A METHOD FOR THE EVALUATION OF COMPLIANCE WITH THE APPROXIMATE ORIGINAL CONTOUR REQUIREMENTS OF CSMC RULE 19.8 NMAC

NEW MEXICO MINING AND MINERALS DIVISION

Revised 1/2010

Table of Contents

Page

Introduction

The purpose of this document is to provide the technical staff of the Mining and Minerals Division (MMD) with guidance in determining compliance with the approximate original contour (AOC) requirements during the technical evaluation of surface coal mining applications. It is not intended, nor will it be considered as a regulation. Applicants may propose alternative methods, and they will be accepted, if they comply with all applicable portions of the regulations which pertain to the reclamation of mined lands to the approximate original contour.

Narrative

The regulatory requirements for returning mined lands to the approximate original contour (AOC) have been debated at great length within the Office of Surface Mining, State Regulatory Authorities, Congress, Industry and the public. Approximate original contour (AOC) is defined in Section 701(2) of SMCRA as follows:

> "Approximate original contour" means that surface configuration achieved by backfilling and grading of the mined area so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to mining and blends into and complements the drainage pattern of the surrounding terrain, with all highwalls and spoil piles eliminated; water impoundments may be permitted where the regulatory authority determines that they are in compliance with section 515(b)(8) of this Act.

The New Mexico Coal Surface Mining Commission Rule 19.8NMAC Section 19.8.1.7 (A) 15 (Definitions) states:

> APPROXIMATE ORIGINAL CONTOUR - means that surface configuration achieved by backfilling and grading of the mined areas so that the reclaimed area, including any terracing or access roads, closely resembles the general surface configuration of the land prior to mining and blends into and complements the drainage pattern of the surrounding terrain with all spoil piles and refuse piles eliminated. Highwalls will also be eliminated except as provided for in Paragraph (2) of Subsection A of 19.8.20.2055 NMAC. Permanent water impoundments may be permitted where the director has determined that they comply with 19.8.20.2017, 2024 and 2075 NMAC.

While the state definition is slightly different from the federal definition in that it allows for the retention of highwalls, the purpose of the regulations are the same.

Although these definitions provide insight to the intent of the AOC requirements, they do not provide a means for systematic evaluation to determine compliance. The requirements for evaluating AOC cannot be found in any one portion of the regulations but are rather a compilation of different regulations which pertain to backfilling and grading, revegetation, and protection of the hydrologic balance. These sections provide the basis for requiring the

backfilling and grading plan proposed by the applicant to: (1) approximate premining slopes, (2) provide a topography capable of stabilizing the surface from excessive erosion, (3) support the approved postmining land use, (4) minimize off-site effects, and (5) minimize changes to the prevailing hydrologic balance.

Below are excerpts from various sections of the regulations which pertain to the return to AOC and MMD's interpretation of these. The reviewer should make sure that the permit application adequately addresses all applicable regulations regarding AOC. The appropriate methodology for achieving compliance with these regulatory requirements will vary from site to site.

Return to AOC

Section 19.8.20.2054 B.(1) states "Except as specifically exempted in this chapter, all disturbed areas shall be returned to their approximate original contour." The definition of "Approximate Original Contour" includes the requirement of the post mining topography to closely resemble the **general surface configuration** of the land prior to mining.

The reviewer must determine if the proposed postmining landscape has a similar drainage density, slope lengths and slope steepness as the pre-mining topography. However, this requirement does not mean it must mirror the original topography. Senate Report No. 28 on Senate Bill S.7 in 1974 shows the intent to distinguish between ***elevation*** and ***configuration*** by stating:

> "It must be emphasized that the requirement to return to approximate original contour does not necessarily mandate the attainment of original elevation." (Senate Report No. 28, 94th Cong., let Sees., at 214 (1974).)

While the regulations do require ***reclamation***, they do not require ***restoration***. This report indicates Congress' awareness of the effects of the stripping ratio and swell factor on whether there is too little or too much spoil available to achieve the exact elevation as existed prior to mining. It is usually preferable to allow a higher postmining elevation on reclaimed areas than have the operator create permanent out-of-pit storage areas if slope length and gradient on the reclaimed slopes can be kept within acceptable limits.

Elevation ***should*** be considered in evaluating compliance when a deviation between premining and postmining elevations would result in an adverse effect on surrounding landowners. Section 19.8.20.2054 B.(2) requires that backfilled material be placed to minimize off-site effects. Naturally a homeowner who lives adjacent to a mine would not appreciate having his view of the mountains blocked by regrading a spoil pile to a final elevation much higher than existed prior to mining.

Compliment Drainage Patterns of the Surrounding Area

The definition of "Approximate Original Contour" also includes the requirement of the post mining topography to compliment the drainage patterns of the surrounding area.

Section 19.8.20.2009 A. states "Surface coal mining operations shall be planned and conducted to minimize changes to the prevailing hydrologic balance in both the permit and adjacent areas and prevent material damage outside of the permit area in order to prevent adverse changes in that balance that could result from those operations."

The applicant's plan for the final surface configuration of the affected area should have similar watershed sizes of major drainages leading off of the disturbed area as the land prior to mining. A small arroyo off the permit area which had a 50 acre watershed prior to mining could be adversely affected if the postmining watershed area was increased to 200 acres. An off permit stock pond which had a large watershed prior to mining could be adversely effected if the postmining watershed to this pond was significantly smaller. If a drainage is created during final grading and directed onto an area which had no established channel or bedrock control, severe erosion and gully formation could result.

In order to evaluate an AOC plan for these potential off-site impacts, the reviewer should compare pre and post mining watershed sizes. Especially important are the major watersheds that lead off of the disturbed area. In some cases, post mining watersheds may have different (both higher and lower) runoff curve numbers than pre mine conditions. In these cases, the reviewer should also compare pre and post mining runoff values (for major watersheds leaving the disturbed area) for a 10 year/24 hour precipitation event (the precipitation event for which all treatment facilities are required to be designed.) A post mining watershed could have a significant size difference, but still have similar peak runoff values to pre mine conditions. Conversely, a post mining watershed may have a similar size as the pre mining watershed, but have vastly different peak runoff values (both volume and peak flow) due to differences in soil type, soil depth, vegetative type and cover and slope length and steepness. The reviewer should also keep in mind that the goal is to prevent ***adverse*** changes. It is generally considered that an increase in infiltration and a decrease in runoff and sediment yield are favorable changes.

Control Sediment and Minimize Pollution – Geomorphic Reclamation

Section 19.8.20.2009 D. (1) states “Each person who conducts surface coal mining operations shall emphasize mining and reclamation practices that prevent or minimize pollution.”

It is instructive to note that the first item listed under Section 19.8.20.2009 D (2) as acceptable practices to control sediment and minimize water pollution is “stabilizing disturbed areas through land shaping.” The MMD considers that a geomorphic approach to backfilling and grading is the best technology currently available (BTCA) for stabilizing coal mine reclamation. Geomorphic reclamation considers factors such as drainage density, slope shape, channel profile and sinuosity. There are numerous books and papers written on fluvial geomorphic landforms, but below are some of the key considerations that a reviewer should check when reviewing a proposed AOC design.

Drainage Density:

One of the first things that the reviewer needs to consider is that the disturbed area no longer has bedrock control, but instead is loose, unconsolidated material. In nature, drainage patterns that form in unconsolidated material tend to be dendritic in nature and have a higher drainage density. Because of this, the post mining topography should have a drainage density equal to, or higher than the original topography. Drainage density is usually measured in feet of valley or drainage bottom per acre. In order to increase drainage density, more but smaller drainage valleys need to be created in the post mining topography. To determine what an appropriate drainage density is, it is best to measure the drainage density of a stable landscape made of unconsolidated materials on or near the permit area. In north-western New Mexico, drainage densities in natural, unconsolidated materials tend to be about 110 to 195 feet per acre. A good (conservative) design range to consider for mine reclamation would be about 160 to 200 feet per acre. It may be appropriate to use a lesser drainage density (120 to 160 feet per acre) where post mining slopes are flatter than 10H: 1V.

Slope Shape:

Another important factor in evaluating post mining slopes is the slope shape or profile. In nature, the lower half of unconsolidated slopes will have a concave shape (flatten out near the bottom of the slope). This shape compensates for the fact that the watershed size increases as the flow reaches the bottom portion of the slope. By flattening the slope bottom, runoff velocities will be lessened, thus increasing the stability of the slope. Conversely, a convex slope bottom will increase runoff velocities at the bottom of the slope and create a less stable (more erosive) slope that will likely lead to rill development and head cutting. Eventually, nature will turn a convex slope bottom into a concave shape.

Drainage Profile:

The same principle that makes concave shapes more stable for slope profiles also applies to drainage profiles. It is important for primary drainage channels, leaving the disturbed area, to tie in closely with the undisturbed portion of the drainage bottom and have similar slope gradients. As the drainage bottom goes up into the reclaimed watershed, it should have a smooth and concave transition into steeper slopes. Because there is a lack of bedrock control, it is extremely important to eliminate any “nick points” in the drainage bottoms. The drainage profiles of each watershed and sub-watershed should have a smooth and continuously concave profile with no convex transitions, especially at channel confluences. Otherwise, head cutting and the need for subsequent riprap placement are a likely consequence.

Drainage Sinuosity:

Drainage sinuosity also plays an important role in landscape stability. By lengthening a drainage channel using sinuosity, you are reducing the overall slope (gradient) of the channel, and hence the velocity of flow in the channel. The reviewer should check the radius of curvature, meander belt width and meander wavelength of channels on or near the permit area (in similar watershed settings) and compare them to the channels in the proposed AOC. Typically, channels with slopes of less than 4% have greater sinuosity and a larger band width than steeper slopes, and channels on steeper slopes have a more zigzag shape. It would generally be considered better to have more sinuous drainages on the reclaimed slopes than what was present on the pre-mining topography.

Note: It should be noted that AOC plans are usually modified on a fairly regular basis (sometimes annually) because of changing mining plans, differences in anticipated swell factors, changes in the locations of pit ramps etc. Because of this, an extreme level of detail placed on a proposed post mining topography map is usually a bit speculative and likely to change due to actual field conditions. Because the exact size, shape and locations of smaller sub-watersheds are likely to change, it is advised to consider requiring the operator to acknowledge this in the text of the mine plan and commit to reclaim to an acceptable range of drainage densities, or a minimum drainage density while still maintaining major watershed sizes, slope shapes, maximum slope lengths and gradients and hilltop elevations. The operator must still submit a plausible and approvable post mining topography map, but it will be understood that minor details can change as long as they remain within an acceptable (as approved) range . This will also make it easier on the operator to be more creative and field-fit what is very often a complex topography.

Slope Steepness

Section 19.8.20.2055 A. states "The final graded slopes shall not exceed in grade the approximate premining slopes, or any lesser slopes approved by the director based on consideration of soil, climate, or other characteristics of the surrounding area."

It should be noted that the Federal regulations do not include this requirement. In formulating the permanent program regulations, the Coal Surface Mining Commission was obviously aware of the erosion problems associated with reclamation in arid or semi-arid areas and recognized that vegetation alone could not always control erosion on steep slopes and felt slope gradient played a vital part in erosion control in New Mexico.

Highwalls

Section 19.8.20.2055 A. (2) states in part "…In all cases the highwall shall be eliminated unless retention of portions of the highwall is approved by the director…"

In spite of the completely negative view Congress took on the highwall retention issue, the New Mexico Coal Surface Mining Commission felt it was beneficial to allow for highwall retention where it is desirable to replace cliff type wildlife habitat. During the past years, the benefits of highwall retention have become evident. Highwall remnants can be used to replace mined-through cliff type habitats and create wildlife habitat and diversity. An often ignored benefit is the role highwall retention can play in reclamation stability. In some cases, highwall retention results in a lower gradient in reclamation areas that would have otherwise had steep and long slopes if completely backfilled. This reduces surface soil erosion which enhances plant production and the postmining land uses of livestock grazing and wildlife habitat. Therefore, MMD views the well planned retention of highwall remnants as a valid reclamation technique and wildlife mitigation.

The reviewer must make sure that all the provisions of Section 19.8.20.2055 A. (2) (a) are adequately addressed by the applicant prior to approving highwall retention.

Small Depressions

Section 19.8.20.2054 B. states in part " …All spoil shall be transported, backfilled, compacted and graded to eliminate spoil piles, depressions and highwalls except:

> (ii) If small depressions are needed in order to retain moisture to assist revegetation as authorized by the Director pursuant to Subsection C of 19.8.20.2055 NMAC."

Section 19.8.20.2055 C. states in part "– Small depressions may be constructed, if they:

(1) Are approved by the Director to minimize erosion, conserve soil moisture, or promote vegetation;

(2) Do not restrict normal access; and

(3) Are not inappropriate substitutes for lower grades on the reclaimed lands."

When properly planned and constructed, small incised depressions can reduce erosion by serving as retention basins created during backfilling and grading operations. These small depressions retain runoff from precipitation events which can benefit vegetation and slow the velocity of overland flow from large precipitation events. In addition, they function as sediment traps which reduce contributions of sediment to stream flow within and off the permit area.

If an operator plans on leaving small depressions, they must adequately address all of the above performance standards and provide details on the size, depth, capacity and general locations of the proposed small depressions.

Disposal of Excess Spoil

Provisions for permanent out-of-pit spoil storage, where necessary, are covered in Sections 19.8.20.2034, 2035, 2036 and 2037. Permanent spoil storage cannot be allowed unless the applicant has completely justified that the spoil is not required to achieve the approximate original contour over the affected area. Where the applicant has demonstrated the need for disposal of excess spoil, the requirements of these four sections should be used to evaluate compliance. For all applications where permanent excess spoil disposal is approved, the final spoil pile configuration must be graded so that the surface and subsurface drainage is compatible with the natural surroundings and suitable for the post mining land use.

Cut and Fill Terraces

Section 19.8.2055 B. - On approval by the director in order to conserve soil moisture, insure stability, and control erosion on final graded slopes, cut-and-fill terraces may be allowed, if the terraces are compatible with the approved postmining land use and are appropriate substitutes for construction of lower grades on the reclaimed lands. The terraces shall meet the following requirements:

(1) The width of the individual terrace bench shall not exceed 20 feet, unless specifically approved by the Director as necessary for stability, erosion control, or roads included in the approved post-mining land use plan.

(2) The vertical distance between terraces shall be as specified by the Director, to prevent excessive erosion and to provide longterm stability.

(3) The slope of the terrace outslope shall not exceed lv:3h (33 1/3 percent). Outslopes which exceed lv:3h (33 1/3 percent) may be approved if they provide adequate control over erosion and closely resemble the surface configuration of land prior to mining. In no case may highwalls be left as part of terraces.

(4) Culverts and underground rock drains shall be used on the terrace only when approved by the Director.

The first reason for the above limitations is that cut and fill terraces (and built up bench terraces) are almost always a poor substitute for a well planned post-mine landscape having numerous drainage channels and short slopes. The second reason is the relatively short life expectancy of terraces on rangeland. Cattle and wildlife trails and mammal burrows reduce

the life expectancy and effectiveness of terraces. The resulting weak places break (overtop or cut through) and contribute to gully formation. Also, terraces often cause differential settlement, piping and siltation preventing their designed drainage. After witnessing decades of terrace failures, it is highly recommended that terraces are approved in only very limited situations (perhaps on the face of a tailings dam) and only when there are no better options available.

In the event that terraces are allowed, they must have an adequate slope to flush sediment build-up and prevent pooling (which contributes to differential settlement and piping.) It has been found that terraces designed to drain at approximately 5 feet per second for the peak flow of a 10 year/ 24 hour precipitation event will flush (or clean) themselves from siltation build up on larger storm event, while not causing excessive erosion, and allow some sediment build up between larger events.

MMD considers terraces to be permanent diversions that must be designed to safely pass the peak flow of a 10yr/24 hour precipitation event in accordance with Section 19.8.20.2011 C. with a freeboard of no less than 0.3' as required in Section 19.8.20.2011 G. (2). Because of the above mentioned problems with terraces, it is recommended that a freeboard of no less than 1.0' be used.

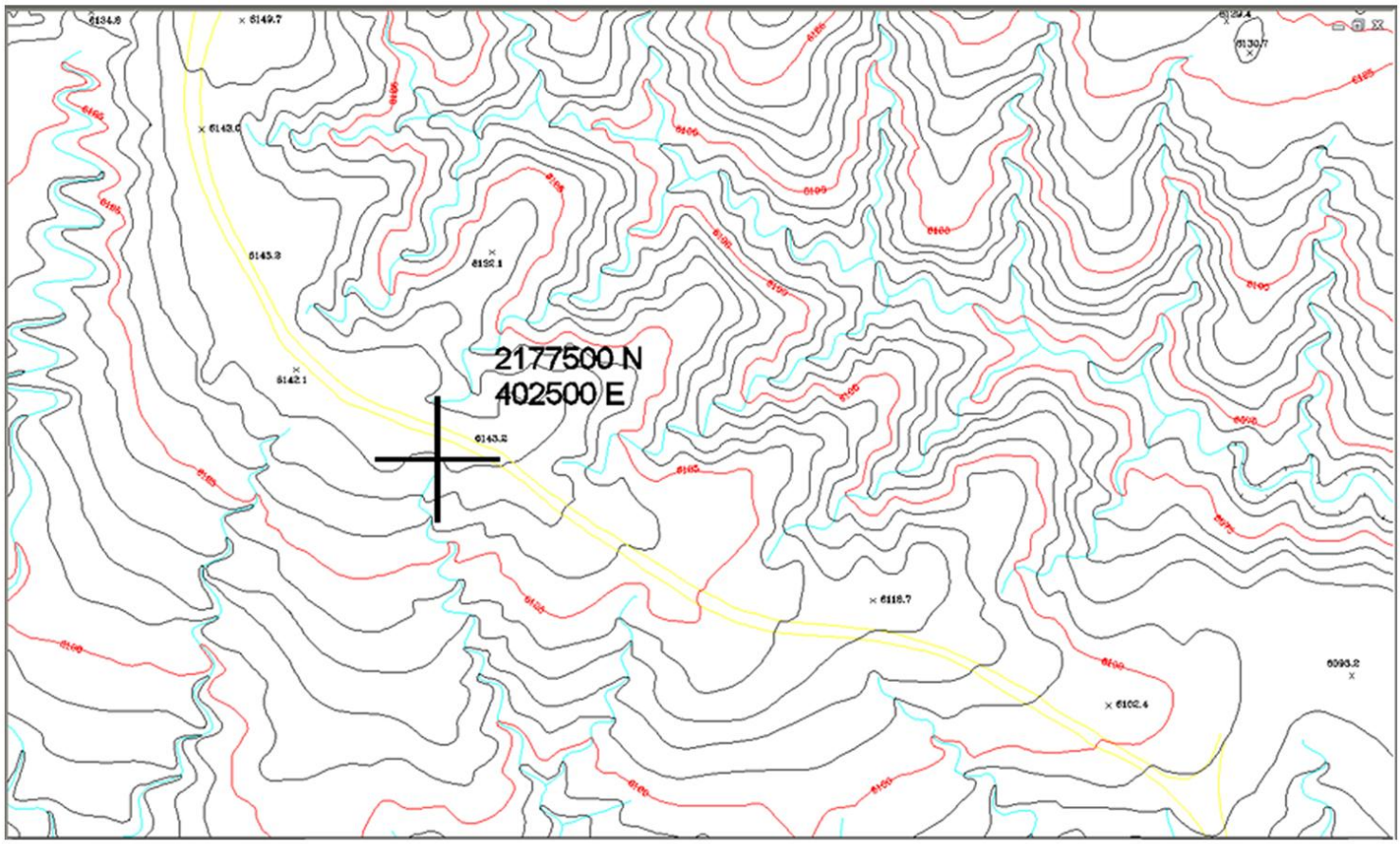
In no case should level or non-draining terraces be approved. They have no mechanism to flush or clean themselves of sediment build-up, and are extremely prone to causing differential settlement and piping.

Additional Regulations

Additional sections of the NM CSMC Regulations (paraphrased) that are applicable include:

Section 19.8.20.2054 B.(2)	Backfilled material be placed to minimize off-site effects and support the approved post mining land use.
Section 19.8.20.2075	All surface lands to be restored to conditions capable of supporting the uses they were capable of supporting before any mining or to a higher or better use.

Example of Successful Geomorphic Reclamation



Scale: 1”=300’ 5’ Contour Interval