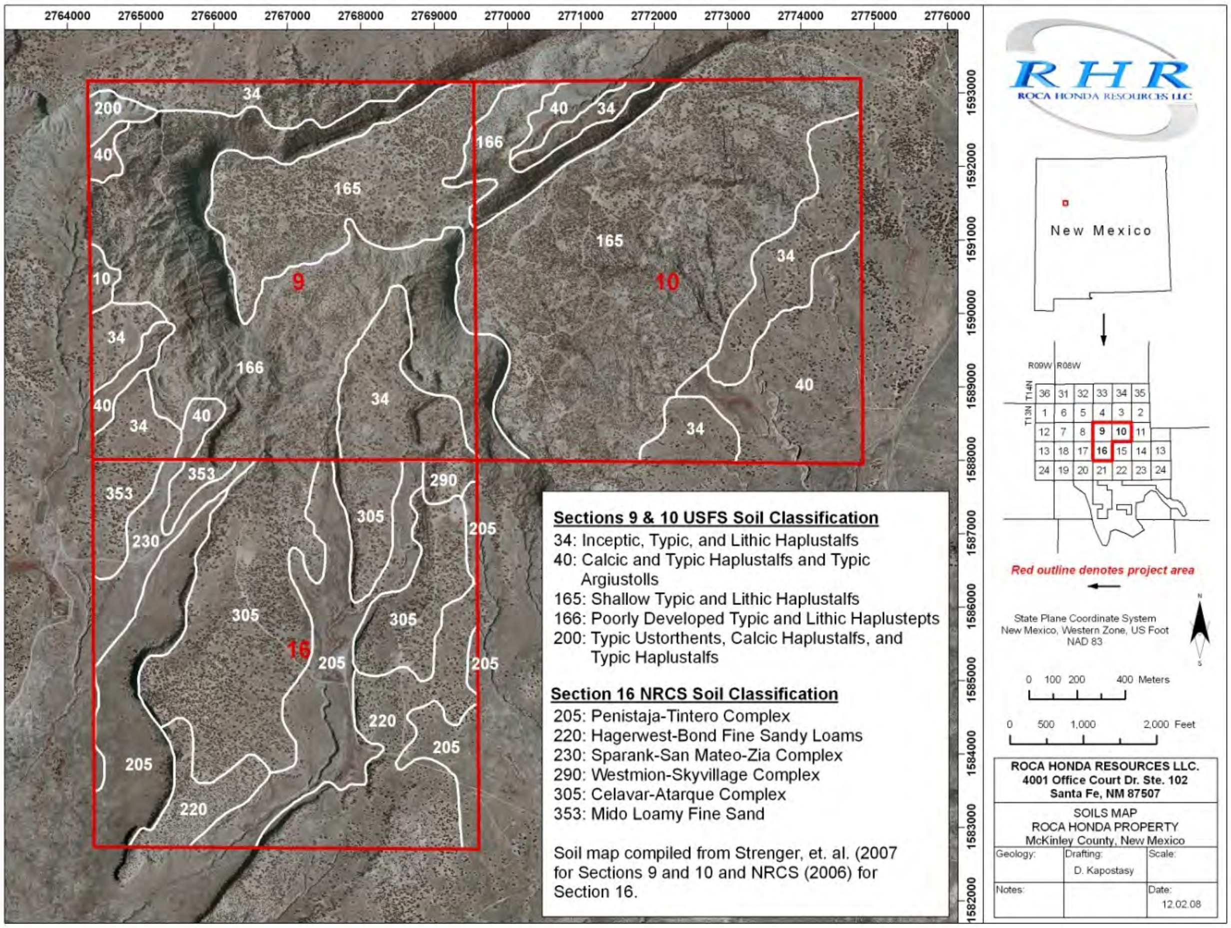

Figure 6-1. Roca Honda Permit Area Soil Survey

when vegetation is removed. Topsoil suitability is rated “poor” due to either being too alkaline or too sandy.

A small portion of the northwest part of Section 9 is covered by a complex of Typic Ustorthents, Calcic Haplustalfs, and Typic Haplustalfs (200) that are on slopes of 7 to 35 percent. Depth to a paralithic contact ranges from 4 to 20 inches in some areas. Particle-size classes range from fine to fine-loamy to loamy skeletal. The soil erosion hazard in this area is considered severe due to the silty nature of the surface. Topsoil suitability is rated “poor” to “fair” due to either low fertility or too thin a layer.

The majority of Section 16 is covered by a Celavar-Atarque complex (305), with roughly 50 percent of the soil being Celavar soils, 35 percent being Atarque soils, and 15 percent other minor components. The depth to bedrock for Celavar soils in this area ranges from 20 to 40 inches. Depth to bedrock for Atarque soils ranges from 10 to 20 inches. These soils are well drained and have sandy clay loam and clay-loam textures. Slopes range from 1 to 8 percent. Topsoil suitability is rated “poor” to “fair” due to depth to bedrock.

Two long, narrow bands of Penistaja-Tintero complex (205) soils run north and south through Section 16. Approximately 45 percent of this complex is Penistaja and similar soils, 40 percent is Tintero and similar soils, and 15 percent is formed of other minor soil components. Depth to bedrock for both Penistaja and Tintero soils is 60 inches or more. These soils are in well drained to excessively well drained areas on 1 to 10 percent slopes. Topsoil suitability is rated “good”.

Two areas in Section 16 contain Hagerwest-Bond fine sandy loams (220). Approximately 50 percent of this area is Hagerwest and similar soils, 35 percent Bond and similar soils, and 15 percent minor components. Depth to bedrock for Hagerwest soils in this area ranges from 20 to 40 inches, and for the Bond soils, it ranges from 10 to 20 inches. Both soils have textures of fine sandy loam, sandy loam, and sandy clay loam. Slopes range from 1 to 8 percent. Topsoil suitability is rated “poor” to “fair” due to depth to bedrock and presence of rock fragments.

The northwest portion of Section 16 is covered by approximately 90 percent Mido loamy fine sand (353) and 10 percent other minor components. Depth to bedrock for the Mido loamy fine sand is 60 inches or more. This soil is excessively well drained and is on 1 to 6 percent slopes. Topsoil suitability is rated “poor” due to being too sandy.

The northwest portion of Section 16 also contains Sparank-San Mateo-Zia complex (230). This complex is approximately 40 percent Sparank, 35 percent San Mateo, 20 percent Zia, and 5 percent other minor soil components. Depth to bedrock for this soil complex is 60 inches or more, and this soil is well drained to excessively well drained. Soil textures range from silty clay loam, clay loam, sandy loam, and fine sandy loam. This complex is on 0 to 3 percent slopes. Topsoil suitability is rated “poor” to “fair” due to sodium content or being too clayey.

A small portion of the northeast corner of Section 16 consists of rock outcrop-Westmion-Skyvillage complex (290) on steep slopes of 30 to 80 percent. This area is approximately 30 percent Westmion and similar soils, 15 percent Skyvillage and similar soils, and 10 percent other minor soil components. The rock outcrop portion of this area is barren or mostly barren on 5 to 15 percent slopes. The Westmion-Skyvillage portion of the complex is well drained and is on 30 to 80 percent slopes. Depth to bedrock for both the Westmion and Skyvillage soils is 5 to

20 inches. Topsoil suitability is rated “poor” due to depth to bedrock, slope, being too clayey, and presence of rock fragments.

6.2 Sampling Objectives

The objectives of the soil sampling plan are to determine: (1) the suitability of in-place soils for use as a topsoil material during reclamation and (2) the volume of suitable material present. First, suitability parameters will be determined. The two parameters that are important in a topsoil source are soil texture and coarse fragment content, because these are the most difficult parameters to change or amend. Also critical, particularly for soils in the southwestern United States, are soil salinity and sodicity. Salt and sodium concentrations in soils affect plant growth and soil infiltration characteristics but are also difficult to amend. Other soil characteristics that are important in reclamation but can more easily be changed or amended are organic matter content, macronutrient concentrations, and micronutrient concentrations.

The second objective is to determine if a borrow source for topsoil is required. After the mine surface features are designed, the amount of area to be reclaimed will be calculated. Based on reclamation requirements and available suitable topsoil, the need for topsoil borrow areas can be determined. The results from the first objective will identify suitable topsoil from the proposed disturbed areas. If the quantity of topsoil obtained from the disturbed areas is not adequate for the reclamation needs, the sampling results will identify the suitable topsoil areas to be used for borrow.

6.3 List of Data to be Collected

Table 6–1 shows the four data needs identified for topsoil. RHR proposes to fill these data needs by characterizing soils in areas that will be disturbed by mining operations or may be used as topsoil borrow sources. The approximate areas of proposed mining disturbance and soil sample locations are shown in Figure 6–2. These proposed disturbance areas will be the source of the topsoil utilized in future reclamation. Therefore, these are the areas which will be characterized in detail as shown in Table 6-1. If additional borrow areas are required, they will also be characterized in detail.

Table 6-1. Data Needs Identified for Topsoil

Data Need	Plan to Address Data Need
Accurate soil depths are needed in areas to be disturbed to ensure proper topsoil volume calculation.	Soil depths will be measured in areas where planned disturbances will take place. Locations will be entered into a GPS unit.
Suitability of stripped material for use as topsoil during reclamation needs to be determined.	Soil samples will be sent to a lab for analysis to determine topsoil characteristics and suitability.
Need for additional topsoil.	Identify potential borrow areas.
Sampling and characterization of material from borrow pits is needed if additional topsoil is needed for reclamation.	Soil characterization and analysis will be conducted on soils that may be used as a borrow source.

6.4 Methods of Collection

RHR will retain expert soil scientists with experience in Northwestern New Mexico soils and soil mapping and sampling. They will review this section of the SAP and consult with MMD to discuss MMD's recommendations on preferred sampling, analysis, and mapping procedures. RHR's experts will then propose a detailed soils sampling procedure to be implemented in the field. Sampling may include collection of soil samples as recommended in *Reclamation of Drastically Disturbed Lands*, Chapter 2, "Sampling Strategies for Drastically Disturbed Lands" (American Society of Agronomy, Inc., et al., 2000).

Soil characterization will be representative of the map units shown in Figure 6–1 that correspond to the proposed disturbed areas identified in Figure 6-2. The soil scientist will use professional judgment to modify the location and number of samples in the field should field checks reveal more or less variability. It is anticipated that the samples will be gathered using a hand auger, shovel, mechanized geoprobe or other means necessary to retrieve samples until bedrock or a hardened surface is reached. Typically, the soil scientist will estimate soil texture (by hand) at 6-inch intervals within the top 2 ft; below 2 ft, texture will be estimated at 1-ft intervals. Soil features, such as color, presence of calcium carbonates, salt accumulation, volume of coarse fragments, and depth to bedrock or rocky layer, will also be noted. For mapping purposes, the location of the subsample will be documented with a GPS instrument.

It is anticipated that at each sample location, a soil sample will be collected at three intervals: 0–6 inches, 6–12 inches, and 12–18 inches. The samples from each interval will be collected in separate buckets so that they can be composited with nine other subsample locations. Once a total of 10 subsamples have been collected in each bucket, the soil will be mixed and composited into a single sample bag (one for each interval) for submission to the soil testing laboratory. Soil samples will be air-dried before submission to the laboratory. Sample handling and chain of custody procedures will be followed for the preparation of soil samples for shipment to the off-site analytical laboratory. Table 6–2 outlines the soil sampling interval and total number of composite samples for the map units in the proposed disturbed areas. Sampling in other map units will be conducted if a construction activity is identified in the future. The final methods and equipment used for sampling will be determined jointly between the RHR soil scientist and NM MMD prior to field implementation.

Once the field and laboratory data are assessed and compared to suitability criteria, the depth of suitable topsoil material will be determined throughout the sampled area. Depth measurements will be used to determine topsoil volumes that can be removed and stockpiled for later revegetation efforts.

Section 10 of this SAP, Radiological Survey Plan, discusses the radiological baseline assessment for the Roca Honda permit area and the associated soil sampling. In order to determine the pre-mining radionuclide concentrations in soils, samples will be collected from the top 15 centimeters of soil at each location following the guidance contained in RP-105.500, Radiological Survey Activities, Procedure 3.2, "Soil Sampling."

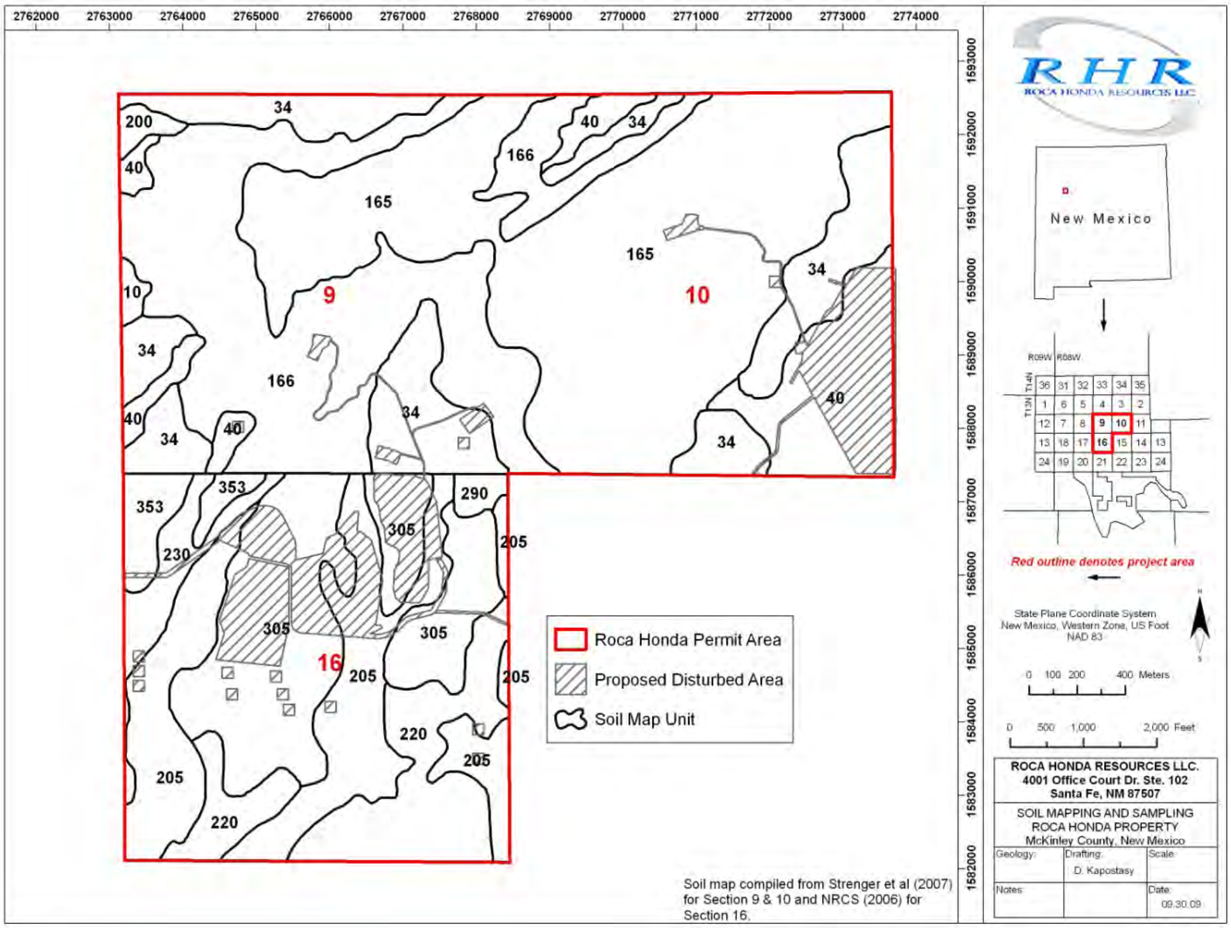

Figure 6-2. Areas to be Disturbed by Mining Activities

Table 6-2. Number of Composite Soil Samples for Map Units in Areas to be Disturbed

Map Unit	Interval within Subsample (inches)	Number of Composite Soil Samples
34	0–6	1
	6–12	1
	12–18	1
40	0–6	4
	6–12	4
	12–18	4
165	0–6	2
	6–12	2
	12–18	2
166	0–6	1
	6–12	1
	12–18	1
205	0–6	2
	6–12	2
	12–18	2
220	0–6	1
	6–12	1
	12–18	1
290	0–6	1
	6–12	1
	12–18	1
305	0–6	8
	6–12	8
	12–18	8
Total Composite Soil Samples		60

6.5 Parameters to be Analyzed

Soil samples will be collected and analyzed at a qualified soil testing laboratory for the soil characteristics summarized in Table 6–3. RHR soil scientists and NM MMD will determine the field parameters and the laboratory analyses to be performed. In performing the field sampling, the field soil scientist will perform analysis of soils for pH and electrical conductivity as necessary in order to “field-calibrate” for these parameters and judge sampling needs.

In addition to the analyses outlined in Table 6-3, samples will be sieved for the break between medium, fine and very fine sands (#60 and #140 sieves). Sieve data will be proportioned to total sample mass (from hydrometer data).

In addition to testing for macro- and micronutrients, RHR will test samples for soluble boron, hot-water soluble selenium, and total uranium and radium (or gross alpha and beta in lieu of uranium and radium). Inorganic carbon will also be tested (to the nearest 0.1% calcium carbonate equivalent). Sodicity data will include component parameters of paste calcium, magnesium and sodium in units of milliequivalents per liter.

Table 6-3. Methods to be Used to Determine Soil Characteristics

Analyte	Extraction Method	Analysis Method	Sample Amount and Container
Soil texture (U.S. Department of Agriculture system)	Method 15-5[a]	Hydrometer	1500 g (half of gallon bag)
Salinity (saturated paste extract)	Method 10-2.3.1[b]	E6010B/E6020[c]	1500 g (half of gallon bag)
Sodicity (as measured by the Sodium Adsorption Ratio)	Method 10-3.4[b]	E6010B/E6020[c]	1500 g (half of gallon bag)
pH	Method 10-3.2[b]	pH meter	1500 g (half of gallon bag)
Organic matter content (Walkley-Black)	Method 29-3.5.2[b]	Spectrophotometer	100 g (soil jar)
Macronutrients (available nitrate-nitrogen, phosphorus, and potassium)	Methods 38-8.1, 24-5.4, and 13-3.5[b]	E353.2, E365.1, and E6010B/E6020[c]	100 g (soil jar)
Micronutrients (iron, zinc, manganese, and copper)	Method 3-5.2	E6010B/E6020[c]	100 g (soil jar)

[a] Reference source is American Society of Agronomy, Inc., and Soil Science Society of America, Inc., 1986.
[b] Reference source is American Society of Agronomy, Inc., and Soil Science Society of America, Inc., 1982.
[c] Number refers to the EPA analytical method (described at www.epa.gov/testmethods) and used by Energy Laboratories (www.energylab.com).

6.6 Maps Providing Sampling Locations

Figure 6-2 shows the soil map units and disturbed areas within the Roca Honda permit area. As discussed previously, the samples will be located within these areas, as determined by RHRs soil scientists and NM MMD.

6.7 Sampling Frequency

The proposed sampling is planned to be conducted as a single sampling event in 2009.

6.8 Laboratory and Field Quality Assurance

Soil sampling will be conducted by or under the direction of a professional soil scientist specializing in soil morphology and mapping. The Task Manager or designee will accompany the sampler to ensure procedures are followed. Sampling will be conducted in accordance with field procedures briefly described above. The sampler will document the sample location on a map, take a GPS reading, and record observations in a log book. Sample handling and chain of custody procedures will be followed for the preparation of soil samples for shipment to the off-site analytical laboratory. Laboratory analysis will be conducted in accordance with methods described in *Methods of Soil Analysis, Parts 1 and 2* (American Society of Agronomy, Inc., and Soil Science Society of America, Inc. 1986 and 1982, respectively). RHR will select a laboratory that operates under a quality program and has expertise and experience with the approved soil analytical methods. Some of the samples may be separated for radiological analysis as mentioned above and shipped to a separate qualified laboratory that can perform the radiological analyses for the parameters listed in Section 10, Radiological Survey.

6.9 Brief Discussion Supporting Proposal

The proposed data collection will allow the characterization and establishment of baseline topsoil conditions across the Roca Honda permit area in advance of mining and will supplement existing topsoil data. A more definitive characterization will be used to calculate the quantity of topsoil to remove in construction areas, how large the topsoil stockpile area will need to be, and how the topsoil may need to be amended before it is used in site reclamation. If the topsoil is found to be limited within the construction areas, a borrow source will be identified and characterized for future uses.

6.10 References

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