0008

PLATEAU MINING CORPORATION

COPY

Willow Creek Mine
P.O. Box 30
Helper, Utah 84526
Phone (435)472-4737

November 13, 2009

Daron Haddock
Ms. ~~Pamela Grubaugh-Littig~~
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Re: **Phase I Bond Release Application, Crandall Canyon, Plateau Mining Corporation, Willow Creek Mine, C/007/0038, Carbon County, Utah**

Dear Mr. Daron Haddock:

Plateau Mining Corporation (PMC) is herewith submitting its application for Phase I Bond Release on 32.96 acres of land in Crandall Canyon.

The attached application includes the C1 and C2 forms, text page replacements and additions, a new as-built appendix including text, tables, hydrology calculations, public notice and notification letters to land owners government agencies, bond release calculations, a reclamation certification and as-built maps.

PMC believes that it has assembled a complete bond release application that adequately addresses the requirements for bond release. A timely review of this application which would allow time for completing both the informal and formal site inspections as soon as weather permits would be greatly appreciated.

If you have any questions or need additional information, please do not hesitate to contact me.

Sincerely,

Dennis N. Ware
Controller and Administrative Manager

Enclosures

Enviro/PermitActions/WillowCreek/CrandallCanyon/CoverLetter

APPLICATION FOR COAL PERMIT PROCESSING

ermit Change ☐ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☒ Transfer ☐ **COPY**

ermittee: Plateau Mining Corporation
Mine: Willow Creek Mine **Permit Number:** C/007/0038
Title: Crandall Canyon Phase I Bond Release
Description, Include reason for application and timing required to implement:
hase I Bond Release

Instructions: If you answer yes to any of the first eight (gray) questions, this application may require Public Notice publication.

☐ Yes ☐ No 1. Change in the size of the Permit Area? Acres: _____ Disturbed Area: _____ ☐ increase ☐ decrease.
☐ Yes ☐ No 2. Is the application submitted as a result of a Division Order? DO# _____
☐ Yes ☐ No 3. Does the application include operations outside a previously identified Cumulative Hydrologic Impact Area?
☐ Yes ☐ No 4. Does the application include operations in hydrologic basins other than as currently approved?
☐ Yes ☐ No 5. Does the application result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes ☐ No 6. Does the application require or include public notice publication?
☐ Yes ☐ No 7. Does the application require or include ownership, control, right-of-entry, or compliance information?
☐ Yes ☐ No 8. Is proposed activity within 100 feet of a public road or cemetery or 300 feet of an occupied dwelling?
☐ Yes ☐ No 9. Is the application submitted as a result of a Violation? NOV # _____
☐ Yes ☐ No 10. Is the application submitted as a result of other laws or regulations or policies?
Explain: _____
☐ Yes ☐ No 11. Does the application affect the surface landowner or change the post mining land use?
☐ Yes ☐ No 12. Does the application require or include underground design or mine sequence and timing? (Modification of R2P2)
☐ Yes ☐ No 13. Does the application require or include collection and reporting of any baseline information?
☐ Yes ☐ No 14. Could the application have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes ☐ No 15. Does the application require or include soil removal, storage or placement?
☐ Yes ☐ No 16. Does the application require or include vegetation monitoring, removal or revegetation activities?
☐ Yes ☐ No 17. Does the application require or include construction, modification, or removal of surface facilities?
☐ Yes ☐ No 18. Does the application require or include water monitoring, sediment or drainage control measures?
☐ Yes ☐ No 19. Does the application require or include certified designs, maps or calculation?
☐ Yes ☐ No 20. Does the application require or include subsidence control or monitoring?
☐ Yes ☐ No 21. Have reclamation costs for bonding been provided?
☐ Yes ☐ No 22. Does the application involve a perennial stream, a stream buffer zone or discharges to a stream?
☐ Yes ☐ No 23. Does the application affect permits issued by other agencies or permits issued to other entities?

Please attach four (4) review copies of the application. If the mine is on or adjacent to Forest Service land please submit five (5) copies, thank you. (These numbers include a copy for the Price Field Office)

I hereby certify that I am a responsible official of the applicant and that the information contained in this application is true and correct to the best of my information and belief in all respects with the laws of Utah in reference to commitments, undertakings, and obligations, herein.

Dennis N Ware
Print Name

[signature] Controller 11/23/09
Sign Name, Position, Date

Subscribed and sworn to before me this 23 day of November, 2009

Ruanne Leefland
Notary Public

My commission Expires: 6-30, 2013
Attest: State of Utah) ss:
County of Emery

Notary Public
RUANNE LEEFLANG
Commission #579452
My Commission Expires
June 30, 2013
State of Utah

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
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Form DOGM- C1 (Revised March 12, 2002)

APPLICATION FOR COAL PERMIT PROCESSING

Detailed Schedule Of Changes to the Mining And Reclamation Plan

COPY

Permittee: Plateau Mining Corporation

Mine: Willow Creek Mine **Permit Number:** C/007/0038

Title: Crandall Canyon Phase I Bond Release

Provide a detailed listing of all changes to the Mining and Reclamation Plan, which is required as a result of this proposed permit application. Individually list all maps and drawings that are added, replaced, or removed from the plan. Include changes to the table of contents, section of the plan, or other information as needed to specifically locate, identify and revise the existing Mining and Reclamation Plan. Include page, section and drawing number as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Volume 15, Exhibit 20, Section 3.7, page 3.7-vii
☒ Add	☐ Replace	☐ Remove	Volume 15, Exhibit 20, Section 3.7, page 3.7-ix
☐ Add	☒ Replace	☐ Remove	Volume 15, Exhibit 20, Section 3.7, page 3.7-29
☒ Add	☐ Replace	☐ Remove	Volume 15, Exhibit 20, Section 3.7, Exhibit 3.7X including Tables and Attachments (see special instructions below)
☒ Add	☐ Replace	☐ Remove	Volume 16, Exhibit 20, Section 3.7, Eshibits 3.7-12AB thru 3.7-17AB
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

The public notice "proof of publicaton" (Attachment 1) of Appendix 3.7X will be provided after the Affidavit is received from the Publisher.

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LIST OF APPENDICES (Continued)

LIST OF EXHIBITS

LIST OF EXHIBITS (Continued)

Crandall Canyon area includes surfacing the road from U.S. Highway 6 to the hoist facilities area with asphalt pavement. The Utah Department of Air Quality was consulted when the facilities layout was developed and they had no further requirements. Additional air quality and control information is presented in Chapter 11.

3.7-4(11) General Maintenance

Roads - Roads P-1 and A-1 will be inspected periodically for erosion, rutting, pothole formation and shoulder deterioration. Grading will be performed as necessary to minimize surface irregularities. Drainage ditches and culverts associated with road drainage will also be inspected periodically and cleaned of flow-impeding debris and sediment. If the roads are damaged by a catastrophic event, such as a flood or earthquake, they will be repaired as soon as practical after the damage has occurred.

Ponds - The ponds will be maintained as required by R645-301-742.221. Sediment will be removed when it reaches the 60% sediment cleanout level, as described in Section 3.7-4(2).3. Spillway culverts and channels will be inspected for deterioration and erosion, and corrective measures taken as necessary.

3.7-5 Reclamation Plan

The Crandall Canyon facilities were reclaimed during 2003 with some rework on the No. 2 Shaft occurring in 2008. Broadcast seeding occurred during the Fall of 2003 and 2008. Seedlings were planted during the fall of 2004. All details regarding as-built reclamation of the site can be found in Appendix 3.7X. As-built topography can be seen on Exhibit 3.7-12AB and 3.7-13AB. The reclamation treatment area can be seen on Exhibit 3.7-16AB. Watershed locations can be seen on Exhibit 3.7-17AB. Cross-sections and channel profiles can be seen on Exhibits 3.7-14AB and 3.7-15AB.

3.7-5(1) General

Plateau Mining Corporation, a subsidiary of RAG American Coal Company, formerly Cyprus Plateau Mining, a subsidiary of Cyprus/Amax Coal (the parent company of Amax Coal Company), developed the Willow Creek site approximately 1 mile east of the intersection of routes US 6 and 191. Development of that site and the associated underground mine workings will incorporate the use of the Crandall Canyon shafts. Therefore, reclamation and reclamation scheduling associated with the Crandall Canyon site will be coordinated with the reclamation of Willow Creek.

The reclamation topography plan is presented on Exhibit 3.7-7A, 7B, and 7C.

APPENDIX 3.7X

CRANDALL CANYON AS-BUILT RECLAMATION

PLATEAU MINING CORPORATION
Carbon County, Utah

Prepared by

EARTHFAX ENGINEERING, INC.
Midvale, Utah

August 2009

APPENDIX 3.7X

CRANDALL CANYON AS-BUILT RECLAMATION

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Attachments

LIST OF EXHIBITS

The maps listed above have been included in the map section of Exhibit 20 Section 3.7. The maps are not included in this appendix but are referenced here to indicate that as-built reclamation maps have been prepared.

3.7-5 Reclamation Plan

3.7-5(1) General

With the closure of the Willow Creek Mine and Preparation Plant, the Crandall Canyon Shafts were no longer needed. Thus, the Crandall Canyon facilities have been reclaimed according to the approved reclamation plan. The Crandall Canyon facilities were initially reclaimed during the summer of 2003 with final seeding in the fall of 2003. Seedlings were planted in the reclaimed are in the fall of 2004.

A small amount of settlement of the backfilled No. 1 (western) shaft occurred in 2004 (less than 10 feet) and 2005 (less than 5 feet) and additional soil from the immediate area around the No. 1 shaft was added and approximately 0.4 acre of ground around the shaft regraded in the fall of 2005. The newly-reclaimed area was reseeded immediately after regrading was complete.

In November 2006, settlement of the backfill in the No. 2 (eastern) ventilation shaft was discovered. Soil from the immediate area was dozed into the shaft until water from the shaft began to spill into the adjacent drainage. The shaft area was then temporarily fenced as a safety measure. Based on the results of analyses of a water sample collected from the shaft in April 2007, this water was pumped from the shaft to the Crandall Canyon drainage. However, the lower portion of the water column contained elevated concentrations of suspended solids. Therefore, a holding basin was constructed adjacent to the shaft and the water was pumping into the holding basin. Additional soil was brought to the site and the shaft was backfilled to the surface. The off-site material used to backfill the shaft was obtained from a pile of excess cut material generated by the Utah Department of Transportation during rework of a section of U.S. Highway 6.

In July 2008, after allowing the backfill to settle, the backfilled soil was excavated to a depth approximately 2 feet below the shaft collar. Bentonite was emplaced on the backfilled soil to the top of the shaft collar and soil was mounded over the shaft above the adjacent ground elevation to allow for future settlement. Once the water percolated from the holding basin, the area around the shaft that had been disturbed (about 1.2 acres) was regraded. The area was reseeded as soon as backfilling was complete. As-built reclamation topography can be seen on Exhibits 3.7-12AB and 3.7-13AB.

The Disturbed Area Boundary ("DAB") for the Crandall Canyon site contains 32.96 acres. Within the DAB 16.93 acres are included in the reclaimed area. The reclaimed area includes 1 acre of reestablished road and 15.93 acres that have been deep gouged and seeded (see Exhibit 3.7-16AB). The area outside the reclaimed area but within the DAB is a combination of undisturbed areas and a road accessing private property above the reclaimed area. PMC is requesting Phase I bond release on the entire property.

3.7-5(2) Postmining Land Use

The postmining land use of Crandall Canyon is wildlife habitat, grazing, and recreational use. The as-built reclamation plan supports these land uses. A more detailed description of the different land uses is listed below.

The postmining land use for Crandall Canyon is for, but not limited to: landowner access or use; hunting; cabin sites; access for the Bureau of Land Management for land management; access for grazing; and/or other recreational uses.

In order to facilitate the postmining land use, the majority of primary road P-1 remains as during the facilities operational phase, a new primary road R-1 was constructed through the reclaimed area as shown on Exhibit 3.7-12AB, and road A-1 was reestablished from where R-1 ends and extends to the leach field whereby unimpeded access is provide to the landowner for access to existing jeep trails or for establishing new trails at his discretion. Design information related to road P-1 is provided in Section 3.7-3(2). Design information related to the construction of road R-1 is provided in Section 3.7-5(3)(3) and on Exhibit 3.7-7D. Design information related to road A-1 is provided in Section 3.7-3(7)(2). By maintaining a road to access the upper parts of the canyon there will be minimal impacts to the reclaimed areas. Access on the road from Highway 6 is restricted by a locked gate.

Since the access road to the reclaimed area and upper Crandall Canyon is built to blend in with the postmining topography, have an erosion resistant surface, and control runoff, it enhances the watershed areas within the mine area. The road will allow for the maintenance of the runoff and alternative sediment control structures, implementation of vegetation husbandry practices necessary to ensure revegetation success, and encourage travel through the canyon on an established corridor, thus reducing unwanted impact to soil and vegetation during the reclamation period and beyond.

The watershed has been improved by providing access into Crandall Canyon via a permanent road with proper drainage controls, restoring the natural drainage patterns; reshaping all cut and fill slopes to be compatible with the postmining land use; reshaping all cut and fill slope to complement the drainage pattern of the surrounding terrain, and implementing the land treatment and revegetation practices provided in the reclamation plan. These improvements result in the following benefits:

> The reduction of the amount of total suspended solids or other pollutants discharged to ground or surface water from the permitted area, improved public or private uses of such water;
>
> Reduced flood hazards resulting from peak flow discharges from precipitation or thaws being lower; and
>
> Not adversely affecting the ecology and diminution of any surface water or any existing or planned use of surface or ground water, during every season of the year, by varying the total volume of flow from the permitted area.

Since the road has been built to blend with the postmining topography and will not negatively affect the land or postmining land uses, leaving the road in place after bond release will not require a variance from the approximate original contour requirements of R645-301-553.600.

Letters to and comments from the legal or equitable owner of record of the surface areas to be affected, concerning the proposed land use are provided in Appendix 3.7V. The landowner in Crandall Canyon has requested that the primary access road be left in place after reclamation to permit access to his property for recreational purposes by his family and friends. Access to the C-Canyon, L.C. property will provide a higher and better use of the land by facilitating their ability to obtain the necessary local governmental approval for improvements to be made and uses to be carried on at the property. Therefore, this reclamation plan addresses the reclamation of the facilities area while leaving the access road and its associated drainage structures intact after reclamation.

The areas shown in Exhibits 3.7-7A and 13AB will be used to facilitate access to the various canyons owned by the adjacent landowner. The landowner does not want any additional reclamation to occur in these areas which would preclude his ability to ingress and egress at will to his property. Plateau Mining Corporation has received Phase III bond release on the leach field area. The landowner is now responsible for maintenance of the road (road A-1) and the associated drainage control system on his property.

According to the approved reclamation plan, the only permanent features of the operational mining plan to be retained are the leach field piping, and the primary access road (from Highway 6 through the leach field) and its associated drainage structures. The leach field piping was left in-place since the piping is covered by a minimum of four feet of soil and removing the piping would result in disturbance of established vegetation.

Currently, the disturbed area in the canyon below elevation 7000 feet is zoned by Carbon County as Mining and Grazing (MG-1) land. Land above 7000 feet is zoned as Critical Environmental (CE-1) because of watershed characteristics.

3.7-5(3) Reclamation Work

Reclamation work in Crandall Canyon consisted of demolition, backfilling of the shafts, backfilling and grading of the general area, resoiling, seeding and mulching.

3.7-5(3)(1) Demolition

Reclamation activities included removal of all surface structures, including but not limited to the main hoist building, emergency hoist, ventilation equipment, warehouse, substation, culverts, hydrants, and above-ground. Additionally, all sections of the Hilfiker retaining walls not covered by a minimum of 4 feet of soil were removed. Materials of value were recycled and non-combustible waste generated from the demolition was typically used to backfill the shafts or was buried under a minimum of 4 feet of soil cover.

Nonhazardous and nonflammable materials such as concrete and steel were used as backfill in the shafts and areas such as cut slopes. These materials were incorporated into the backfill in a manner that did not create voids within the backfill or reduce the effective compaction necessary for backfilling. These materials were intermixed with backfill to ensure voids were filled and compacted. Concrete slabs or foundations buried in-place were covered with a minimum of four feet of fill to ensure adequate root depth and soil moisture retention for vegetation. Whenever possible, steel was salvaged rather than buried. However, rebar or other steel that is incorporated in the concrete was not removed from the concrete prior to burial.

No hazardous waste was encountered during reclamation of the site. Thus, no hazardous waste needed to be disposed of. The only wastes handled during reclamation were concrete and steel which were used to backfill the shafts and against cut-slopes.

3.7-5(3)(2) Permanent Sealing of Shafts

As part of demolition and backfilling activities during reclamation, both shafts have been backfilled. As indicated in Section 3.7-5(1), both shafts experienced some settlement following initial backfilling. Additional backfill was added to mitigate this settlement, with most of this backfill being obtained from the immediate vicinity of the shaft. At the No. 2 (eastern) shaft, some of the additional backfill was brought to the shaft from an off-site location. This soil was obtained from a pile of excess cut material generated by the Utah Department of Transportation and stored prior to that time near the junction of U.S. Highways 6 and 191. A 2-foot thick layer of bentonite was also placed in the No. 2 shaft to minimize the potential for water to rise in the shaft to the surface.

Monitoring of the ground surface at each shaft indicated that backfill in the No. 1 shaft settled less than 0.1 foot within the 1-year period following additional reclamation work. Backfill in the No.2 shaft settled 1.4 feet in the period of September 2008 to August 2009. Since settlement is generally most rapid immediately following backfilling, and since both shafts have been backfilled with excess soil to accommodate future settlement, the shafts are currently considered stable. Both shaft areas will be monitored for additional settlement. If settlement continues, additional soil will be hauled in as necessary to repair the damage. All activities to repair settlement damage will be conducted in such a manner as to disturb as little of the reclaimed area as possible.

3.7-5(3)(3) Backfilling and Grading

The as-built reclamation topography is presented on Exhibits 3.7-12AB and 13AB. The reclamation has been completed to be in compliance with the R645 requirements for obtaining approximate original contour, as discussed in Section 3.7-5(3)(4). The engineering issues relating to reclamation of the walls, roads, shafts, and utilities are discussed in this section. The hydraulic and sediment control issues are presented in Section 3.7-5(4).

During the grading process, the following work was performed:

1. Elimination of berms and temporary operational diversions,
2. Grading to establish surface overland flow drainage, and backfilling of shafts,
3. Construction of permanent stream channels,
4. Removal of certain operational culverts,
5. Removal of sediment ponds,
6. Construction of alternative sediment controls, and
7. Construction of reclamation road R-1. This is a primary road with compacted roadbase or equivalent and an approximate 2% top slope towards a ditch on the inside of the road (see Exhibit 3.7-12AB). The road will be used for access for the intended post mining land uses.

The site was graded to establish drainage and stabilize cut slopes. Sediment ponds remained in place as long as possible during grading work. During construction straw bales, silt fences, and depressions were also used to control sediment.

The as-built topography, as shown on Exhibit 3.7-12AB and 13AB, meets the criteria set forth in R645-301-553, Backfilling and Grading. The disturbed areas were graded to approximate the original contours by blending soil into the surrounding area and creating landforms that resemble the surrounding terrain. Reclamation slopes are concave in cross section and do not exceed a slope of 2:1 except in very small areas. To the extent possible, cut slopes were backfilled during reclamation operations. Retained cut slopes exist where there was insufficient material and/or space to cover the cut slope (see Exhibit 3.7-13AB). Limiting slopes to 2:1 resulted in some cut slopes that could not be covered since the undisturbed slope is greater than 2:1. The retained cut slopes were graded to blend into the existing topography as much as possible. Cut slopes were analyzed by EarthFax Engineering, Inc. for slope stability. A copy of the "Slope Stability Analyses" is provided in Appendix 3.7R and additional information is provided in Appendix 3.7U.

The as-built reclamation topography is compatible with the approved postmining land use, and provides adequate drainage and long-term stability as required by R645-301-553.522. There are no highwalls in Crandall Canyon, since the only access to the underground workings was through the shafts. There were no spoil piles, refuse piles, or small depressions retained after reclamation.

The primary objectives of the backfilling and grading were to reclaim the main channel, reclaim cut slopes in the canyon where possible, sufficiently cover remaining building foundations with a minimum of 4 feet of soil, and backfill the shafts. Backfill was placed in the shafts in accordance with the approved MSHA Shaft Backfilling/Sealing Plan (Appendix 3.7N). No slopes exceed the maximum safe angle of repose. As discussed in Section 3.7-5(3)(5) and Appendix 3.7R, a 36 degree slope would have a critical safety factor of 1.4 under static conditions. However, since slopes greater than 2:1 can be erosionally unstable, slopes within the reclaimed area were generally constructed to lie at or less than a 2:1 slope. Only very small areas exceed a slope of 2:1.

Cut material necessary to cover the facilities area came from two on-site sources. Initially, topsoil was removed from the disturbed area and stored in stockpiles No. 1 and 2. However, since stockpile No. 1 was contaminated with noxious weeds it was not used. Therefore, topsoil was taken only from stockpile No. 2, located along access road P-1, and from soils located within the facility area. If the soil in stockpile No. 1 is used in the future, it will not be used within 4 feet of the surface to prevent the spread of noxious weeds in the reclaimed area. The soils report in Appendix 3.7S concluded that at least the upper 8 feet of soil in the facility area can be used as substitute topsoil. The approximate volume of substitute topsoil available was 51,400 cubic yards, which is far more than was needed to cover the reclaimed area with 1 foot of topsoil. Soils in the facility area were used to achieve final grade. All of the topsoil from stockpile No. 2 was used in the reclamation of the site.

No acid forming or toxic materials were encountered during reclamation

As part of reclamation, access was maintained in Crandall Canyon for reclamation repairs as needed and for other intended postmining land uses. The only segment of the access road affected by reclamation activities was the portion of road within the site area that was replaced with reclamation road R-1. Road R-1 is generally located where the upper portion of operational road P-1 and the lower portion of operational road A-1 were located (Exhibit 3.7-5B).

The surface of reclamation road R-1 received a minimum 6-inch layer of compacted roadbase. The surface of the road typically slopes at an angle of 2% towards the roadside ditch along the inside of the road. A typical cross-section is shown on Exhibit 3.7-14AB.

Electrical Power Lines – Primary power was conveyed into Crandall Canyon via an electrical distribution line from Hardscrabble Canyon. All of the poles and wire have been removed with the exception of some poles that are being used as raptor habitat. Ground that was disturbed during reclamation of the power line right-of-way was roughly regraded and seeded.

Leach Field Piping and Other Underground Utilities – Underground utility piping (electrical, water, sewer, LP gas) was removed only to the extent that it interfered with reclamation grading. The ends of the pipes that were abandoned in place were capped. The approximate locations of the gas line and water lines are described on Exhibits 3.7-5A and 3.7-5B

3.7-5(3)(4) Approximate Original Contour Compliance

The natural topography of Crandall Canyon is characterized by steep canyon side slopes and a relatively broad canyon bottom, as shown in Exhibits 3.7-1 and 3.7-2. Relative to the drainage flows of the geologic past, the recent flows are relatively small. Consequently, the main stream meanders on top of, and erodes slowly through, unconsolidated materials that were deposited previously during high flow, high energy events. These conditions have resulted in various configurations of stream alignments along the base of the canyon, including stream alignments against one side of the canyon, centered alignments, meandering alignments, and two alignments coexisting in the same reach of the canyon where subdrainages intersect the canyon bottom. The areas adjacent to the incised channel tend to be relatively flat in cross-section. Exhibit 3.7-7D presents cross-sections A-A' through G -G', which were cut through the undisturbed areas of the canyon shown on Exhibit 3.7-7B. These sections depict the flat areas associated with the broad canyon bottom, and the steep slopes where the stream has recently eroded through unconsolidated materials.

To achieve the approximate original contour, the as-built reclamation returns the channel to near the center of the canyon floor, with concave fill slopes extending from the undisturbed boundary to the reclaimed channel. This has been done to allow for the fill slopes to be less than the angle of repose for the granular backfill, and flatter than a 2:1 slope in most areas. In the areas of the shafts, a topographically high area has been constructed over the shafts. These high areas will aid in maintaining the location of the reclaimed channels. These topographic highs have been constructed in such a manner as to blend in with existing topographic features to the extent possible.

All cut slopes within the disturbed facilities area were reclaimed consistent with current UDOGM regulations. As allowed by these regulations, limited portions of cut slopes remain where they mimic or blend with existing topography and where fully reclaiming the cut slopes would result in slopes with a static factor of safety less than 1.3. Exhibit 3.7-12AB shows the location of cut slopes that remain. The cut slopes that remain have experienced no signs of abnormal instability.

3.7-5(3)(5) As-Built Reclaimed Slope Stability

According to R645-301-553.130, reclamation slopes shall not exceed the angle of repose and shall have a minimum long-term static safety factor of greater than 1.3. The angle of repose of any soil is a function of the soil gradation, moisture content, and degree of compaction. It is expected that the reclamation fill will be fairly dry. According to the soil sampling program conducted by EarthFax (1995a), residual and overburden soils in the Crandall Canyon area generally consist of sandy loam to loamy sand with 5 to 15% clay and 5 to 75% rock (gravel through boulders). Because of the variability in the soil texture, the angle of repose of the soil will also vary.

The angle of repose of loose sand generally varies between 30 and 35 degrees (Holtz and Kovacs, 1981). According to Tomlinson (1986), the angle of repose for loose, dry sand can vary from 28.5 degrees for round uniform sand grains to 34 degrees for angular well-graded sand grains. Increasing the density of the sand can increase the angle of repose to 33 to 46 degrees, respectively. According to Bowles (1984), unsaturated, non-plastic remolded and undisturbed soils can have an angle of repose between 34 and 36 degrees.

Though slopes up to 36 degrees (1.4:1 slope) would have a critical safety factor of 1.4 under static conditions (see Appendix 3.7R), some sloughing of surface soils may occur, especially as the soils dry or if the soils are placed in a loose condition. Since soil may be erosionally unstable at inclinations greater than 2:1, reclamation slopes were generally constructed at or less than a 2:1 slope. The area of slope that is greater than 2:1 is very limited in area and has short slope lengths. The only places that the reclamation slopes are steeper than 2:1 are where the reclamation slope is tying into a natural slope with a slope greater than 2:1.

3.7-5(3)(6) Resoiling

Topsoil from Topsoil Stockpile 2 and on-site materials were used for resoiling. The on-site materials were demonstrated to be acceptable growth media as indicated previously. Backfilling of the shafts utilized the majority of the material removed during the construction of the shafts.

As noted previously, settlement of the backfill in the ventilation shafts required additional reclamation work. Shaft No. 1 was backfilled solely with material that was locally available. Shaft No. 2 was backfilled with both local soil as well as soil that was imported to the site from two sources:

- Excess cut material from road wok on U.S. Highway 6 and
- Bentonite to serve as an impermeable cap.

The upper 4 feet of backfill above the adjacent ground surface at Shaft No. 2 was backfilled with local soil.

Access to the shafts, following the backfilling, by wildlife and humans is precluded by fencing the areas and posting the appropriate signage. This fencing and signage may be removed after it has been determined that all settlement has ceased.

3.7-5(3)(7) Seeding and Mulching

Following placement of the growth media and prior to application of the reclamation seed mix, hay was incorporated into the growth media at a rate of 2 tons per acre. This was done to improve soil structure for aeration purposes, increase micropore space, and improve the water holding capacity of the soil. Incorporation of the hay mulch occurred during deep gouging.

No fertilizer was used during the reseeding activities associated with the main canyon reclamation project. Following seeding with the approved Crandall Canyon Reclamation Seed Mix (see Section 3.7-5(3)(7) of the permit), an additional 1.5 tons per acre of straw mulch was spread over the seeded area mostly by mechanical blowers but occasionally by hand spreading. The straw mulch was then sprayed with a tackifier and mulch mixture at about 500 lbs per acre following spreading to retain it on the reseeded slopes. The tackifier and mulch provided a better means for retaining the straw mulch on the reseeded areas than did crimping.

The space between rocks in the riprap channels was filled with soil to provide additional channel stability and to provide soil for vegetation growth in the channel. The channels were then seeded with the same seed mix as the rest of the site. The vegetation growth in the channels will not be compared to a reference area as a success standard (verbal agreement made at a meeting with UDOGM personnel, 8/31/95).

Ponderosa pine and Douglas fir seedlings were planted within approximately 200 feet on either side of the reclamation channel and on the slopes in the canyon containing CCRD-3 at a rate of 100 Ponderosa pines and 150 Douglas fir seedlings per acre. Bigtooth maple and cottonwood seedlings were spaced every 20 feet along the channel.

3.7-5(3)(8) Reference Areas

The reference areas identified in Section 3.7-5(3)(8) of the permit will be used to evaluate the revegetation success.

3.7-5(3)(9) Performance Standards

The performance standards discussed in Section 3.7-5(3)(9) of the permit text will be used to assess reclamation success prior to bond release.

3.7-5(4) As-Built Reclamation Hydrology

3.7-5(4)(1) General

Reclamation channels were built to complement the drainage pattern of the surrounding terrain. Culverts used during mine operation to route undisturbed area runoff under the facilities pad area were removed. Runoff from the undisturbed drainages is routed through the regraded site area and into the reclaimed stream channel. The site area has been regraded, roughened, seeded, and mulched to minimize sediment loading to both the undisturbed stream channel below the site area and to the Price River.

3.7-5(4)(2) As-Built Reclamation Channels

The reclamation channels were built according to the approved reclamation plan. The reclamation channel watershed areas for Crandall Canyon are shown on Exhibit 3.7-17AB. Each watershed area is labeled according to the mine area (CC=Crandall Canyon) and reclaimed watershed (RWS). The watershed boundaries have been redrawn based on the as-built reclamation topography of the site.

To verify the capacity and stability of the constructed reclamation channels, a peak discharge rate was calculated using the redefined watershed boundaries and the same assumptions as used for the approved design calculations. For example, the curve numbers used for the undisturbed and reclaimed areas were the same as used for the channel designs.

Peak discharge rates used to verify channel capacities and riprap sizes for the intermittent and perennial reclamation channels were calculated based on the 100-year, 6-hour precipitation event of 2.0 inches (Miller et. al, 1973). Permanent ephemeral drainage channels were verified for the 10-year 6-hour storm event of 1.4 inches (Miller et. al, 1973), in accordance with R645-301-742.333. Pursuant to the regulations found in R645-301-742.333, permanent ephemeral drainages have been verified to handle the 10-year, 6-hour storm event. This includes the ditches and swales associated with reclamation road R-1. The operational ditches and culverts along road P-1 and A-1 that are not being affected by reclamation have been designed to handle the 10-year, 24-hour storm event. Hence the operational ditches to remain exceed the regulatory requirements. A summary of the peak flows is presented in Table 3.7-11AB. The supporting calculations are contained in Attachment 1 of this appendix.

The following general approach was used during verification of the reclamation channels:

∃ The capacity of the perennial and intermittent reclamation channels was verified based on the 100-year, 6-hour storm and the <u>minimum</u> channel slope.

∃ The capacity of the ephemeral reclamation channels was verified based on the 10-year, 6-hour storm and the <u>minimum</u> channel slope.

∃ Riprap size was verified based on the 100-year, 6-hour storm and the <u>maximum</u> channel slope for perennial and intermittent channels.

∃ Riprap size was verified based on the 10-year, 6-hour storm and the <u>maximum</u> channel slope for ephemeral drainage channels.

∃ The roughness coefficient (Manning's "n") for riprapped channels was determined according to the equation (Abt et al., 1981):

$$n = 0.0456(D_{50}*\text{slope})^{0.159}$$

where: n = Manning's roughness coefficient
D_{50} = median riprap diameter (ft)
Slope = channel slope (ft/ft)

∃ For all channels, riprap size verification is based on the methodology presented in U.S. Department of Transportation Hydraulic Engineering Circular No. 11 (1967). The thickness of the riprap for these channels is twice the D_{50} of the riprap, or a minimum of 6 inches, as recommended by Barfield et al. (1981).

∃ The riprap size was kept constant throughout reclamation channels.

∃ The reclamation channels are verified to pass the peak discharge with an approximate freeboard of 0.5 foot or greater with the exception of swale-3 which has a freeboard of 0.37 feet.

∃ Filter blanket thickness is equal to one half of the thickness of the riprap, but no less than 6 inches (Barfield, 1981).

Information regarding the operational diversions is presented in Section 3.7-4(2) of the permit. These structures were retained unless replaced during reclamation.

As-built Reclamation channel geometries are summarized in Table 3.7-12AB. Calculations verifying the capacity and stability of the as-built channels are presented in Attachment 1 of this appendix.

3.7-5(4)(3) Reclamation Culvert Design

No culverts were installed as part of reclamation. However, operational culverts along the unchanged portions of the road have been left in place to control road runoff. The location of operational culverts is shown on Exhibits 3.7-7A, 3.7-7B, and 3.7-7C and Exhibit 3.7-6. Only the existing culverts in the facilities area were removed during reclamation activities. Culverts CCC-7 and CCC-8 which were located in the main stream channel were removed, while CCC-24 (Exhibit 3.7-5C) remains. Culverts CCRC-1 and 2 in the approved reclamation plan were replaced with swales to reduce maintenance and eliminate problems associated with culverts.

3.7-5(4)(4) Primary Sediment Control (Ponds)

Both of the operational sedimentation ponds, Pond 014 and Pond 015, were removed during reclamation. The ponds remained in-place as long as possible during reclamation to assist in the sedimentation control efforts. However, once the drainage areas to the ponds were reduced to the point where the pond no longer functioned or the area of the pond needed to be regraded, the ponds were removed.

3.7-5(4)(5) Alternative Sediment Control Measures

Due to the desire to avoid redisturbance of a significant portion of Crandall Canyon in a future phase of reclamation, the operational sedimentation ponds 014, and 015 were removed during reclamation grading operations. Therefore, alternative sediment control measures ("ASCMs") were implemented during reclamation of the site to reduce the sediment yield from the site. These ASCMs included the following practices in varying degrees:

1. Incorporation of hay mulch into the growth media,
2. Deep gouging of the growth media,
3. Seeding the prepared soil,
4. Addition of more mulch following seeding, and
5. Chemically anchoring the final mulch layer.

Based on success at previously reclaimed sites, these methods are effective at controlling sediment yields for the purpose of mine reclamation. The areas where the ASCMs were implemented consist of the topsoil stockpile No. 2 and the facilities area. The areas where ASCMs were used can be seen on Exhibit 3.7-16AB.

Mechanical treatment was performed following the topsoil spreading and mulching of the site area by gouging the soil to a depth of 12" to 18" using the bucket of a track-mounted backhoe. Gouging loosens the soil, allowing root penetration, increased surface roughness, and increased moisture storage. This allows for quicker vegetation establishment, which reduces erosion. The depressions from the gouging trap sediment dislodged by raindrop impact and overland flow. They also shorten the exposed reaches over which runoff will flow, thereby reducing the sediment carrying capacity of the runoff.

In regard to surface protection measures, the incorporation of hay mulch during surface roughening ensures that the major portion of mulch is incorporated into the soil. The mulch itself significantly reduces the amount of sediment yield from an area (Simons, Li & Associates, 1983, p. 4.30). The mulch also helps retain moisture to allow for seed germination. Hay mulch was incorporated into the soil at a rate of 2 tons/acre.

Permanent plant growth is the best method of controlling erosion from slopes, according to Simons, Li & Associates (1983, p.4.44). After deep gouging, the surface was seeded with grasses, forbs, and shrubs. The seed mix used was the species mix specified in Section 3.7-5(3)(7). Initial seeding was performed during the fall of 2003, with reseeding in 2004 in the vicinity of Shaft No. 1 and 2008 adjacent to Shaft No. 2, as indicated above. Following seeding the site area was mulched again at a rate of 1.5 tons per acre.

Appendix 3.7-7Q presents calculations of sediment yield, using the Universal Soil Loss Equation (USLE), for the steepest reclaimed slopes. The calculations compare the sediment yield with no erosion protection, with natural vegetative cover, and with the proposed vegetative cover, mechanical treatment, and mulching that has been used for sediment and erosion control at the Crandall Canyon site. As noted, implementation of the ASCMs substantially reduces the amount of sediment eroded from the reclaimed areas as compared with natural areas.

Corrections to any weaknesses in the implementation of the sediment control plan will be remedied immediately to prevent future sediment runoff into the main stream channel. Corrective action will be taken when a gully greater than nine inches in depth is created due to lack of vegetation establishment, or when the mulch and seed have been transported by wind or overland flow. Corrective action will consist of regrading of the ground surface only as necessary to fill in gullies caused by erosion, and reseeding and mulching to reestablish vegetation.

3.7-5(5) Reclamation Surface and Ground Water Monitoring

The groundwater and surface water monitoring sites for Crandall Canyon will continue to be monitored quarterly during and after completion of reclamation activities and until bond release is achieved in accordance with the approved plan.

Operational monitoring sites B-26 and B-22-1 will be retained for monitoring after reclamation. Exhibit 3.7-12AB and 3.7-13AB shows the locations of these monitoring sites. These sites will be monitored for the parameters listed in Table 4.7-2 of the MR&P.

3.7-5(6) Reclamation Timetable

The reclamation of the Crandall Canyon facilities began during the summer of 2003 and was initially completed during the fall of 2003. Broadcast seeding occurred initially during the fall of 2003, with seedlings planted during the fall of 2004. The area around Shaft No. 1 was re-graded and reseeded during the fall of 2005 to repair the settlement of the shaft. The area adjacent to Shaft No. 2 was regraded and reseeded in July 2008. The entire site has been reclaimed to the final configuration. Reclamation monitoring will continue until bond release.

3.7-6 Bond Release

Phase III bond release was authorized for the Crandall Canyon leach field area as shown on Exhibits 3.7-7A and 3.7-7B and supported by information in Appendix 3.7V and Appendix 3.7W. Phase I bond release is being requested for all areas of Crandall Canyon.

3.7-7 References

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TABLE 3.7-11 AB

CRANDALL CANYON
AS-BUILT RECLAMATION HYDROLOGY PEAK FLOWS

DIVERSION	CONTRIBUTING WATERSHEDS (CCRWS-)	AREA (ACRES)	PEAK WATERSHED FLOW (CFS)
CCRD-1	1	41.83	0.43
CCRD-2	2	45.53	0.47
CCRD-3	3	235.06	2.37
CCRD-4	4	43.53	0.45
CCRD-5	5	8.13	0.25
CCRD-6	5 and 6	53.66	2.65
CCRD-7	7 and 9	28.01	0.77
CCRD-8	5	8.13	0.25
CCRD-9	8	10.87	0.34
CCRD-10	7	24.05	0.52
CCRD-11	10	2202.12	133.64
CCRD-12	8	10.87	0.34
CCRD-13	9	3.97	0.25
SWALE-1	7 and 9	28.01	0.77
SWALE-2	8	10.87	0.34
SWALE-3	5 and 6	53.66	2.65

NOTE: All channels are verified to be able to handle the a peak flow at least equal to that resulting from the 10-year, 6-hour storm event. CCRD-10 is the main channel and has been constructed to handle the peak flow resulting from the 100-year, 6-hour storm event. Watershed CCRWS-10 includes watersheds CCRWS-1 thru 9.

TABLE 3.7-12 AB

CRANDALL CANYON AS-BUILT RECLAMATION DITCH DESIGN SUMMARY

Diversion Ditch (CCRD-)	Design Flow (cfs)	Minimum Conditions				Calculation Results		Min. Design Requirements	
		Bottom Width (ft)[a]	Side Slopes (ft)	Max. Bottom Slope (%)	Min. Bottom Slope (%)	Max. Velocity (ft/s)	Max. Flow Depth (ft)	Channel Depth (ft)	Riprap D_{50} (in)
1	0.43	3	1.5:1	27.4	14.6	2.33	0.07	1.17	6
2	0.47	4	2.3:1	58.0	7.2	2.53	0.07	1.17	6
3	2.37	10	3:1	13.4	2.4	2.86	0.14	2.0	None
4	0.45	5	2:1	27.0	7.1	2.41	0.05	1.0	None
5	0.25	3	3.4:1	32.1	19.2	1.93	0.05	0.58	6
6	2.65	5	3:1	32.8	5.3	3.69	0.19	1.0	6
7	0.77	4	1.7:1	6.4	2.1	2.08	0.12	1.0	None
8	0.25	0.5	1.6:1	13.8	3.8	3.07	0.17	1.75	None
9	0.34	0.5	2.1:1	6.5	3.7	2.76	0.17	1.17	None
10	0.52	0.50	2.7:1	6.3	1.1	2.63	0.29	0.79	None
11	133.64	8.50	2.2:1	14.1	2.6	10.51	1.59	1.75[b]	12
12	0.34	5	2.75:1	50.0	5.5	1.86	0.06	1.0	12
13	0.25	0.67	1.7:1	9.7	4.1	2.88	0.13	1.25	None
Swale-1	0.77	11	16:1	2.1	2.1	1.05	0.06	3.0	None
Swale-2	0.34	8	12:1	5.5	5.5	1.18	0.03	0.63	None
Swale-3	2.65	6	16:1	5.4	5.4	2.53	0.13	0.5	None

(a) Minimum bottom width measured at minimum depth from top of channel.
(b) This minimum depth does not correspond to the same place as the minimum slope. The minimum slope is in an area with a depth of 1.08 ft and a smaller flow since it is upstream of three large drainages.

ATTACHMENT 1

AS-BUILT RECLAMATION HYDROLOGY CALCULATIONS

As-Build Hydrology Calculations
Crandall Canyon

The purpose of these calculations is to demonstrate that the constructed reclamation channels can handle the peak flow generated from the required storm event. The main Channel (CCRD-10) is required to handle the 100-year 6-hour storm event. All other channels must be able to handle the 10-year 6-hour storm event. All channels will be shown to be capable of safely handling the design event.

Methodology

- Curve Number techniques of the U.S. SCS (1972)
- Triangular Unit Hydrograph approach of the U.S. SCS (1972) as programed by Hawkins and Marshall (1979)
- Drainage areas, slopes and hydraulic lengths determined from as-built aerial topography. See Exhibit 3.7-17 AB for watershed locations.

Rainfall Depths

10-year 6-hour	1.4 inches
100-year 6-hour	2.0 inches

Reclamation Curve Numbers

The curve number for each watershed is determined by an area weighted average between undisturbed and reclaimed areas. The same curve numbers for each vegetation type will be used as listed in Appendix 3.7D of Exhibit 20. Namely:

South Facing (Pinyon/Juniper-Grass)	CN = 70
North Facing (Douglas fir/Pine)	CN = 65

Crandall Canyon Reclamation Curve Numbers

Watershed Area (a)	Undisturbed		Road Area		Reclaimed		Weighted CN (b)
	Area (ac.)	CN	Area (ac.)	CN	Area (ac.)	CN	
CCRWS-1	41.52	65	0	89	0.31	80	65
CCRWS-2	45.21	65	0	89	0.32	80	65
CCRWS-3	233.84	65	0	89	1.22	80	65
CCRWS-4	43.3	65	0	89	0.23	80	65
CCRWS-5	7	70	0.32	89	0.81	80	72
CCRWS-6	112.97	70	0.05	89	0.21	80	70
CCRWS-7	23.63	70	0.21	89	0.21	80	70
CCRWS-8	9.29	70	0.34	89	1.24	80	72
CCRWS-9	2.61	70	0.37	89	0.98	80	74
CCRWS-10 (c)	2183.72	68	1.29	89	17.11	80	68

(a) See Exhibit 3.7-17AB for watershed locations
(b) Weighted CN = (CN1)(A1)+(CN2)(A2)+(CN3)(A3) / (A1+A2+A3)
(c) CCRWS-10 includes CCRWS-1 thru 9

Crandal Canyon
Summary of Watershed Data

Watershed Area	Drainage Area (ac)	Curve Number	S (in)	Y (%)	I (ft)	L (hr)	Time of Conc. (hr)	Peak Flow (cfs)
CCRWS-1	41.83	65	5.385	64.8	2804	0.137	0.229	0.43
CCRWS-2	45.53	65	5.385	69.3	3057	0.142	0.237	0.47
CCRWS-3	235.06	65	5.385	64.1	5346	0.231	0.386	2.37
CCRWS-4	43.53	65	5.385	64.5	3504	0.164	0.274	0.45
CCRWS-5	8.13	72	3.889	77.4	1110	0.050	0.083	0.25
CCRWS-6	113.23	70	4.286	41.7	4455	0.217	0.362	2.40
CCRWS-7	24.05	70	4.286	70.3	1979	0.087	0.146	0.52
CCRWS-8	10.87	72	3.889	70.3	1012	0.048	0.081	0.34
CCRWS-9	3.96	74	3.514	72.6	442	0.023	0.039	0.25
CCRWS-10	2202.12	68	4.706	54.5	13412	0.484	0.808	133.64

Notes

Watershed location can be found on Exhibit 3.7-17AB
S = 1000/CN - 10
Y = average watershed slope = (length of contour lines)(contour interval)/(watershed area)
I = hydraulic length
L = watershed lag =(I^0.8(S+1)^0.7) / (1900(Y)^0.5)
Time of Concentration = 1.67L
Peak Flow is based on a 10-yr 6-hr storm event.
CCRWS-10 includes CCRWS-1 thru 9
* Peak flow for a 100-year 6-hour storm event

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-1 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 41.83 acres
Depth = 1.40 inches	CN = 65.00
Duration = 6.0 hrs	Time conc.= 0.23 hrs

OUTPUT SUMMARY

Runoff depth: 0.018 inches
Initial abstr: 1.077 inches
Peak flow: 0.43 cfs (0.010 iph)
at time: 6.015 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-2 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 45.53 acres
Depth = 1.40 inches	CN = 65.00
Duration = 6.0 hrs	Time conc.= 0.24 hrs

OUTPUT SUMMARY

Runoff depth: 0.018 inches
Initial abstr: 1.077 inches
Peak flow: 0.47 cfs (0.010 iph)
at time: 6.036 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-3 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 235.06 acres
Depth = 1.40 inches	CN = 65.00
Duration = 6.0 hrs	Time conc.= 0.39 hrs

OUTPUT SUMMARY

Runoff depth:	0.018 inches
Initial abstr:	1.077 inches
Peak flow:	2.37 cfs (0.010 iph)
at time:	6.022 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-4 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 43.53 acres
Depth = 1.40 inches	CN = 65.00
Duration = 6.0 hrs	Time conc.= 0.27 hrs

OUTPUT SUMMARY

Runoff depth: 0.018 inches
Initial abstr: 1.077 inches
Peak flow: 0.45 cfs (0.010 iph)
at time: 6.028 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-5 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 8.13 acres
Depth = 1.40 inches	CN = 72.00
Duration = 6.0 hrs	Time conc.= 0.08 hrs

OUTPUT SUMMARY

Runoff depth: 0.086 inches
Initial abstr: 0.778 inches
Peak flow: 0.25 cfs (0.031 iph)
at time: 3.519 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-6 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 113.23 acres
Depth = 1.40 inches	CN = 70.00
Duration = 6.0 hrs	Time conc.= 0.36 hrs

OUTPUT SUMMARY

Runoff depth: 0.061 inches
Initial abstr: 0.857 inches
Peak flow: 2.40 cfs (0.021 iph)
at time: 5.647 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-7 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 24.05 acres
Depth = 1.40 inches	CN = 70.00
Duration = 6.0 hrs	Time conc.= 0.15 hrs

OUTPUT SUMMARY

Runoff depth: 0.061 inches
Initial abstr: 0.857 inches
Peak flow: 0.52 cfs (0.022 iph)
at time: 5.529 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-8 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 10.87 acres
Depth = 1.40 inches	CN = 72.00
Duration = 6.0 hrs	Time conc.= 0.08 hrs

OUTPUT SUMMARY

Runoff depth: 0.086 inches
Initial abstr: 0.778 inches
Peak flow: 0.34 cfs (0.031 iph)
at time: 3.510 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-9 10-YEAR 6-HOUR STORM

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 3.96 acres
Depth = 1.40 inches	CN = 74.00
Duration = 6.0 hrs	Time conc.= 0.04 hrs

OUTPUT SUMMARY

Runoff depth: 0.115 inches
Initial abstr: 0.703 inches
Peak flow: 0.25 cfs (0.061 iph)
at time: 2.512 hrs

Triangular Hydrograph Calculations using

SCSHYDRO Program

Watershed I.D.:
CCRWS-10 100-YEAR 6-HOUR

INPUT SUMMARY

STORM :	WATERSHED :
Dist.= SCS Type `b'	Area = 2,202.12 acres
Depth = 2.00 inches	CN = 68.00
Duration = 6.0 hrs	Time conc.= 0.81 hrs

OUTPUT SUMMARY

Runoff depth: 0.194 inches
Initial abstr: 0.941 inches
Peak flow: 133.64 cfs (0.060 iph)
at time: 3.771 hrs

Channel Verification

Assumptions

1. The main channel (CCRD-11) is being verified to handle the 100-year 6-hour storm event. All other channels are verified for the 10-year 6-hour storm event,

2. When determining the adequacy of the riprap the method presented by Searcy, (1967) will be used,

3. Riprap thickness is twice the D_{50},

4. A Mannings n for riprap channels will be determined using the method presented by Abt, S.R., et. al. (1987)

$$n = 0.0456(D_{50} \times Slope)^{0.159}$$

Where: D50 = median riprap size (inches)
Slope = (ft\ft)

5. A Mannings n for rocky ground will be assumed to be 0.035. The Mannings n for bare ground will be assumed to be 0.030

6. The channels are verified by assessing the erosional stability at the maximum slope and the capacity of the channel at the minimum slope.

The channels were measured in the fall of 2004. The channels were measured at the location of the minimum flow area. Thus, the channels typically have a greater capacity than indicated in this calculation. Calculation sheets can be found on pages 16 to 44 with a summary on page 15.

Channel cross-sections for each of the channels can be found on pages 45 through 60. Channel profiles can be found on Exhibit 3.4-15ab.

CRANDALL CANYON AS-BUILT RECLAMATION DITCH DESIGN SUMMARY

Diversion Ditch (CCRD-)	Design Flow (cfs)	Minimum Conditions				Calculation Results		Min. Design Requirements	
		Bottom Width (ft)[(a)]	Side Slopes (ft)	Max. Bottom Slope (%)	Min. Bottom Slope (%)	Max. Velocity (ft/s)	Max. Flow Depth (ft)	Channel Depth (ft)	Riprap D_{50} (in)
1	0.43	3	1.5:1	27.4	14.6	2.33	0.07	1.17	6
2	0.47	4	2.3:1	58.0	7.2	2.53	0.07	1.17	6
3	2.37	10	3:1	13.4	2.4	2.86	0.14	2.0	None
4	0.45	5	2:1	27.0	7.1	2.41	0.05	1.0	None
5	0.25	3	3.4:1	32.1	19.2	1.93	0.05	0.58	6
6	2.65	5	3:1	32.8	5.3	3.69	0.19	1.0	6
7	0.77	4	1.7:1	6.4	2.1	2.08	0.12	1.0	None
8	0.25	0.5	1.6:1	13.8	3.8	3.07	0.17	1.75	None
9	0.34	0.5	2.1:1	6.5	3.7	2.76	0.17	1.17	None
10	0.52	0.50	2.7:1	6.3	1.1	2.63	0.29	0.79	None
11	133.64	8.50	2.2:1	14.1	2.6	10.51	1.59	1.75[(b)]	12
12	0.34	5	2.75:1	50.0	5.5	1.86	0.06	1.0	12
13	0.25	0.67	1.7:1	9.7	4.1	2.88	0.13	1.25	None
Swale-1	0.77	11	16:1	2.1	2.1	1.05	0.06	3.0	None
Swale-2	0.34	8	12:1	5.5	5.5	1.18	0.03	0.63	None
Swale-3	2.65	6	16:1	5.4	5.4	2.53	0.13	0.5	None

(a) Minimum bottom width measured at minimum depth from top of channel.
(b) This minimum depth does not correspond to the same place as the minimum slope. The minimum slope is in an area with a depth of 1.08 ft and a smaller flow since it is upstream of three large drainages.

CCRD-1 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.045		D_{50} = 6"
Slope	146000	ft/ft	14.6%
Left Side Slope	1.50	H : V	
Right Side Slope	1.50	H : V	
Bottom Width	3.00	ft	
Discharge	0.43	cfs	

Results			
Depth	0.07	ft	<< 1.17' ok
Flow Area	0.2	ft²	
Wetted Perim	3.24	ft	
Top Width	3.20	ft	
Critical Depth	0.08	ft	
Critical Slope	0.068250	ft/ft	
Velocity	2.05	ft/s	
Velocity Head	0.07	ft	
Specific Enerç	0.13	ft	
Froude Numb	1.41		
Flow Type	Supercritical		

CCRD-1 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.050	D_{50} = 6"
Slope	274000	ft/ft 27.4%
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	3.00	ft
Discharge	0.43	cfs

Results		
Depth	0.06	ft
Flow Area	0.2	ft²
Wetted Perim	3.21	ft
Top Width	3.18	ft
Critical Depth	0.08	ft
Critical Slope	0.084069	ft/ft
Velocity	2.33	ft/s < 7 fps ok
Velocity Head	0.08	ft
Specific Energ	0.14	ft
Froude Numb	1.71	
Flow Type	Supercritical	

CCRD-2 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.040		D_{50} = 6"
Slope	072000	ft/ft	7.2 %
Left Side Slope	2.30	H : V	
Right Side Slope	2.30	H : V	
Bottom Width	4.00	ft	
Discharge	0.47	cfs	

Results			
Depth	0.07	ft	<< 1.17' ok
Flow Area	0.3	ft²	
Wetted Perim	4.35	ft	
Top Width	4.32	ft	
Critical Depth	0.07	ft	
Critical Slope	0.056736	ft/ft	
Velocity	1.63	ft/s	
Velocity Head	0.04	ft	
Specific Energ	0.11	ft	
Froude Numb	1.11		
Flow Type	Supercritical		

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CCRD-2 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.056		D_{50} = 6"
Slope	580000	ft/ft	58 %
Left Side Slope	2.30	H : V	
Right Side Slope	2.30	H : V	
Bottom Width	4.00	ft	
Discharge	0.47	cfs	

Results			
Depth	0.05	ft	
Flow Area	0.2	ft²	
Wetted Perim	4.23	ft	
Top Width	4.21	ft	
Critical Depth	0.07	ft	
Critical Slope	0.109609	ft/ft	
Velocity	2.53	ft/s	< 7.5 fps ok
Velocity Head	0.10	ft	
Specific Energ	0.14	ft	
Froude Numb	2.13		
Flow Type	Supercritical		

CCRD-3 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.035	rocky ground
Slope	024000 ft/ft	2.4%
Left Side Slope	3.00 H : V	
Right Side Slope	3.00 H : V	
Bottom Width	10.00 ft	
Discharge	2.37 cfs	

Results		
Depth	0.14 ft	<< 2'+ ok
Flow Area	1.4 ft²	
Wetted Perim	10.86 ft	
Top Width	10.81 ft	
Critical Depth	0.12 ft	
Critical Slope	0.036884 ft/ft	
Velocity	1.68 ft/s	
Velocity Head	0.04 ft	
Specific Energ	0.18 ft	
Froude Numb	0.82	
Flow Type	Subcritical	

CCRD-3 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.035	rocky ground
Slope	134000	ft/ft 13.4%
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	10.00	ft
Discharge	2.37	cfs

Results		
Depth	0.08	ft
Flow Area	0.8	ft²
Wetted Perim	10.51	ft
Top Width	10.49	ft
Critical Depth	0.12	ft
Critical Slope	0.036883	ft/ft
Velocity	2.86	ft/s < 5 fps ok
Velocity Head	0.13	ft
Specific Energ	0.21	ft
Froude Numb	1.79	
Flow Type	Supercritical	

CCRD-4 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.035		rocky ground
Slope	071000	ft/ft	7.1 %
Left Side Slope	2.00	H : V	
Right Side Slope	2.00	H : V	
Bottom Width	5.00	ft	
Discharge	0.45	cfs	

Results			
Depth	0.05	ft	< 1' ok
Flow Area	0.3	ft²	
Wetted Perim	5.25	ft	
Top Width	5.22	ft	
Critical Depth	0.06	ft	
Critical Slope	0.045657	ft/ft	
Velocity	1.61	ft/s	
Velocity Head	0.04	ft	
Specific Energ	0.09	ft	
Froude Numb	1.22		
Flow Type	Supercritical		

CCRD-4 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.035		rocky earth
Slope	270000	ft/ft	27.0 %
Left Side Slope	2.00	H : V	
Right Side Slope	2.00	H : V	
Bottom Width	5.00	ft	
Discharge	0.45	cfs	

Results			
Depth	0.04	ft	
Flow Area	0.2	ft^2	
Wetted Perim	5.16	ft	
Top Width	5.15	ft	
Critical Depth	0.06	ft	
Critical Slope	0.045654	ft/ft	
Velocity	2.41	ft/s	< 5.0 fps ok
Velocity Head	0.09	ft	
Specific Energ	0.13	ft	
Froude Numb	2.23		
Flow Type	Supercritical		

CCRD-5 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.047		D_{50} = 6"
Slope	192000	ft/ft	19.2%
Left Side Slope	3.40	H : V	
Right Side Slope	3.40	H : V	
Bottom Width	3.00	ft	
Discharge	0.25	cfs	

Results			
Depth	0.05	ft	< 0.58 ok
Flow Area	0.1	ft²	
Wetted Perim	3.33	ft	
Top Width	3.31	ft	
Critical Depth	0.06	ft	
Critical Slope	0.084020	ft/ft	
Velocity	1.73	ft/s	
Velocity Head	0.05	ft	
Specific Energ	0.09	ft	
Froude Numb	1.46		
Flow Type	Supercritical		

CCRD-5 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.051		D50 = 6"
Slope	321000	ft/ft	32.1%
Left Side Slope	3.40	H : V	
Right Side Slope	3.40	H : V	
Bottom Width	3.00	ft	
Discharge	0.25	cfs	

Results			
Depth	0.04	ft	
Flow Area	0.1	ft²	
Wetted Perim	3.29	ft	
Top Width	3.28	ft	
Critical Depth	0.06	ft	
Critical Slope	0.098638	ft/ft	
Velocity	1.93	ft/s	< 7.5 fps ok
Velocity Head	0.06	ft	
Specific Enerç	0.10	ft	
Froude Numb	1.71		
Flow Type	Supercritical		

CCRD-6 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyor
Flow Element	Trapezoidal Cha
Method	Manning's Formı
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.038		$D_{50} = 6''$
Slope	053000	ft/ft	5.3 %
Left Side Slope	3.00	H : V	
Right Side Slope	3.00	H : V	
Bottom Width	5.00	ft	
Discharge	2.65	cfs	

Results			
Depth	0.18	ft	< 12"
Flow Area	1.0	ft²	
Wetted Perimı	6.13	ft	
Top Width	6.07	ft	
Critical Depth	0.20	ft	
Critical Slope	0.037679	ft/ft	
Velocity	2.68	ft/s	
Velocity Head	0.11	ft	
Specific Enerç	0.29	ft	
Froude Numbı	1.17		
Flow Type	Supercritical		

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Project Engineer: Richard White

CCRD-6 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyor
Flow Element	Trapezoidal Cha
Method	Manning's Form
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.051		D_{50} = 6"
Slope	328000	ft/ft	32.8%
Left Side Slope	3.00	H : V	
Right Side Slope	3.00	H : V	
Bottom Width	5.00	ft	
Discharge	2.65	cfs	

Results			
Depth	0.12	ft	
Flow Area	0.7	ft²	
Wetted Perim	5.79	ft	
Top Width	5.75	ft	
Critical Depth	0.20	ft	
Critical Slope	0.067691	ft/ft	
Velocity	3.97	ft/s	< 8 fps ok
Velocity Head	0.24	ft	
Specific Energ	0.37	ft	
Froude Numb	2.05		
Flow Type	Supercritical		

CCRD-7 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.035		rocky ground
Slope	021000	ft/ft	2.1 %
Left Side Slope	1.70	H : V	
Right Side Slope	1.70	H : V	
Bottom Width	4.00	ft	
Discharge	0.77	cfs	

Results			
Depth	0.12	ft	< 1' ok
Flow Area	0.5	ft²	
Wetted Perim	4.49	ft	
Top Width	4.42	ft	
Critical Depth	0.10	ft	
Critical Slope	0.039241	ft/ft	
Velocity	1.47	ft/s	
Velocity Head	0.03	ft	
Specific Energ	0.16	ft	
Froude Numb	0.75		
Flow Type	Subcritical		

CCRD-7 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.035		rocky ground
Slope	064000	ft/ft	6.4%
Left Side Slope	1.70	H : V	
Right Side Slope	1.70	H : V	
Bottom Width	4.00	ft	
Discharge	0.77	cfs	

Results			
Depth	0.09	ft	
Flow Area	0.4	ft^2	
Wetted Perim	4.35	ft	
Top Width	4.30	ft	
Critical Depth	0.10	ft	
Critical Slope	0.039240	ft/ft	
Velocity	2.08	ft/s	< 5 fps ok
Velocity Head	0.07	ft	
Specific Energ	0.16	ft	
Froude Numb	1.25		
Flow Type	3upercritical		

CCRD-8 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.035		rocky ground
Slope	138000	ft/ft	13.8%
Left Side Slope	1.60	H : V	
Right Side Slope	1.60	H : V	
Bottom Width	0.50	ft	
Discharge	0.25	cfs	

Results			
Depth	0.12	ft	
Flow Area	0.1	ft²	
Wetted Perim	0.95	ft	
Top Width	0.88	ft	
Critical Depth	0.16	ft	
Critical Slope	0.040414	ft/ft	
Velocity	3.07	ft/s	< 5.0 fps ok
Velocity Head	0.15	ft	
Specific Energ	0.26	ft	
Froude Numb	1.78		
Flow Type	Supercritical		

CCRD-8 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.035	rocky earth
Slope	038000 ft/ft	3.8 %
Left Side Slope	1.60 H : V	
Right Side Slope	1.60 H : V	
Bottom Width	0.50 ft	
Discharge	0.25 cfs	

Results		
Depth	0.17 ft	< 1.75' ok
Flow Area	0.1 ft²	
Wetted Perim	1.13 ft	
Top Width	1.04 ft	
Critical Depth	0.16 ft	
Critical Slope	0.040415 ft/ft	
Velocity	1.94 ft/s	
Velocity Head	0.06 ft	
Specific Enerç	0.23 ft	
Froude Numb	0.97	
Flow Type	Subcritical	

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CCRD-9 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.030	bare earth
Slope	037000	ft/ft 3.7 %
Left Side Slope	2.10	H : V
Right Side Slope	2.10	H : V
Bottom Width	0.50	ft
Discharge	0.34	cfs

Results		
Depth	0.17	ft < 1.17' ok
Flow Area	0.2	ft²
Wetted Perim	1.31	ft
Top Width	1.23	ft
Critical Depth	0.19	ft
Critical Slope	0.028205	ft/ft
Velocity	2.25	ft/s
Velocity Head	0.08	ft
Specific Enerç	0.25	ft
Froude Numb	1.14	
Flow Type	Supercritical	

CCRD-9 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.030		bare earth
Slope	065000	ft/ft	6.5%
Left Side Slope	2.10	H : V	
Right Side Slope	2.10	H : V	
Bottom Width	0.50	ft	
Discharge	0.34	cfs	

Results			
Depth	0.15	ft	
Flow Area	0.1	ft²	
Wetted Perim	1.20	ft	
Top Width	1.13	ft	
Critical Depth	0.19	ft	
Critical Slope	0.028205	ft/ft	
Velocity	2.76	ft/s	< 5.0 fps ok
Velocity Head	0.12	ft	
Specific Energ	0.27	ft	
Froude Numb	1.48		
Flow Type	Supercritical		

CCRD-10 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.035		rocky ground
Slope	011000	ft/ft	1.1 %
Left Side Slope	2.70	H : V	
Right Side Slope	2.70	H : V	
Bottom Width	0.50	ft	
Discharge	0.52	cfs	

Results			
Depth	0.29	ft	< 0.79' ok
Flow Area	0.4	ft²	
Wetted Perim	2.18	ft	
Top Width	2.08	ft	
Critical Depth	0.22	ft	
Critical Slope	0.036272	ft/ft	
Velocity	1.38	ft/s	
Velocity Head	0.03	ft	
Specific Energ	0.32	ft	
Froude Numb	0.57		
Flow Type	Subcritical		

CCRD-10 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coeffic	0.035	rocky earth
Slope	063000	ft/ft 6.3%
Left Side Slope	2.70	H : V
Right Side Slope	2.70	H : V
Bottom Width	0.50	ft
Discharge	0.52	cfs

Results		
Depth	0.19	ft
Flow Area	0.2	ft²
Wetted Perim	1.61	ft
Top Width	1.54	ft
Critical Depth	0.22	ft
Critical Slope	0.036272	ft/ft
Velocity	2.63	ft/s < 5.0 fps ok
Velocity Head	0.11	ft
Specific Energ	0.30	ft
Froude Numb	1.30	
Flow Type	Supercritical	

CCRD-11 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.050		$D_{50} = 12''$
Slope	141000	ft/ft	14.1%
Left Side Slope	2.20	H : V	
Right Side Slope	2.20	H : V	
Bottom Width	8.50	ft	minimum measured width
Discharge	133.64	cfs	

Results			
Depth	1.15	ft	
Flow Area	12.7	ft²	
Wetted Perim	14.07	ft	
Top Width	13.57	ft	
Critical Depth	1.69	ft	
Critical Slope	0.034901	ft/ft	
Velocity	10.51	ft/s	< 10.8 fps OK
Velocity Head	1.72	ft	
Specific Energ	2.87	ft	
Froude Numb	1.92		
Flow Type	Supercritical		

CCRD-11 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.038		D_{50} = 12"
Slope	026000	ft/ft	2.6 %
Left Side Slope	2.20	H : V	
Right Side Slope	2.20	H : V	
Bottom Width	8.50	ft	
Discharge	133.64	cfs	

Results			
Depth	1.59	ft	< 1.75' to 2.92' ok
Flow Area	19.0	ft²	
Wetted Perim	16.17	ft	
Top Width	15.48	ft	
Critical Depth	1.69	ft	
Critical Slope	0.020485	ft/ft	
Velocity	7.03	ft/s	
Velocity Head	0.77	ft	
Specific Energ	2.35	ft	
Froude Numb	1.12		
Flow Type	Supercritical		

minimum depth does not correspond to the minimum bottom width. Thus, the flow depth will be less than the calculated depth in the area of the minimum slope.

CCRD-12 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.043		D_{50} = 12"
Slope	055000	ft/ft	5.5"
Left Side Slope	2.75	H : V	
Right Side Slope	2.75	H : V	
Bottom Width	5.00	ft	
Discharge	0.34	cfs	

Results			
Depth	0.06	ft	<< 1' OK
Flow Area	0.3	ft²	
Wetted Perim	5.33	ft	
Top Width	5.31	ft	
Critical Depth	0.05	ft	
Critical Slope	0.072228	ft/ft	
Velocity	1.17	ft/s	
Velocity Head	0.02	ft	
Specific Enerç	0.08	ft	
Froude Numb	0.88		
Flow Type	Subcritical		

CCRD-12 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.061		D_{50} = 12"
Slope	500000	ft/ft	50%
Left Side Slope	2.75	H : V	
Right Side Slope	2.75	H : V	
Bottom Width	5.00	ft	
Discharge	0.34	cfs	

Results			
Depth	0.04	ft	
Flow Area	0.2	ft²	
Wetted Perim	5.21	ft	
Top Width	5.20	ft	
Critical Depth	0.05	ft	
Critical Slope	0.145464	ft/ft	
Velocity	1.86	ft/s	<< 11 fps ok
Velocity Head	0.05	ft	
Specific Energ	0.09	ft	
Froude Numb	1.75		
Flow Type	Supercritical		

CCRD-13 MINIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.030		bare earth
Slope	041000	ft/ft	4.1%
Left Side Slope	1.70	H : V	
Right Side Slope	1.70	H : V	
Bottom Width	0.67	ft	
Discharge	0.25	cfs	

Results			
Depth	0.13	ft	<< 1.25' ok
Flow Area	0.1	ft²	
Wetted Perim	1.19	ft	
Top Width	1.12	ft	
Critical Depth	0.14	ft	
Critical Slope	0.029578	ft/ft	
Velocity	2.14	ft/s	
Velocity Head	0.07	ft	
Specific Energ	0.20	ft	
Froude Numb	1.16		
Flow Type	Supercritical		

CCRD-13 MAXIMUM SLOPE
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.030		bare ground
Slope	097000	ft/ft	9.7 %
Left Side Slope	1.70	H : V	
Right Side Slope	1.70	H : V	
Bottom Width	0.67	ft	
Discharge	0.25	cfs	

Results			
Depth	0.10	ft	
Flow Area	0.1	ft²	
Wetted Perim	1.08	ft	
Top Width	1.02	ft	
Critical Depth	0.14	ft	
Critical Slope	0.029578	ft/ft	
Velocity	2.88	ft/s	< 5.0 fps ok
Velocity Head	0.13	ft	
Specific Energ	0.23	ft	
Froude Numb	1.74		
Flow Type	Supercritical		

SWALE 1
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.030		gravel
Slope	021000	ft/ft	2.1%
Left Side Slope	16.00	H : V	
Right Side Slope	16.00	H : V	
Bottom Width	11.00	ft	
Discharge	0.77	cfs	

Results			
Depth	0.06	ft	<< 3'± ok
Flow Area	0.7	ft²	
Wetted Perim	12.95	ft	
Top Width	12.95	ft	
Critical Depth	0.05	ft	
Critical Slope	0.035946	ft/ft	
Velocity	1.05	ft/s	< 5.0 fps ok
Velocity Head	0.02	ft	
Specific Energ	0.08	ft	
Froude Numb	0.78		
Flow Type	Subcritical		

SWALE 2
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.030		gravel
Slope	055000	ft/ft	5.5 %
Left Side Slope	12.00	H : V	
Right Side Slope	12.00	H : V	
Bottom Width	8.00	ft	
Discharge	0.34	cfs	

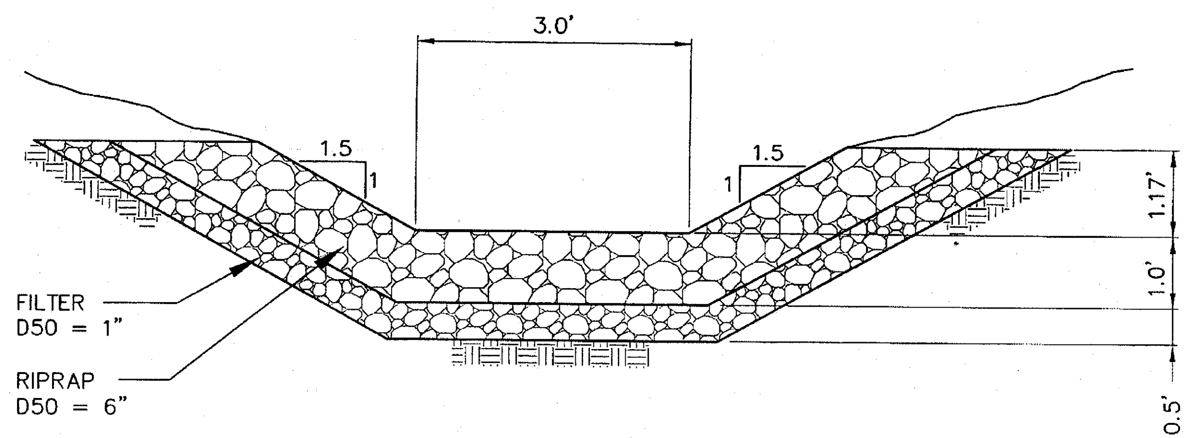
Results			
Depth	0.03	ft	<< 0.63' ok
Flow Area	0.3	ft²	
Wetted Perim	8.82	ft	
Top Width	8.82	ft	
Critical Depth	0.04	ft	
Critical Slope	0.039857	ft/ft	
Velocity	1.18	ft/s	< 5 fps ok
Velocity Head	0.02	ft	
Specific Energ	0.06	ft	
Froude Numb	1.16		
Flow Type	Supercritical		

SWALE 3
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Crandall Canyon As·
Flow Element	Trapezoidal Channe
Method	Manning's Formula
Solve For	Channel Depth

Input Data			
Mannings Coeffic	0.030		gravel
Slope	054000	ft/ft	5.4%
Left Side Slope	16.00	H : V	
Right Side Slope	16.00	H : V	
Bottom Width	6.00	ft	
Discharge	2.65	cfs	

Results			
Depth	0.13	ft	< 0.5' ok
Flow Area	1.0	ft²	
Wetted Perim	10.16	ft	
Top Width	10.15	ft	
Critical Depth	0.16	ft	
Critical Slope	0.026513	ft/ft	
Velocity	2.53	ft/s	5.0 fps ok
Velocity Head	0.10	ft	
Specific Energ	0.23	ft	
Froude Numb	1.39		
Flow Type	Supercritical		

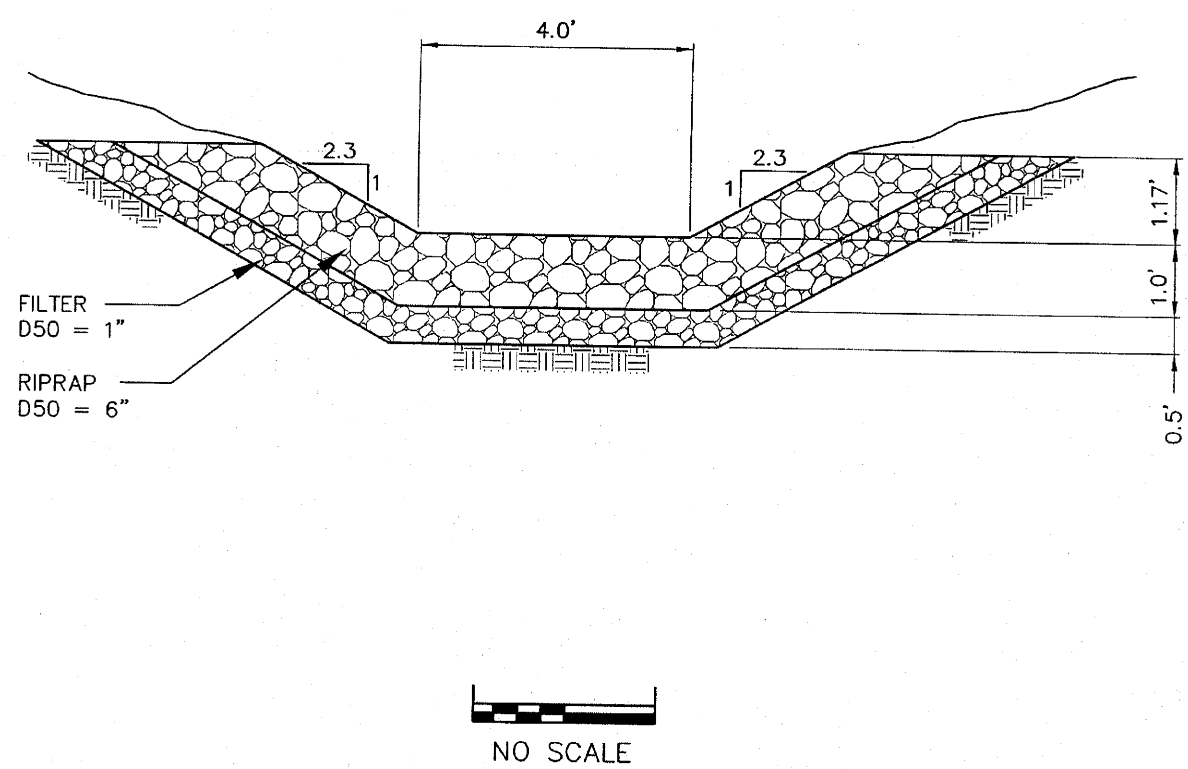


CCRD-1 CHANNEL CROSS-SECTION

EarthFax

C:\UC709\22\FIG-CCRD-2.DWG

45

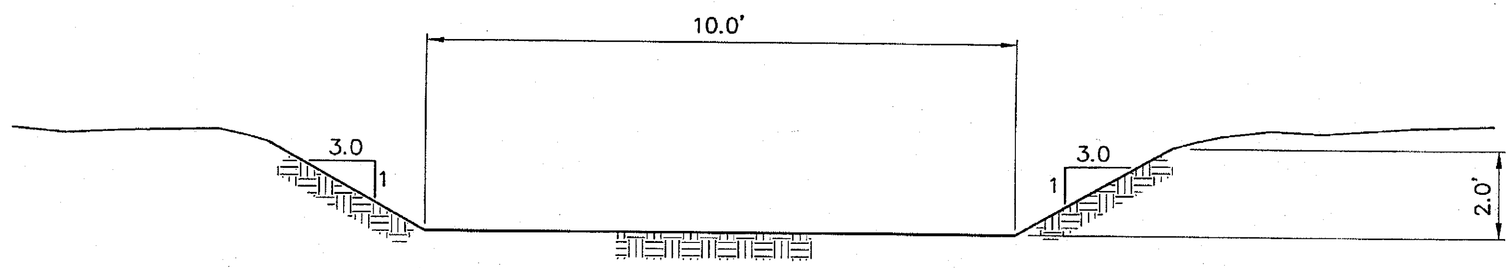


CCRD-2 CHANNEL CROSS-SECTION

EarthFax

G:\UC709\22\FIG-CCRD-2.DWG

46



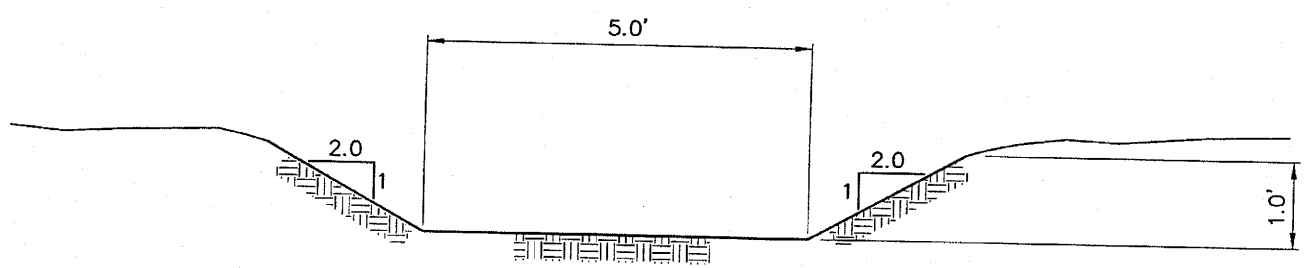
NO SCALE

CCRD–3 CHANNEL CROSS–SECTION

EarthFax

G:\UC709\22\FIG-CCRD-3.DWG

47



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CCRD–4 CHANNEL CROSS–SECTION

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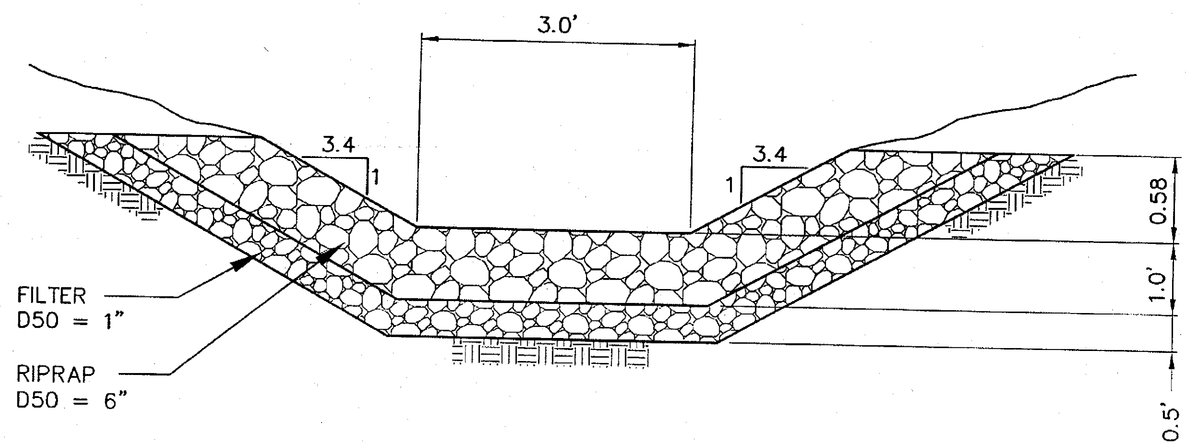
G:\UC709\22\FIG-CCRD-4.DWG

48

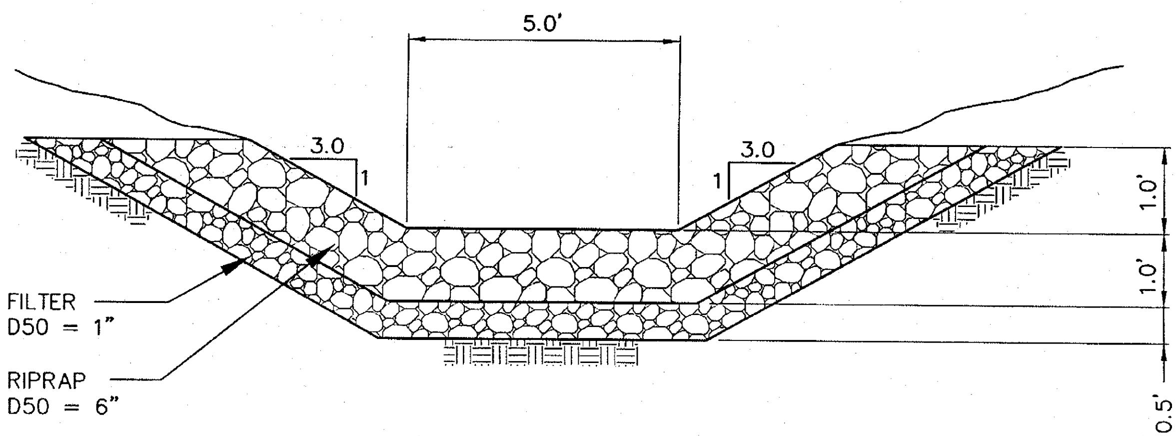


CCRD–5 CHANNEL CROSS–SECTION

EarthFax

G:\UC709\22\FIG-CCRD-5.DWG

49



NO SCALE

CCRD-6 CHANNEL CROSS-SECTION

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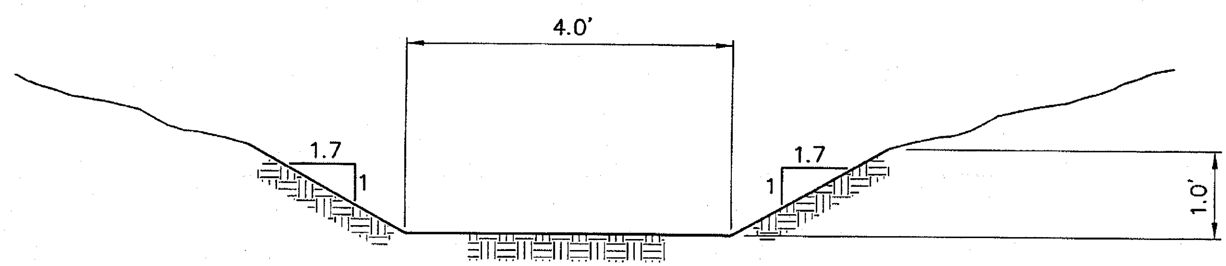
G:\UC709\22\FIG-CCRD-6.DWG

50

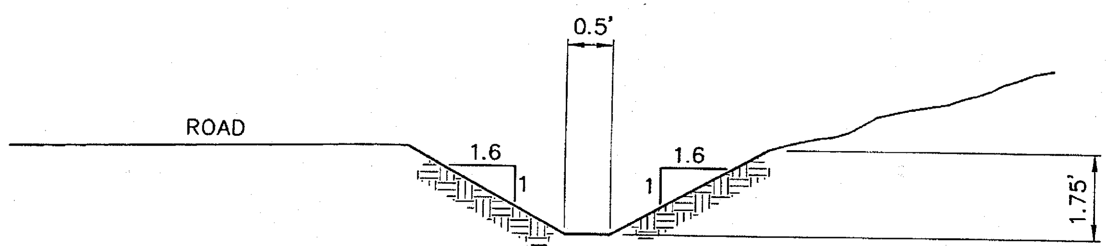


CCRD-7 CHANNEL CROSS-SECTION

EarthFax

G:\UC709\22\FIG-CCRD-7.DWG

51

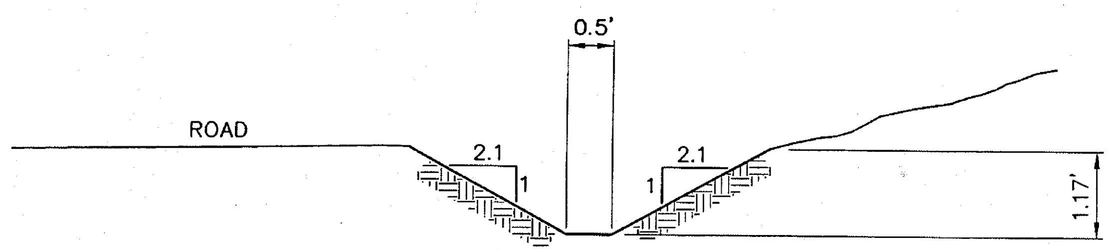


CCRD–8 CHANNEL CROSS–SECTION

EarthFax

G:\UC709\22\FIG–CCRD–8.DWG

52



CCRD–9 CHANNEL CROSS–SECTION

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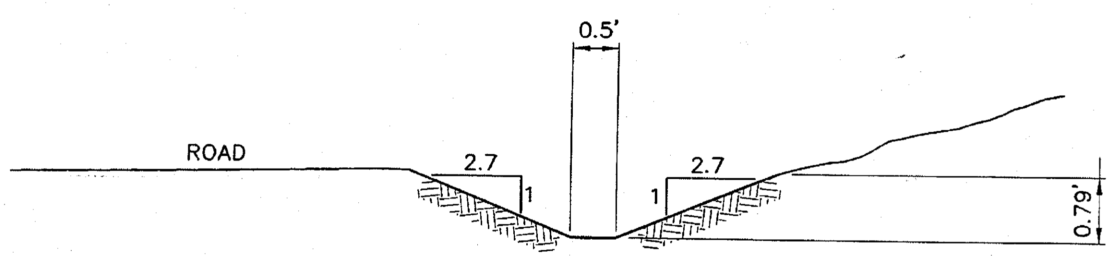
G:\UC709\22\FIG-CCRD-9.DWG

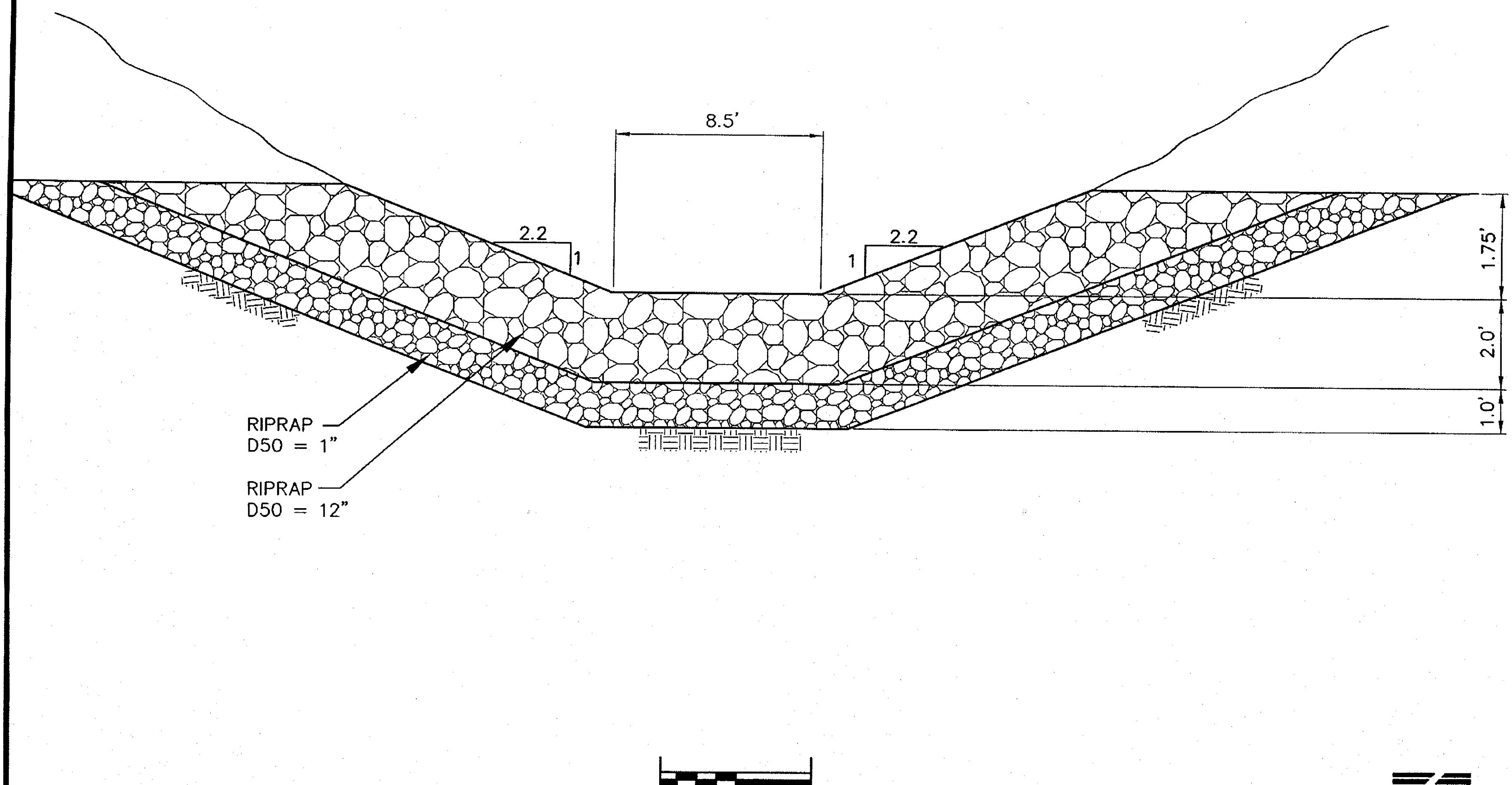
53



CCRD–10 CHANNEL CROSS–SECTION

EarthFax

G:\UC709\22\FIG-CCRD-10.DWG

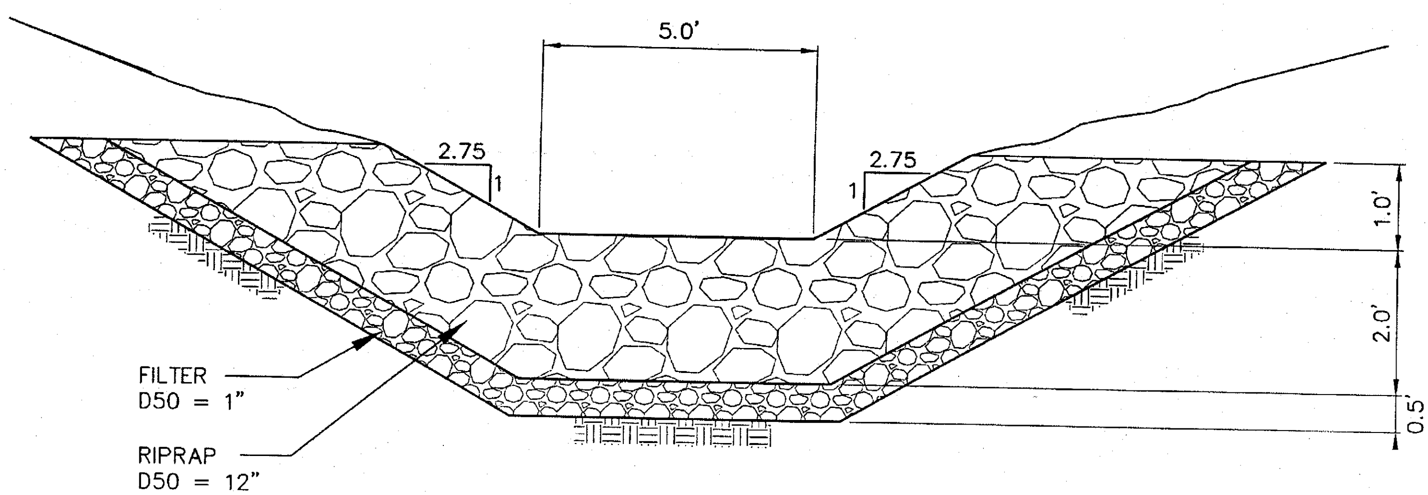


CGRD-11 CHANNEL CROSS-SECTION

EarthFax

G:\UC709\22\FIG-CCRD-11.DWG

55



NO SCALE

CCRD-12 CHANNEL CROSS-SECTION

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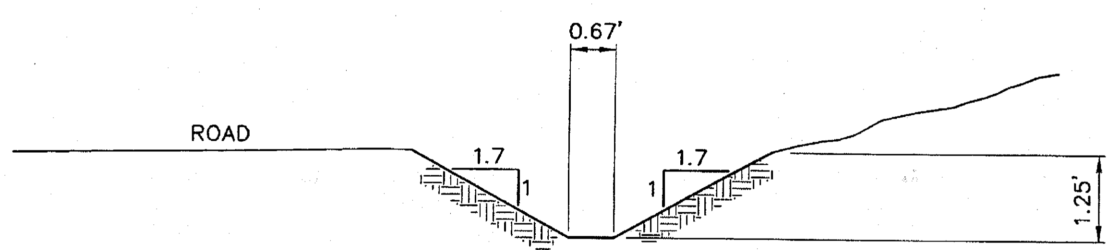
C:\UC709\22\FIG-CCRD-12.DWG

56

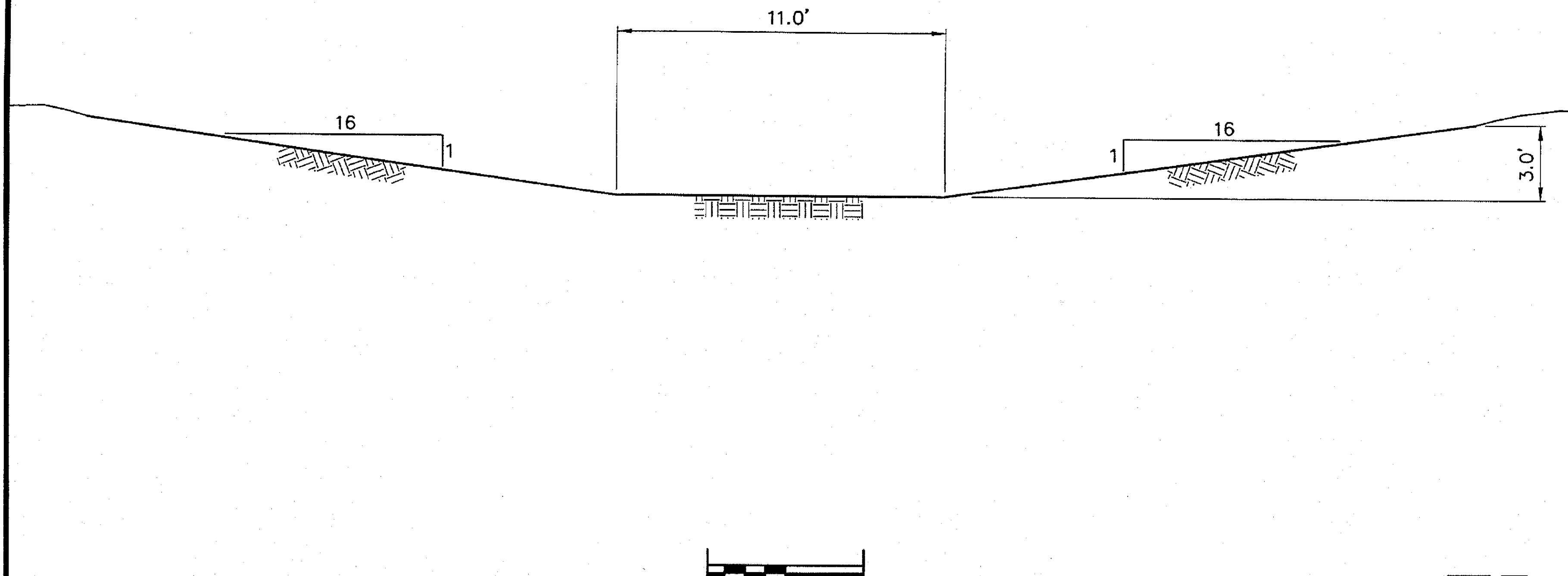


CCRD-13 CHANNEL CROSS-SECTION

EarthFax

G:\UC709\22\FIG-CCRD-13.DWG

57



SWALE-1 CHANNEL CROSS-SECTION

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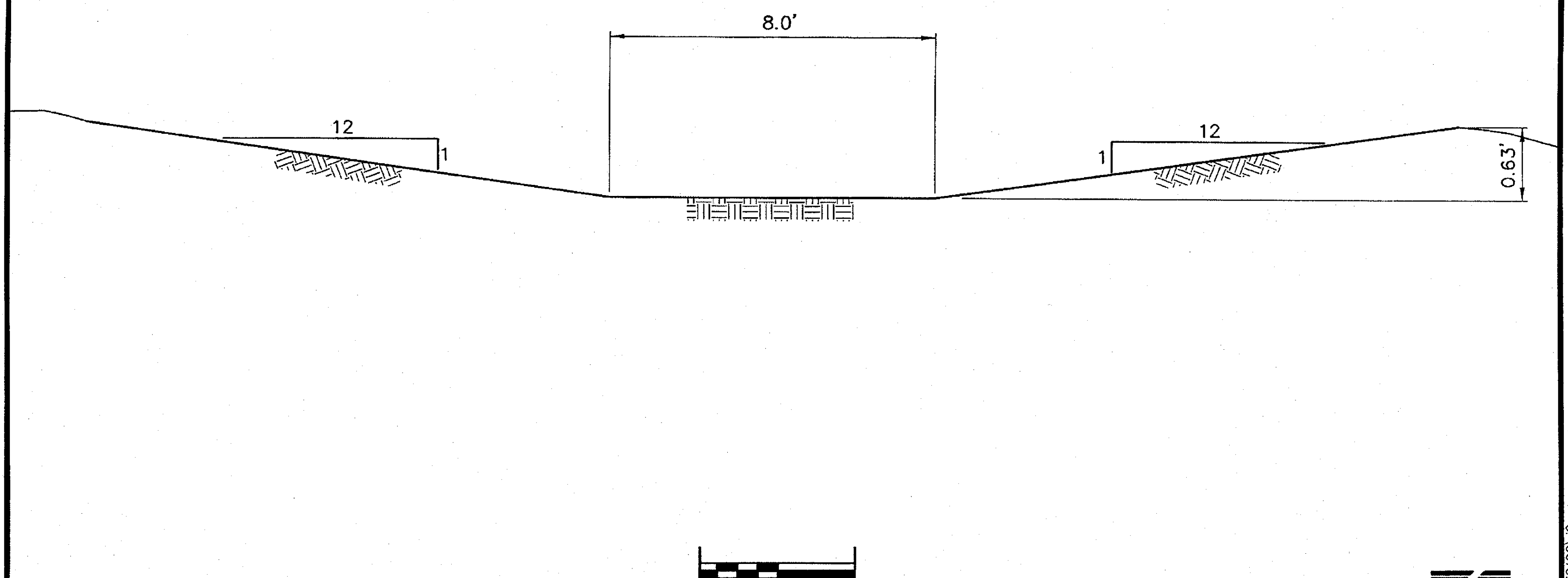
G:\UC709\22\FIG-SWALE-1.DWG

58



SWALE–2 CHANNEL CROSS–SECTION

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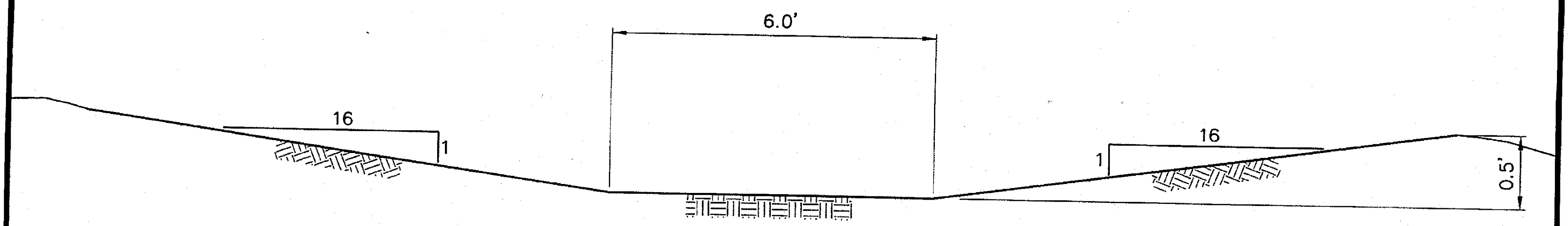
G:\UC709\22\FIG-SWALE-2.DWG

59



NO SCALE

SWALE-3 CHANNEL CROSS-SECTION

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G:\UC709\22\FIG-SWALE-3.DWG

60

ATTACHMENT 2

PUBLIC NOTICE AND LETTERS TO AGENCY AND LAND OWNERS

Public Notice

Application for Phase I Bond Release for Crandall Canyon
Plateau Mining Corporation
Willow Creek Mine
Permit C/007/0038, Last Renewed on 04/24/2006
Carbon County, Utah

Plateau Mining Corporation, P.O. Box 30, Helper, UT 84526, has completed Phase I of the approved reclamation plan for the approximately 32.96 acres of land related to the Crandall Canyon portion of the Willow Creek Mine Permit. This Phase I bond release application is based on completing the demolition, backfilling and grading and drainage control requirements in accordance with the approved reclamation plan. The initial reclamation work applicable to this bond release application was completed in 2003, subsequent maintenance was completed in 2008.

In accordance with the requirements of R645-301-880, of the State of Utah R645-Coal Mining Rules, notice is hereby given to the general public that Plateau Mining Corporation is applying for partial release of the performance bond posted for this operation.

The surety bond posted for the Willow Creek Mine is $2,175,114 of which $1,251,000 is designated for Crandall Canyon. Plateau Mining Corporation is seeking Phase I release of $750,600 from the Crandall Canyon portion of the bond.

Crandall Canyon is located on the Helper, Utah, U.S. Geological Survey 7.5 minute quadrangle map. This reclaimed land is located in Crandall Canyon approximately 5 miles north of Helper, Utah on the following described lands:

Township 12 South, Range 9 East, SLB&M, Utah

Section 22: Portions of the	SE1/4, SW1/4, and SW1/4, SE1/4,
Section 27: Portions of the	NE1/4, NW1/4, and SW1/4, NW1/4,
Section 28: Portions of the	NW1/4, SW1/4, NE1/4, SW1/4, SW1/4, SW1/4. NW1/4, SE1/4, NE1/4, SE1/4, SW1/4, SE1/4, and SE1/4, SE1/4

The Utah Division of Oil, Gas and Mining will now evaluate the proposal to determine whether it meets all the criteria of the Permanent Program Performance Standards according to the requirements of the Utah Coal Mining Rules.

Written comments, objections and requests for public hearing or informal conference on this proposal may be addressed to:

Utah Coal Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 1210
P.O. Box 145801
Salt Lake City, Utah 84114-5801

Closing date for submission of such comments, objections and requests for public hearing or informal conference on this proposal must be submitted by XXXXXXXX, 2009.

Published in the Sun Advocate - ________, _______, _______, and ______, 2009

Plateau Mining Corporation
P.O. Box 30
Helper, Utah 84526
Phone 435-472-4737

Re: **Notification of Application for Phase I Bond Release for the Crandall Canyon Portion of the Willow Creek Mine Permit C/007/0038**

Mr. Reed L Martineau
Park Ventures and C-Canyon, LC
5458 Merlyn Dr.
Salt Lake City, Utah 84117

Dear Mr. Martineau,

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Township 12 South, Range 9 East, SLB&M, Utah

Section 22: Portions of the	SE1/4, SW1/4, and SW1/4, SE1/4,
Section 27: Portions of the	NE1/4, NW1/4, and SW1/4, NW1/4,
Section 28: Portions of the	NW1/4, SW1/4, NE1/4, SW1/4, SW1/4, SW1/4.

NW1/4, SE1/4,
NE1/4, SE1/4,
SW1/4, SE1/4, and
SE1/4, SE1/4

The Utah Division of Oil, Gas and Mining will now evaluate the proposal to determine whether it meets all the criteria of the Permanent Program Performance Standards according to the requirements of the Utah Coal Mining Rules.

Comments concerning bond release from the legal or equitable owner of record of the surface areas to be affected and from the Federal, Utah and local government agencies which would have to initiate, implement, approve or authorize the proposed use of the land following reclamation should be mailed to :

Plateau Mining Corporation
Attention: Dennis N. Ware
P.O. Box 30
Helper, Utah 84526

Sincerely,

Dennis N. Ware
Controller and Administrative Manager
435-472-4737
Cell 435-650-2951
dware@foundationcoal.com

Land Owner Notification Mailed to:

Mr. Dave Levanger
Carbon County Planning and Zoning
120 East Main Street
Price, Utah 84501

Mr. Roger Wheeler
Blackhawk Coal Company
Director Land Management
700 Morrison Road
Gahanna, Ohio 43230-6642

Mr. Gary Harwood
Helper City
P.O. Box 221
Helper, Utah 84526

Carbon County Commissioners
120 East Main Street
Price, Utah 84501

PRWID
265 South Fairgrounds Road
Price, Utah 84501

Mr. Michael Stiewig
Field Manager
Bureau of Land Management
125 South 600 West
Price, Utah 84501

Mr. Reed L Martineau
Park Ventures and C-Canyon, LC
5458 Merlyn Dr.
Salt Lake City, Utah 84117

ATTACHMENT 3

BOND RELEASE CALCULATIONS

Willow Creek Bond
Before and After Crandall Canyon Phase I Release

Bond Summary	Before Crandall Canyon Phase I Bond Release	Crandall Canyon Phase I Bond Release	After Crandall Canyon Phase I Bond Release
Mine Facilities Area	$289,514	$0.00	$289,514
Preparation Plant Facility Area	$571,000	$0.00	$571,000
Gravel Canyon	$63,600	$0.00	$63,600
Crandall Canyon	$1,251,000	$750,600	$500,400
Total Bond	$2,175,114	$750,600	$1,424,514

Crandall Canyon Phase I Bond Release request is 60% of the Crandall Canyon portion of the Willow Creek Bond as allowed for per R645-301.880.310

3

As of: June 30, 2009

COAL BONDS

NAME Of Project Permit Number	Disturbed Surface Acres	Present Bond Amount (Year Dollars)	Type of Bond Posted	Principal Holder* (Best's Rating) 2007	Year Date Posted (Ridered)	Cost per Acre	Comments
Plateau Mining Corp. Willow Creek Mine C/007/038	71.44	$2,175,114 (2004)	Surety	Travelers Casualty & Surety Ins. Co. #104329367 (A+)	07/01/99 (07/20/06)	$16,367	Permit issued 4/23/96. Three replacement bonds submitted and accepted on 7/1/99, ($3,983,069 each, $11,949,205 total). Temporary cessation on 12/11/00. Ridered on 1/21/02 from $11,949,000 to $7,866,000 due to more detailed reclamation costs. Permanent cessation on 9/6/2002. Reclamation Agreement resigned on 6/5/03. The three bonds with St. Paul Fire and Insurance, Travelers and Insurance Company of the State of PA were released, effective July 30, 2004 – replaced with one Travelers bond in the amount of $7,866,000. Reduced to $7,770,600 on March 20, 2006 (Gravel Canyon Phase I bond release). Reduced to $4,410,114 (bond release of $$3,360489) on July 20, 2006 for phase I (overland conveyor) and phase III (mine facilities). Reduced to $2,275,114 (bond release of $2,135,000) on September 20, 2006 for phase I (refuse pile and Barn Canyon shaft) and phase III (prep plant). $2,275,114 remaining. Authorized to reduce by $100,000 as a result of removing the Barn Canyon Shaft. New amount $2,175,114.

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Synopsis: Willow Creek Mine Bond History

3 bonds @ $3,983,069 $11,949,205
7/1/99
Reduced to $7,866,000
Due to More Detailed
Reclamation Costs 1/21/02

3 bonds Released 7/30/2004
Replaced with
One Travelers Bond @ $7,866,000

Bond Release 3/20/2006 $7,770,600
Gravel Canyon Phase I
Amount Released ($95,400)

Bond Release $3,360,484 $4,410,114
7/20/2006
Phase I overland conveyor
Phase III Mine Facilities

Bond Release $2,135,000 $2,275,114
9/20/2006 Phase I Refuse Pile/Barn Cyn
Phase III Prep Plant

Removal of Barn Cyn Shaft
($100,000)

$2,175,114

ATTACHMENT 4

RECLAMATION CERTIFICATION

Plateau Mining Corporation
Willow Creek Mine
C/007/0038

Phase I Bond Release on 32.96 acres of land in Crandall Canyon which is in Willow Creek Mine Permit C/007/0038.

I herby certify to the best of my information and belief all the information contained in this application for phase I bond release is true and correct and that all applicable reclamation activities have been accomplished in accordance with the requirement of the Act, the regulatory program and the approved reclamation plan.

Dennis N Ware
Print Name

[signature] Controller, 11-23-09
Sign Name, Position, Date

Subscribed and sworn to before me this 23 day of November, 2009

[signature]
Notary Public

My Commission Expires: 6-30, 2013
Attest: State of Utah
County of Emery

Notary Public
RUANNE LEEFLANG
Commission #579452
My Commission Expires
June 30, 2013
State of Utah