C/015/009 Incoming

Canyon Fuel Company, LLC
A Subsidiary of Bowie Resource Holdings, LLC

#5265

Fossil Rock Mine
Rick Parkins
General Manager
225 North 5th Street, Suite 900
Grand Junction, CO 81501
(970)263-5130

October 13, 2016

Permit Supervisor, Utah Coal Regulatory Program
Utah Division of Oil, Gas and Mining
1594 West North Temple, Suite 121
PO Box 145801
Salt Lake City, UT 84114-5801

Re: Clean Copies of Abatement Action for Citation #211730, Task ID# 5265,
Fossil Rock Resources, LLC, Permit Number C/015/0009

Dear Sirs:

Please find enclosed with this letter are two copies of an amendment to the Fossil Rock Permit to address the Abatement Action for Citation #211730. The amendment includes calculations and text associated with ditches and diversions at the waste rock site.

If you have questions or need addition information please contact Vicky Miller at (435)286-4481.

CANYON FUEL COMPANY, Fossil Rock Mine

Vicky S Miller for

Rick Parkins
General Manager

Encl.

cc: DOGM Correspondence File

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APPLICATION FOR COAL PERMIT PROCESSING

Permit Change ☒ New Permit ☐ Renewal ☐ Exploration ☐ Bond Release ☐ Transfer ☐

Permittee: Canyon Fuel Company, LLC
Mine: Fossil Rock Resources, LLC **Permit Number:** C/015/0009
Title: Clean Copies of Abatement Action for Citation # 21173, Task ID# 5265
Description, Include reason for application and timing required to implement:

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 # 21173
☐ 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.

Richard Parkins
Print Name

[signature], GENERAL MANAGER, 10-4-16
Sign Name, Position, Date

Subscribed and sworn to before me this 4TH day of OCTOBER, 2016
[signature]
Notary Public
My commission Expires: 8-3, 2018
Attest: State of COLORADO } ss:
County of MESA

KATHLEEN WIDNER
Notary Public
State of Colorado
Notary ID 19944011144
My Commission Expires Aug 3, 2018

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining
		RECEIVED OCT 14 2016 DIV. OF OIL, GAS & MINING

Form DOGM- C1 (Revised March 12, 2002)

APPLICATION FOR COAL PERMIT PROCESSING
Detailed Schedule Of Changes to the Mining And Reclamation Plan

Permittee: Canyon Fuel Company, LLC
Mine: Fossil Rock Resources, LLC **Permit Number:** C/015/0009
Title: Clean Copies of Abatement Action for Citation # 21173, Task ID#5265

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.

Add	Replace	Remove	DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐	☒	☐	Waste Rock Site Binder, Volume 4
☐	☒	☐	Chapter 4, TOC
☐	☒	☐	Chapter 5, Pages 8 thru 10
☐	☒	☐	Chapter 7, TOC, Pages 6 thru 9
☒	☐	☐	Chapter 7, Appendix C-1
☐	☒	☐	Plate 4-12

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.

October 13, 2016

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Form DOGM - C2 (Revised March 12, 2002)

Chapter 4 – Land Use and Air Quality

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To minimize erosion on the road bed the road cross-section was sloped 1% toward the roadside ditch (refer to Exhibit I). Roadside ditches have been provided along the entire length of the road to channel runoff into the cross culverts. Sediment controls, i.e. straw bales and/or silt fences perpendicular to the flow have been placed at no more than 200 foot intervals to prevent additional sediments from entering the natural channel.

All drainage culverts are designed to safely pass the 10 year, 6 hour precipitation event without a buildup of head water at the inlet. The inlet of all culverts has been provided with a rock rip-rap headwall to protect against erosion. The culverts have a minimum of 12 inches of compacted cover and have been installed in line with the natural drainage channel. Refer to Plate 4-4 for location of all culverts and R645-301-700 Hydrology, Appendix C and C-1 for calculations.

Operation and Maintenance

On an as needed basis, as the road surface deteriorates due to usage and weather, a blade will be used to recontour the travel surface of the road. The rills and gullies will be backfilled and a smooth surface will be developed with side slopes of 1%. Road base gravel will be added to the surface as needed.

The ditches along the access road will be maintained at the same time as the road surface. A blade will be used to clean sediment and debris from the ditch. In areas where excessive erosion occurs, rock rip-rap will be placed to help control it.

The inlet and outlet works of all culverts will be maintained as needed. Any debris clogging these structures will be removed. Rock rip-rap will be used to control erosion. Any erosion that occurs on the fill or cut slopes will be repaired by either backfilling or in those cases where a small channel has developed, due to drainage concentration, a rip-rap channel will be established.

The silt fences along the toe of the road fill sections or in the roadside ditches will be cleaned of sediment accumulation by backhoe or hand methods. This material will be either used to backfill rills and gullies or disposed in the waste rock site.

Waste Rock Storage Facility Design

The facility is designed to fit into the existing topography of the area with as little disturbance as is possible to the existing drainage system. Only one ephemeral drainage channel required a permanent diversion for the construction and operation at the facility. At completion, only 15.82 acres have been disturbed. A sediment pond designed and constructed as part of the facility catches and treats all the runoff from the site before releasing it back into the natural channel (refer to R645-301-700, Appendix C). The construction, operation, and reclamation of the facility will occur in the following sequence:

1. Installation of sediment control (i.e. silt fence, straw bales, etc.) prior to initial disturbance.
2. Construction of access road.
3. Initial construction of Waste Rock Storage Facility, including the topsoil and subsoil

stockpiles, sediment pond dam and the initial diversion ditch. Construction date: June 1990.

4. Installation of silt fences at the base of soil stockpiles.
5. Construction of the perimeter fence.
6. Interim revegetation of soil stockpiles and road cut and fill slopes.
7. Placement of underground development waste and sediments, and construct perimeter berms.
8. Cover perimeter berms with soil and revegetate.
9. Construction and maintenance of diversion ditches to be ongoing for the duration of the facility's utilization.
10. Contemporaneous reclamation of outside slopes of berms.
11. Construction of permanent diversion around waste rock site into sediment pond.
12. Monitoring and cleaning of sediment pond as required.
13. Two years after seeding of outslopes and completed filling of the waste rock pile, reclaim top of pile according to plan, remove of sediment pond, and regrade of access roads begins.
14. Monitoring of revegetation efforts for bond release.

Waste Rock Storage Facility Drainage Control

The drainage of the Waste Rock Storage Facility is confined to a single ephemeral stream at the bottom of a small valley. There is 15.3 acres of undisturbed land which normally drains through the valley that's diverted around the waste pile. This undisturbed runoff and the runoff from 15.82 acres of disturbed land are diverted into a sediment pond where it is retained to remove suspended solids prior to release into the natural channel. Alternative sediment control areas (ASCA) on the outside slopes of the soil stock piles consisting of 0.9 acres are treated through use of silt fences and straw bales. (refer to Area 1D, Plate 4-2.)

<u>Initial Construction</u>

The initial construction of the Waste Rock Storage Facility included the construction of the sediment pond and stripping and stockpiling of the topsoil and subsoil and construction of the initial diversion ditch on the west side of the valley. This diversion ditch was designed to convey the runoff from a 100 year, 6 hour storm event in a V-ditch with a 2% channel slope. This gentle slope keeps the velocity below 5 feet per second to minimize erosion. As the waste material pile grows and encroaches upon the initial diversion ditch and against the western and northern slopes, approximately 10" of soil material will be salvaged across the slopes. The ditch will be reconstructed at the toe of the waste pile to the same specifications as the initial ditch. Interim control of drainage on the surface of the pile will slope in a southwesterly direction. Runoff from the surface of the pile will discharge in a controlled manner into ditch DA and then to the sediment pond as shown on Drawing CM-10877-WB, Plate 4-14. Should water accumulate in depressions on the surface of the waste material, to a level which may affect the stability of the waste pile, this water will be pumped to the sediment pond. When the active surface of the refuse pile reaches an elevation of approximately 6,795 feet, drainage control will be as the following describes. The western diversion ditch, labeled DA on Plate 4-5, drains the upland undisturbed areas, the top of the waste pile, the west slope of the waste pile and the top and inside slope of the topsoil pile. The eastern diversion ditch (DB) drains the east slope of the waste pile and top and inside slope of the subsoil stockpile. The total runoff to be collected into the sediment pond is 2.17 acre feet for the 10 year, 24 hour storm event. The estimated annual sediment production for the site is 1.65 acre feet. The actual design of the sediment pond provides 4.58 acre feet of storage so that there is 2.41 ac. ft. of sediment storage available. The spillway for the sediment pond safely passes runoff from a 25 year, 6 hour storm event with the required one foot freeboard. Refer to R645-301-700 Hydrology, Appendix C and C-1 for all hydrological calculations.

The outside slopes of the two soil stockpiles have silt fences constructed at their bases to treat the runoff from precipitation and are designated as alternate sediment control area 1D, Plate 4-2. Interim revegetation was accomplished as soon as practical after construction to stabilize the slopes.

As needed the ditches and diversion will be re-established/cleaned using equipment suited to the task. Due to the limitations associated with access to ditches DA and DB, their proximity to the undisturbed area boundary and refuse pile slopes the cleaned ditches will resemble a box shape. Eventually the ditches will take on various geometric shapes as the unconsolidated native and fill material reach their natural angle of repose. The ditches will be re-established/cleaned in a manner to convey runoff to the sediment pond, with appropriate flow capacities as required by the permit.

Supplemental information has been added in Appendix C-1, Figure 2 provides additional configurations for Ditch DA. A trapezoidal ditch as permitted has been drawn inside the outline of the various ditch shape having the potential to occur as the box ditch obtains its natural angle of repose.

Monitoring of these drainage controls will be on a regular basis and maintenance will be scheduled as needed to ensure that they operate as designed. The ditches and silt fences will be cleaned, repaired and reshaped with a backhoe or hand methods as appropriate.

Waste Rock Storage Facility Placement and Handling of Materials

During the operation of the mine, certain waste products are generated that are not part of the coal product, they include; underground development waste, trommel screen reject, and sediment from the pond and drainages. The fill of the disposal site comprises of material that will be permanently stored within the Waste Rock Storage Facility.

Topsoil

After the vegetative material was removed from the site the topsoil was stripped and stockpiled as shown on Plates 4-4 and 7-2. Stripping areas and depths were staked to facilitate topsoil excavation. Care was taken to avoid unnecessary compaction of the topsoil material. Following soil placement, the stockpile was planted with an interim seed mix (refer to R645-301-300 Biology).

Subsoil

Following removal of the topsoil material the remaining material needed for the subsoil stockpile was excavated to the lines and grades specified on the cross-sections. The material was placed, leveled and compacted in 12" maximum lifts. Rocks larger than the lift thickness was worked into the fill to avoid forming voids. Those rocks that make good rip-rap and were

Chapter 7 - Hydrology

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Storage Facility include the access road and the subsoil pile. Refer to Plate 4-2 for location of ASCA areas with this site. Also refer to Appendix C and C-1 for the design of drainage control structures.

R645-301-747 Disposal of Non-Coal Mine Waste

Inherently, non-coal mine waste finds its way into the coal produced from the underground mining process. This waste is transported out of the mine with the produced coal. During breaking and screening (sizing) of the coal product, coal mine waste (refuse) is removed and separated from the final coal product. This waste stream is transported to the Waste Rock Storage Facility for permanent disposal.

As required by R645-301-528.330, non-coal wastes including, but not limited to, grease, lubricants, paints, flammable liquids, garbage, and other combustible materials generated during mining activities will be disposed of in a solid waste disposal area. Non-coal wastes found in the storage pile are removed prior to permanent placement of the material. The non-coal waste is temporarily stored at the site until such time it can be transported off-site to a proper solid waste disposal site.

R645-301-748 Casing and Sealing of Wells

The water well located at the Waste Rock Storage Facility shall be cased, sealed, or otherwise managed, as approved by the Division, to prevent acid or other toxic drainage from entering ground or surface water, to minimize disturbance to the hydrologic balance, and to ensure the safety of people, livestock, fish and wildlife, and machinery in the permit and adjacent area.

The well has been provided with a steel casing and cemented in place at the surface. A lockable end cap is installed to prevent unauthorized access to the well.

R645-301-750 Performance Standards

Coal mining and reclamation operations will be conducted to minimize disturbance to the hydrologic balance within the permit and adjacent areas, to prevent material damage to the hydrologic balance outside the permit area and support approved post-mining land uses in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302. For the purposes of SURFACE COAL MINING AND RECLAMATION ACTIVITIES, operations will be conducted to assure the protection or replacement of water rights in accordance with the terms and conditions of the approved permit and the performance standards of R645-301 and R645-302.

R645-301-751 Water Quality Standard and Effluent Limitations

Discharges of water from areas disturbed by coal mining and reclamation operations will be made in compliance with Utah and federal water quality laws and regulations and with effluent limitations for coal mining promulgated by the U.S. Environmental Protection Agency set forth in 40 CFR Part 434.

If the site receives a storm greater than the designed capacity of the sediment pond, discharge from the sediment pond will be routed through the designed emergency spillway and into the ephemeral drainage. Discharge from the sediment pond would constitute an emergency situation and comply with State of Utah Department of Environmental Quality Division of Water Quality storm water regulations.

R645-301-752 Sediment Control Measures

Sediment control measures will be located, maintained, constructed and reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-760 (refer to Appendix C and C-1: Drainage Control Plan for design, construction and maintenance of sediment controls for the Waste Rock Storage Facility).

At reclamation of the Waste Rock Storage Facility, pocking (or surface roughening) will be used to intercept and trap sediment on a microscale. Roughening also collects moisture, which improves vegetation establishment and consequently prevents erosion. Pocking is highly recommended for moderate to steep slopes (up to 1h:1½v) but is also useful for flat or gently sloping areas with erosive soils and arid climates. Pocks are created by the use of a track-hoe shovel to dig, poke, or push basins with a minimum depth of eighteen inches. These basins should be 1 ½ to 2 feet deep and have the width of the bucket. This allows the basins to be up to four feet wide. The most common construction method is to dig a bucket load of soil and then drop it 2 to 3 feet above the soil surface. Repeat this process in a random and overlapping pattern, making it impossible for water to flow down slope.

Sediment control shall be maintained as runoff will be limited or eliminated by ponding water within the pocks. To illustrate the effectiveness of the pocks for controlling erosion and sedimentation, the revised universal sediment loss equation is used in a modeling program as discussed below (UDOGM, Practical Guide to Reclamation in Utah, pg 106).

Justification to control runoff is made by utilizing the computer program RUSLE2. This program solves a set of mathematical equations that compute values for rill and inter-rill erosion on the overland portion of the landscape. The user inputs variables to describe the site conditions such as climate, topography, soils, management practices, etc. to compute estimates for soil loss within the site.

Three areas were modeled using RUSLE2. These areas are the reclaimed berms of the refuse pile, the reclaimed top of the pile, and the reference area immediately north of the pile. The reference area was chosen because it is a main contributor of sediment near the site.

Variables used are those listed in the database files of the RUSLE2 program version 2.0.4.0. Not all variables are directly representative (i.e. location) of the site conditions; however they were similar to the conditions found at the site.

Results of the modeling calculations showed that sediment contributions from the pile are 0.23 t/ac/yr (top of reclaimed pile) and 0.16 t/ac/yr (reclaimed berms). The soil loss eroded portion of the reclaimed berms computed a 2.6 t/ac/yr. However, because of how terraces are constructed on the berms during reclamation, the program credits for deposition of sediment.

The reference area calculations (or soil loss from areas out of the permit area) showed sediment contributions of 16 t/ac/yr. The yield from this area is appreciably more than the sediment contributions from the reclaimed area. Therefore, a case is made that shows there will be no additional contributions of suspended solids to areas outside of the permit area than what naturally exist. Refer to Exhibit XXII to review the Erosion Calculation Worksheets.

752.100 Siltation structures and diversions are located, maintained, constructed and will be reclaimed according to plans and designs given under R645-301-732, R645-301-742 and R645-301-763.

752.200 Road Drainage. Roads are located, designed, constructed, reconstructed, used, maintained and will be reclaimed according to R645-301-732.400, R645-301-742.400 and R645-301-762 and to achieve the following:

752.210 Control or prevent erosion, siltation and the air pollution attendant to erosion by vegetating or otherwise stabilizing ~~all~~ exposed surfaces in accordance with current, prudent engineering practices;

752.220 Control or prevent additional contributions of suspended solids to stream flow or runoff outside the permit area;

752.230 Neither cause nor contribute to, directly or indirectly, the violation of effluent standards given under R645-301-751;

752.240 Minimize the diminution to or degradation of the quality or quantity of surface- and ground-water systems; and

752.250 Refrain from significantly altering the normal flow of water in streambeds or drainage channels.

R645-301-753 Impoundments and Discharge Structures

Impoundments and discharge structures have been located, maintained, constructed and will be reclaimed to comply with R645-301-733, R645-301-734, R645-301-743, R645-301-745 and R645-301-760. The sediment pond will be reclaimed no sooner than two years after the last augmented seeding of the reclaimed berms and soil storage pile locations.

R645-301-755 Casing and Sealing of Wells

All wells will be managed to comply with R645-301-748 and R645-301-765. The water well will be cased, sealed, or otherwise managed, as approved by the Division.

R645-301-760 Reclamation

Before abandoning a permit area or seeking bond release, the permittee will ensure that temporary structures are removed and reclaimed, and that sedimentation ponds, diversions, impoundments and treatment facilities meet the requirements of R645-301 and R645-302 for permanent structures, have been maintained properly and meet the requirements of the approved reclamation plan for permanent structures and impoundments. The permittee will renovate such structures if necessary to meet the requirements of R645-301 and R645-302 and to conform to the approved reclamation plan. For complete discussion related to the reclamation plan for the Waste Rock Storage Facility refer to R645-301-500 Engineering, and Plates 4-7 and 4-12 in the Maps Section.

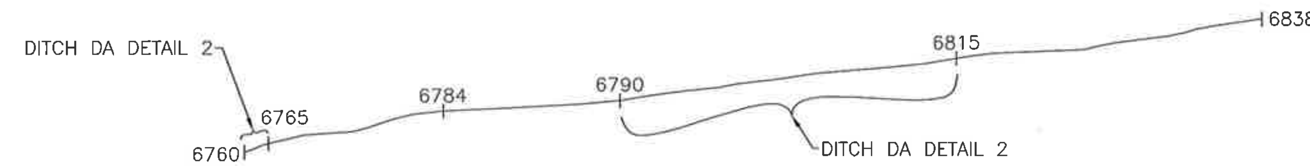
R645-301-763 Siltation Structures

It is planned for the sediment pond to be removed during the reclamation of the Waste Rock Site as outlined in R645-301-540. State and Federal regulation require such structures to remain for at least two years after the last augmented seeding unless removal is authorized by the Division. For the Division to authorize removal a case must be made by the permittee that removal of the siltation structure will not contribute additional suspended solids to stream flow or runoff outside the permit area.

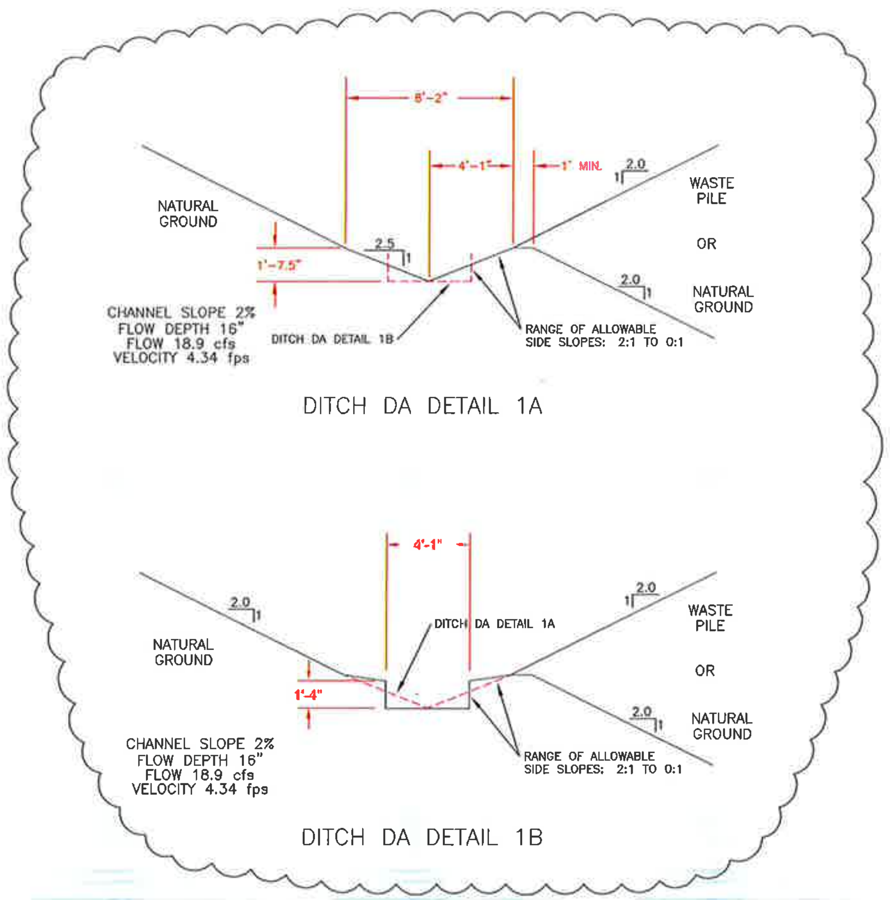
R645-301-765 Permanent Casing and Sealing of Wells

When no longer needed for monitoring or other use approved by the Division upon a finding of no adverse environmental or health and safety effects, the water well shall be abandoned and provided a watertight barrier to the migration of water in the well bore, in the annular spaces or in fractures and openings adjacent to the well bore. Well abandonment shall be conducted as approved by the Division.

FINAL RECLAMATION PROFILE OF DIVERSION DITCH DA
SCALE: 1"=50'

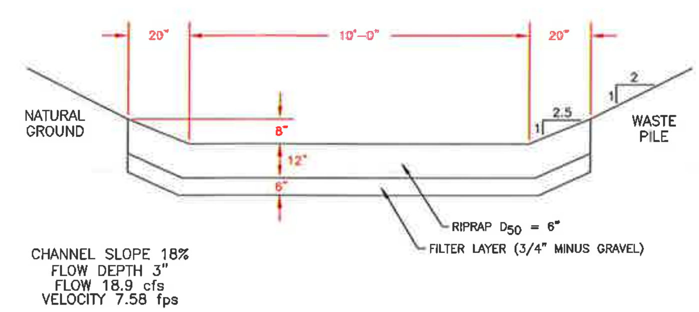


FINAL RECLAMATION PROFILE OF DIVERSION DITCH DB
SCALE: 1"=50'

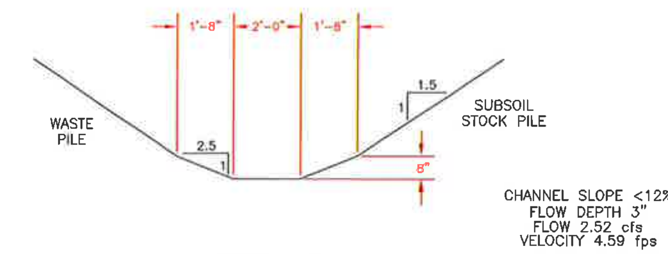


DITCH DA DETAIL 1A

DITCH DA DETAIL 1B



DITCH DA DETAIL 2



DITCH DB

INCORPORATED
OCT 20 2016
Div. of Oil, Gas & Mining

CAD FILE NAME/DISK#: CM-10830-WB.DWG
4-12

Fossil Rock Resources, LLC
Fossil Rock Mine

FOSSIL ROCK MINE
WASTE ROCK STORAGE FACILITY
DIVERSION DITCH PROFILES & CROSS SECTIONS

DATE	REVISIONS	BY	CHK
8-16-16	ADDITIONAL DETAILS FOR DITCH DA	ABE	
1-27-15	CONVERTED DRAWING TO THE TEAL MOUNTAIN PERMIT AND REMOVED REFERENCE TO THE COTTONWOOD PERMIT	KJL	
1-13-14	UPDATED UTILIZING AEROQUEST TOPOGRAPHY LINES DATA		
1-4-93	REVISED DIVERSION DITCH DA AND DB PROFILES TO REFLECT FINAL RECLAMATION	KJL	

DRAWN BY: A. ETTER
SCALE: AS NOTED
DATE: AUGUST 08, 2016
DRAWING #: CM-10830-WB
SHEET 1 OF 1
REV. ___

CHAPTER 7

APPENDIX C-1 – ADDITIONAL DIVERSION DITCH DETAILS

Drainage Control Design

General

The Waste Rock Storage Facility encompasses 16.9 acres of disturbed land and has an access road 1,435 feet long. Drainage along the road will be routed to four culverts which will convey storm runoff safely under the road surface and into the natural drainage channels. Runoff from the waste pile and from the 15.5 undisturbed acres of land which normally drain through the waste rock site will be diverted to a sediment pond where the water will be retained to remove suspended solids before discharging back into the natural drainage.

Sediment Pond Sizing

This section details the methods used to estimate storm runoff volume and mean sediment yield to determine the design volume of the sediment pond.

Storm Runoff Volume

Sediment ponds and other sediment treatment facilities are required to treat the runoff from a 10 year, 24 hour storm event.

The runoff depth resulting from a given rainfall event was determined using the runoff curve number technique, as defined by the USDA Soil Conservation Service (now Natural Resource Conservation Service) in 1972. According to the curve number methodology, the relationship between storm rainfall, soil moisture storage, and runoff can be expressed by the equations:

$$Q = \frac{(P-0.2S)^2}{P+0.8S} \quad (1)$$

$$CN = \frac{1000}{10+S} \quad (2)$$

Where:

Q = direct runoff depth, inches
P = storm rainfall depth, inches
S = maximum infiltration depth (defined as Q), inches; and
CN = curve number, dimensionless

Use of equations 1 and 2 requires the selection of a curve number, which is a function of vegetative cover and hydrologic soil groups. Curve numbers for the study area were selected from information provided by the USDA Soil Conservation Service (1972), by US Bureau of

Reclamation (1977), and from personal hydrologic judgment following field observation. To determine a representative curve number the 31.3 acres were divided into two nearly homogeneous subareas. The south facing slopes above 6900 feet elevation, consisting of 15.3 acres, are deteriorated shale and sandstone ledges with very little vegetative cover. The sandstone ledges are close to vertical while the shale colluvial slopes range from 1:1 to 2.5:1 with an average of about 1.5:1. Select CN of 86 based on soil type C, 10% ground cover and figure 9.6, Soil Conservation Service National Engineering Handbook Section 4, Exhibit VI. Below 6900 feet elevation, the slopes are less steep with more vegetation including the valley floor. From Figure 9.6 (Exhibit VI), select CN of 80 based in soil type C and 30% ground cover for the 16.0 acres. Therefore a weighted average CN = ((5.3 x 86) + (16.0 x 80)) / (15.3 + 16.0) = 82.9.

Equation 1 is based on the assumption that Ia = 0.2S, where Ia is the initial abstraction from storm rainfall, defined as the rainfall which must fall before runoff begins (i.e., to satisfy interception, evaporation, and soil-water storage). Therefore, determination of runoff from Equation 1 is valid only when P ≥ O.2S. Below this point, no runoff can occur. Once Q was determined from the above equation, the runoff volume was calculated by multiplying the runoff depth by the drainage area.

Values of precipitation (P) were selected for the design return periods from Volume VI-Utah of the NOAA ATLAS 2 Precipitation-Frequency Atlas of the Western United States, (Miller et.al., 1973). For P equal to 2.2 inches and weighted average curve number of 82.9, the computed runoff is 0.831 inches over 31.3 acres or 2.17 acre feet.

Mean Annual Sediment Yield

The amount of sediment to be deposited in the sediment pond was determined from the Universal Soil loss Equation from B. J. Barfield, R.C. Warner, and C. T. Haan, Applied Hydrology and Sedimentology for Disturbed Areas, Oklahoma State University, Stillwater, Oklahoma, 1981. In accordance with this equation, the annual soil loss due to precipitation related erosion is:

$$A = R \bullet K \cdot LS \cdot CP$$

where:

A = computed amount of soil loss 'in tons/acre/year
R = rainfall factor, average annual value
K = rainfall factor, average annual value
LS = topographic factor
CP = erosion control factor

The R value can be estimated from Equation 5.5, Barfield et.al.

$$R = 27 x (P_{2,6})^{2.2}$$

Where, $P_{2,6}$ is the 2 year, 6 hour precipitation inches. For the Waste Rock Site, the $P_{2,6}$ is 1.0 inches (NOAA ATLAS Volume VI). Therefore:

$$R = 27\,(1.0)^{2.2} = 27$$

The K - value was taken as 0.03 from the map presented by C. Earl Israelsen, Joel E. Fletcher, Frank W. Haws, and Eugene K. Israelsen, Erosion and Sedimentation in Utah: A Guide for Control. UWRL/H-84/03, 1984 Utah Water Research Laboratory, College of Engineering, Utah State University, Logan, Utah.

LS values are determined for each subarea of the watershed based on equation 5.10, Barefield et.al.

$$LS = \frac{(L)^m}{72.6}\,(430x^2 + 30x + 0.43)/(6.613)$$

where:

L = slope length, feet

M = exponent dependent on the slope
- if slope 3% then m = .3
- if slope = 4% then m = .4
- if slope 5% then m = .5

X = sine of the slope angle
= sin (arc tan (slope %)/100)

The CP values are also determined from Barefield, et.al., from either table 5.8 or table S.A.3.

Table 4.1 summarizes the sediment prediction calculations and references the areas depicted in the map in Exhibit XI.

TABLE 4.1

Description	Subarea ID	Area (Acres)	Length (ft)	Slope (%)	LS	CP	CP Source Table #	A* Tons/Acre/Yr	Annual Sediment Yield
Undisturbed 10% Cover No Canopy	A	14.4	800	62.5	68.8	0.32	5.A.3	178	2570
Undisturbed 10% Cover No Canopy	B	2.0	320	56.2	37.6	0.32	5.A.3	97	195
Undisturbed 30% Cover No Canopy	C	2.8	150	40	15.4	0.15	5.A.3	19	52
Reclaimed Soil Stockpile, 20% cover, No Canopy	D	1.6	100	67	26.7	0.2	5.A.3	43	69
Disturbed, Compacted	E	1.7	100	50	17.7	1.3	5.8	186	317
Disturbed, Compacted	F	6.3	500	2	0.32	1.3	5.8	3.3	21
Disturbed, Compacted	G	1.8	120	50	19.4	1.3	5.8	204	368

*A = R *x* K *x* LS *x* CP = (27) (0.3) LS *x* CP

Total = 3,592 tons/yea

The total sediment yield per year is 3,592 tons. For a density of 100 pounds per cubic foot, that relates to

3,592 tons x 2,000 lbs/ton *x* ft^3/100 lbs *x* Acre foot/43,560 ft^3 = 1.65 Ac. Ft.

Table 4.2 Sediment Pond Design

Precipitation from 10 Year 24 Hour Storm	2.2 inches
Weighted Average Curve Number	82.9
Direct Runoff	0.831 inches
Contributing Area	31.3 acres
Total Collected Runoff per Design Storm	2.17 ac ft
Annual Sediment Production	3,592 tons/year
Total Volume of Annual Sediment	1.65 ac ft
Combined Total Required Pond Volume 2.17 + 1.65	3.82 ac ft
Design Volume of Pond	4.58 ac ft
Additional Sediment Volume Provided (4.58 – 3.82)	0.76 ac ft
Design Sediment Volume (1.65 + 0.76)	2.41 ac ft
Clean out required at 60% of annual sediment production plus Additional sediment volume provided (60% x 1.65) + 0.76	1.75 ac ft

Refer to Exhibit XX Sediment Pond Storage – Capacity and Stage – Discharge Curves.

Spillway Design

A single, non-erodible open channel spillway will be provided to safely discharge from the impoundment without damage to the dam. The peak flow calculated for the 100 year, 6 hour storm event (refer to the section entitled "Peak Flow Determination" below) was 22.13 cubic feet per second. The channel will be concrete lined with random exposed rocks for roughness to achieve a Manning's N value of 0.030 (Chapter 4, State Department of Transportation, Manual of Instruction, Part 4, Road Way Drainage, 1984). The slope of the channel across the 15 foot wide crest is 5%. Manning's equation is used to determine the depth of flow and channel geometry. A six foot wide channel with 2:1 side slopes results in a design depth of six inches. The channel will be continued down the slope of the dam and discharge into the natural channel.

General

Temporary diversions will be constructed at the base of the valley side slopes to collect the runoff from the undisturbed areas and convey it to the sediment pond. As the waste pile grows and expands to cover the initial diversion ditch, new diversions will be constructed to convey the collected runoff to the pond. This process will be repeated until the waste pile reaches its maximum size in plan view and the ditches will not be moved thereafter. (Refer to Exhibit IV) Upon final reclamation, the ditches will become permanent diversions of the natural ephemeral drainage channel.

Sub-Area Divisions

The Waste Rock Storage Facility is divided into four subareas for hydrologic calculations based on the route that runoff takes to enter the sediment pond. (Refer to Map 4-2) The first area, 1A, includes the largest portion of the disturbed area consisting of the top and western slope of the waste pile, the inside slope and top of the topsoil stockpile and the undisturbed areas above the site which will also drain into the sediment pond. The ditch for this area, DA, will be constructed on a 2% slope until it reaches the last 355 feet before the sediment pond. The slope will then change to 18%. The total area to be drained by this ditch is 26.4 acres.

The second area, 1B, totaling 3.4 acres, consists of the eastern slope of the waste pile, the road to the top of the waste pile, and the inside slope and top of the subsoil stockpile. The ditch, DB, will be constructed on grades of 2.5% and 12% until it reaches the sediment pond.

Area 1C consists of the slopes above the sediment pond and the pond itself where runoff will flow directly into the pond without ditches. This area totals 1.6 acres.

The last area, 1D, consists of 0.9 acres including the outside slopes of the two soil stock piles and the dam. Runoff from these areas will not be collected in the sediment pond. Treatment of these areas will be by silt fences and straw bales.

Peak Flow Determination

A unit hydrograph program by Richard Hawkins and Kim Marshall, "Storm Hydrograph Program" Utah State University, 1974, was used to model the rainfall and resulting runoff. The model *is* based on the Soil Conservation Service rainfall runoff function, also called the curve number equation. As such, a curve number was determined for each sub-area along with a time of concentration. See Exhibit 10, Tables 1-A and 1-B for hydrograph results.

Curve numbers were derived based Conservation Service National Engineering Handbook, Section 4 - Hydrology, Chapters 7, 8, and 9.

Time of concentration was based on two methods. For the flow from the undisturbed area, the following relationships from Barfield et.al., were used:

$t_c = t_{l/.6}$

t_c = time of concentration, hours
t_l = lag time, hours
$t_l = L^{0.8} (S+1)^{0.7} / (1900 \times y^{0.5})$
L = hydraulic length, feet
S = (1000/curve number - 10)
Y = slope in percent

For subarea 1A, the first portion of the travel time for the runoff from the highest point in the subarea to the diversion ditch is 0.0796 hours, or 4.78 minutes, based on a length of 1350 feet, CN = 83 and an average slope of 59%.

The second portion consists of the time required to travel in the ditch to the pond. Manning's equation was used to derive a value for the velocity of the flow in the ditch. Assuming a flow rate of 20 cfs and a V-ditch with 2.5:1 side slopes and channel slope of 2%, Manning's n = 0.035, the velocity was determined to be 4.40 feet/second. The length of the ditch is 1300 feet which gives a travel time of 4.92 minutes. Therefore, the total time of concentration is 4.78 + 4.92 or 9.7 minutes.

The t_c for subarea 1B was similarly determined from 185 feet of overland flow at 50% slope and CN=82 to yield an initial travel time of 0.0182 hours or 1.09 minutes. The travel times for the two foot wide trapezoidal ditch estimated as follows:

1.5 cfs; 400 feet at 2.5% slope = 2.3 fps= 2.90 minutes
2.5 cfs; 320 feet at 12 % slope = 4.6 fps= 1.16 minutes
3.0 cfs; 170 feet at 7.5% slope = 4.1 fps= 0.69 minutes
Total ditch travel time = 4.75 minutes

Therefore the t_c for the Area 1B equals 5.84 minutes.

Peak flows from Area 1C were determined based on assuming 100% of the rainfall went directly to the pond. The peak flows for the ditches occurred at 2.52 hours when the rainfall intensity was 0.22 inches in 30 minutes or 0.0073 inches/minute. This resulted in a peak flow of:

$$1.6\ acres\ x\ \frac{0.0073\ inches}{minute}\ x\ \frac{43{,}560\ ft2}{acres}\ x\ \frac{1\ minute}{60\ second}\ x\ \frac{1\ foot}{12\ inches} = 0.71\ cubic\ feet/second$$

Table 4-2.1: Diversion Peak Flow Rates

	Acres	Curve No.	Time of Concentration	Peak Flow
1A	26.3	82.6	0.162 hrs	18.9 cfs
1B	3.4	82	0.0973	2.52
1C	1.6	-		0.71
1D	0.9	-		
Total	**32.2 acres**			**22.13 cfs**

(Peak flows based on 100 year, 6 hour storm event of 2.2 inches)

Each ditch was designed to keep the velocity below 5 feet per second in order to prevent erosion. Due to the stability characteristics of the native soils Ditch DA is designed to be constructed and maintained in unconsolidated material. The ditch may evolve into a cross-sectional shape somewhere between the V-ditch or trapezoidal ditch configurations with minimum and maximum side slopes of 2:1 and 0:1 (vertical), respectively. See Plate 4-12. At all times the ditch will be able to pass the design flows. This ditch configuration will remain for the entire length until it approaches the pond where the slope increases from 2 to 18%. At that point, a wide trapezoidal ditch will be used with a rip-rap lining. Ditch DB will be a narrow trapezoidal ditch for its entire length. Both ditches will be monitored throughout the life of the facility for erosion and formation of gullies. If erosion does occur with the ditches, the applicant will repair any gullies and install velocity controls (i.e. rip-rap, gabions, etc.) as needed to correct the problem.

Rip-rap sizing for the steep section of ditch DA was taken from Utah State Department of Transportation Manual of Instruction, Part 4, Roadway Drainage, Section 4-610.30, Stable Channel Design. Using a stone diameter of 0.5 feet, Manning's n = 0.0305 from fig. 3-28, Utah DOT MOI Part 4 (Exhibit VII), the calculated depth of the flow is less than the stone diameter so use velocity against stone equal to the average velocity. (Exhibit VIII) Then entering the calculated velocity of 7.58 fps in fig. 3-30 (Exhibit IX) the required stone size for 2.5: 1 side slope is confirmed at the assumed size, i.e. 0.5 feet diameter for D_{50}.

Ditch DA (Plate 4-12)

- V-ditch, 2.5:1 side slopes, 2% channel slope, Manning's n = 0.035, peak flow 18.9 cfs, depth 1.32 feet, velocity 4.34 feet/second.
- Trapezoidal, 4.1 foot bottom with, vertical side slopes, Manning's n = 0.035, peak flow 23.1 cfs, depth 1.15 feet, velocity 4.90 feet/second.
- Trapezoidal, 10 foot bottom width, 2.5:1 side slopes, 18% channel slope, Manning's n = 0.0305, peak flow 18.9 cfs, depth 0.235 feet, velocity 7.58 feet/second, rip-rap D50 size = 0.5 feet.

Ditch DB (Plate 4-12)

- Trapezoidal, 2 foot bottom width, 2.:1 side slopes, 12% channel slope, Manninng's n = 0.035, peak flow 2.52 cfs, depth 0.217 feet, velocity 4.59 fps.

Combined Ditch A and B (after final reclamation and removal of sediment pond)

- Trapezoidal, 10 foot bottom width, 3:1 side slopes, 2.1% channel slope, Manning's n = 0.035, peak flow 22.1 cfs, depth of flow 0.52 feet, depth of ditch 1.0 feet, velocity 3.61 feet/second.

CURVE NUMBER DETERMINATION FOR DIVERSION PEAK FLOW CALCULATION

Area 1A

15.3 Acres Undisturbed

Sage Grass, 10% Cover, Soil Type C

CN = 83 SCS NEH-4 fig 9.6 (Exhibit VI)

11.0 Acres Disturbed

Waste rock pile consisting of soils with moderate infiltration rate, deep and well drained with moderate fine to moderate coarse texture use Soil Type B, NO Cover, Dirt Roads

CN = 82 NEH-4 Table 9.1

Weighted Average CN =

(15.3 (83) + 11.0 (82)) / (15.3 + 11.0) = 82.6

Area 1B

Use CN = 82 as above for disturbed area with No Cover.

Access Road Drainage

The access road will cross several natural ephemeral drainage channels and will require culverts to convey the runoff underneath the road surface. The drainage areas for each culvert have been marked on Map 4-2 and numbered 2 through 5. (Area 1 is the waste rock storage site and the undisturbed area which naturally drains through the site.) Peak flows were determined in the same manner as was used for the diversions in the previous section. Table 4-3 gives the parameters used to determine peak flows and culvert sizing. See Exhibit 10, Tables 2 through 5 for hydrograph results. Refer to Exhibit XIX for culvert outlet protection and trash racks.

Application to Alter a Natural Stream Channel

See following page.

STATE OF UTAH
NATURAL RESOURCES
Water Rights

Norman H. Bangerter, Governor
Dee C. Hansen, Executive Director
Robert L. Morgan, State Engineer

Southeastern Area • 453 S. Carbon Avenue • P.O. Box 718 • Price, UT 84501-0718 • 801-637-1303

April 3, 1990

UP&L Mining Division
Attn: Val Payne, Senior Environmental Engineer
P.O. Box 310
Huntington, Utah 84528

Dear Val:

Pursuant to the requirements set forth in Section 73-3-29 (Natural Stream Channel Alteration) Utah Code Annotated, 1953, a field examination of the proposed Wilberg Waste Rock Site was completed on March 30, 1990. Upon review of the designed channel crossings, it was concluded that the existing channels are, at best, ephemeral in nature and are not supportive of a riparian type habitat. Further, installation of the drainage controls (culverts) and ancillary site construction should not adversely impact the immediate drainage areas. Therefore, application to alter a natural stream channel is hereby waived.

In regards to construction of monitor wells, applications should be submitted to this office prior to drilling. I have enclosed several application forms for your use, which should incorporate any existing as well as proposed monitor wells. Please be advised that all wells must be constructed by a licensed well driller of the State of Utah.

In addition, I have included Administrative Rules for Well Drillers and Stream Channel Alterations as requested. If I can be of any further assistance, please feel free to contact me at your convenience.

Sincerely,

William A. Warmack

William A. Warmack
Assistant Area Engineer

Enclosures
WAW/mjk

Table 4.3: Access Road Culvert Sizing

Area #	Acres	Hydrologic Length	Slope (%)	Curve Number	Time of Conc. (hrs)	Peak Flow (cfs)	Culvert Diameter (in)	Culvert Capacity (cfs)	Minimum Culvert Slope (%)
2	2.21	420	37.4	80	0.0433	0.589	12	2.3	0.5
3	25.14	2630	34.6	80	0.195	5.08	24	13	0.5
4	4.18	915	8.6	73	0.207	0.186	12	2.3	0.5
5	33.97	3260	29.3	80	0.252	6.21	24	13	0.5

Earth Dam Design

The earth dam is analyzed for stability using a computer program, Rotational Equilibrium Analysis of Multilayered Embankments, by Yang H. Huang. (Exhibit XII) Both the simplified Bishop method and the normal method of slices are used to determine a factor of safety based on a cylindrical failure surface. The method allows a variety of conditions to be analyzed including both static and seismic loading and seepage through the earth dam. A piezometric surface is specified along with the geometry of the dam as input for the program. Soil data includes density, angle of internal friction, cohesion, depth and thickness of each layer.

The factors of safety are determined for a number of points forming a grid pattern above the slope. A routine within the program automatically searches for the minimum factor of safety between the grid points and displays the location of the center and gives the radius and the most critical factor of safety.

The analysis of stability is based on the method of slices which assumes the failure surface is cylindrical and the earth mass rotates about some center point located above the slope. The sliding mass is divided into separate slices, each slice being acted upon by a set of forces. The weight of the soil in the slice acts to cause the soil to move. This is the driving force of the slope failure. The resisting force is the sum of the shear and cohesion acting along the failure surface. The factor of safety is the ratio of resisting forces to the driving force.

$$SF = \frac{\sum_{i=1}^{n}(\bar{c}\,Li + \bar{N}i\tan\overline{\emptyset})}{\sum_{i=1}^{n}(Wi\sin\theta i)}$$

Where:

SF	=	Factor of Safety
n	=	Number of slices
$\bar{c}$	=	Effective cohesion
Li	=	Length of *ith* slice at the failure surface
$\bar{N}i$	=	Effective normal force at the failure surface
$\overline{\emptyset}$	=	Angle of internal friction of the soil
$\bar{N}i$ Tan	=	Shear strength of the soil
Wi	=	Weight of *ith* slice
θ	=	Angle of inclination of the *ith* slice

Equation 2.7, Yang H. Huang, STABILITY ANALYSIS OF EARTH SLOPES, Van Nostrand Reinhold Co., 1983.

The normal method of slices assumes the resultant of all forces on the vertical sides of the slice is zero in the direction normal to the failure arc for that slice. This method is usually conservative in comparison to other stability methods. The simplified Bishop method assumes the resultant of the forces on the sides of the slice is zero in the vertical direction. This produces an equation for the safety factor as follows:

$$SF = \frac{\sum_{i=1}^{n}[\bar{c}\,Li + (Wi - UiLi)\,tan\bar{\theta}][\frac{1}{Mi(\theta)}]}{\sum_{i=1}^{n} Wi \sin \theta i}$$

Where *Ui* = Pore pressure = depth from phreatic surface x density of water

$$Mi\;(\theta) = Cos\;\theta i\;[1 + \frac{\tan \emptyset}{SF}]$$

All other parameters described above.

Equation 24.12, T.W. Lambe and Robert V. Whitman, SOIL MECHANICS, John Wiley and Sons, 1969.

Because the equation contains the expression for safety factor on both sides, the solution is a trial and error procedure.

The earth dam is analyzed under three conditions of loading: (1) full reservoir and steady - state seepage, (2) full reservoir with seismic loading, and (3) rapid draw down. Soil layer strength parameters are obtained from the geotechnical investigation performed by Rollins, Brown and Gunnell, Inc. dated 7 September, 1989 (See Geotechnical Report R645-301-500 Engineering, Appendix A). Strength parameters for the dam embankment were determined by the same firm and dated 29 September, 1989 (refer to this report within the Geotechnical Report page number 4-62). The location of the phreatic surface was determined from Figure 4.3, Huang, a chart for determining the point of exit of the phreatic surface from the earth slope. (Exhibit XIII) The seismic coefficient of 1.13 was taken from Table 2.2, Huang, for Zone 2 which includes Central and Eastern Utah. (Exhibit XIV).

The results of the analysis are:

Condition	Safety Factor	Exhibit
Full reservoir with steady state seepage	1.9	XV
Full reservoir with seismic loading	1.3	XVI
Rapid draw down	2.4	XVII

Refer to Exhibit XVIII for the diagram of the input data for the program and the location of critical failure surfaces.