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C/007/0020
Task ID #4797
Received 2/17/15

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February 17, 2015

VIA HAND DELIVERY

Daron Haddock
Coal Program Manager
Utah Division of Oil, Gas & Mining
1594 West North Temple, Suite 1210
Salt Lake City, Utah 84116

Re: Permit Amendment Application, Hidden Splendor Resources, Inc.
Horizon Mine, Permit No. C/007/0020, Carbon County, Utah

Dear Mr. Haddock:

On behalf of Hidden Splendor Resources, Inc. and pursuant to Utah Adm. Code R645-303-220, we hereby submit a minor permit amendment application for the Horizon Mine, Permit No. C/007/0020. Enclosed please find executed and notarized change application forms (C1 and C2), two redline strike-out copies and two clean copies of the revised Horizon Mine MRP. Please contact me with any questions.

Very truly yours,

Snell & Wilmer

Denise A. Dragoo

DAD:mkm

Enclosures

21034319

Snell & Wilmer is a member of LEX MUNDI, The Leading Association of Independent Law Firms.

APPLICATION FOR COAL PERMIT PROCESSING

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

Permittee: Hidden Splendor Resources

Mine: Horizon Mine **Permit Number:** 007020

Title: Permit Change Application, Horizon Mine MRP Revisions

Description, Include reason for application and timing required to implement:

Reclamation Plan Revision

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 one (1) review copy of the application.

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.

Alexander Walker III
Print Name

President 2/17/15
Sign Name, Position, Date

Subscribed and sworn to before me this 17 day of Feb, 2015

Notary Public

My commission Expires: 1-25, 2018

Attest: State of UT } ss:
County of Salt Lake

Notary Public
HILARY MILLS
Commission #671683
My Commission Expires
January 25, 2018
State of Utah

For Office Use Only:	Assigned Tracking Number:	Received by Oil, Gas & Mining

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

Permittee: Hidden Splendor Resources, Inc.
Mine: Horizon Mine **Permit Number:** 007020
Title: Permit Change Application, Horizon Mine MRP Revisions

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	3-3, 3-5, 3-6, 3-23, 3-32, 3-33, 3-34, 3-35, 3-36, 3-37, 3-41, 3-42, 3-44, 3-45, 3-52, 3-53
☐ Add	☐ Replace	■ Remove	3-52, 3-53 (renumbered as 3-43 and 3-44)
■ Add	☐ Replace	☐ Remove	3-38
☐ Add	■ Replace	☐ Remove	4-5, 4-6
☐ Add	■ Replace	☐ Remove	7-47, 7-54, 7-59, 7-63, 7-64, 7-65, 7-66, 7-67, 7-68, 7-69, 7-73 (blank page), 7-80
☐ Add	■ Replace	☐ Remove	7-70 through 8-7-79, and 7-81 through 7-83 are renumbered
☐ Add	☐ Replace	■ Remove	7-79 through 7-84
☐ Add	■ Replace	☐ Remove	Appendix 7-4
☐ Add	■ Replace	☐ Remove	8-25
☐ Add	■ Replace	☐ Remove	9-7, 9-9
☐ Add	☐ Replace	☐ Remove	
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Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	**Received by Oil, Gas & Mining**

Horizon Mine
Permit No. 007020

Chapter 3
Redline

See Section 3.3.1.2 for mine portal descriptions. Portal locations are noted on Plate 3-1.

3.2.3 Surface Buildings and Structures

Locations of proposed surface buildings and structures are shown on Plate 3-1. ~~Upon termination of mining operations, all structures will be removed and the area reclaimed as outlined in Section 3.5.~~

Surface Facilities. Plate 3-1 shows the locations of the following surface facilities:

- Buildings, utility corridors, and facilities to be used, including:

  Water Tank - one metal tank on concrete pad,
  Fueling Station - metal tank and containment structure with fueling equipment,
  Storage Building - portable building, to be used above ground or underground, Transformer - portable, to be used above ground or underground,
  Portals - see Section 3.3.1.2,
  Conveyor - see subsequent portions of this Section,
  Fan - metal structure containing a fan,
  Substation (2) - metal structure sitting on gravel and concrete pad,
  Roads - see Section 3.2.3.300,
  Sedimentation Pond- see Chapter 7,
  Temporary Office Trailer- mobile trailer,
  Temporary Bath House Trailer- mobile trailer,
  Parking Areas - soil pads,
  Storage Areas - soil pads,
  Crusher and Screen - metal structure on concrete pad/footings,
  Emergency Escapeway - corrugated metal,
  Dumpster(s) - metal, contractor owned,

- The area of disturbance at the mine mouth,

- Coal storage and loading facilities, and

- The explosive storage and handling facility, which includes approved explosive magazine(s).

Cross sections of the surface facilities are provided on Plate 3-2. The disturbed area shown on Plate 3-1 is the same as the land area for which a performance bond or other guarantee has been posted.

Upon termination of mining operations, the following structures will be removed and the area reclaimed as outlined in Section 3.5

Drainage facilities are shown on Plate 7-4, including the site sedimentation pond, culverts, and ditches.

~~Cross sections of the surface facilities are provided on Plate 3-2. The disturbed area shown on Plate 3-1 is the same as the land area for which a performance bond or other guarantee has been posted.~~

Transportation Facilities. Roads that have been constructed, used, or maintained by Horizon in the permit area for the mining and reclamation operations are shown on Plate 3-1. No rail systems or overland conveyor systems (other than the material-handling conveyors in the mine yard) will

Surface Configurations. Certified maps and cross sections showing the proposed final (post-reclamation) surface configuration of the Horizon disturbed area are provided on Plates 3-7 and 3-7A, respectively.

3.2.3.1 Plans and Engineering Designs

All plans and engineering designs presented in this M&RP were prepared by or under the direction of and certified by a qualified registered professional engineer.

Excess Spoil. No excess spoil (R645-100-200) will be generated from the permit area.

Durable Rock Fills. No durable rock fills will exist in the permit area.

Coal Mine Waste. No coal mine waste disposal facilities will exist on the surface in the permit area.

Impoundments. The only impoundment to be constructed for the mining and reclamation operation will consist of the sedimentation pond (see Plate 3-1 and Chapter 7). This impoundment has been designed under the direction of a professional engineer using current, prudent, engineering practices. These designs were certified by a qualified registered professional engineer.

Primary Roads. The design and construction of the primary roads associated with the mine have been certified by a professional engineer as meeting the requirements of R645-301-534.200 and R645-301-742.420 (see Plate 3-4).

Variance From Approximate Original Contour. No variance from the approximate original contour requirements of the regulations is being requested in this M&RP.

3.2.3.2 Utility Installation and Support Facilities

Utility Installations. All coal mining and reclamation operations will be conducted to minimize damage, destruction, or disruption of services provided by electric lines, telephone transmission stations, water lines, and sewer lines which pass over, under. or through the permit area. Areas where these utilities will be located are within non-subsidence zones. No other utility installations exist in the permit area. ~~All utility installations associated with the Horizon Mine will be removed following mining in accordance with the reclamation plan discussed in Section 3.5 of this M&RP.~~

Support Facilities. Support facilities at the Horizon Mine will be operated in accordance with the permit issued for the mine. Support facilities will be located, maintained, and used in a manner that:

- Prevents or controls erosion and siltation, water pollution, and damage to public or private property;
- To the extent possible, using the best technology currently available, minimizes damage to fish, wildlife, and related environmental values; and

Support Facilities. Support facilities at the Horizon Mine will be operated in accordance with the permit issued for the mine. Support facilities will be located, maintained, and used in a manner that:

- Prevents or contro.ls erosion and siltation, water pollution, and damage to public or private property;
- To the extent possible, using the best technology currently available, minimizes damage to fish, wildlife, and related environmental values; and
- Minimizes additional contributions of suspended solids to stream flow or runoff outside the permit area.

~~All support facilities will be removed following mining in accordance with the reclamation plan discussed in Section 3.5 of this M&RP.~~

Water Pollution Control Facilities. Water pollution control facilities at the Horizon Mine consist of the sedimentation pond and the appurtenant structures associated with the sedimentation pond. ~~All water pollution control facilities will be removed following mining in accordance with the reclamation plan discussed in Section 3.5 of this M&RP.~~ The sedimentation pond and appurtenant structures were constructed as discussed in Chapter 7.

3.2.3.3 Road Classification

Primary roads within the disturbed area include the lower haul road loop and the upper pad road. The upper pad (approach) road and parking area have been paved. See Plates 3-1 and 3-4. No ancillary roads exist within the disturbed area. The locations of these roads are shown on Plates 3-1 and 3-4. Typical cross sections representing these roads are shown on Plate 3-4.

The unimproved dirt roads outside of the disturbed area but within the permit area will not be classified. They may be used by Horizon for access to the lease area surfaces for the collection of monitoring data (environmental and subsidence data) as well as other uses deemed appropriate by Horizon and as allowed by the associated landowner.

3.2.3.4 Description of Transportation Facilities

No surface conveyors (other than those in the mine yard immediately adjacent to the portals) or rail systems will be constructed, used, or maintained within the permit area. A description of the conveyor systems that will be used in the mine yard is provided in this M&RP.

Road Specifications. Cross sections of roads that will be used or maintained by Horizon are provided on Plate 3-4. This plate provides information regarding road widths, gradients, surfaces, etc. Information regarding road drainage structures is presented in Chapter 7.

The road which will access the mine is the Beaver Creek county road that extends from Consumers Road to the town of Clear Creek. Letters from Carbon County regarding the use of both Beaver Creek Road and Consumers Road are provided in Appendix 3-1. As indicated in this appendix,

- Maintaining a berm along the west edge of the sedimentation pond to minimize the potential for inadvertent entry into the pond.

Mine-Related Structures. Generally, all mine surface facilities are located within or in close proximity to the associated operations areas. Future building construction will generally involve grading and preparation of foundation areas, excavation and installation of foundations, building erection, interior and exterior finish work, and connection of utilities. Storage areas will generally be open graded, providing outside storage for large supplies. Both building sites and storage areas will be graded to ensure effective drainage to disturbed-area ditches and culverts as noted on Plate 7-5. Operation and maintenance of support structures and facilities at the Horizon Mine will involve regular grading of facility areas, together with inspection, cleaning, and repairs as required.

General refuse that is generated on site will be stored in a dumpster(s) to be situated at a convenient location within the disturbed area. This waste will consist predominantly of old brattice cloth, ventilation tubing, broken timbers, wire, broken machinery parts, paper, cardboard, and miscellaneous garbage. This non-hazardous, non-toxic, non-coal, non-waste rock refuse will be disposed of periodically through Carbon County at a state-approved landfill.

During site construction, operation, and reclamation activities, any spilled petroleum products such as grease, hydraulic fluid, fuel, oil, joint coating, or other pollutants will be removed immediately with the associated contaminated soil and disposed of at a state-approved facility that is permitted to receive such waste. Adequate spill collection materials (including absorbents to stop or contain contaminants that may enter a stream) will be readily available at the site during these activities to contain any such spills.

During construction and other activities at the site, wet concrete will not be allowed to enter or come into contact with stream flows. Any water at the site which is contaminated with wet concrete or other contaminants will not be discharged into stream channels. Concrete trucks and other equipment used in the mixing and placement of concrete will be washed in areas well away from stream channels.

3.2.4 Coal Handling

Coal will be brought out of the mine by conveyor. The coal stream passes under an ash analyzer to determine the potential quantity of ash content of the mined coal. The surface conveyor system consists of two (2) drop points. Point #1 is manual and Point #2 is controlled by a computerized signal from the ash analyzer. The coal flow can be dropped at Points 1 or 2 within the disturbed area boundary. The coal discharged into the stockpile will be blended by the use of a front-end loader by bucket loads or by the stacking belt into the trucks. The location of the drops and the ash analyzer are shown on Plate 3-1.

3.2.5 Power System

The power obtained from Utah Power and Light Company will reach Portal Canyon substation by way of a transmission line which runs along County Road 290 then along Jewkes Canyon on the

east side to the substation. The location of the power line and substation are shown on Plate 3-1. See Chapter 10 for a discussion of raptor safe power lines.

3.2.6 Water Supply

Water for non-culinary use will be stored in a tank/pond within the disturbed area.

3.2.7 Sewage System

Chemical toilets will be used during initial development, construction, and operation of the mine. A service contract will be entered for maintenance of the chemical toilets and disposal of waste therefrom. Additional sewage facilities required for normal operation of the mine (after development) will be designed in accordance with UDH regulations. Plans for sewage facilities will be submitted for review and approval by UDH prior to construction of said facilities. It is anticipated that sewage facilities will consist of a collection system and holding tank.

3.2.8 Water Diversion Structures

Diversions will be installed to direct disturbed-area runoff to sediment-control structures and/or facilities. Runoff from undisturbed areas will be diverted away from the disturbed areas to the extent practical. Detailed discussions of the design of diversion structures are provided in Chapter 7.

3.2.9 Sedimentation Control Structures and Water Treatment Facilities

All runoff from the disturbed area is directed into the sedimentation pond located directly below the area of disturbance. The pond has been designed to contain runoff resulting from the 10-year, 24-hour precipitation event. The pond spillway has been designed to safely pass the peak flow resulting from a 25-year, 6-hour precipitation event.

The location of the pond is shown on Plate 3-1. Design, construction, maintenance and operation of the pond are discussed in detail in Section 7.2.3.2.

3.2.10 Transportation

Coal will be transported from the mine via a conveyor and discharged onto the coal storage area. Coal handling is discussed in Section 3.2.4. Transportation to and from the mine site (coal, personnel, and materials) is discussed in Sections 3.2.3.300 and 3.2.3.400.

3.2.11 Total Area for Surface Disturbance During Permit Term

See Section 2.117 for the acreage of the proposed surface-disturbance.

3.2.12 Additional Areas for Surface Disturbance for Life of Mine

There are no plans to disturb any additional surface area for the life of the operation beyond that to be initially disturbed.

portal sealing) change in the future, the U.S. Bureau of Land Management and the Division will be properly informed.

3.3.3.1 Projected Maximum Recovery

Coal reserves within the permit area are summarized below. Recoverable reserves were estimated using a recovery rate of 82 percent of the mineable reserve base.

Area	Hiawatha Seam (million tons)		
	Total	Mineable	Recoverable
Original Permit Boundary	1.03	1.03	0.66
2000 Revised Permit Boundary	3.90	2.0	1.2
Remaining Coal Lease UTU-74804	8.45	4.92	4.60
Total	13.38	7.92	6.46

3.3.3.2 Justification for Non-recovery

All coal that can economically and safely be recovered will be recovered. Barrier pillars and buffer zones will be left only where required to protect surface resources, provide safe mining conditions, and as required by law or regulation.

3.3.3.3 Access for Future Reserves

Access to additional reserves will depend upon the results of exploration activities and obtaining leases. However, it is currently anticipated that the mine workings contemplated by this plan will provide access to reserves in Sections 6, 7, 8, and 18, T13S R8E.

3.3.4 Equipment Selection

Major equipment to be used underground will include the following:

2 - Continuous Miner
3 - Roof Bolter RD1-43
6 - Shuttle Cars
2 - Feeder Breaker
3 - Scoop
1 - Compressor
2 - Rock Dusters
5 - Conveyor Drives & Tail Pieces

3.3.6 Operations Schedule

3.3.6.1 Annual Production Per Year for Permit Term

Coal will be produced from the mine at an anticipated rate of approximately 700,000 tons per year. The production could increase to 1.5 million tons per year when federal coal leases are secured and if the market and mining conditions are favorable.

3.3.6.2 Operations Schedule - Days - Shifts

Production will occur in two production shifts per day and a small crew will perform maintenance work and other non-production jobs on the off production shift.

3.3.6. 4 Temporary Cessation

If operations are to be temporarily ceased for more than 30 days, Horizon will submit to the Division a notice of intention to cease or abandon the operations. In accordance with R645-301-529.210, each mine entry that has further projected useful service will be protected by barricades or other covering devices, fenced, and posted with signs to prevent access into the entry and to identify the hazardous nature of the opening. These devices will be periodically inspected and maintained by Horizon.

3.3.7 Mine Permit Area

3.3.7.1 Acreage and Delineation of Mine Permit Area

See Chapter 2 for the total acreage contained within the mine permit boundary.

3.3.7.2 Projected Mining by Year

The projected mining by year is shown on Plate 3-3.

3.3.8 Mine Plan Area

Horizon plans to mine within the mine permit boundary as shown on Plate 1-1. Plans for mining beyond the permit term will be developed as additional information is acquired. No new areas will be mined until appropriate permits have been obtained from their corresponding regulatory agencies.

3.4 Environmental Protection

3.4.1 Preservation of Land Use

Upon completion of mining operations, final reclamation work will commence. Reclamation efforts will be directed to to accommodate post-mining ~~recreating the pre-mining~~ land use. ~~This will be achieved by use of acceptable seed mixtures. Refer to Chapter 4 for pre-mining land use information.~~

3.4.1.1 Projected Impacts of Mining on Current and Future Land-Use

3.4.3.2 Control Measures to Mitigate Impacts and Monitoring Procedures

Horizon will maintain sedimentation control structures to prevent impacts to the surface waters in Jewkes Creek and the North Fork of Gordon Creek. In the event that the quantity of groundwater encountered during mining is in excess of underground requirements, the water will be settled first in underground sumps and then discharged to the surface. Any such discharges will be monitored in accordance with the UPDES permit.

Surface and groundwater monitoring programs have been or will be implemented to assess the impacts of mining operations at the Mine on hydrologic resources in the area. Details of these monitoring programs are presented in Chapter 7.

3.4.4 Preservation of Soil Resources and Projected Impacts of Mining on SoH Resources

Soil resource information for the mine area is presented in Chapter 8. Soil surveys were performed in the area in May 1980 and in January 1990. Naturally-occurring and presently-disturbed soils were delineated. The purposes of the surveys were to identify soils and their stripping depths for salvaging suitable natural soil prior to additional disturbance and to determine the amount of topsoil available for final reclamation.

Most of the existing disturbance at the mine occurred prior to enactment of P.L. 95-87 or the Utah Interim Program that set forth regulations for salvaging topsoil (i.e., pre-1950's disturbance). However, some topsoil exists along the shoulders of cut areas where it was not disturbed during previous construction activities.

During construction of surface facilities, available topsoil resources will be segregated and stockpiled as indicated in Chapter 8. In addition, presently-disturbed soils will be carefully handled to salvage as much soil as possible for potential future use as substitute topsoil materials.

3.4.4.1 Control Measures to Mitigate Impacts to Soil Resources

Surface disturbances will be limited to the disturbed area boundary noted on Plate 1-1. Topsoil that is stockpiled for future reclamation efforts will be vegetated with an interim cover to reduce erosion of the stockpile. All areas disturbed during mining activities will be reclaimed in accordance with the approved reclamation plan (see Section 3.5).

3.4.5 Protection of Vegetative Resources

3.4.5.1 Projected Impact of Mining on Vegetative Resources

Previous mining activities have resulted in alteration of natural vegetation at the site area. The majority of this area has been disturbed previously by mining operations.

3.5 Reclamation Plan

3.5.1 Contemporaneous and Interim Reclamation

Disturbed area's when no longer needed, will be backfilled, graded, retopsoiled, and revegetated. Seeding, fertilizing, and mulching will be performed as soon as practical following redistribution of topsoil. Seed Mix #2 presented in Table 3-3 will be planted, and erosion-control matting will be installed in specific areas as described in Section 3.5.5.3. Reclamation techniques are described below. Areas that will not be redisturbed will be classified as contemporaneously reclaimed. Seed Mix #1 will be used in areas requiring soil stabilization during the operational period of mining. These areas will likely be redisturbed either during the operation or reclamation of the mine site. The areas that will be redisturbed during operation or final reclamation contouring will be classified as interim reclamation. Areas where interim reclamation contacts a steep bank dropping to a diversion ditch will be protected by attempting to control the loss of topsoil by installing a mulch mat a minimum of one foot above and below the grade break.

During October 1997, the areas designated on Plate A within Appendix 8-1 are scheduled for stabilization seeding using Seed Mix No. 1. Refer to Section 8.8 for additional information.

Underground Coal Mining and Reclamation Activities. All surface equipment, structures, or other facilities not required for continued underground mining activities and monitoring, unless approved by the Division as suitable for the post-mining land use or environmental monitoring, will be removed and the affected lands reclaimed following permanent cessation of mining operations.

Reclamation Timetable. A timetable for the completion of each major step in the reclamation plan is presented in Table 3-4.

Plan for Backfilling, Soil Stabilization, Compacting, and Grading. The regrading plan for the Horizon Mine was designed to meet the objectives of balancing cut and fill quantities and maintaining a geotechnically and erosionally stable base. The primary features of this plan are Backfilling to remove portal entrances (highwalls) within the objectives noted above (Cut and fill balance, site stability, and erosion control).~~:~~

- ~~Removal of the pad upon which surface activities will be constructed at the mine, thereby creating a slope which will adequately drain while minimizing long-term erosion concerns;~~
- ~~Backfilling to remove portal entrances (highwalls) within the objectives noted above (cut and fill balance, site stability, and erosion control);~~
- ~~Construction of stable channels across regraded areas;~~
- ~~Placement of topsoil;~~
- ~~Revegetation and mulching of the topsoiled site; and~~
- ~~Removal of the sedimentation pond (together with accompanying regrading, topsoiling, revegetation, and mulching of the sedimentation pond area) and implementation of interim sediment-control measures.~~

(Details regarding topsoil placement and revegetation following regrading are provided in Chapters 3 and 8, respectively.3-3)

TABLE-3-4 REMOVED AND REVISED
Reclamation Timetable

TABLE 3-1

RECLAMATION CUT AND FILL CALCULATIONS

Using present surface contours from Plate 3-7 in conjunction with revised reclamation contours through AutoCad 2000 and Survcadd 2000

Area in Cut: ~~186,023.6~~18,295 sq ft, ~~4.271~~0.420 acres
Area in Fill: ~~189,050.1~~17,997 sq ft, ~~4.340~~0.413 acres
Total inclusion area: ~~8.611~~0.833 acres
Cut to Fill ratio: 1.15
Average Cut Depth: ~~1.71~~7.26 ft
Average Fill Depth: ~~1.46~~6.41 ft
Cut volume: ~~11,752.91~~4,916 cubic yards
Fill volume: ~~: 1 0,238. 7 4~~4,275 cubic yards

Backfilling and Compaction. As indicated previously in this M&RP, the surface at the Horizon Mine was originally disturbed between the 1920s and the 1950s by previous mining operations. These prior operators made no effort to salvage any topsoil or other soil material for subsequent site reclamation. Therefore, restoration to a contour that approximates pre-mining conditions is neither practical nor required by the regulations. However, it is the intent of Horizon to restore the area to a topography that is compatible with the post-mining land use, using materials that are available at the site.

All vegetation, organic matter, and debris will be cleared from areas to receive fill. The cut material from site regrading will be placed as fill and graded to facilitate drainage from the mine site and contributing side areas. All fill placed during recontouring of the site will be compacted to at least 85 percent of maximum Proctor density (ASTM 0698). Compaction will be accomplished using repeated passes of rubber-tired equipment, rollers, and other appropriate equipment.

Side hill embankments, where the width is too narrow to allow access by compaction equipment, will be initially constructed by spreading the soil with a dozer, but only to a width necessary to allow compaction equipment access. After this is achieved, the fill will be placed in lifts and compacted to at least 85 percent of maximum Proctor density.

Care will be taken to ensure that fill materials are not frozen during placement or compaction. Any areas that are damaged by freezing will be reconditioned, reshaped, and recompacted to at least 85 percent of maximum Proctor density. All fill placement and compaction activities will be overseen by an experienced engineer.

~~In general, grading and backfilling operations will proceed from the upstream end of the surface facilities to the downstream end, thus allowing the sedimentation pond to remain effective for as long as possible.~~

~~**Construction of Reclamation Channels**. Reclamation channels will be constructed at the locations shown on Plate 3-7. These channels will be constructed to capture runoff from undisturbed areas and convey this runoff to and through Portal Canyon and Jewkes Creek. Details regarding the design and construction of these channels are provided in Chapter 7 of this M&RP.~~

~~As noted on Plate 3-7, slopes adjacent to the reclaimed streams are generally much shallower than the natural slopes upstream from the disturbed area (where natural slopes on the hillsides adjacent to the streams are typically 1.5H: 1 V or steeper). Hence, access to the streams by wildlife and livestock under post-mining conditions should not be hindered within the reclaimed area.~~

~~**Sedimentation Pond Removal and Interim Sediment Control**. Prior to the start of reclamation activities, temporary silt fences will be emplaced in Jewkes Creek perpendicular to the flow direction. A minimum of four such silt fences will be installed in the creek downstream from the bypass culvert (UC-1) outlet but within the disturbed area prior to removal of the culvert. The silt fences will be located in an area convenient for maintenance and cleanout. The silt fences will be removed when reclamation construction activities are completed. During reclamation, the silt fences will be periodically inspected and accumulated sediment will be removed from behind the silt fences when required to minimize downstream impacts.~~

~~The sedimentation pond will be retained for as long as practical during reclamation. Once backfilling and grading operations proceed to the location of the pond, it will be removed. Because the pond is designed primarily as an excavated structure, removal of the pond will consist primarily of backfilling. This removal will be accomplished using backhoes, loaders, dozers, and other appropriate earthmoving equipment.~~

~~As soon as regrading of an area no longer allows that area to drain to the sedimentation pond, silt fences will be installed along the base of the slopes adjacent to the associated stream to control erosion on an interim basis prior to revegetation success. These silt fences will be installed using a supportive backing and burying the toe of the filter fabric.~~

~~On a temporary basis, straw-bale dikes may also be installed as necessary to control localized erosion prior to the establishment of revegetation efforts. If installed, locations of the straw-bale dikes will be selected to reduce sediment contributions to runoff based on field observations. Straw-bale dikes will be installed by keying the bales into the ground.~~

Roads. ~~All r~~Roads within the disturbed area will be reclaimed if not needed for post-mining land use.~~immediately after they are no longer needed for mining and reclamation operations. These roads will be graded and/or backfilled as indicated above.~~ Topsoil will be applied to the regraded surfaces and the area will be revegetated as discussed in Chapters 3 and 8, respectively.

3.5.2 Soil Removal and Storage

Soil surveys conducted at the mine site have distinguished disturbed lands from undisturbed soil mapping units (see Chapter 8, Plate 8-1). Areas mapped as disturbed land are areas where the soils, vegetation, or both were affected by previous mining operations. Disturbance of the roads and pads occurred prior to regulatory requirements to salvage topsoil from those areas.

All topsoil/growth medium to be generated during the future disturbances will be stockpiled. The stockpiles will be contoured, fertilized, vegetated with Seed Mix #1 outlined in Section 3.5.5.2, and mulched as outlined in Section 3.5.5.3. Markers will be placed indicating that the piles contain topsoil. Berms and/or strawbales will be placed around the stockpile to minimize off-pile transport of sediment.

Areas of interim reclamation that will be redisturbed for final reclamation contouring will have the depth topsoil that was placed on those areas removed and placed back on the topsoil stockpile for redistribution onto the newly recontoured area. A qualified person will be present during the removal of the topsoil in these areas. See Plate 3-7 for areas where interim reclamation will be redisturbed and areas where re-contouring is complete an interim vegetation has been established.

Refer to Section 8.8 for the methods being used in the removal and redistribution of soils.

3.5.3 Final Abandonment

Upon permanent cessation of operations, permanent reclamation will be performed. ~~All s~~Surface equipment, structures and facilities (other than sedimentation control) associated with the operation not needed for post-mining land use will be removed during reclamation of the affected area.

3.5.3.1 Sealing of Mine Openings

Abandonment of Openings. When no longer needed for mining operations, all portals will be sealed and backfilled by collapsing the concrete canopies over each portal. Prior to the sealing of the mine openings, all combustible materials will be removed from the portal area. All structures that would interfere with sealing of the mine openings wlll also be removed. The permanent closures will be constructed to prevent access to mine workings by people, livestock, and wildlife. Potential surface drainage will also be kept from entering the sealed entries.

All mine openings will be sealed at least 20 feet inside the mine opening. Prior to installation of the seal, all loose material will be removed from the roof, floor, and rib of the mine within the seal area. The seal will then be constructed using solid concrete blocks with nominal dimensions of 8 inches high, 8 inches wide, and 16 inches long. Mortar will consist of one part cement, three parts sand, and no more than 7 gallons of water per sack of cement.

In the bottom course, each block will be laid with its long axis parallel to the rib. The long axis in succeedingly higher courses will be perpendicular to the long axis of the blocks in the preceding course. The seal will be recessed at least 8 inches deep into each rib and 8 inches deep into the floor. No recess will be made into the roof.

The seals will have a thickness of approximately 16 inches. Following seal construction, the entries will be backfilled from the seal to the outside surface with soil that is sloped at the surface to match the final slope at the entry.

Casing and Sealing of Underground Openings. Each underground opening to the mine will be sealed and backfilled when no longer needed for monitoring or other use approved by the Division upon finding of no adverse environmental or health and safety effects. This closure method has been designed to prevent access to the mine workings by people, livestock, fish and wildlife, and machinery. The closures have also been designed to keep water from flowing from the mine workings to prevent acid or other toxic drainage from entering ground and surface waters.

~~Monitoring wells associated with the Horizon Mine will be sealed when no longer needed for monitoring groundwater. Sealing of these wells will occur in accordance with the requirements of the Utah Division of Water Rights (R655-4-12).~~

Details of the seals are shown on Figure~~s 3-6 and~~ 3-7.

3.5.3.2 Removal of Surface Structures

Following sealing of the portals, ~~all~~ surface structures and facilities not required for post-mining use~~associated with the mining operation~~ will be removed. The schedule and cost of removal is detailed in Section 3.5.6 and 3.5.7, respectively.

Building Demolition. Prior to significant regrading activities at the Horizon facility, existing buildings, retaining walls, utilities, coal-handling facilities, and other above-ground structures will be removed from the area insofar as they are not needed for post-mining land use. To the extent possible, these structures and facilities will be salvaged. Nonhazardous and nonflammable materials, such as concrete and steel, may be used as backfill.

~~in areas such as the sediment pond, portal entrances (slopes), and cut slopes.~~ If thus disposed of, these materials will be incorporated into the backfill under at least 4 feet of soil cover in a manner that will not create voids within the backfill or reduce the effective compaction necessary for backfilling. If foundations will not interfere with ~~regrading activities~~post-mining land use, they will be left in place for on-site burial~~ under at least 4 feet of soil cover~~.

During the site regrading, if any of the toxic coal waste that is buried in the mine pad fill is uncovered, the material will be properly placed in the fill areas of the recontouring outside drainage flows so it can be covered beneath four feet of non-toxic fill material and erosion of the drainage over time will not contact these areas. The locations will be mapped at the time of placement and submitted to the Division.

Non-coal wastes found during reclamation, such as garbage, lumber, and other combustible materials generated during previous mining activities, will be segregated and stored in a controlled manner in a temporary storage area in appropriate containers.

Final disposal of all such waste will be in the backfill (as indicated above) or at a State-approved solid waste disposal facility, as appropriate. Notwithstanding any other provision of the R645

Rules, any non-coal mine waste defined as "hazardous" will be handled in accordance with the requirements of Subtitle C of RCRA and any implementing agency.

Mining equipment too large for a container will be placed in a designated temporary storage area as determined at the time of reclamation activities. Final decisions regarding salvage or disposal of structures and equipment will be made just prior to reclamation following an assessment of the salvageability of the structures and equipment.

3.5.3.3 Disposition of Dams, Ponds, and Diversions

Diversions that are not planned for permanent use following reclamation will be removed during the backfilling and regrading operations. ~~The area will be recontoured to drain to the final reclamation channel (Section 7.2.3.2, Reclamation Hydrology Design).~~

~~Sediment control following removal of the sedimentation pond will be provided as outlined in Sections 3.5.4.3 and 7.2.3.2.~~

3.5.4 Backfilling and Grading Plans

Approximate Original Contour. The area of the Horizon surface facilities was disturbed by previous mining activities. No pre-mining topographic maps of the area are known to exist. The reclamation plan has been designed to ~~backfill and grade the site to~~ achieve ~~the assumed approximate original contour (i.e., to blend into the surrounding topography)~~post-mining land use and eliminate highwalls associated with the Horizon Mine.

Elimination of Highwalls, Spoil Piles, and Depressions. The backfilling and grading plan has been designed to eliminate highwalls at the site that were associated with the Horizon Mine. The access to the coal seam is by three slopes from the surface to the coal seam some 46 feet below the ground elevation of the top of the slopes. The return slope uses the old Blue Blaze No. 1 Mine slope. A 50 foot concrete portal cover was constructed from the mouth of the old slope and was backfilled to eliminate any exposed

highwall. The old slope was then widened to accommodate modern mining equipment. The belt slope was excavated a length of 95 feet to solid overburden where the slope could be driven down to the seam. A 95 foot concrete portal cover was constructed for the belt slope. The intake slope was excavated a length of 125 feet to solid overburden. A 125 foot concrete portal cover was constructed for the intake slope. The excavated portions of the portal covers have been covered to eliminate any highwall faces. No highwalls exist on the current disturbed area. The portal accesses to the seam are constructed for easy demolition and use of the material as backfill. No spoil piles exist. With the exception of the small depressions to retain moisture, minimize erosion and to assist in revegetation, no depressions will remain at the site following reclamation. Refer to Plate 3-7 and Figure 3-6.

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, plasticity, and degree of compaction of the soil. It is expected that the reclamation fill will be fairly dry and will be placed without the benefit of significant compaction or moisture conditioning. See Appendix 3-3.~~

Based on information provided in Chapter 8 of this M&RP, soils at the Horizon site consist of low plasticity, cohesive materials with a wide assortment of grain sizes. The angle of repose in such soil is dependent not only on interparticle friction, but also on cohesion, which is dependent on the density, moisture content, and compaction moisture content of the soil. In general, as long as they do not become saturated or are not fissured, cohesive soils have a greater angle of repose than non-cohesive soils and can maintain vertical or near-vertical slopes under certain conditions. The angle of repose of a loose sand generally varies between 30 and 35 degrees (Holtz and Kovacs, 1981). Therefore, presumably, the angle of repose of a slightly cohesive granular soil will be greater than 30 to 35 degrees. For the purpose of this site, the angle of repose will be assigned a value of 35 degrees, which corresponds to a slope of about 1.5 horizontal to 1 vertical (1.5H: 1 V).

Backfilled and regraded slopes have been designed to not exceed the angle of repose. Design calculations indicate that the minimum safety factor of emplaced soil, at a slope of 1.5H:1V, is 1.4 under saturated conditions and 1.9 under unsaturated conditions. The static safety factor will increase with decreasing slope. The slopes have thus been designed to prevent slides.

Erosion and Water Pollution. Temporary sediment-control measures will be implemented during and following backfilling and regrading. ~~During redistribution of the topsoil, silt fences will be established at the bottom of fill slopes and along the top bank of the reclamation channel to control possible erosion from newly graded and seeded areas~~. As vegetation becomes established on the reclaimed surfaces, erosion potentials will be further minimized. By minimizing erosion, water pollution will also be precluded. Additional water-quality concerns do not exist at the site (see Chapter 7).

~~In order to blend with natural slopes, soil may be replaced during reclamation at slopes of up to 1.5H:1 V. The steepness of these slopes will be reduced at their base, providing a concave slope. As noted above, these slopes will be geotechnically stable. Dozers will be used during placement of the topsoil or substitute topsoil on these steep slopes, taking care to achieve a reasonably uniform thickness of the final soil cover.~~

3.5.4.3 Fencing and Erosion Control

~~The sedimentation pond will be retained as discussed in Section 7.2.3.2.~~ Fencing will be placed as required to protect revegetation efforts from livestock grazing. This fencing will be removed prior to requesting final bond release. Refer to Section 3. 5.4 for additional information on erosion control.

3.5.4.4 Soil Redistribution and Stabilization

When final reclamation begins, the disturbed areas to be reclaimed will be loosened by ripping to allow easier backfilling and grading operations. During redistribution of soils, care will be taken to prevent excessive compaction.

Soils disturbed during mining, including but not limited to fill material, will be placed within the disturbed area boundary. Refer to Section 8.8 for further information concerning plans for soil redistribution.

3.5.5 Revegetation Plan

The revegetation plan has been designed to assure that all disturbed lands will be reclaimed to accommodate post-mining land use~~returned to productive self-perpetuating plant communities~~ once the mining operation has been completed. The plan calls for temporary revegetation of disturbed areas where possible during the mining operation~~, as well as permanent reclamation of all areas once mining has ceased.~~

~~The goal of the plan is to create diverse plant communities which are at least as productive and in comparable amounts to plant cover existing on the site prior to this mining operation.~~

3.5.5.1 Soil Preparation

After backfilling, grading, recontouring, scarifying, and the redistribution of topsoil, the seed bed will be prepared using the best technology currently available. Prior to seeding, composite soil samples as will be collected and analyzed as discussed in Section 8.9. Based on the results of these analyses, fertilizer will be applied at the time of seeding.

3.5.5.2 Seeding

Areas to be revegetated~~which have been disturbed during mining operations~~ will be reseeded with either Seed Mix #1 (Table 3-2) or with Seed Mix #2 (Table 3-3), as outlined below. These mixes are composed primarily of native species which either occur on the site or would be expected to grow on the site.~~, especially on reclaimed areas.~~ The mixes have been designed to include species which will provide sufficient cover to prevent soil erosion, and should contain sufficient species diversity to produce a stable self-perpetuating plant community. All seeds will comply with applicable state and federal seed laws.

Temporary Seed Mix

On those sites where revegetation is needed during the operating years, a temporary seed mix will beused. This mix (Table 3-2) is composed primarily of native species and is designed for quick establishment and erosion control. Only one Introduced grass species (pubescent wheatgrass - Agropyron trichophorum), is included in the mix. It has been included since it is known to do well on dry sites, and will assist in controlling soil erosion. Clcer milkvetch (Astragalus ciscer) has been included because of its ability to fix nitrogen. No shrubs or forbs are included in the temporary mix, since these areas will be re-disturbed prior to final reclamation. At the actual time of planting, the mix may be altered depending on availability of the listed species. ~~and under the approval of the Division prior to substitution~~.

Permanent Seed Mix

The permanent revegetation mix is composed of a mixture of native grasses, forbs, shrubs and trees (Table 3-3). The grasses, forbs, and some of the shrubs will be planted as seeds. The remaining shrubs and trees will be planted as containerized stock. A variety of species are included in the mix in order to obtain a higher level of diversity on the revegetated surfaces. This will increase habitat diversity as variations in the microenvironments of the reclaimed surface will enhance or inhibit the germination and development of the various species.

The permanent seed mix reflects the .composition of the original communities which occurred on the site. It is included because of its ability to fix nitrogen. Approval will be obtained from the Division prior to using any substitution in seed mixtures and on the number of containerized shrubs needed per acre.

Thc riparian sceding mix is included in Table 3-3.

Seeding Methods

~~Reclaimed~~Revegitation areas will be seeded by broadcasting. Seeds when broadcast will be raked to ensure proper seed/soil contact. See Tables 3-2 and 3-3 for the seeding rates. If the first seeding does not establish, the area will be reseeded. ~~Reclaimed areas will be seeded in the fall. Since the majority of the species in the mix are cool season grasses, fall is a better time to plant.~~ The containerized stock will be planted in late fall or early spring, attempting to avoid undesirable conditions such as overly wet, overly dry, or frozen soils. Should the planting window close prior to completion of seeding, a sterile, quick growing ground cover will be planted to control erosion during the winter months. ~~The final reclamation seed mixture will be planted during the following year. Small depressions will be left in areas where containerized stock is planted to accumulate water during wet periods.~~

~~In the riparian disturbed area (see Section 9.4.1 .2) the containerized or cuttings of willow stock will be planted in clumps along the banks of Jewkes Creek. Other containerized shrubs and sedges will be planted in clumps within the riparian area. The seed mix (Table 3-3, Riparian Reclamation Seeding Mix) will be planted using the methods described above.~~

3.5.5.3 Mulching

During reclamation mulch will be applied to all newly reseeded areas in order to provide a more equitable environment for seed germination and initial growth. A mulch will be applied at a rate of 2000 pounds per acre. Once applied, the mulch will be incorporated while the surface is being roughened before seeding. Erosion control matting will be placed on all slopes 2 1/2H:1V or steeper.

At the time of reclamation the most beneficial type of mulch to be used will be determined by Horizon ~~and UOGM~~, for bonding purposes the price will be assumed to be that for alfalfa.

3.5.5.4 Reclamation Management

The reclaimed and revegetated areas will be closely monitored to determine if any maintenance is necessary (refer to Sections 3.5 and 9.8 for a description of the monitoring program). Problems which may require management include severe erosion, excessive weeds, bare patches of failed planting, and damage by wildlife. Hills and gullies which form in areas that have been regraded and topsoiled and which either disrupt the approved post-mining land use or the reestablishment of the vegetative cover, or, cause or contribute to a violation of water quality standards for receiving streams, shall be filled, regraded, or otherwise stabilized; topsoil replaced; and the areas shall be reseeded or replanted. If weeds occur, a weed control plan will be proposed to UDOGM and implemented upon approval. No weed control will be attempted during the first growing season. It is likely that weed species will form a conspicuous part of the vegetation on the reclaimed areas during the first year but will be replaced by revegetative species thereafter.

3.5.5.5 Revegetation Monitoring

Revegetated areas will be monitored in accordance with Section 9.8 of this permit application.

3.5.5.6 Establishment of Wildlife Habitat

~~Reclamation is particularly important as a means of controlling erosion and restoring disturbed areas to a productive state. To assist in meeting these desirable ends, the following aspects have been incorporated into the reclamation plan: (1) planting a diverse mixture of native grasses, forbs, and (where appropriate) woody species, (2) using seedling stock rather than relying solely on seeds for trees or shrubs, and (3) planting vegetation to create an edge effect by clumping selected shrub or tree species.~~

Section 10.5 provides a detailed discussion of the reclamation, mitigation and management plans for terrestrial habitats and wildlife.

~~Enhancement of the area for wildlife will be accomplished by the installation of rock piles for smaller mammals, the improved revegetation of the area, and planting of Salix cuttings per acre along the creek banks within the disturbed area. Rock piles will be scattered along the perimeter of Jewkes Creek, and through Portal Canyon. Containerized shrub stock will be planted near the rock piles to provide additional cover and as a food source. The appropriate regulatory agencies (i.e.,~~

~~UDOGM, DWR) will be consulted as to the frequency and placement of the rock piles during reclamation.~~

3.5.6 Reclamation Monitoring

The standards for success in the previously disturbed areas of the site are outlined in section R645-301-356.250 of the regulations. The applicant intends to return the previously disturbed areas ~~to stable plant communities capable of withstanding the~~ to accommodate intended post-mining land use and controlling erosion (see Section 9.8).

3.5.7 Schedule of Reclamation for Horizon Mine

3.5.7.1 Timetable for Completion of Major Reclamation Processes

The approximate schedule of reclamation activities is outlined in Table 3-4. The graphical schedule has been extended by approximately 10 percent beyond the numerical estimates presented below to account for unanticipated delays. ~~Reclamation is proposed to be initiated within 90 days (weather permitting) of final abandonment of the mining operation. Each listing is for an 8-hour work day.~~

The Phase I reclamation tasks are therefore proposed to be completed within 24 weeks following the start of reclamation activities, assuming adequate weather conditions. Eight weeks are planned for the completion of Phase II reclamation tasks.

~~Due to the size and topography of the mine site, the concept of completing reclamation activities in Portal Canyon prior to starting reclamation activities in Jewkes Canyon is not feasible. Potential problems include having to move topsoil twice and not having the fill in Jewkes Canyon to reclaim slopes in Portal Canyon. Horizon commits to begin reclamation activities in Portal Canyon and to leave the sediment pond and UC-1 located in Jewkes Canyon in place as long as possible. Prior to the removal of the sediment pond during reclamation, UDOGM hydrologist will be notified and given the opportunity to inspect and endorse the removal. The timetable and sequence for removal of sediment control structures will depend upon the season of the year and precipitation.~~

3.5.8 Cost Estimate for Final Reclamation

The estimated cost to reclaim the Horizon Mine surface facilities is provided in Appendix 3-7.

The reclamation costs were evaluated to determine if the 1 00-foot culvert extension planned for 1997 (Appendix 3-9) would be covered by the estimated amount.

3.6 References

Dunrud, C. Richard, 1998, Engineering Geology Applied to the Design and Operation of Underground Coal mines, U.S. Geological Survey, Information Services.

Guy, Dan, Personal Statement, 1985

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(Waiting for 3-34 table)

See Section 3.3.1.2 for mine portal descriptions. Portal locations are noted on Plate 3-1.

3.2.3 Surface Buildings and Structures

Locations of proposed surface buildings and structures are shown on Plate 3-1.

Surface Facilities. Plate 3-1 shows the locations of the following surface facilities:

- Buildings, utility corridors, and facilities to be used, including:

  Water Tank - one metal tank on concrete pad,
  Fueling Station - metal tank and containment structure with fueling equipment,
  Storage Building - portable building, to be used above ground or underground, Transformer - portable, to be used above ground or underground,
  Portals - see Section 3.3.1.2,
  Conveyor - see subsequent portions of this Section,
  Fan - metal structure containing a fan,
  Substation (2) - metal structure sitting on gravel and concrete pad,
  Roads - see Section 3.2.3.300,
  Sedimentation Pond- see Chapter 7,
  Temporary Office Trailer- mobile trailer,
  Temporary Bath House Trailer- mobile trailer,
  Parking Areas - soil pads,
  Storage Areas - soil pads,
  Crusher and Screen - metal structure on concrete pad/footings,
  Emergency Escapeway - corrugated metal,
  Dumpster(s) - metal, contractor owned,

- The area of disturbance at the mine mouth,

- Coal storage and loading facilities, and

- The explosive storage and handling facility, which includes approved explosive magazine(s).

Cross sections of the surface facilities are provided on Plate 3-2. The disturbed area shown on Plate 3-1 is the same as the land area for which a performance bond or other guarantee has been posted.

Upon termination of mining operations, the following structures will be removed and the area reclaimed as outlined in Section 3.5

Drainage facilities are shown on Plate 7-4, including the site sedimentation pond, culverts, and ditches.

Transportation Facilities. Roads that have been constructed, used, or maintained by Horizon in the permit area for the mining and reclamation operations are shown on Plate 3-1. No rail systems or overland conveyor systems (other than the material-handling conveyors in the mine yard) will

Surface Configurations. Certified maps and cross sections showing the proposed final (post-reclamation) surface configuration of the Horizon disturbed area are provided on Plates 3-7 and 3-7A, respectively.

3.2.3.1 Plans and Engineering Designs

All plans and engineering designs presented in this MRP were prepared by or under the direction of and certified by a qualified registered professional engineer.

Excess Spoil. No excess spoil (R645-100-200) will be generated from the permit area.

Durable Rock Fills. No durable rock fills will exist in the permit area.

Coal Mine Waste. No coal mine waste disposal facilities will exist on the surface in the permit area.

Impoundments. The only impoundment to be constructed for the mining and reclamation operation will consist of the sedimentation pond (see Plate 3-1 and Chapter 7). This impoundment has been designed under the direction of a professional engineer using current, prudent, engineering practices. These designs were certified by a qualified registered professional engineer.

Primary Roads. The design and construction of the primary roads associated with the mine have been certified by a professional engineer as meeting the requirements of R645-301-534.200 and R645-301-742.420 (see Plate 3-4).

Variance From Approximate Original Contour. No variance from the approximate original contour requirements of the regulations is being requested in this MRP.

3.2.3.2 Utility Installation and Support Facilities

Utility Installations. All coal mining and reclamation operations will be conducted to minimize damage, destruction, or disruption of services provided by electric lines, telephone transmission stations, water lines, and sewer lines which pass over, under. or through the permit area. Areas where these utilities will be located are within non-subsidence zones. No other utility installations exist in the permit area.

Support Facilities. Support facilities at the Horizon Mine will be operated in accordance with the permit issued for the mine. Support facilities will be located, maintained, and used in a manner that:

- Prevents or contro.ls erosion and siltation, water pollution, and damage to public or private property;
- To the extent possible, using the best technology currently available, minimizes damage to fish, wildlife, and related environmental values; and
- Minimizes additional contributions of suspended solids to stream flow or runoff outside the permit area.

Water Pollution Control Facilities. Water pollution control facilities at the Horizon Mine consist of the sedimentation pond and the appurtenant structures associated with the sedimentation pond. The sedimentation pond and appurtenant structures were constructed as discussed in Chapter 7.

3.2.3.3 Road Classification

Primary roads within the disturbed area include the lower haul road loop and the upper pad road. The upper pad (approach) road and parking area have been paved. See Plates 3-1 and 3-4. No ancillary roads exist within the disturbed area. The locations of these roads are shown on Plates 3-1 and 3-4. Typical cross sections representing these roads are shown on Plate 3-4.

The unimproved dirt roads outside of the disturbed area but within the permit area will not be classified. They may be used by Horizon for access to the lease area surfaces for the collection of monitoring data (environmental and subsidence data) as well as other uses deemed appropriate by Horizon and as allowed by the associated landowner.

3.2.3.4 Description of Transportation Facilities

No surface conveyors (other than those in the mine yard immediately adjacent to the portals) or rail systems will be constructed, used, or maintained within the permit area. A description of the conveyor systems that will be used in the mine yard is provided in this M&RP.

Road Specifications. Cross sections of roads that will be used or maintained by Horizon are provided on Plate 3-4. This plate provides information regarding road widths, gradients, surfaces, etc. Information regarding road drainage structures is presented in Chapter 7.

The road which will access the mine is the Beaver Creek county road that extends from Consumers Road to the town of Clear Creek. Letters from Carbon County regarding the use of both Beaver Creek Road and Consumers Road are provided in Appendix 3-1. As indicated in this appendix,

3.3.6 Operations Schedule

3.3.6.1 Annual Production Per Year for Permit Term

Coal will be produced from the mine at an anticipated rate of approximately 700,000 tons per year. The production could increase to 1.5 million tons per year when federal coal leases are secured and if the market and mining conditions are favorable.

3.3.6.2 Operations Schedule - Days - Shifts

Production will occur in two production shifts per day and a small crew will perform maintenance work and other non-production jobs on the off production shift.

3.3.6. 4 Temporary Cessation

If operations are to be temporarily ceased for more than 30 days, Horizon will submit to the Division a notice of intention to cease or abandon the operations. In accordance with R645-301-529.210, each mine entry that has further projected useful service will be protected by barricades or other covering devices, fenced, and posted with signs to prevent access into the entry and to identify the hazardous nature of the opening. These devices will be periodically inspected and maintained by Horizon.

3.3.7 Mine Permit Area

3.3.7.1 Acreage and Delineation of Mine Permit Area

See Chapter 2 for the total acreage contained within the mine permit boundary.

3.3.7.2 Projected Mining by Year

The projected mining by year is shown on Plate 3-3.

3.3.8 Mine Plan Area

Horizon plans to mine within the mine permit boundary as shown on Plate 1-1. Plans for mining beyond the permit term will be developed as additional information is acquired. No new areas will be mined until appropriate permits have been obtained from their corresponding regulatory agencies.

3.4 Environmental Protection

3.4.1 Preservation of Land Use

Upon completion of mining operations, final reclamation work will commence. Reclamation efforts will be directed to accommodate post-mining land use.

3.4.1.1 Projected Impacts of Mining on Current and Future Land-Use

3.5 Reclamation Plan

3.5.1 Contemporaneous and Interim Reclamation

Disturbed area's when no longer needed, will be backfilled, graded, retopsoiled, and revegetated. Seeding, fertilizing, and mulching will be performed as soon as practical following redistribution of topsoil. Seed Mix #2 presented in Table 3-3 will be planted, and erosion-control matting will be installed in specific areas as described in Section 3.5.5.3. Reclamation techniques are described below. Areas that will not be redisturbed will be classified as contemporaneously reclaimed. Seed Mix #1 will be used in areas requiring soil stabilization during the operational period of mining. These areas will likely be redisturbed either during the operation or reclamation of the mine site. The areas that will be redisturbed during operation or final reclamation contouring will be classified as interim reclamation. Areas where interim reclamation contacts a steep bank dropping to a diversion ditch will be protected by attempting to control the loss of topsoil by installing a mulch mat a minimum of one foot above and below the grade break.

During October 1997, the areas designated on Plate A within Appendix 8-1 are scheduled for stabilization seeding using Seed Mix No. 1. Refer to Section 8.8 for additional information.

Underground Coal Mining and Reclamation Activities. All surface equipment, structures, or other facilities not required for continued underground mining activities and monitoring, unless approved by the Division as suitable for the post-mining land use or environmental monitoring, will be removed and the affected lands reclaimed following permanent cessation of mining operations.

Reclamation Timetable. A timetable for the completion of each major step in the reclamation plan is presented in Table 3-4.

Plan for Backfilling, Soil Stabilization, Compacting, and Grading. The regrading plan for the Horizon Mine was designed to meet the objectives of balancing cut and fill quantities and maintaining a geotechnically and erosionally stable base.

- Backfilling to remove portal entrances (highwalls) within the objectives noted above (cut and fill balance, site stability, and erosion control),
- Construction of stable channels across regraded areas:
- Placement of topsoil;
- Revegetation and mulching of the topsoiled site; and

TABLE 3-4

Reclamation Timetable

Task	Months from Start of Reclamation					
	1	2	3	4	5	6
PHASE I						
Seed/Plant Ordering	---------					
Portal Sealing	---------					
Demolition - Structure Removal	---------	---------				
Rough and Final Grading		---------	---------	---------		
Soil Testing/Order Amendments				---------		
Topsoil Distribution				---------	---------	
Seeding & Mulching						-------
Vegetation/Water Monitoring						-------
PHASE II - To Follow Phase I Bond Release						
Seed/Plant/Amendment Ordering*	---------					
Topsoil Distribution					---------	
Seeding & Mulching						-------
Reclamation Monitoring	Until bond release					

TABLE 3-1

RECLAMATION CUT AND FILL CALCULATIONS

Using present surface contours from Plate 3-7 in conjunction with revised reclamation contours through AutoCad 2000 and Survcadd 2000

Area in Cut: 18,295 sq ft, 0.420 acres
Area in Fill: 17,997 sq ft, 0.413 acres
Total inclusion area: 0.833 acres
Cut to Fill ratio: 1.15
Average Cut Depth: 7.26 ft
Average Fill Depth: 6.41 ft
Cut volume: 4,916 cubic yards
Fill volume: 4,275 cubic yards

Backfilling and Compaction. As indicated previously in this M&RP, the surface at the Horizon Mine was originally disturbed between the 1920s and the 1950s by previous mining operations. These prior operators made no effort to salvage any topsoil or other soil material for subsequent site reclamation. Therefore, restoration to a contour that approximates pre-mining conditions is neither practical nor required by the regulations. However, it is the intent of Horizon to restore the area to a topography that is compatible with the post-mining land use, using materials that are available at the site.

All vegetation, organic matter, and debris will be cleared from areas to receive fill. The cut material from site regrading will be placed as fill and graded to facilitate drainage from the mine site and contributing side areas. All fill placed during recontouring of the site will be compacted to at least 85 percent of maximum Proctor density (ASTM 0698). Compaction will be accomplished using repeated passes of rubber-tired equipment, rollers, and other appropriate equipment.

Side hill embankments, where the width is too narrow to allow access by compaction equipment, will be initially constructed by spreading the soil with a dozer, but only to a width necessary to allow compaction equipment access. After this is achieved, the fill will be placed in lifts and compacted to at least 85 percent of maximum Proctor density.

Care will be taken to ensure that fill materials are not frozen during placement or compaction. Any areas that are damaged by freezing will be reconditioned, reshaped, and recompacted to at least 85 percent of maximum Proctor density. All fill placement and compaction activities will be overseen by an experienced engineer.

Roads. Roads within the disturbed area will be reclaimed if not needed for post-mining land use. Topsoil will be applied to the regraded surfaces and the area will be revegetated as discussed in Chapters 3 and 8, respectively.

3.5.2 Soil Removal and Storage

Soil surveys conducted at the mine site have distinguished disturbed lands from undisturbed soil mapping units (see Chapter 8, Plate 8-1). Areas mapped as disturbed land are areas where the soils, vegetation, or both were affected by previous mining operations. Disturbance of the roads and pads occurred prior to regulatory requirements to salvage topsoil from those areas.

All topsoil/growth medium to be generated during the future disturbances will be stockpiled. The stockpiles will be contoured, fertilized, vegetated with Seed Mix #1 outlined in Section 3.5.5.2, and mulched as outlined in Section 3.5.5.3. Markers will be placed indicating that the piles contain topsoil. Berms and/or strawbales will be placed around the stockpile to minimize off-pile transport of sediment.

Areas of interim reclamation that will be redisturbed for final reclamation contouring will have the depth topsoil that was placed on those areas removed and placed back on the topsoil stockpile for redistribution onto the newly recontoured area. A qualified person will be present during the removal of the topsoil in these areas. See Plate 3-7 for areas where interim reclamation will be redisturbed and areas where re-contouring is complete an interim vegetation has been established.

Refer to Section 8.8 for the methods being used in the removal and redistribution of soils.

3.5.3 Final Abandonment

Upon permanent cessation of operations, permanent reclamation will be performed. Surface equipment, structures and facilities (other than sedimentation control) associated with the operation not needed for post-mining land use will be removed during reclamation of the affected area.

3.5.3.1 Sealing of Mine Openings

Abandonment of Openings. When no longer needed for mining operations, all portals will be sealed and backfilled by collapsing the concrete canopies over each portal. Prior to the sealing of the mine openings, all combustible materials will be removed from the portal area. All structures that would interfere with sealing of the mine openings wlll also be removed. The permanent closures will be constructed to prevent access to mine workings by people, livestock, and wildlife. Potential surface drainage will also be kept from entering the sealed entries.

All mine openings will be sealed at least 20 feet inside the mine opening. Prior to installation of the seal, all loose material will be removed from the roof, floor, and rib of the mine within the seal area. The seal will then be constructed using solid concrete blocks with nominal dimensions of 8 inches high, 8 inches wide, and 16 inches long. Mortar will consist of one part cement, three parts sand, and no more than 7 gallons of water per sack of cement.

In the bottom course, each block will be laid with its long axis parallel to the rib. The long axis in succeedingly higher courses will be perpendicular to the long axis of the blocks in the preceding course. The seal will be recessed at least 8 inches deep into each rib and 8 inches deep into the floor. No recess will be made into the roof.

The seals will have a thickness of approximately 16 inches. Following seal construction, the entries will be backfilled from the seal to the outside surface with soil that is sloped at the surface to match the final slope at the entry.

Casing and Sealing of Underground Openings. Each underground opening to the mine will be sealed and backfilled when no longer needed for monitoring or other use approved by the Division upon finding of no adverse environmental or health and safety effects. This closure method has been designed to prevent access to the mine workings by people, livestock, fish and wildlife, and machinery. The closures have also been designed to keep water from flowing from the mine workings to prevent acid or other toxic drainage from entering ground and surface waters.

Details of the seals are shown on Figure 3-7.

3.5.3.2 Removal of Surface Structures

Following sealing of the portals, surface structures and facilities not required for post-mining use will be removed. The schedule and cost of removal is detailed in Section 3.5.6 and 3.5.7, respectively.

Building Demolition. Prior to significant regrading activities at the Horizon facility, existing buildings, retaining walls, utilities, coal-handling facilities, and other above-ground structures will be removed from the area insofar as they are not needed for post-mining land use. To the extent possible, these structures and facilities will be salvaged. Nonhazardous and nonflammable materials, such as concrete and steel, may be used as backfill.

If thus disposed of, these materials will be incorporated into the backfill under at least 4 feet of soil cover in a manner that will not create voids within the backfill or reduce the effective compaction necessary for backfilling. If foundations will not interfere with post-mining land use, they will be left in place for on-site burial.

During the site regrading, if any of the toxic coal waste that is buried in the mine pad fill is uncovered, the material will be properly placed in the fill areas of the recontouring outside drainage flows so it can be covered beneath four feet of non-toxic fill material and erosion of the drainage over time will not contact these areas. The locations will be mapped at the time of placement and submitted to the Division.

Non-coal wastes found during reclamation, such as garbage, lumber, and other combustible materials generated during previous mining activities, will be segregated and stored in a controlled manner in a temporary storage area in appropriate containers.

Final disposal of all such waste will be in the backfill (as indicated above) or at a State-approved solid waste disposal facility, as appropriate. Notwithstanding any other provision of the R645

Rules, any non-coal mine waste defined as "hazardous" will be handled in accordance with the requirements of Subtitle C of RCRA and any implementing agency.

Mining equipment too large for a container will be placed in a designated temporary storage area as determined at the time of reclamation activities. Final decisions regarding salvage or disposal of structures and equipment will be made just prior to reclamation following an assessment of the salvageability of the structures and equipment.

3.5.3.3 Disposition of Dams, Ponds, and Diversions

Diversions that are not planned for permanent use following reclamation will be removed during the backfilling and regrading operations.

3.5.4 Backfilling and Grading Plans

Approximate Original Contour. The area of the Horizon surface facilities was disturbed by previous mining activities. No pre-mining topographic maps of the area are known to exist. The reclamation plan has been designed to achieve post-mining land use and eliminate highwalls associated with the Horizon Mine.

Elimination of Highwalls, Spoil Piles, and Depressions. The backfilling and grading plan has been designed to eliminate highwalls at the site that were associated with the Horizon Mine. The access to the coal seam is by three slopes from the surface to the coal seam some 46 feet below the ground elevation of the top of the slopes. The return slope uses the old Blue Blaze No. 1 Mine slope. A 50 foot concrete portal cover was constructed from the mouth of the old slope and was backfilled to eliminate any exposed

highwall. The old slope was then widened to accommodate modern mining equipment. The belt slope was excavated a length of 95 feet to solid overburden where the slope could be driven down to the seam. A 95 foot concrete portal cover was constructed for the belt slope. The intake slope was excavated a length of 125 feet to solid overburden. A 125 foot concrete portal cover was constructed for the intake slope. The excavated portions of the portal covers have been covered to eliminate any highwall faces. No highwalls exist on the current disturbed area. The portal accesses to the seam are constructed for easy demolition and use of the material as backfill. No spoil piles exist. With the exception of the small depressions to retain moisture, minimize erosion and to assist in revegetation, no depressions will remain at the site following reclamation. Refer to Plate 3-7 and Figure 3-6.

Slope Stability. Based on information provided in Chapter 8 of this M&RP, soils at the Horizon site consist of low plasticity, cohesive materials with a wide assortment of grain sizes. The angle of repose in such soil is dependent not only on interparticle friction, but also on cohesion, which is dependent on the density, moisture content, and compaction moisture content of the soil. In general, as long as they do not become saturated or are not fissured, cohesive soils have a greater angle of repose than non-cohesive soils and can maintain vertical or near-vertical slopes under certain conditions. The angle of repose of a loose sand generally varies between 30 and 35 degrees (Holtz and Kovacs, 1981). Therefore, presumably, the angle of repose of a slightly cohesive granular soil will be greater than 30 to 35 degrees. For the purpose of this site, the angle of repose will be assigned a value of 35 degrees, which corresponds to a slope of about 1.5 horizontal to 1 vertical (1.5H: 1 V).

Backfilled and regraded slopes have been designed to not exceed the angle of repose. Design calculations indicate that the minimum safety factor of emplaced soil, at a slope of 1.5H:1V, is 1.4 under saturated conditions and 1.9 under unsaturated conditions. The static safety factor will increase with decreasing slope. The slopes have thus been designed to prevent slides.

Erosion and Water Pollution. Temporary sediment-control measures will be implemented during and following backfilling and regrading. As vegetation becomes established on the reclaimed surfaces, erosion potentials will be further minimized. By minimizing erosion, water pollution will also be precluded. Additional water-quality concerns do not exist at the site (see Chapter 7).

Post-Mining Land Use. The disturbed area will be backfilled and regraded in a manner that supports the approved post-mining land use.

Exposed Coal Seams. No coal seams are currently exposed in the disturbed area. Should any coal seams be exposed during the recontouring phase of reclamation, the coal outcrops exposed will be covered with a minimum of 4 feet of nontoxic and noncombustible materials during final backfilling and grading. This cover material may consist of material removed during grading of the site, subsoil, and/or topsoil.

Acid- and Toxic-Forming Materials. Buried waste materials from mining operations that used Portal Canyon are shown on Plate 3-7.

Combustible Materials. All combustible materials that are exposed, used, or produced during mining will be disposed of off site.

Cut-and-Fill Terraces. No cut-and-fill terraces occurring from or used by the Horizon operation will be retained at the site following final grading activities.

Highwalls From Previously Mined Areas. Several highwalls exist outside the disturbed area that are the result of previous mining operations. The reclamation plan has been designed to eliminate the faceup area made by Horizon Mine within the disturbed area. The anticipated post-mining contours indicate that the available materials are sufficient to eliminate the face up highwall within the disturbed-area boundary during reclamation.

The schedule for backfilling and grading is detailed in Section 3.5.7.1.

3.5.4.1 Removal or Reduction of Highwalls

No exposed highwalls exit on the current disturbed area. Final reclamation cross sections and contours of the portal accesses show that no new highwall features will be created after the collapse of the portal covers. See Figure 3-6 and Plate 3-7 and refer to Section 3.5.4.

3.5.4.2 Recontouring

All surface reclaimed areas will be protected and stabilized to effectively control erosion. Final grading, preparation of overburden, and placement of topsoil will be done along the contour to minimize subsequent erosion and instability. Rills and gullies which form in areas that have been regraded and topsoiled and either disrupt the approved post-mining land use or the reestablishment of the vegetative cover, or, cause or contribute to a violation of water quality standards for receiving streams, shall be filled, regraded, or otherwise stabilized; topsoil shall be replaced; and the areas shall be reseeded or replanted. This will be accomplished using the best technology currently available.

3.5.4.3 Fencing and Erosion Control

Fencing will be placed as required to protect revegetation efforts from livestock grazing. This fencing will be removed prior to requesting final bond release. Refer to Section 3. 5.4 for additional information on erosion control.

3.5.4.4 Soil Redistribution and Stabilization

When final reclamation begins, the disturbed areas to be reclaimed will be loosened by ripping to allow easier backfilling and grading operations. During redistribution of soils, care will be taken to prevent excessive compaction.

Soils disturbed during mining, including but not limited to fill material, will be placed within the disturbed area boundary. Refer to Section 8.8 for further information concerning plans for soil redistribution.

3.5.5 Revegetation Plan

The revegetation plan has been designed to assure that all disturbed lands will be reclaimed to accommodate post-mining land use once the mining operation has been completed. The plan calls for temporary revegetation of disturbed areas where possible during the mining operation.

3.5.5.1 Soil Preparation

After backfilling, grading, recontouring, scarifying, and the redistribution of topsoil, the seed bed will be prepared using the best technology currently available. Prior to seeding, composite soil samples as will be collected and analyzed as discussed in Section 8.9. Based on the results of these analyses, fertilizer will be applied at the time of seeding.

3.5.5.2 Seeding

Areas to be revegetated will be reseeded with either Seed Mix #1 (Table 3-2) or with Seed Mix #2 (Table 3-3), as outlined below. These mixes are composed primarily of native species which either occur on the site or would be expected to grow on the site. The mixes have been designed to include species which will provide sufficient cover to prevent soil erosion, and should contain sufficient species diversity to produce a stable self-perpetuating plant community. All seeds will comply with applicable state and federal seed laws.

<u>Temporary Seed Mix</u>

On those sites where revegetation is needed during the operating years, a temporary seed mix will beused. This mix (Table 3-2) is composed primarily of native species and is designed for quick establishment and erosion control. Only one Introduced grass species (pubescent wheatgrass - Agropyron trichophorum), is included in the mix. It has been included since it is known to do well on dry sites, and will assist in controlling soil erosion. Clcer milkvetch (Astragalus ciscer) has been included because of its ability to fix nitrogen. No shrubs or forbs are included in the temporary mix, since these areas will be re-disturbed prior to final reclamation. At the actual time of planting, the mix may be altered depending on availability of the listed species. .

Permanent Seed Mix

The permanent revegetation mix is composed of a mixture of native grasses, forbs, shrubs and trees (Table 3-3). The grasses, forbs, and some of the shrubs will be planted as seeds. The remaining shrubs and trees will be planted as containerized stock. A variety of species are included in the mix in order to obtain a higher level of diversity on the revegetated surfaces. This will increase habitat diversity as variations in the microenvironments of the reclaimed surface will enhance or inhibit the germination and development of the various species.

The permanent seed mix reflects the .composition of the original communities which occurred on the site. It is included because of its ability to fix nitrogen. Approval will be obtained from the Division prior to using any substitution in seed mixtures and on the number of containerized shrubs needed per acre.

The riparian seeding mix is included in Table 3-3.

Seeding Methods

Revegetation areas will be seeded by broadcasting. Seeds when broadcast will be raked to ensure proper seed/soil contact. See Tables 3-2 and 3-3 for the seeding rates. If the first seeding does not establish, the area will be reseeded. The containerized stock will be planted in late fall or early spring, attempting to avoid undesirable conditions such as overly wet, overly dry, or frozen soils. Should the planting window close prior to completion of seeding, a sterile, quick growing ground cover will be planted to control erosion during the winter months.

3.5.5.3 Mulching

During reclamation mulch will be applied to all newly reseeded areas in order to provide a more equitable environment for seed germination and initial growth. A mulch will be applied at a rate of 2000 pounds per acre. Once applied, the mulch will be incorporated while the surface is being roughened before seeding. Erosion control matting will be placed on all slopes 2 1/2H:1V or steeper.

At the time of reclamation the most beneficial type of mulch to be used will be determined by Horizon, for bonding purposes the price will be assumed to be that for alfalfa.

3.5.5.4 Reclamation Management

The reclaimed and revegetated areas will be closely monitored to determine if any maintenance is necessary (refer to Sections 3.5 and 9.8 for a description of the monitoring program). Problems which may require management include severe erosion, excessive weeds, bare patches of failed planting, and damage by wildlife. Hills and gullies which form in areas that have been regraded and topsoiled and which either disrupt the approved post-mining land use or the reestablishment of the vegetative cover, or, cause or contribute to a violation of water quality standards for receiving streams, shall be filled, regraded, or otherwise stabilized; topsoil replaced; and the areas shall be reseeded or replanted. If weeds occur, a weed control plan will be proposed to UDOGM and implemented upon approval. No weed control will be attempted during the first growing season. It is likely that weed species will form a conspicuous part of the vegetation on the reclaimed areas during the first year but will be replaced by revegetative species thereafter.

3.5.5.5 Revegetation Monitoring

Revegetated areas will be monitored in accordance with Section 9.8 of this permit application.

3.5.5.6 Establishment of Wildlife Habitat

Section 10.5 provides a detailed discussion of the reclamation, mitigation and management plans for terrestrial habitats and wildlife.

3.5.6 Reclamation Monitoring

The standards for success in the previously disturbed areas of the site are outlined in section R645-301-356.250 of the regulations. The applicant intends to return the previously disturbed areas to accommodate intended post-mining land use and controlling erosion (see Section 9.8).

3.5.7 Schedule of Reclamation for Horizon Mine

3.5.7.1 Timetable for Completion of Major Reclamation Processes

The approximate schedule of reclamation activities is outlined in Table 3-4. The graphical schedule has been extended by approximately 10 percent beyond the numerical estimates presented below to account for unanticipated delays.

The Phase I reclamation tasks are therefore proposed to be completed within 24 weeks following the start of reclamation activities, assuming adequate weather conditions. Eight weeks are planned for the completion of Phase II reclamation tasks.

3.5.8 Cost Estimate for Final Reclamation

The estimated cost to reclaim the Horizon Mine surface facilities is provided in Appendix 3-7.

The reclamation costs were evaluated to determine if the 1 00-foot culvert extension planned for 1997 (Appendix 3-9) would be covered by the estimated amount.

3.6 References

Dunrud, C. Richard, 1998, Engineering Geology Applied to the Design and Operation of Underground Coal mines, U.S. Geological Survey, Information Services.

Guy, Dan, Personal Statement, 1985

Tables 3-3
Reclamation Seeding

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~~Chapter 4, Land Use~~
~~Hidden Splendor Resources, Inc. April 2004~~

4.4.2 Mine Plan Area Land Use - Past and Present

The land on which the Horizon No. 1 Mine is located has long been used for coal mining. Other than coal mining, this area has been used for hunting, hiking, and grazing. ~~There are no developed campgrounds or paved public roads within the area and none are planned for the future.~~

The land use within and adjacent to the permit boundary at the time of this application is the monitoring *of* previous mining operations, mining reclamation activities, wildlife habitat, and grazing. The lands within the permit boundary are monitored to gather data necessary in permitting a mining operation. Horizon is unaware as to the owners intended use for all lands in the area, therefore Plate 4-1 outlines areas with specific or specialized land uses.

Private landowners presently administer the lands in this area for limited livestock forage. Cattle and sheep are herded through the proposed mine site area in spring and back through in the fall. Wildlife habitat, watershed, dispersed recreation, and coal mining are also land uses in the area. There are no range improvements in the area. Access to the grazing lands is limited to jeep trails into the higher elevations leading to Beaver Creek above the proposed mine sites. There are no plans to alter this access situation. The mine area has been classified as M & G by Carbon County. Supportive and descriptive documentation is located in Appendix 4-1.

Carbon County owns and maintains two roads, one runs parallel to the permit boundary on the south (290), the second runs through the disturbed area (for approximately 1250') enabling access to higher elevations for grazing and recreational activities (Consumers/Clear Creek).

4.4.3 ~~Affect~~Effect of Operations on Land Use and Mitigation Measures

The surface disturbance at the No. 1 Mine will consist *of* access/haul roads and surface facilities that will service the mining operations; some wildlife will be displaced due to coal hauling and facility operation. There will be little impact on range land as the mine disturbed area is below areas used for grazing by private landowners.

There are no public roads or public parks in or near the proposed mining operations that would suffer any impacts from mining operations. The Gordon Creek State Wildlife Management Unit lies southeast of the permit area.

The sedimentation pond will be constructed below the disturbed area to prevent sediment from entering the North Fork Gordon Creek. Refer to Chapter 7 for the location of runoff and diversion structures.

It is not projected that the mining operation will affect the land use within and adjacent to the permit boundary.

~~Chapter 4, Land Use~~
~~Hidden Splendor Resources, Inc. April 2004~~

4.5 Post Mining Land Use

Once mining has ceased, the disturbed areas will be reclaimed to ~~a degree acceptable to UDOGM and the land will once again support its principle pre-mining use: i.e., undeveloped land.~~support wildlife, hunting, hiking, grazing and recreation. Existing access roads will be maintained to facilitate access for hunting and hiking. Neighboring, ~~P~~private landowners will continue to graze sheep and cattle on areas near Beaver Creek, which is above the mine site.

The restoration of the area will be achieved by ~~regrading the yards, reclaiming the roads and portal areas to a practical degree~~, planting ~~all~~ disturbed areas not being used post-mining. ~~and monitoring the revegetation effort.~~.

4.6 Socioeconomic Consideration

The coal mining industry within Emery and Carbon Counties has shown several erratic periods of renewed growth and sudden decline. During the 1950-1960 census period, the population of Emery County declined 8.79 percent. From 1960 to 1970, Emery County's population declined .74 percent per year. From 1970 to 1975, the population increased from 5,137 to an estimated 6,700 persons, a 23 percent increase.

Carbon and Emery Counties are economically dependent upon conditions in the coal market. This is evident by the slump in population of these counties that occurred between 1950 - 1970. The recent increase in coal mining has centered in Emery County where mining employment has increased over 210 percent from 1969 to 1980. The increase has been more modest in Carbon (40 to 50 percent).

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4.4.2 Mine Plan Area Land Use - Past and Present

The land on which the Horizon No. 1 Mine is located has long been used for coal mining. Other than coal mining, this area has been used for hunting, hiking, and grazing.

The land use within and adjacent to the permit boundary at the time of this application is the monitoring *of* previous mining operations, mining reclamation activities, wildlife habitat, and grazing. The lands within the permit boundary are monitored to gather data necessary in permitting a mining operation. Horizon is unaware as to the owners intended use for all lands in the area, therefore Plate 4-1 outlines areas with specific or specialized land uses.

Private landowners presently administer the lands in this area for limited livestock forage. Cattle and sheep are herded through the proposed mine site area in spring and back through in the fall. Wildlife habitat, watershed, dispersed recreation, and coal mining are also land uses in the area. There are no range improvements in the area. Access to the grazing lands is limited to jeep trails into the higher elevations leading to Beaver Creek above the proposed mine sites. There are no plans to alter this access situation. The mine area has been classified as M & G by Carbon County. Supportive and descriptive documentation is located in Appendix 4-1.

Carbon County owns and maintains two roads, one runs parallel to the permit boundary on the south (290), the second runs through the disturbed area (for approximately 1250') enabling access to higher elevations for grazing and recreational activities (Consumers/Clear Creek).

4.4.3 Effect of Operations on Land Use and Mitigation Measures

The surface disturbance at the No. 1 Mine will consist *of* access/haul roads and surface facilities that will service the mining operations; some wildlife will be displaced due to coal hauling and facility operation. There will be little impact on range land as the mine disturbed area is below areas used for grazing by private landowners.

There are no public roads or public parks in or near the proposed mining operations that would suffer any impacts from mining operations. The Gordon Creek State Wildlife Management Unit lies southeast of the permit area.

The sedimentation pond will be constructed below the disturbed area to prevent sediment from entering the North Fork Gordon Creek. Refer to Chapter 7 for the location of runoff and diversion structures.

It is not projected that the mining operation will affect the land use within and adjacent to the permit boundary.

4.5 Post Mining Land Use

Once mining has ceased, the disturbed areas will be reclaimed to support wildlife, hunting, hiking, grazing and recreation. Existing access roads will be maintained to facilitate access for hunting and hiking. Neighboring, private landowners will continue to graze sheep and cattle on areas near Beaver Creek, which is above the mine site.

The restoration of the area will be achieved by , planting disturbed areas not being used post-mining. .

4.6 Socioeconomic Consideration

The coal mining industry within Emery and Carbon Counties has shown several erratic periods of renewed growth and sudden decline. During the 1950-1960 census period, the population of Emery County declined 8.79 percent. From 1960 to 1970, Emery County's population declined .74 percent per year. From 1970 to 1975, the population increased from 5,137 to an estimated 6,700 persons, a 23 percent increase.

Carbon and Emery Counties are economically dependent upon conditions in the coal market. This is evident by the slump in population of these counties that occurred between 1950 - 1970. The recent increase in coal mining has centered in Emery County where mining employment has increased over 210 percent from 1969 to 1980. The increase has been more modest in Carbon (40 to 50 percent).

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located on Jewkes Creek down- and upstream from the proposed surface facilities, respectively, and will provide information regarding the impacts of surface disturbances. Stations SS-7 and SS-8 are located on Beaver Creek up- and downstream from potential future expansions of the mine. Similarly, stations SS-10 and SS-11 are located in tributaries to Jump Creek and Beaver Creek, respectively, downstream from potential future expansions of the mine. Through the collection of flow and water-quality data up- and downstream from underground mining activities, these latter four stations will provide information on the potential impacts of underground mining activities (e.g. increases or decreases In flow and water quality due to subsidence and other potential interruptions to the hydrologic regime) on surface hydrologic conditions.

Flow data collected from stations SS-7 and SS-8 will be compared to determine variations in flows up- and downstream from the proposed workings. It should be noted that wide variations have been noted historically between these stations, with flows increasing and decreasing in the downstream direction. If the data suggest that abnormal variations in flow are occurring between stations SS-7 and SS-8, additional seepage evaluations will be conducted along Beaver Creek, similar to those described above in Section 7.1.2.

In addition to the above monitoring program and in accordance with a request by UDOGM, North Fork of Gordon Creek will be monitored for flow below Coal Canyon (see Plate 7-1) on a quarterly basis when the site is accessible. Data collected from this site will serve as a basis for evaluating the potential overall hydrologic impacts of mining within the permit area. Furthermore, station SS-12 (Plate 7-1) will be established for the collection of flow data from Beaver Creek to further evaluate flow conditions in the creek as mining progresses to the northwest. These flow data will be collected on a quarterly basis during normal monitoring periods.

Once every five years, during the low-flow season of the year (i.e., late summer or early autumn), each stream station will be sampled during the low-flow season for baseline parameters. This list of parameters is the same as that provided in Table 7-5 plus the following:

Acidity
Aluminum (dissolved)
Arsenic (dissolved)
Boron (dissolved)
Cadmium (dissolved)
Copper (dissolved)
Lead (dissolved)
Molybdenum (dissolved)
Ammonia
Nitrate
Nitrite
Phosphate (ortho)
Selenium (dissolved)
Zinc (dissolved)

~~During field reclamation activities following mining, samples will again be collected from Jewkes Creek above and below the disturbed area on a weekly basis. These samples will be analyzed in the field for turbidity as a measure of the effectiveness of the sediment control measures that will be implemented during reclamation construction~~.

By the end of each month following each calendar quarter (i.e., April 30, August 31, October 31, and January 31), a report will be submitted to the Division summarizing monitoring activities during the previous quarter. Annual reports summarizing monitoring activity will also be submitted to the UDOGM. Quarterly reports will include field measurements, observations, and analytical results

$$Q = A*V \quad \textbf{(11)}$$

Where V = Velocity (feet per second)
R= Hydraulic radius (feet)
S= Hydraulic slope (feet per foot)
N= Manning's roughness coefficient
Q= Discharge (cubic feet per second)
A= Flow area (square feet)

$$V = \frac{1.486}{n} * R^{2/3} * S^{1/2} \quad \textbf{(12)}$$

Channel parameters required for the solution of Equations (11) and (12) were obtained from design cross sections and the proposed longitudinal profile of the various channels. Values of the roughness coefficient were obtained by comparing proposed conditions with tabulated values provided by Chow (1959) and the U.S. Soil Conservation Service (1956).

For the design of the undisturbed area diversions ~~and the reclaimed channel~~s, a maximum permissible velocity of 5 feet per second was determined to be non-erosive. This was determined from Barfield, et. al. (1981) based on a graded loam soil with gravel for sediment laden flows.

Undisturbed Area Runoff Control

General. Runoff from the undisturbed area upstream of the surface facilities in Portal Canyon and Jewkes Creek will be diverted beneath the mine facilities via three culvert~~s. The culverts are designed as temporary structures for the life of the facility and will be removed following the operations.~~ The undisturbed-area culverts are sized to pass the peak flow resulting from the 100-year, 6-hour precipitation event. Calculations supporting these designs are presented in Appendix 7-4. A copy of the stream alteration permit from the Utah Division of Water Rights required for installation of the undisturbed-area culverts is included in Appendix 7-12.

Diversions. The bypass culverts are sized to safely pass the peak flow resulting from the 100-year, 6-hour precipitation event. Plate 7-5 shows the location of the culverts and the drainage area to each structure, respectively.

Undisturbed area culvert UC-1 will bypass drainage runoff from culverts UC-2 and UC-3 (i.e., Portal Canyon and Jewkes Creek, respectively). The combined 100-year, 6-hour peak flow from these drainages is 27.9 cfs. The culvert to be installed in this section of the drainage will have a diameter of 36 inches, based on the minimum slope section and open-channel flow conditions for the culvert.

Culvert UC-2 will receive runoff from Portal Canyon. The 100-year, 6-hour peak flow for this culvert is 8.3 cfs. A 24-inch diameter culvert is planned to be installed at this location. This size is based

Disturbed-area culverts will be installed to convey runoff beneath roadways on the facility pad. Culvert DC-1 will be installed to carry runoff from the fan-portal access road beneath the main pad roadway into diversion DD-1. The peak discharge to this culvert from the 25-year, 6-hour precipitation event will be 0.60 cfs. An 18-inch diameter culvert is planned to be installed at this location, based on inlet control conditions with a headwater to depth ratio of one or less. This culvert will be extended to facilitate the installation of a transformer adjacent to the conveyor. The culvert is shown on Plate 7-4.

Culvert DC-2 was installed to convey runoff from the coal loadout area beneath the main facility roadway and into the sediment pond. The peak discharge to this culvert from the 25-year, 6-hour precipitation event will be 0.59 cfs. Culvert DC-2 will consist of an 18-inch diameter culvert, based on inlet control conditions for the culvert with a headwater to depth ratio of one or less.

Culvert DC-3 was installed to convey runoff from the hillside on the north side of Portal Canyon and below culvert DC-1. Waters discharging to DC-3 will run beneath the roadway and into diversion DD-1. The peak discharge to this culvert from the 25-year, 6-hour precipitation event will be 0.04 cfs. Culvert DC-3 consists of an 18-inch diameter culvert, based on inlet control conditions for the culvert with a headwater to depth ratio of one or less.

Drainage from the ancillary roads will be controlled by the use of water bars and berms. Plate 7-4 shows the location of the water bars on the ancillary roads to the fan portal and the monitoring well. Plate 3-4a shows the details of the water bars. Each of the water bars has been sized to handle the drainage from the 10 year - 6 hour event for the largest area reporting to a water bar. The worst case peak flow is estimated to be 0.24 cfs (maximum discharge). Based on the water bar details, the anticipated flow depth for this peak flow is 0.2 foot with a flow velocity of 1.48 feet per second. Appendix 7-4 presents the design calculations and a diagram outlining the largest drainage area reporting to a water bar on either ancillary road. The design depth of the water bar is 1 foot, thence the freeboard is 0.8 foot. The velocity is not erosive as it is less than 5 feet per second. Therefore, the proposed design for water bars on the ancillary roads, as indicated on Plate 3-4a, is adequate. The road is now asphalt and previously was compacted therefore, the runoff curves are comparable. ~~This road is a temporary road.~~

The water diverted by the water bars will be collected in a half-round culvert and conveyed over the downslope into a gravel lined basin. The water will then travel overland into the diversion channel and into the sediment pond.

In two places the ancillary road will need to cross the DD-1 ditch. In both locations, the cross-section of ditch DD-1 will transition to a 1 foot deep, 5H:1V sideslope, triangular shaped ditch. The channel slope through the transition section will be limited to 0.05 foot per foot. Based on the calculations presented in Appendix 7-4, the flow depth through these transition section will be 0.29 foot deep and the design velocity will be 3.02 fps.

Sedimentation Pond Design. Runoff from the disturbed area and adjacent undisturbed areas will be directed to the sedimentation pond as indicated above. The areas around all surface facilities, including buildings, trash containers, coal storage, and the topsoil stockpile, will be sloped so that the drainage from these facilities will be directed to the sedimentation pond.

Reclamation Hydrology Design

General. Following the completion of mining operations, the mine site area will be reclaimed as discussed in Chapter 3 of this application. ~~As part of the reclamation activities, Horizon will reestablish the natural drainage patterns and reconstruct the drainage channels.~~

~~The channels to be reestablished are Portal Canyon Creek and Jewkes Creek. These channels will need to be reestablished within the canyon bottom. Due to the proposed reclamation site configuration and the location of the sedimentation pond embankment, it is not practical to retain the operations sedimentation pond through the entire reclamation period. Prior to the removal of the sedimentation pond during reclamation, a UDOGM hydrologist will be notified and given the opportunity to inspect and endorse the removal. Several options are available to handle the reclamation drainage. For one pond to handle the total runoff from the entire 551 acres, a pond larger than the disturbed area would be needed. If the undisturbed runoff were past through the site using open channels, a minimum of three ponds, one at the bottom of the wedge formed by the junction of Portal Canyon Creek and Jewkes Creek and two ponds, one on each side of Jewkes Creek, at the lower end of the disturbed area boundary, would be required to contain the runoff, due to the presents of the open channels.~~ The existing drainage structure will, be left in place. Riparian vegetation around the existing ditches, culverts, and sediment pond is well developed.,

~~Also, each of these ponds would require a series of disturbed and undisturbed diversion ditches to bypass the undisturbed water above the reclaimed areas and to collect the reclaimed area drainage and convey it to the ponds. Additionally, once the portions of the site draining to the ponds were revegetated and the ponds and disturbed and undisturbed diversion ditches were ready to be removed, almost half of the revegetated area draining to the ponds would need to be disturbed again, due to the limited area between the open channel and the disturbed area boundary. As a result, the use of sedimentation ponds during the entire reclamation period would lengthen the time necessary to establish permanent vegetation throughout the permit area. Therefore, Horizon proposes to retain the sedimentation pond for as long as practical during regrading of the site area and removal of the bypass culverts. Once it is no longer practical to retain the sedimentation pond, it will be removed and the area will be reclaimed. Based on calculations presented in Appendix 7-4, the use of alternative sediment control measures (such as mulching, deep gouging, and reseeding) will produce less sediment than undisturbed watersheds at the same site.~~

If feasible, efforts will be made to minimize reclamation activities during periods of wet weather. During short periods when reclamation construction activities will be suspended (i.e., evenings and weekends), the construction site will be left in a condition which would minimize the impact on the hydrologic system if a precipitation event were to occur. Since conditions will vary between each area to be protected and each event, various siltation structures will be used. Horizon commits to establish and maintain sediment control using the best technology available at the time of reclamation. Refer to Section 7.2.3.2, Sediment Control for various possible structures.

~~Reclamation Channel Design. Reclamation channels have been designed to convey the peak flow from the 100-year, 6-hour precipitation event. Plate 7-7 presents the drainage areas of the proposed drainages following reclamation activities. Appendix 7-4 presents the calculations for the peak flows for these drainages. As indicated in Appendix 7-4, the design capacities of the reclamation channels exceed the capacities of the natural stream channels up- and downstream from the proposed reclamation channels. Specifically, as indicated in Appendix 7-4, the natural and reclaimed capacities of Portal Canyon Creek and Jewkes Creek are as follows:~~

~~Creek~~	~~Upstream~~	~~Downstream~~	~~Reclamation~~
	~~Capacity (cfs)~~	~~Capacity (cfs)~~	~~Capacity (cfs)~~
~~Portal Canyon (RD-1)~~	~~13.1~~	~~---~~	~~56.7~~
~~Jewkes (RD-2)~~	~~27.6~~	~~38.7~~	~~143.5~~
~~Jewkes (RD-3)~~	~~27.6~~	~~38.7~~	~~150.6~~

~~Drainage from the 181.2-acre Portal Canyon watershed will flow through the reclaimed stream channel RD-1. As indicated in Appendix 7-4, the peak flow for the 100-year, 6-hour event for this drainage is 9.95 cfs. The reclaimed channel will be trapezoidal in shape and will be constructed with an 8-foot bottom width, 2H:1V sideslopes, and a channel slope ranging from 0.038 to 0.167 foot/foot (see Figure 7-12 and Plate 3-7). The channel will be constructed in regraded materials and will be riprapped to provide a stable stream section. To handle this event, the channel will have a maximum flow depth of 0.36 feet and a maximum velocity of 5.79 fps. The channel depth is planned to be a minimum of 1 foot, resulting in a freeboard of 0.68 feet. Riprap with a median diameter of 0.5 foot will be installed to enhance long-term erosion protection. Material gradation for this riprap is presented in Table 7-6. A sand filter blanket will be installed beneath the riprap as indicated in Appendix 7-4 and Figure 7-12.~~

~~Reclamation channel RD-2 will receive flow from the 358.2 acre Upper Jewkes Creek drainage. The reclaimed channel will be a compound channel to provide channel stability and assist in establishment of the riparian/wet meadow vegetative community which currently exists along portions of Jewkes Creek. The base channel will be trapezoidal in shape and will be constructed with an 8-foot bottom width, 2H:1V sideslopes, and a channel slope of 0.013 to 0.087 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this low flow channel, based on the 100-year, 6-hour event, is 19.75 cfs. The channel will be constructed in regraded materials and will be riprapped to a stable stream section. To handle this event, the channel will have a maximum flow depth provide of 0.65 foot and a maximum velocity of 6.06 fps. The channel depth is planned to be 2.0 feet deep, resulting in a freeboard of 1.35 feet. According to Appendix 7-4, the channel will be lined with riprap which will have a median diameter of 0.5 foot, with a material gradation as presented in Table 7-6. A sand filter blanket will be installed beneath the riprap as indicated in Appendix 7-4 and Figure 7-12.~~

~~Two procedures will be implemented during reclamation to assist in the re-establishment of riparian/wet meadow vegetation along Jewkes Creek. First, following installation of the filter blanket and the riprap, soil will be worked into the voids of the riprap using the bucket of a backhoe. The purpose of this soil will be to provide a growth medium for the seeds and seedlings that are planted in the channel during revegetation.~~

figure 7-12

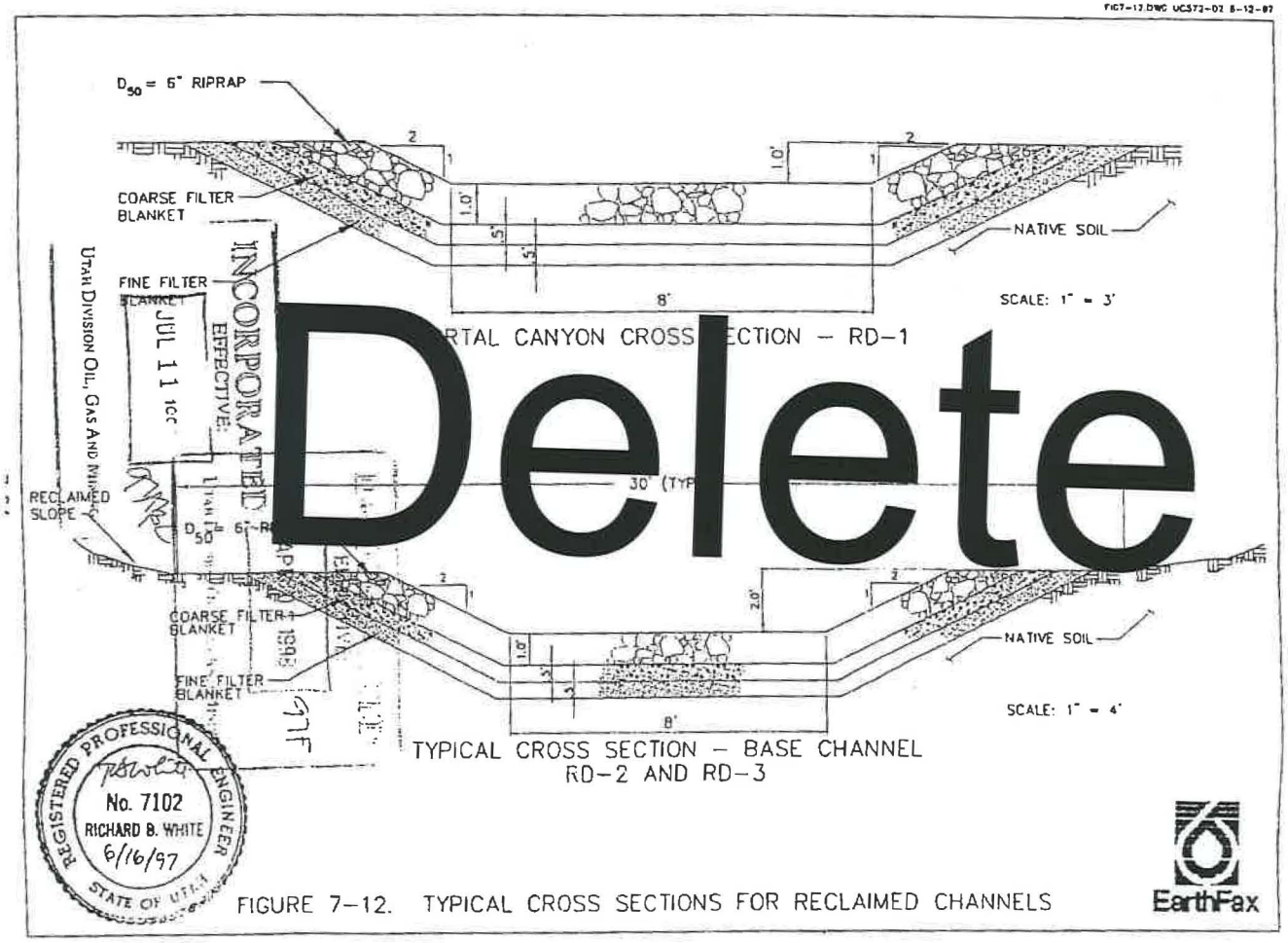

FIGURE 7-12. TYPICAL CROSS SECTIONS FOR RECLAIMED CHANNELS

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REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
6/16/97
STATE OF UTAH
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DIV OF OIL GAS & MINING

~~econd, loose-rock check dams will be installed at the locations indicated on Plate 3-7 in accordance with Figure 7-12a. These check dams have been designed in accordance with the procedures outlined by Heede (1976) as indicated in Appendix 7-4 and will cause naturally- occurring sediment in the stream to be deposited in the reclaimed channel. As noted in Appendix 7-4, the rock used in the check dams will have a median diameter of 9 inches, which size has been found by Heede (1976) to be stable under conditions similar to those at the Horizon site. This deposited sediment will provide an additional soil base for re-establishment of the riparian/wet meadow vegetation and will also provide a cross section which is more typical of that which currently exists. Nonetheless, should a major storm event occur, the underlying base channel will provide long-term protection against excessive erosion.~~

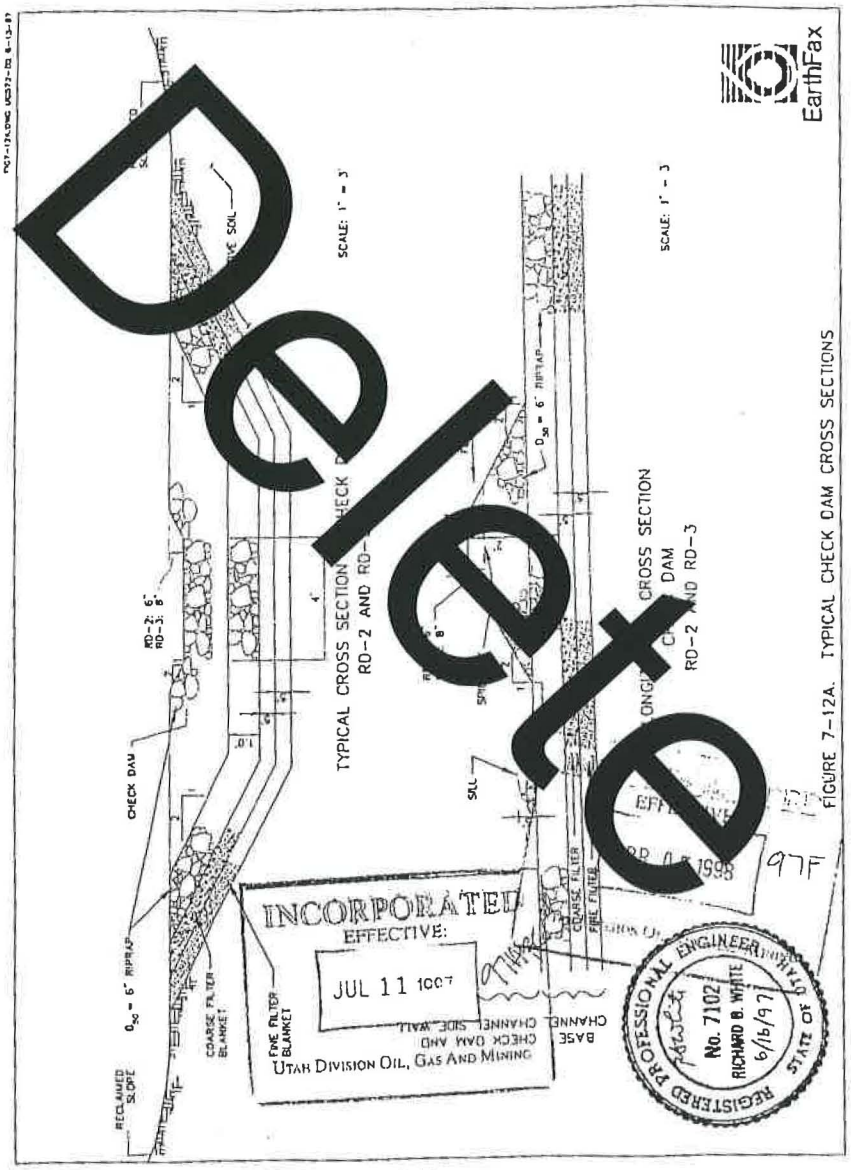
~~The check dams have been designed with a spillway that is capable of passing the peak flow resulting from the 10-year, 6-hour precipitation event. Discharge in excess of that event will flow onto the adjacent flood plain. By spreading this flow, moisture will be provided to the riparian/wet meadow vegetation to assist in its re-establishment. Data included in Appendix 7-4 indicate that the soil in the flood plain will be erosionally stable during runoff resulting from the 100-year, 6-hour rainfall event.~~

~~The width of the reclaimed flood plain will be at least equal to that of the current riparian/wet meadow vegetation community, as defined on Figure 2 of Appendix 9-2. The planned width of the reclamation flood plain is indicated on Plate 3-7. Check dams will be installed within the flood-plain sections as indicated on Plate 3-7. Even though the calculations provided in Appendix 7-4 indicate that the flood plain soils will be erosionally stable, a temporary jute matting will be installed in these flood plain areas to provide additional protection for the seeds until vegetation is established.~~

~~The flood plain of channel RD-2 will also be trapezoidal in shape and will be constructed with a typical bottom width of 30 feet, 2H:1V sideslopes, and a channel slope ranging from approximately 0.013 to 0.087 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this flood plain channel, based on the 100-year, 6-hour event, is 19.75 cfs. Allowing for the capacity of the low-flow channel, the flood plain will only be required to handle 10.29 cfs. The channel will be constructed in regraded materials and will be stabilized using a temporary jute mesh erosion control blanket. This blanket will be in place only until the vegetation planting for the flood plain mature and provide natural protection. To handle this event, the flood plain channel will have a maximum flow depth of 0.19 foot and a maximum velocity of 3.24 fps. The velocity is less than the 5.5 fps allowed for jute mesh.~~

~~Reclamation channel RD-3 will receive flow from the 551.0 acre Lower Jewkes Creek drainage, below the confluence of Jewkes Creek and Portal Canyon. The reclaimed channel will also be a compound channel. It will consist of a base channel and a flood plain, with loose-rock check dams. The base channel will be trapezoidal in shape and will be constructed with an 8-foot bottom width, 2H:1V sideslopes, and a channel slope ranging from approximately 0.022 to 0.100 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this base channel, based on the 100-year, 6-hour event, is 30.21 cfs. The channel will be constructed in regraded materials and will be riprapped to provide a stable stream section. To handle this event, the base channel will have a maximum flow depth of 0.71 foot and a maximum velocity of 7.38 fps. The channel depth is planned to be 2. 0 feet, resulting in a~~

figure 7-12a



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~~freeboard of 1.29 feet. The velocity is greater than 5 fps, requiring riprap protection. According to Appendix 7-4, this riprap will have a median diameter of 0.5 foot, with a material gradation as presented in Table 7-6. A sand filter blanket will be installed beneath the riprap as indicated in Appendix 7-4 and Figure 7-12.~~

~~Soil will be worked into the channel riprap and loose-rock check dams will be installed in channel RD-3 as indicated above. The flood plain will also be trapezoidal in shape and will be constructed with a typical bottom width of 30 feet (but at least equal to the extent of the pre-mining riparian/wet meadow vegetation community as defined on Figure 2 of Appendix 9-2), 2H:1V sideslopes, and a channel slope ranging from approximately 0.022 to 0.100 foot/foot (see Figure 7-12 and Plate 3-7). Peak flow for this flood plain channel, based on the 100-year, 6-hour event, is 30.21 cfs. Allowing for the capacity of the low flow channel, the flood plain will only be required to handle 15.66 cfs. The channel will be constructed in regraded materials and will be stabilized using a temporary jute mesh erosion control blanket. This blanket will be in place only until the vegetation planting for the flood plain mature and provide natural protection. To handle this event, the flow plain channel will have a maximum flow depth of 0.20 foot and a maximum velocity of 3.99 fps. The velocity is less than the 5.5 fps allowed for jute mesh.~~

~~As indicated on Plate 3-7, no check dams will be installed in the middle portion of the channel RD-3. This section is currently narrow and the reclamation plan seeks to re-establish the riparian/wet meadow vegetation in this area at a width which is indicative of current conditions. Only the base channel will exist in this section, wherein the establishment of riparian/wet meadow vegetation will be enhanced by working soil into the riprap as indicated above.~~

Sediment Control. To minimize the hydrologic impacts of the ~~reclamation~~ post-mining land use, ~~work,~~ Horizon commits to ~~construct the reclaimed~~maintain existing drainage system to minimize runoff into Jewkes Creek from the disturbed areas and areas to be used during post-mining. ~~stream channels commencing at the upstream end of each channel.~~ To the extent that existing drainage systems will need to be expanded or repaired Horizon Coal Corporation proposes to employ the following ~~alternative~~ methods during ~~reclamation~~ to control sediment:

1. Silt fences
2. Surface ripping, pocking, and deep gouging
3. Mulching
4. Straw-bale dikes
5. Seeding
6. Reseeding areas that do not exhibit successful germination

~~The approximate locations of silt fences to be installed during the reclamation period are indicated on Plate 7.7a. The fences will be installed parallel to the contours with the ends of the fences turned up perpendicular to the contours to contain the sediment. Silt fences will be installed in accordance with Figure 7-5. The filter fabric will be installed against a supportive backing. To prevent sediment runoff from passing under the fence, the fabric will be secured by burying the bottom edge in a small trench along the length of the fence. In addition silt fences or straw-bale dikes will be installed in roadside ditches immediately downstream from the disturbed area.~~

Upon completion of the redistribution of the soil (Section 8.8), ~~the~~ any reclaimed areas will be seeded as outlined in Chapter 3.

To the extent that reditching is required during reclamation, ~~E~~erosion control ~~during and following reclamation~~ will be assisted by the addition of a vegetative mulch and erosion-control matting.~~, as indicated in Section 3:5.5 of this permit application. Erosion-control matting will be installed on all slope steeper than 2 1/2H:1V (see Plate 7-7a).~~ The mulch or matting significantly reduces the amount of sediment yield from an area (Simons, et. al., 1983). The mulch or matting also helps retain moisture to allow for seed germination.

~~Prior to commencing with reclamation, s~~Specifications regarding the specific erosion control matting which is proposed for installation will be submitted to UDOGM for approval as one of the Best Technologies Currently Available. Horizon will install all erosion control matting in accordance with manufacturer's instructions.

~~An evaluation of the effectiveness of the reclamation sediment-control measures outlined above is provided in Appendix 7-4. This evaluation compared the sediment production from the reclaimed surface assuming:~~

- ~~Bare Surface~~
- ~~Bare, Ripped Surface~~
- ~~Ripped and Mulched Surface~~
- ~~Ripped and Mulched Surface with Silt Fences~~

~~The sediment production from these surfaces was compared to the sediment production expected from the reclaimed surface with an established vegetative cover required for bond release. The Universal Soil Loss Equation was used to make these comparisons. According to this comparison, the proposed alternative sediment control measures will actually provide better erosion control than the control planned for the Phase II reclaimed/revegetated surface. This level of protection justifies removal of the sediment pond. Once the sediment pond is removed and the low flow channel constructed, the riparian habitat/vegetation can be established. Therefore, the alternative measures are considered to and be adequate replacement for the sedimentation pond.~~

Sediment Control Monitoring and Maintenance. The alternative sediment controls constructed during reclamation will be inspected monthly and after every major storm event. Required repairs will be implemented immediately to prevent future sediment contributions to the main stream channel.

Corrective action will consist or repairing, replacing, or adding silt fences as necessary, replacing straw bales, localized regrading of the ground surface as necessary to fill in gullies caused by erosion, and reseeding and mulching to reestablish vegetation. Soil material trapped by sediment control measures that is not used in repairing the site will be removed and disposed of in an approved area.

7.3 Probable Hydrologic Consequences

The Probable Hydrologic Consequences (PHC) of the proposed Horizon No. 1 Mine are herein determined as per Utah Coal Mining Regulation R645-301-728.100 and R645-301-728.200. Baseline geologic information is presented in Chapter 6. Baseline hydrologic information is presented in Sections 7.1 and 7.2.

7. 3.1 Potential Impacts to .Surface and Groundwater

Potential impacts of coal mining on the quantity and quality of surface and groundwater flow may include:

- Increased sediment yield from disturbed areas;
- Diminution of springs in perched aquifers overlying the mine area;
- Decreased availability of groundwater in the regional aquifer system;
- Impacts on surface and groundwater availability due to subsidence;
- Hydrocarbon contamination due to spills or leaks;
- Contamination of surface and groundwater from road salting;
- Impacts to the chemical quality of surface and groundwater;
- Impacts to public water supplies; and o Flooding or stream flow alteration.

These potential impacts are discussed in the following sections of this permit application.

7.3. 2 PHC Determination

Sediment Yield. In accordance with State and Federal regulations, a runoff conveyance and sedimentation control plan has been developed which mitigates the impacts of mining operations. Surface runoff originating upon or traveling across disturbed areas will be diverted into a sedimentation pond which will improve water quality and decrease peak flows.

Although some surface waters are temporarily diverted out of their original channels, they shortly thereafter re-enter the main channel and continue their course downstream having experienced little overall modification. Disturbed waters exiting the sedimentation pond will re-enter the natural downstream drainage system.

The potential impact of construction, mining, and. reclamation on sediment yield is an increase in suspended sediment in the surface waters downstream from the disturbed area. However, sediment-control measures (such as sedimentation pond, diversions, silt fences, straw-bale dikes, etc.) will be utilized during construction, operation, and reclamation phases (Section 7.2) to

minimize the impact that could result from elevated TSS concentrations. These facilities will be regularly inspected (see Section 7.2) and maintained as outlined in the permit and UDOGM regulations.

Impacts to the Perched Aquifer System. The hydrologic data presented in Section 7.1 indicate an absence of significant perched aquifers within the Blackhawk Formation overlying the coal to be mined. The geology of the area and the occurrence of springs in the Blackhawk Formation (Section 7.1) indicate the presence of small, laterally discontinuous perched aquifers in the Blackhawk. These small perched aquifers within or adjacent to the mine plan area may be impacted as a result of mining related subsidence. These water sources will be monitored as discussed in Section 7.1.

The perched aquifers of the Blackhawk Formation characteristically produce water from channel sandstones bounded by impervious shale beds at their bases. If subsidence fractures do intersect these perched aquifers, clay minerals contained within these shale beds will likely seal the fracture planes. Sealing of the fracture planes may allow spring discharge to continue uninterrupted.

According to the Cumulative Hydrologic Impact Assessment prepared for the area by UDOGM (1989), "Subsidence impacts are largely related to extension and expansion of the existing fracture system and upward propagation of new fractures." Vertical and lateral migration of water is partially controlled by fracture conduits. Potential changes include increased flow rates along fractures and diverting flow along new fractures or within permeable lithologies. Subsurface flow diversion may result in diminution and/or loss of flow to springs that are undermined.

Retreat mining also results in uniform downwarping and lowering of strata above the mined interval. This uniform downward movement is generally not accompanied by a significant degree of fracturing. As a result, the original attitude and integrity of the strata are maintained. Little impact on the perched aquifers of the overburden are expected to result from downwarping.

The probable consequences of mining on the hydrologic resources associated with perched aquifers are considered minimal due to: 1) small number of springs, 2) low and/or erratic spring flow, 3) absence of municipal water use rights, 4) water loss experienced at one location may be accompanied in an increased flow at another location, and 5) possible sealing of subsidence fractures by clay minerals.

Impacts to the Regional Aquifer System. As previously discussed (Section 7.1), it is anticipated that the coal in the Horizon No. 1 Mine will be saturated essentially from the beginning of mining. The potential inflow to the Horizon No. 1 Mine workings was estimated using methods presented by Lines (1985), who modeled the impacts of coal mining on groundwater conditions in the Trail Mountain area located in the Wasatch Plateau approximately 20 miles south-southwest of the proposed Horizon No. 1 permit area. From

this modeling effort, Lines (1985) presented estimates of mine inflow for various lengths and widths of mine workings as well as various hydraulic gradients. These estimates are presented in Figure 7-13.

Currently, the proposed workings within the permit area are anticipated to have a width of approximately 1,500 feet and a length of about 4,000 feet. The maximum future potential mine workings may extend over a width of 4,000 feet and a length of 8,000 feet.

The pre-mining hydraulic gradient in the permit and adjacent areas is 0.014 ft/ft, based on the data presented in Figure 7-2. This hydraulic gradient is lower than the lowest values presented in the analysis of Lines (1985) on Figure 7-13. Hence, the data presented in Figure 7-13 were utilized to prepare curves of inflow versus hydraulic gradient, based on the mine dimensions anticipated at the Horizon No. 1 Mine. These curves are presented in Figure 7-14. The curves presented in Figures 7-13 and 7-14 are based on assumed hydraulic conductivities of 0.01 ft/day for the Blackhawk Formation and 0.02 ft/day for the Star Point Sandstone, which values are approximately one order of magnitude lower than that for unfractured bedrock within the permit area (see Section 7. 1.2.2). According to Lines (1985), If the hydraulic conductivity is one order of magnitude higher than the values assumed for Figure 7-13, the estimated steady-state inflow to the mine will be one-order of magnitude larger than that predicted by Figure 7-13 (and Figure 7-14). Hence, utilizing average hydraulic conductivities of 0.2 ft/day for the Star Point Sandstone and 0.1 ft/day for the Blackhawk Formation, the potential groundwater inflow to the Horizon No. 1 Mine was estimated to be 0.08 cfs (10 times the value predicted by Figure 7-14, or 36 gpm) under current plans. Potential future expansion of the mine workings may increase this inflow to 0.20 cfs (90 gpm). Hence, inflow to the mine workings during the initial and future permit terms can be expected to be in the range of 36 to 90 gpm.

As indicated in Appendix 7-9, average water usage for the mining operation (underground and surface) will be approximately 30,888 gallons per day (21 gpm). Of this, 21,256 gallons per day (15 gpm) will be used underground and the remainder (6 gpm) will be used in surface operations (road watering, shop use. bathhouse, etc.). The water which is used underground is not considered a consumptive use, since it will remain with the coal or seep back into the ground. Therefore, of the 21 gpm water use requirement for mining operations, only 6 gpm is considered a consumptive use. Additional consumptive use beyond that accounted for in Appendix 7-9 will occur with water that is removed from the mine as moisture in the coal and that which is lost to evaporation in the mine ventilation system.

Based on an average moisture content of 7.99 percent in the Hiawatha coal seam (as noted in Section 6.5.6) and a maximum production of 700,000 tons per year (as noted in Section 3.3.6.1), approximately 41 acre-feet per year (25 gpm) of groundwater will be removed in the coal. Data presented in Appendix 7-9 indicate that the net loss of water by evaporation due to mine ventilation will be approximately 6 gpm (10 acre-feet per year). Hence, the total consumptive loss to the hydrologic system will be 37 gpm (6 gpm for surface consumptive uses, 25 gpm as moisture in the coal, and 6 gpm as evaporative loss in the mine ventilation system a total of 60 acre-feet per year). When mining commenced it was discovered that the old mine workings had intercepted a water bearing fault that produced in excess of 450 gpm when the mine was first de-watered . After a few months the flow from the fault decreased to an average of about 300 gpm. The inflow to the mine other than from the fault is expected to average 36 gpm. With an average inflow of 336 gpm and an average consumptive use of 37 gpm during the initial permit term, it is likely that groundwater will be discharged from mine during the initial permit term. However, under the expanded conditions anticipated in the future, approximately 300 gpm of water may be discharged from the mine during average operating periods. For a short period after mining intercepts this water bearing fault the discharge from the mine may approach 523 gpm for a short period of time.

figure 7-13
figure 7-14

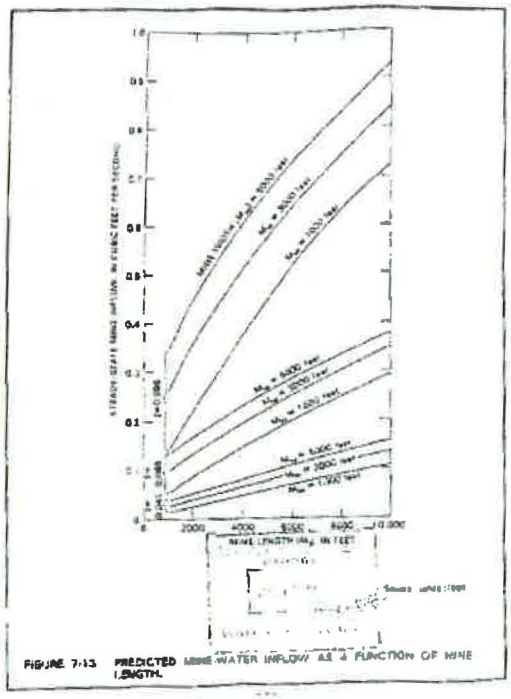

FIGURE 7-13 PREDICTED MINE WATER INFLOW AS A FUNCTION OF MINE LENGTH.

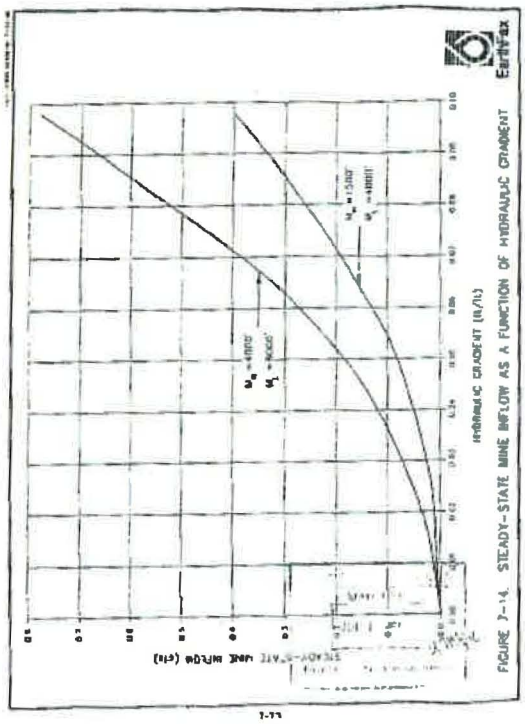

FIGURE 7-14. STEADY-STATE MINE INFLOW AS A FUNCTION OF HYDRAULIC GRADIENT

During early 1998 quantities of water greater than previously expected were encountered while mining. Due to a delay in issuance of a discharge permit for Outfall 002, in-mine water will be discharged to the sediment pond. Flow quantities and potential hydrologic impacts will be assessed as additional data is collected.

It should be noted that the above estimates assume that groundwater inflow to the mine workings will occur primarily as a result of porous-medium flow rather than fracture flow. Historically, large amounts of the Hiawatha Coal seam have been mined out to the southwest of the proposed permit area by Sweet Coal Company's Sweet Mine, Blue Blaze Company's No. 1 Mine, National Coal Company's No. 1 Mine, and Beaver Creek Coal Company's No. 3 Mine. Based on a review of mine records (Skaggs, 1992), many faults have been mined through in the Hiawatha seam with only insignificant/minor amounts of water being encountered.

Only one fault has produced significant quantities of water when mined through. This fault lies in the east portion of the permit area and was intersected in mining of the Beaver Creek Coal Company No. 3 Mine. Inflows of approximately 400 gpm occurred when this fault was encountered (Skaggs, 1992). This fault will be located and avoided when mining the proposed Horizon No. 1 Mine by evaluating mine maps from the Beaver Creek No. 3 Mine and, if necessary, by periodically drilling horizontally from the Horizon No. 1 workings into the fault zone.

Soon after initiating mining it became evident that far more than 36 to 90 gpm was flowing into the mine. The old workings had intercepted a fault that was conveying a large volume of groundwater into the workings. This fault may be the same fault encountered in the Beaver Creek Coal Company No. 3 Mine or a fault connected to it. The North Mains and a panel were extended to the north until the same water bearing fault was encountered. When mining first encountered the fault, the inflow was greater than 450 gpm. After the initial surge of groundwater, which lasted approximately 2 months, the fault produced between 200 and 300 gpm. During a period when the mine was shutdown in 2002 and 2003 the mine pumped an average of 279 gpm from the mine. During the period of shutdown the pumping data shows a slight decrease in the pumping rate over time. During the period of shutdown in 2002 the average pumping rate was 294 gpm. During the period of shutdown in 2003 the average pumping rate was 269 gpm. Thus the formation is slowly being de-watered and is producing less water with time. Upon resuming mining in the West Mains in August of 2003 the average pumping rates increased due to groundwater encountered at the mining face. Operators estimate the inflow at the face to be approximately 30 gpm. Operators have also observed that approximately 100 feet back from the face the entries no longer produce water. At this time the mining is in an area that has not had any faulting identified and water is being produced by porous-medium flow rather than fracture flow. Based on observation the inflow estimate based on Lines (1985) is valid if mining is occurring in unfractured areas. However, when mining encounters faulting or other geologic structures such as channel sands the inflow to the mine greatly exceeds the estimated inflow based on Lines (1985). Please see annual reports for pumping rates from the mine.

Based on the where the mine workings have intercepted the water bearing fault the strike of the fault is roughly the same as the strike of the coal of (N. 68° W). Thus, based on the mining plan mining can be expected to intercept the fault in the future. The maximum inflow to the mine can be expected to be similar to the maximum inflow rate encountered when the water bearing fault was first encountered plus whatever groundwater is being produced by the mine workings in unfractured areas. Based on the highest monthly average pumping rate from March of 2002 of 473 gpm and the maximum estimated inflow based on Lines (1985) methods the maximum inflow would

be approximately 560 gpm. This is considered a conservative estimate since the formation is being further de-watered as mining continues. Also an inflow of this magnitude would be expected to only last a short period of time before returning to an average inflow between 200 and 300 gpm.

With an average consumptive use of 37 gpm the maximum discharge from the mine would be approximately 523 gpm with the average discharge from the mine being between 200 and 300 gpm. Surface mapping and mining experience in the overlying Castlegate "A" seam within the permit area indicate that fracturing within the permit area is not significant. Therefore, the previous estimates of potential groundwater inflow rates to the mine workings are considered adequate for non-faulted areas.

As noted in Section 7.1.4 of this permit application, groundwater which is encountered underground and consumed in the mining operation will be used in accordance with water right number 91-330. Water needed to operate the mine equipment will be derived from a spring which is covered by water rights 91-94 and 91-353. These rights have been leased by Hidden Splendor Resources, Inc.

In November 2001 a monitoring well (HZ-01-06-1) was installed to provide potentiometric surface data for the area north of Beaver Creek. As can be seen on Table 7-1 in the annual reports the potentiometric surface dropped 85 feet between the first and second readings. It is unclear whether the drop was due to the mine de-watering the aquifer or if the initial reading was inaccurate. During drilling circulation was lost numerous times resulting in drilling fluid flowing into the formation. The loss of the drilling fluid may have artificially elevated the potentiometric surface for the first reading. However, HZ-95-1 experienced a 104' drop in a similar time period between the fall of 1999 and spring of 2000. Due to the rapid drop in the potentiometric surface and the magnitude of the drop at HZ-95-1 it can be concluded that the influence of water bearing fault discussed above extends at least as far north as Beaver Creek. If the initial water level reading for HZ-01-06-1 is valid then it can be concluded that the influence of the water bearing fault on the potentiometric surface extends at least to the northern permit boundary.

Water level monitoring indicates that mining will depress the regional aquifer to the maximum depth of the mined entries. Due to the large amount of water being transported by faulting in the area the potentiometric surface will be depressed in an area much larger than the permit area. However, when pumping ceases the potentiometric surface will return to pre-mining conditions as evidenced by the conditions prior to the Horizon Mine beginning production. The old workings had intercepted the water bearing fault thus dropping the potentiometric surface during the period when this area was first mined. When mining ceased in the old workings the potentiometric surface recovered as shown by the water level measurements taken prior to initiating mining at the Horizon Mine. Thus, the impact to the regional aquifer is expected to be temporary. The potentiometric surface will return to pre-mining conditions as soon as pumping ceases.

Impacts to the Hydrologic System Resulting From Subsidence. As noted In Section 3.3.2.2, stream buffer zones will not be maintained under Beaver Creek. According to Gentry and Abel (1978), topographic lows (e.g., stream channels) tend to be protected by unwarping of adjacent slopes during subsidence. Therefore, mining-induced surface fracturing should be very limited (or nonexistent) within the Beaver Creek stream channel area. With an overburden of approximately 1000 feet and a coal thickness of 7.5 feet there is little potential for subsidence cracks to propagate to the surface. Any fracturing that does occur in the stream channel is likely to fill rapidly as a result

of sedimentation. Appendix 7-13 contains the Skyline Mine subsidence study which, among other things, concluded that with more than 800 feet of cover, panels oriented perpendicular to the stream, and full extraction of the coal, some short term effects occurred to the stream but after three years the stream had reverted to a pre-mining configuration. The study was carried out at the Skyline Mine from 1992 to 1998 by the Forestry Science's Laboratory, Rocky Mountain Research Station in conjunction with the Manti-Lasal National Forest and Arch Coal Company/Canyon Resources LLC. The study was completed on an area of the mine that was undermining Burnout Canyon and a perennial stream. Two seams were extracted (Upper and Lower O'Conner) under the stream over the six year period and, in summary, the conclusions were:

1. There were no "measurable" significant impacts due to subsidence on stream flow, silt, or vegetation.

2. There was year to year variability in the stream, but it was less than the year to year variability of the nearby control stream.

3. There were temporary changes during the first year after mining in the number of pools, stream drops, and stream width, but the stream had reverted to normal by the third year after mining. The coal seams at Skyline are in the Blackhawk formation as is the coal seam at Horizon.

It is also not anticipated that subsidence will significantly affect springs within the permit and adjacent areas. Von Schonfeldt et al. (1980) found that uniform subsidence "rarely causes problems to renewable resources such as aquifers, streams, and ranch lands." Since second mining will occur uniformly across the permit area the resulting subsidence should also be uniform, minimizing the potential impacts to overlying springs.

As noted in the Cumulative Hydrologic Impact Assessment, mining in the area adjacent to the proposed Horizon permit area has not resulted in hydrologic impacts due to subsidence. Given the lack of extensive aquifer systems in lithologic units that overlie the coal within the permit and adjacent areas, it is not anticipated that groundwater will be significantly affected by subsidence. Thus, subsidence caused as a result of mining by Hidden Splendor Resources, Inc. should not cause significant surface or groundwater impacts within the permit or adjacent areas.

Potential Hydrocarbon Contamination. Diesel fuel, oils, greases, and other hydrocarbons products will be stored at the mine site. Diesel fuel will be contained in above-ground tanks. Diesel fuel may spill during filling of the storage tank, leakage of the tank, and filling of vehicle tanks. Hydrocarbons may be spilled during use in surface and underground activities.

The extent of contamination by spillage of hydrocarbons will likely be small since storage tanks will be located above-ground and thus leakage can be readily detected and abated. Furthermore, and spillage of hydrocarbons during filling of the tank and mine vehicles will be minimized to avoid loss of an economically valuable product, and the fuel storage area will be surrounded by an enclosure of sufficient size to contain a fuel spill if the tanks were to rupture. In the event of a fuel or hydrocarbon leak or spill, Hidden Splendor Resources, Inc. will abate the problem in accordance with the Spill Prevention, Control, and Countermeasure Plan (see Appendix 7-10). Absorbent materials will be kept within easy access for the purpose of spill cleanup and control.

Hidden Splendor resources does not intend to abandon any equipment underground. However if it becomes necessary to abandon any equipment underground all petroleum products will be

drained from the equipment. Also any equipment to be abandoned will be located on a mine map and submitted to the Division for reference purposes.

Road Salting. The access road to the mine is a gravel road maintained by the county. Paving of the road is not expected. Since the road is to remain gravel, the likelihood of road salting is extremely small. As a result, the likelihood of road salting impacting water quality is very remote.

Impacts to Water Quality. Data presented in Appendix 7-3 indicate that the average TDS concentration of the surface water measured at station SS-3 (immediately downstream from the proposed surface facilities) is 427 mg/1, with a standard deviation of 122 mg/1. The calculated 95- percent confidence interval for the average concentration is 407 to 447 mg/1, based on the historical record.

As noted in Section 7.1. 3, water standing in the old mine workings of the Blue Blaze No. 1 Mine has a TDS concentration which has been measured at 414 to 452 mg/1. These values are approximately within the 95-percent confidence interval range of the mean calculated for station SS-3. Hence, assuming that water must be discharged from the mine workings, the salinity of the surface water should not be adversely impacted by the salinity of the underground water.

It is currently anticipated that a calcium-carbonate rock dust will be used in mining operations rather than a calcium-sulfate rock dust. Since surface and groundwater within the permit and adjacent areas is characterized as a calcium bicarbonate type, changes in the general chemical characteristics of water in the area should not occur if water from the mine seeps into the adjacent groundwater or under the condition that water is discharged from the mine to surface water resources.

North Fork Gordon Creek flows across the Mancos Shale immediately downstream from the mine area. Since the Mancos Shale is a gypsiferous formation, sulfate and TDS concentrations naturally increase as the surface water contacts this formation (Waddell et. al., 1981). Thus, increases in TDS concentrations downstream from the surface facilities, if they occur, will more likely result from natural conditions rather than mining impacts.

It is anticipated that water will be discharged from the mine workings to the surface during the initial permit term. As mining progresses during future permit terms, additional water will likely be pumped from the mine. As also noted above, the mine water is anticipated to have a TDS concentration which approximates that of the surface water immediately downstream from the proposed surface facilities.

If the excess groundwater encountered in the mining operation was allowed to flow naturally rather than being discharged from the mine, this water would flow naturally downgradient and eventually discharge into the North Fork of Gordon Creek (see the potentiometric surface map presented in Figure 7-2). As it flows downgradient, the water would come increasingly into contact with the underlying Mancos Shale, dissolving additional salts in the process. Hence, water which is discharged from the mine should have a lower TDS concentration than that which would seep naturally into the local surface-water system. As a result, the TDS concentration of surface water downstream from the proposed surface facilities will be improved (i.e., decreased) if water is discharged from the mining operation.

Information regarding the acid- and toxic-forming potential of the coal, as well as the roof and floor materials, is presented in Section 6.5.6 of this document. As indicated therein, the roof and floor materials (i.e., that which may become waste rock) is neither acid nor toxic forming, suggesting that the material which comprises coal parting would also not be acid- or toxic-forming. However, the coal has a potential to be acid forming. The acid-forming potential of the coal will be tempered by its slightly alkaline nature (with a pH that varies from 7.3 to 7.8, according to Appendix 6-2). Furthermore, impacts to the environment of the permit and adjacent areas resulting from this acid- forming potential will be minimized by three factors. First, coal will be stored on the surface for only short periods of time before being shipped off site, thus reducing the potential for weathering, oxidation, and generation of acid drainage. Second, runoff from the coal stockpile will be routed through the facility sedimentation pond, where it will mix with more-alkaline runoff from additional areas, thus neutralizing any acidic drainage which might form. Finally, acidic leachate which is generated from coal which is left underground and exposed to the mine air will be buffered by the naturally alkaline environment in which the coal occurs. Hence, impacts to the acidity of the local hydrologic system are not anticipated.

Public Water Supplies. The water located in the Gordon Creek Drainage system is not a culinary water supply. The water in this drainage is used for agricultural, livestock, wildlife and industrial use (see Appendix 3-3).

Water derived from the spring associated with water rights 91-94 and 91-353 will be piped to Sweet's Pond and pumped from there to the mine for surface and underground use. As noted previously, it is not anticipated that large quantities of groundwater will be discharged from the mine during the initial permit term. Water that may be encountered underground during mining operations will be used in conjunction with dust abatement.

Flooding Potential of Downstream Areas. Runoff from all disturbed areas will flow through a sedimentation pond or other sediment-control device (Section 7.2). Three factors indicate that these sediment-control devices will minimize or preclude potential flooding impacts to downstream areas as a result of mining operations:

1. The sediment-control facilities have been designed to be geotechnically stable. Thus, the potential is minimized for breaches of the sediment-control devices to occur that could cause downstream flooding.

2. By retaining sediment on-site in the sediment-control devices, the bottom elevations of stream channels downstream from the disturbed areas are not artificially raised. Thus, the hydraulic capacity of the stream channels is not altered.

3. The flow routing that occurs through the sediment control devices reduces peak flows from the disturbed areas. This precludes flooding impacts to downstream areas.

As discussed above the mine discharges directly to Jewkes Creek. The maximum discharge will be 523 gpm (1.17 cfs) with an average discharge of 200 to 300 gpm (0.45 to 0.67 cfs). The maximum discharge will occur only after mining through a water bearing fault and then only for a short period of time. Calculations presented in Appendix 7-4 indicate a channel capacity for Jewkes Creek of 38.7 cfs. Additional calculations in Appendix 7-4 indicate that the peak flow from the 100-year 6-hour storm event below the mine facilities would be 28.9 cfs including .a mine water

discharge of 1 cfs. The natural channel downstream of the mine facilities has a capacity nearly 10 cfs greater than the peak flow generated by a 100-year 6-hour storm event. Thus, even the maximum discharge from the mine of 1.17 cfs during the 100-year 6-hour storm event would not cause Jewkes Creek to exceed its channel capacity below the mine facilities. The addition of the discharged mine water is not expected to alter the natural channel. The maximum discharge from the mine is only about 3% of the natural channel capacity. The average discharge is less than 2% of the natural channel capacity. Thus, the potential for stream channel alteration is minimal.

Due to geologic structure, depth of cover and a relatively thin coal seam there is not expected to be surface subsidence under Beaver Creek. However, there is the potential of subsidence under Beaver Creek. If subsidence does occur it is expected to be uniform with little to no impact on Beaver Creek or other drainages in the area. However, at the edges of the graben, which bounds the mine workings, there is potential for a sharp drop at the faults. At the upstream fault a sharp drop under Beaver Creek may cause headcutting in the channel and potentially a loss of flow into the fault. In the event that a sharp drop occurs at the fault, the impacted section of the channel would need to be reconstructed to be erosionally stable. If stream flow is lost into the fault the fault scarp, in the channel area, would be excavated and backfilled with clay prior to reconstructing the channel. At the downstream fault a sharp drop would cause pending in the stream channel and potentially loss of stream flow into the fault. If this occurs the impacted section would be reconstructed to prevent erosion and loss of topsoil. If stream flow was being lost into the fault the channel area, would be excavated and backfilled with clay prior to reconstructing the channel. If subsidence fractures occur in Beaver Creek without vertical displacement and flow is lost into the fracture a mixture of soil and bentonite will be used to seal the fracture. In the event that stream channel mitigation is required HSR will submit designs to the Division for approval prior to commencing any construction activities. The need for mitigation activities will be assessed during each subsidence monitoring event.

~~Following reclamation, stream channels will be returned to a stable state, thus minimizing detrimental effects that may result from flooding.~~

7.4 Alluvial Valley Floor Determination

A reconnaissance investigation of the permit and adjacent areas was conducted to delineate alluvial deposits which might be considered to be alluvial valley floors. Identification of locations where unconsolidated stream-laid deposits occur was performed using surficial geology and soils maps of the area. Further, field reconnaissance and an analysis of aerial photographs of the mine permit and adjacent areas were conducted. Locations of stream-laid deposits thus identified are the same as those identified on Plate 6-1 as Qal (Recent Alluvium) and Qoa (Older Alluvium).

From a geomorphic standpoint, the rugged mountainous terrain of the permit and adjacent areas has resulted in drainages still in a youthful stage of development. The streams are confined in narrow, steep-sided, V-shaped valleys with steep channel gradients. Meanders normally associated with AVF development are absent except in a few isolated locations.

Information presented on Plate 6-1 indicates that alluvial deposits exist in the permit and adjacent areas along Beaver Creek, North Fork Gordon Creek, and Jewkes Creek, as well as short distances into tributaries of the above drainages. Alluvial deposits along Beaver Creek exhibit minor stream meandering and contain numerous beaver ponds. Some of the stream-laid deposits along Beaver Creek, particularly at the mouths of small tributary canyons, appear to be debris

flows. Soils in the valley exhibit localize signs of being flooded or water logged during a field visit to the site.

Alluvial deposits were also identified at the mouth of Jewkes Creek and along North Fork Gordon Creek. The alluvial deposits at these locations are below the coal outcrop and thus, could not be directly impacted by mine subsidence. The soils investigation showed the upper reaches of the alluvial deposit along Jewkes Creek and North Fork Gordon Creek to be disturbed and consisting of about 90 percent fill material (i.e., from road cuts and coal waste). Included in the area are small areas of Patmos and Podo soils as well as areas of rock outcrops. Even before disturbance, this area had limited range and wildlife capability. The valley floor is quite narrow along these reaches.

Agricultural developments are not found along North Fork Gordon Creek, Beaver Creek, or their tributaries in the permit and adjacent areas. The agricultural potential of the valley floors in the area is limited by the soil capability and the short growing season. The narrow valleys are occupied by the stream and the road and both break up the narrow valley so that development of hay meadows or improved pasture is impractical.

The valley floor along Beaver Creek, North Fork Gordon Creek, and their tributaries would be incapable of supporting agricultural activities without proper drainage. Even with adequate drainage, agricultural development would be restricted to grasses and pasture because of the high elevations and short growing seasons. Hence, given the extensive prior disturbance in the proposed disturbed area, the narrowness of the valleys, and climactic conditions in the area, the stream-laid deposits in the permit and adjacent areas are not considered to be alluvial valley floors. This conclusion is supported by the opinion of Mr. T.B. Hutchings, State Soil Scientist with the U.S. Soil Conservation Service (see Appendix

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located on Jewkes Creek down- and upstream from the proposed surface facilities, respectively, and will provide information regarding the impacts of surface disturbances. Stations SS-7 and SS-8 are located on Beaver Creek up- and downstream from potential future expansions of the mine. Similarly, stations SS-10 and SS-11 are located in tributaries to Jump Creek and Beaver Creek, respectively, downstream from potential future expansions of the mine. Through the collection of flow and water-quality data up- and downstream from underground mining activities, these latter four stations will provide information on the potential impacts of underground mining activities (e.g. increases or decreases In flow and water quality due to subsidence and other potential interruptions to the hydrologic regime) on surface hydrologic conditions.

Flow data collected from stations SS-7 and SS-8 will be compared to determine variations in flows up- and downstream from the proposed workings. It should be noted that wide variations have been noted historically between these stations, with flows increasing and decreasing in the downstream direction. If the data suggest that abnormal variations in flow are occurring between stations SS-7 and SS-8, additional seepage evaluations will be conducted along Beaver Creek, similar to those described above in Section 7.1.2.

In addition to the above monitoring program and in accordance with a request by UDOGM, North Fork of Gordon Creek will be monitored for flow below Coal Canyon (see Plate 7-1) on a quarterly basis when the site is accessible. Data collected from this site will serve as a basis for evaluating the potential overall hydrologic impacts of mining within the permit area. Furthermore, station SS-12 (Plate 7-1) will be established for the collection of flow data from Beaver Creek to further evaluate flow conditions in the creek as mining progresses to the northwest. These flow data will be collected on a quarterly basis during normal monitoring periods.

Once every five years, during the low-flow season of the year (i.e., late summer or early autumn), each stream station will be sampled during the low-flow season for baseline parameters. This list of parameters is the same as that provided in Table 7-5 plus the following:

Acidity
Aluminum (dissolved)
Arsenic (dissolved)
Boron (dissolved)
Cadmium (dissolved)
Copper (dissolved)
Lead (dissolved)
Molybdenum (dissolved)
Ammonia
Nitrate
Nitrite
Phosphate (ortho)
Selenium (dissolved)
Zinc (dissolved)

By the end of each month following each calendar quarter (i.e., April 30, August 31, October 31, and January 31), a report will be submitted to the Division summarizing monitoring activities during the previous quarter. Annual reports summarizing monitoring activity will also be submitted to the UDOGM. Quarterly reports will include field measurements, observations, and analytical results

$$Q = A*V \quad \textbf{(11)}$$

Where V = Velocity (feet per second)
R= Hydraulic radius (feet)
S= Hydraulic slope (feet per foot)
N= Manning's roughness coefficient
Q= Discharge (cubic feet per second)
A= Flow area (square feet)

$$V = \frac{1.486}{n} * R^{2/3} * S^{1/2} \quad \textbf{(12)}$$

Channel parameters required for the solution of Equations (11) and (12) were obtained from design cross sections and the proposed longitudinal profile of the various channels. Values of the roughness coefficient were obtained by comparing proposed conditions with tabulated values provided by Chow (1959) and the U.S. Soil Conservation Service (1956).

For the design of the undisturbed area diversions s, a maximum permissible velocity of 5 feet per second was determined to be non-erosive. This was determined from Barfield, et. al. (1981) based on a graded loam soil with gravel for sediment laden flows.

Undisturbed Area Runoff Control

General. Runoff from the undisturbed area upstream of the surface facilities in Portal Canyon and Jewkes Creek will be diverted beneath the mine facilities via three culverts The undisturbed-area culverts are sized to pass the peak flow resulting from the 100-year, 6-hour precipitation event. Calculations supporting these designs are presented in Appendix 7-4. A copy of the stream alteration permit from the Utah Division of Water Rights required for
installation of the undisturbed-area culverts is included in Appendix 7-12.

Diversions. The bypass culverts are sized to safely pass the peak flow resulting from the 100-year, 6-hour precipitation event. Plate 7-5 shows the location of the culverts and the drainage area to each structure, respectively.

Undisturbed area culvert UC-1 will bypass drainage runoff from culverts UC-2 and UC-3 (i.e., Portal Canyon and Jewkes Creek, respectively). The combined 100-year, 6-hour peak flow from these drainages is 27.9 cfs. The culvert to be installed in this section of the drainage will have a diameter of 36 inches, based on the minimum slope section and open-channel flow conditions for the culvert.

Culvert UC-2 will receive runoff from Portal Canyon. The 100-year, 6-hour peak flow for this culvert is 8.3 cfs. A 24-inch diameter culvert is planned to be installed at this location. This size is based

Disturbed-area culverts will be installed to convey runoff beneath roadways on the facility pad. Culvert DC-1 will be installed to carry runoff from the fan-portal access road beneath the main pad roadway into diversion DD-1. The peak discharge to this culvert from the 25-year, 6-hour precipitation event will be 0.60 cfs. An 18-inch diameter culvert is planned to be installed at this location, based on inlet control conditions with a headwater to depth ratio of one or less. This culvert will be extended to facilitate the installation of a transformer adjacent to the conveyor. The culvert is shown on Plate 7-4.

Culvert DC-2 was installed to convey runoff from the coal loadout area beneath the main facility roadway and into the sediment pond. The peak discharge to this culvert from the 25-year, 6-hour precipitation event will be 0.59 cfs. Culvert DC-2 will consist of an 18-inch diameter culvert, based on inlet control conditions for the culvert with a headwater to depth ratio of one or less.

Culvert DC-3 was installed to convey runoff from the hillside on the north side of Portal Canyon and below culvert DC-1. Waters discharging to DC-3 will run beneath the roadway and into diversion DD-1. The peak discharge to this culvert from the 25-year, 6-hour precipitation event will be 0.04 cfs. Culvert DC-3 consists of an 18-inch diameter culvert, based on inlet control conditions for the culvert with a headwater to depth ratio of one or less.

Drainage from the ancillary roads will be controlled by the use of water bars and berms. Plate 7-4 shows the location of the water bars on the ancillary roads to the fan portal and the monitoring well. Plate 3-4a shows the details of the water bars. Each of the water bars has been sized to handle the drainage from the 10 year - 6 hour event for the largest area reporting to a water bar. The worst case peak flow is estimated to be 0.24 cfs (maximum discharge). Based on the water bar details, the anticipated flow depth for this peak flow is 0.2 foot with a flow velocity of 1.48 feet per second. Appendix 7-4 presents the design calculations and a diagram outlining the largest drainage area reporting to a water bar on either ancillary road. The design depth of the water bar is 1 foot, thence the freeboard is 0.8 foot. The velocity is not erosive as it is less than 5 feet per second. Therefore, the proposed design for water bars on the ancillary roads, as indicated on Plate 3-4a, is adequate. The road is now asphalt and previously was compacted therefore, the runoff curves are comparable.

The water diverted by the water bars will be collected in a half-round culvert and conveyed over the downslope into a gravel lined basin. The water will then travel overland into the diversion channel and into the sediment pond.

In two places the ancillary road will need to cross the DD-1 ditch. In both locations, the cross-section of ditch DD-1 will transition to a 1 foot deep, 5H:1V sideslope, triangular shaped ditch. The channel slope through the transition section will be limited to 0.05 foot per foot. Based on the calculations presented in Appendix 7-4, the flow depth through these transition section will be 0.29 foot deep and the design velocity will be 3.02 fps.

Sedimentation Pond Design. Runoff from the disturbed area and adjacent undisturbed areas will be directed to the sedimentation pond as indicated above. The areas around all surface facilities, including buildings, trash containers, coal storage, and the topsoil stockpile, will be sloped so that the drainage from these facilities will be directed to the sedimentation pond.

Reclamation Hydrology Design

General. Following the completion of mining operations, the mine site area will be reclaimed as discussed in Chapter 3 of this application. The existing drainage structure will, be left in place.

If feasible, efforts will be made to minimize reclamation activities during periods of wet weather. During short periods when reclamation construction activities will be suspended (i.e., evenings and weekends), the construction site will be left in a condition which would minimize the impact on the hydrologic system if a precipitation event were to occur. Since conditions will vary between each area to be protected and each event, various siltation structures will be used. Horizon commits to establish and maintain sediment control using the best technology available at the time of reclamation. Refer to Section 7.2.3.2, Sediment Control for various possible structures.

Sediment Control. To minimize the hydrologic impacts of the post-mining land use, Horizon commits to maintain existing drainage system to minimize runoff into Jewkes Creek from the disturbed areas and areas to be used during post-mining. To the extent that existing drainage systems will need to be expanded or repaired Horizon Coal Corporation proposes to employ the following methods during to control sediment:

1. Silt fences
2. Surface ripping, pocking, and deep gouging
3. Mulching
4. Straw-bale dikes
5. Seeding
6. Reseeding areas that do not exhibit successful germination

Upon completion of the redistribution of the soil (Section 8.8), any reclaimed areas will be seeded as outlined in Chapter 3

To the extent that reditching is required during reclamation, erosion control will be assisted by the addition of a vegetative mulch and erosion-control matting. The mulch or matting significantly reduces the amount of sediment yield from an area (Simons, et. al., 1983). The mulch or matting also helps retain moisture to allow for seed germination. Specifications regarding the specific erosion control matting which is proposed for installation will be submitted to UDOGM for approval as one of the Best Technologies Currently Available. Horizon will install all erosion control matting in accordance with manufacturer's instructions.

Sediment Control Monitoring and Maintenance. The alternative sediment controls constructed during reclamation will be inspected monthly and after every major storm event. Required repairs will be implemented immediately to prevent future sediment contributions to the main stream channel.

Corrective action will consist or repairing, replacing, or adding silt fences as necessary, replacing straw bales, localized regrading of the ground surface as necessary to fill in gullies caused by erosion, and reseeding and mulching to reestablish vegetation. Soil material trapped by sediment control measures that is not used in repairing the site will be removed and disposed of in an approved area.

7.3 Probable Hydrologic Consequences

The Probable Hydrologic Consequences (PHC) of the proposed Horizon No. 1 Mine are herein determined as per Utah Coal Mining Regulation R645-301-728.100 and R645-301-728.200. Baseline geologic information is presented in Chapter 6. Baseline hydrologic information is presented in Sections 7.1 and 7.2.

7. 3.1 Potential Impacts to .Surface and Groundwater

Potential impacts of coal mining on the quantity and quality of surface and groundwater flow may include:

- Increased sediment yield from disturbed areas;
- Diminution of springs in perched aquifers overlying the mine area;
- Decreased availability of groundwater in the regional aquifer system;
- Impacts on surface and groundwater availability due to subsidence;
- Hydrocarbon contamination due to spills or leaks;
- Contamination of surface and groundwater from road salting;
- Impacts to the chemical quality of surface and groundwater;
- Impacts to public water supplies; and o Flooding or stream flow alteration.

These potential impacts are discussed in the following sections of this permit application.

7.3. 2 PHC Determination

Sediment Yield. In accordance with State and Federal regulations, a runoff conveyance and sedimentation control plan has been developed which mitigates the impacts of mining operations. Surface runoff originating upon or traveling across disturbed areas will be diverted into a sedimentation pond which will improve water quality and decrease peak flows.

Although some surface waters are temporarily diverted out of their original channels, they shortly thereafter re-enter the main channel and continue their course downstream having experienced little overall modification. Disturbed waters exiting the sedimentation pond will re-enter the natural downstream drainage system.

The potential impact of construction, mining, and. reclamation on sediment yield is an increase in suspended sediment in the surface waters downstream from the disturbed area. However, sediment-control measures (such as sedimentation pond, diversions, silt fences, straw-bale dikes, etc.) will be utilized during construction, operation, and reclamation phases (Section 7.2) to minimize the impact that could result from elevated TSS concentrations. These facilities will be regularly inspected (see Section 7.2) and maintained as outlined in the permit and UDOGM regulations.

Impacts to the Perched Aquifer System. The hydrologic data presented in Section 7.1 indicate an absence of significant perched aquifers within the Blackhawk Formation overlying the coal to be mined. The geology of the area and the occurrence of springs in the Blackhawk Formation (Section 7.1) indicate the presence of small, laterally discontinuous perched aquifers in the Blackhawk. These small perched aquifers within or adjacent to the mine plan area may be impacted as a result of mining related subsidence. These water sources will be monitored as discussed in Section 7.1.

The perched aquifers of the Blackhawk Formation characteristically produce water from channel sandstones bounded by impervious shale beds at their bases. If subsidence fractures do intersect these perched aquifers, clay minerals contained within these shale beds will likely seal the fracture planes. Sealing of the fracture planes may allow spring discharge to continue uninterrupted.

According to the Cumulative Hydrologic Impact Assessment prepared for the area by UDOGM (1989), "Subsidence impacts are largely related to extension and expansion of the existing fracture system and upward propagation of new fractures." Vertical and lateral migration of water is partially controlled by fracture conduits. Potential changes include increased flow rates along fractures and diverting flow along new fractures or within permeable lithologies. Subsurface flow diversion may result in diminution and/or loss of flow to springs that are undermined.

Retreat mining also results in uniform downwarping and lowering of strata above the mined interval. This uniform downward movement is generally not accompanied by a significant degree of fracturing. As a result, the original attitude and integrity of the strata are maintained. Little impact on the perched aquifers of the overburden are expected to result from downwarping.

The probable consequences of mining on the hydrologic resources associated with perched aquifers are considered minimal due to: 1) small number of springs, 2) low and/or erratic spring flow, 3) absence of municipal water use rights, 4) water loss experienced at one location may be accompanied in an increased flow at another location, and 5) possible sealing of subsidence fractures by clay minerals.

Impacts to the Regional Aquifer System. As previously discussed (Section 7.1), it is anticipated that the coal in the Horizon No. 1 Mine will be saturated essentially from the beginning of mining. The potential inflow to the Horizon No. 1 Mine workings was estimated using methods presented by Lines (1985), who modeled the impacts of coal mining on groundwater conditions in the Trail Mountain area located in the Wasatch Plateau approximately 20 miles south-southwest of the proposed Horizon No. 1 permit area. Fromthis modeling effort, Lines (1985) presented estimates of mine inflow for various lengths and widths of mine workings as well as various hydraulic gradients. These estimates are presented in Figure 7-13.

Currently, the proposed workings within the permit area are anticipated to have a width of approximately 1,500 feet and a length of about 4,000 feet. The maximum future potential mine workings may extend over a width of 4,000 feet and a length of 8,000 feet.

The pre-mining hydraulic gradient in the permit and adjacent areas is 0.014 ft/ft, based on the data presented in Figure 7-2. This hydraulic gradient is lower than the lowest values presented in the analysis of Lines (1985) on Figure 7-13. Hence, the data presented in Figure 7-13 were utilized to prepare curves of inflow versus hydraulic gradient, based on the mine dimensions anticipated at the Horizon No. 1 Mine. These curves are presented in Figure 7-14. The curves presented in Figures 7-13 and 7-14 are based on assumed hydraulic conductivities of 0.01 ft/day for the Blackhawk Formation and 0.02 ft/day for the Star Point Sandstone, which values are approximately one order of magnitude lower than that for unfractured bedrock within the permit area (see Section 7. 1.2.2). According to Lines (1985), If the hydraulic conductivity is one order of magnitude higher than the values assumed for Figure 7-13, the estimated

steady-state inflow to the mine will be one-order of magnitude larger than that predicted by Figure 7-13 (and Figure 7-14). Hence, utilizing average hydraulic conductivities of 0.2 ft/day for the Star Point Sandstone and 0.1 ft/day for the Blackhawk Formation, the potential groundwater inflow to the Horizon No. 1 Mine was estimated to be 0.08 cfs (10 times the value predicted by Figure 7-14, or 36 gpm) under current plans. Potential future expansion of the mine workings may increase this inflow to 0.20 cfs (90 gpm). Hence, inflow to the mine workings during the initial and future permit terms can be expected to be in the range of 36 to 90 gpm.

As indicated in Appendix 7-9, average water usage for the mining operation (underground and surface) will be approximately 30,888 gallons per day (21 gpm). Of this, 21,256 gallons per day (15 gpm) will be used underground and the remainder (6 gpm) will be used in surface operations (road watering, shop use. bathhouse, etc.). The water which is used underground is not considered a consumptive use, since it will remain with the coal or seep back into the ground. Therefore, of the 21 gpm water use requirement for mining operations, only 6 gpm is considered a consumptive use. Additional consumptive use beyond that accounted for in Appendix 7-9 will occur with water that is removed from the mine as moisture in the coal and that which is lost to evaporation in the mine ventilation system.

Based on an average moisture content of 7.99 percent in the Hiawatha coal seam (as noted in Section 6.5.6) and a maximum production of 700,000 tons per year (as noted in Section 3.3.6.1), approximately 41 acre-feet per year (25 gpm) of groundwater will be removed in the coal. Data presented in Appendix 7-9 indicate that the net loss of water by evaporation due to mine ventilation will be approximately 6 gpm (10 acre-feet per year). Hence, the total consumptive loss to the hydrologic system will be 37 gpm (6 gpm for surface consumptive uses, 25 gpm as moisture in the coal, and 6 gpm as evaporative loss in the mine ventilation system a total of 60 acre-feet per year). When mining commenced it was discovered that the old mine workings had intercepted a water bearing fault that produced in excess of 450 gpm when the mine was first de-watered . After a few months the flow from the fault decreased to an average of about 300 gpm. The inflow to the mine other than from the fault is expected to average 36 gpm. With an average inflow of 336 gpm and an average consumptive use of 37 gpm during the initial permit term, it is likely that groundwater will be discharged from mine during the initial permit term. However, under the expanded conditions anticipated in the future, approximately 300 gpm of water may be discharged from the mine during average operating periods. For a short period after mining intercepts this water bearing fault the discharge from the mine may approach 523 gpm for a short period of time.

figure 7-13
figure 7-14

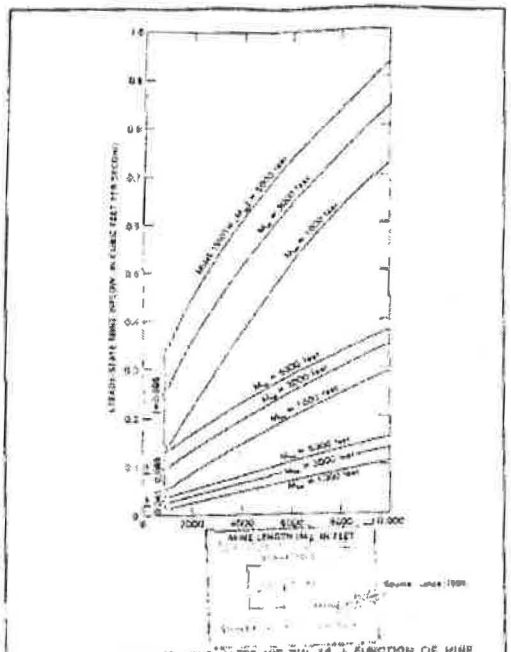

FIGURE 7-13 PREDICTED MINE WATER INFLOW AS A FUNCTION OF MINE LENGTH.

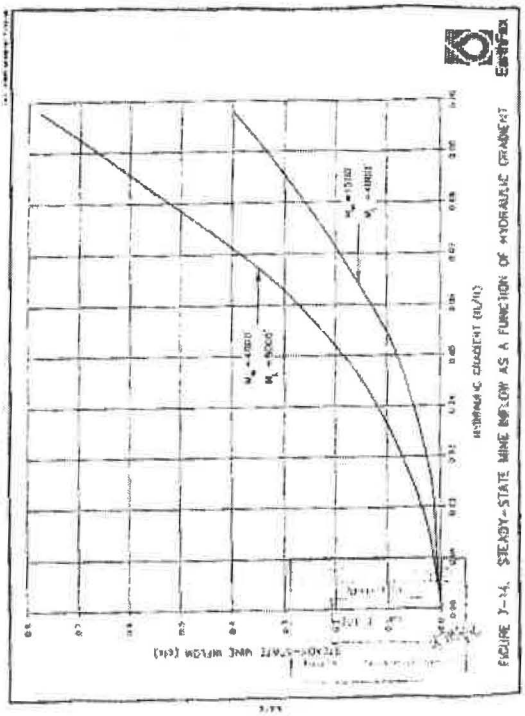

FIGURE 7-14. STEADY-STATE MINE INFLOW AS A FUNCTION OF HYDRAULIC GRADIENT

During early 1998 quantities of water greater than previously expected were encountered while mining. Due to a delay in issuance of a discharge permit for Outfall 002, in-mine water will be discharged to the sediment pond. Flow quantities and potential hydrologic impacts will be assessed as additional data is collected.

It should be noted that the above estimates assume that groundwater inflow to the mine workings will occur primarily as a result of porous-medium flow rather than fracture flow. Historically, large amounts of the Hiawatha Coal seam have been mined out to the southwest of the proposed permit area by Sweet Coal Company's Sweet Mine, Blue Blaze Company's No. 1 Mine, National Coal Company's No. 1 Mine, and Beaver Creek Coal Company's No. 3 Mine. Based on a review of mine records (Skaggs, 1992), many faults have been mined through in the Hiawatha seam with only insignificant/minor amounts of water being encountered.

Only one fault has produced significant quantities of water when mined through. This fault lies in the east portion of the permit area and was intersected in mining of the Beaver Creek Coal Company No. 3 Mine. Inflows of approximately 400 gpm occurred when this fault was encountered (Skaggs, 1992). This fault will be located and avoided when mining the proposed Horizon No. 1 Mine by evaluating mine maps from the Beaver Creek No. 3 Mine and, if necessary, by periodically drilling horizontally from the Horizon No. 1 workings into the fault zone.

Soon after initiating mining it became evident that far more than 36 to 90 gpm was flowing into the mine. The old workings had intercepted a fault that was conveying a large volume of groundwater into the workings. This fault may be the same fault encountered in the Beaver Creek Coal Company No. 3 Mine or a fault connected to it. The North Mains and a panel were extended to the north until the same water bearing fault was encountered. When mining first encountered the fault, the inflow was greater than 450 gpm. After the initial surge of groundwater, which lasted approximately 2 months, the fault produced between 200 and 300 gpm. During a period when the mine was shutdown in 2002 and 2003 the mine pumped an average of 279 gpm from the mine. During the period of shutdown the pumping data shows a slight decrease in the pumping rate over time. During the period of shutdown in 2002 the average pumping rate was 294 gpm. During the period of shutdown in 2003 the average pumping rate was 269 gpm. Thus the formation is slowly being de-watered and is producing less water with time. Upon resuming mining in the West Mains in August of 2003 the average pumping rates increased due to groundwater encountered at the mining face. Operators estimate the inflow at the face to be approximately 30 gpm. Operators have also observed that approximately 100 feet back from the face the entries no longer produce water. At this time the mining is in an area that has not had any faulting identified and water is being produced by porous-medium flow rather than fracture flow. Based on observation the inflow estimate based on Lines (1985) is valid if mining is occurring in unfractured areas. However, when mining encounters faulting or other geologic structures such as channel sands the inflow to the mine greatly exceeds the estimated inflow based on Lines (1985). Please see annual reports for pumping rates from the mine.

Based on the where the mine workings have intercepted the water bearing fault the strike of the fault is roughly the same as the strike of the coal of (N. 68° W). Thus, based on the mining plan mining can be expected to intercept the fault in the future. The maximum inflow to the mine can be expected to be similar to the maximum inflow rate encountered when the water bearing fault was first encountered plus whatever groundwater is being produced by the mine workings in unfractured areas. Based on the highest monthly average pumping rate from March of 2002 of 473 gpm and the maximum estimated inflow based on Lines (1985) methods the maximum inflow would

be approximately 560 gpm. This is considered a conservative estimate since the formation is being further de-watered as mining continues. Also an inflow of this magnitude would be expected to only last a short period of time before returning to an average inflow between 200 and 300 gpm.

With an average consumptive use of 37 gpm the maximum discharge from the mine would be approximately 523 gpm with the average discharge from the mine being between 200 and 300 gpm. Surface mapping and mining experience in the overlying Castlegate "A" seam within the permit area indicate that fracturing within the permit area is not significant. Therefore, the previous estimates of potential groundwater inflow rates to the mine workings are considered adequate for non-faulted areas.

As noted in Section 7.1.4 of this permit application, groundwater which is encountered underground and consumed in the mining operation will be used in accordance with water right number 91-330. Water needed to operate the mine equipment will be derived from a spring which is covered by water rights 91-94 and 91-353. These rights have been leased by Hidden Splendor Resources, Inc.

In November 2001 a monitoring well (HZ-01-06-1) was installed to provide potentiometric surface data for the area north of Beaver Creek. As can be seen on Table 7-1 in the annual reports the potentiometric surface dropped 85 feet between the first and second readings. It is unclear whether the drop was due to the mine de-watering the aquifer or if the initial reading was inaccurate. During drilling circulation was lost numerous times resulting in drilling fluid flowing into the formation. The loss of the drilling fluid may have artificially elevated the potentiometric surface for the first reading. However, HZ-95-1 experienced a 104' drop in a similar time period between the fall of 1999 and spring of 2000. Due to the rapid drop in the potentiometric surface and the magnitude of the drop at HZ-95-1 it can be concluded that the influence of water bearing fault discussed above extends at least as far north as Beaver Creek. If the initial water level reading for HZ-01-06-1 is valid then it can be concluded that the influence of the water bearing fault on the potentiometric surface extends at least to the northern permit boundary.

Water level monitoring indicates that mining will depress the regional aquifer to the maximum depth of the mined entries. Due to the large amount of water being transported by faulting in the area the potentiometric surface will be depressed in an area much larger than the permit area. However, when pumping ceases the potentiometric surface will return to pre-mining conditions as evidenced by the conditions prior to the Horizon Mine beginning production. The old workings had intercepted the water bearing fault thus dropping the potentiometric surface during the period when this area was first mined. When mining ceased in the old workings the potentiometric surface recovered as shown by the water level measurements taken prior to initiating mining at the Horizon Mine. Thus, the impact to the regional aquifer is expected to be temporary. The potentiometric surface will return to pre-mining conditions as soon as pumping ceases.

Impacts to the Hydrologic System Resulting From Subsidence. As noted In Section 3.3.2.2, stream buffer zones will not be maintained under Beaver Creek. According to Gentry and Abel (1978), topographic lows (e.g., stream channels) tend to be protected by unwarping of adjacent slopes during subsidence. Therefore, mining-induced surface fracturing should be very limited (or nonexistent) within the Beaver Creek stream channel area. With an overburden of approximately 1000 feet and a coal thickness of 7.5 feet there is little potential for subsidence cracks to propagate to the surface. Any fracturing that does occur in the stream channel is likely to fill rapidly as a result

of sedimentation. Appendix 7-13 contains the Skyline Mine subsidence study which, among other things, concluded that with more than 800 feet of cover, panels oriented perpendicular to the stream, and full extraction of the coal, some short term effects occurred to the stream but after three years the stream had reverted to a pre-mining configuration. The study was carried out at the Skyline Mine from 1992 to 1998 by the Forestry Science's Laboratory, Rocky Mountain Research Station in conjunction with the Manti-Lasal National Forest and Arch Coal Company/Canyon Resources LLC. The study was completed on an area of the mine that was undermining Burnout Canyon and a perennial stream. Two seams were extracted (Upper and Lower O'Conner) under the stream over the six year period and, in summary, the conclusions were:

1. There were no "measurable" significant impacts due to subsidence on stream flow, silt, or vegetation.

2. There was year to year variability in the stream, but it was less than the year to year variability of the nearby control stream.

3. There were temporary changes during the first year after mining in the number of pools, stream drops, and stream width, but the stream had reverted to normal by the third year after mining. The coal seams at Skyline are in the Blackhawk formation as is the coal seam at Horizon.

It is also not anticipated that subsidence will significantly affect springs within the permit and adjacent areas. Von Schonfeldt et al. (1980) found that uniform subsidence "rarely causes problems to renewable resources such as aquifers, streams, and ranch lands." Since second mining will occur uniformly across the permit area the resulting subsidence should also be uniform, minimizing the potential impacts to overlying springs.

As noted in the Cumulative Hydrologic Impact Assessment, mining in the area adjacent to the proposed Horizon permit area has not resulted in hydrologic impacts due to subsidence. Given the lack of extensive aquifer systems in lithologic units that overlie the coal within the permit and adjacent areas, it is not anticipated that groundwater will be significantly affected by subsidence. Thus, subsidence caused as a result of mining by Hidden Splendor Resources, Inc. should not cause significant surface or groundwater impacts within the permit or adjacent areas.

Potential Hydrocarbon Contamination. Diesel fuel, oils, greases, and other hydrocarbons products will be stored at the mine site. Diesel fuel will be contained in above-ground tanks. Diesel fuel may spill during filling of the storage tank, leakage of the tank, and filling of vehicle tanks. Hydrocarbons may be spilled during use in surface and underground activities.

The extent of contamination by spillage of hydrocarbons will likely be small since storage tanks will be located above-ground and thus leakage can be readily detected and abated. Furthermore, and spillage of hydrocarbons during filling of the tank and mine vehicles will be minimized to avoid loss of an economically valuable product, and the fuel storage area will be surrounded by an enclosure of sufficient size to contain a fuel spill if the tanks were to rupture. In the event of a fuel or hydrocarbon leak or spill, Hidden Splendor Resources, Inc. will abate the problem in accordance with the Spill Prevention, Control, and Countermeasure Plan (see Appendix 7-10). Absorbent materials will be kept within easy access for the purpose of spill cleanup and control.

Hidden Splendor resources does not intend to abandon any equipment underground. However if it becomes necessary to abandon any equipment underground all petroleum products will be

drained from the equipment. Also any equipment to be abandoned will be located on a mine map and submitted to the Division for reference purposes.

Road Salting. The access road to the mine is a gravel road maintained by the county. Paving of the road is not expected. Since the road is to remain gravel, the likelihood of road salting is extremely small. As a result, the likelihood of road salting impacting water quality is very remote.

Impacts to Water Quality. Data presented in Appendix 7-3 indicate that the average TDS concentration of the surface water measured at station SS-3 (immediately downstream from the proposed surface facilities) is 427 mg/1, with a standard deviation of 122 mg/1. The calculated 95- percent confidence interval for the average concentration is 407 to 447 mg/1, based on the historical record.

As noted in Section 7.1. 3, water standing in the old mine workings of the Blue Blaze No. 1 Mine has a TDS concentration which has been measured at 414 to 452 mg/1. These values are approximately within the 95-percent confidence interval range of the mean calculated for station SS-3. Hence, assuming that water must be discharged from the mine workings, the salinity of the surface water should not be adversely impacted by the salinity of the underground water.

It is currently anticipated that a calcium-carbonate rock dust will be used in mining operations rather than a calcium-sulfate rock dust. Since surface and groundwater within the permit and adjacent areas is characterized as a calcium bicarbonate type, changes in the general chemical characteristics of water in the area should not occur if water from the mine seeps into the adjacent groundwater or under the condition that water is discharged from the mine to surface water resources.

North Fork Gordon Creek flows across the Mancos Shale immediately downstream from the mine area. Since the Mancos Shale is a gypsiferous formation, sulfate and TDS concentrations naturally increase as the surface water contacts this formation (Waddell et. al., 1981). Thus, increases in TDS concentrations downstream from the surface facilities, if they occur, will more likely result from natural conditions rather than mining impacts.

It is anticipated that water will be discharged from the mine workings to the surface during the initial permit term. As mining progresses during future permit terms, additional water will likely be pumped from the mine. As also noted above, the mine water is anticipated to have a TDS concentration which approximates that of the surface water immediately downstream from the proposed surface facilities.

If the excess groundwater encountered in the mining operation was allowed to flow naturally rather than being discharged from the mine, this water would flow naturally downgradient and eventually discharge into the North Fork of Gordon Creek (see the potentiometric surface map presented in Figure 7-2). As it flows downgradient, the water would come increasingly into contact with the underlying Mancos Shale, dissolving additional salts in the process. Hence, water which is discharged from the mine should have a lower TDS concentration than that which would seep naturally into the local surface-water system. As a result, the TDS concentration of surface water downstream from the proposed surface facilities will be improved (i.e., decreased) if water is discharged from the mining operation.

Information regarding the acid- and toxic-forming potential of the coal, as well as the roof and floor materials, is presented in Section 6.5.6 of this document. As indicated therein, the roof and floor materials (i.e., that which may become waste rock) is neither acid nor toxic forming, suggesting that the material which comprises coal parting would also not be acid- or toxic-forming. However, the coal has a potential to be acid forming. The acid-forming potential of the coal will be tempered by its slightly alkaline nature (with a pH that varies from 7.3 to 7.8, according to Appendix 6-2). Furthermore, impacts to the environment of the permit and adjacent areas resulting from this acid- forming potential will be minimized by three factors. First, coal will be stored on the surface for only short periods of time before being shipped off site, thus reducing the potential for weathering, oxidation, and generation of acid drainage. Second, runoff from the coal stockpile will be routed through the facility sedimentation pond, where it will mix with more-alkaline runoff from additional areas, thus neutralizing any acidic drainage which might form. Finally, acidic leachate which is generated from coal which is left underground and exposed to the mine air will be buffered by the naturally alkaline environment in which the coal occurs. Hence, impacts to the acidity of the local hydrologic system are not anticipated.

Public Water Supplies. The water located in the Gordon Creek Drainage system is not a culinary water supply. The water in this drainage is used for agricultural, livestock, wildlife and industrial use (see Appendix 3-3).

Water derived from the spring associated with water rights 91-94 and 91-353 will be piped to Sweet's Pond and pumped from there to the mine for surface and underground use. As noted previously, it is not anticipated that large quantities of groundwater will be discharged from the mine during the initial permit term. Water that may be encountered underground during mining operations will be used in conjunction with dust abatement.

Flooding Potential of Downstream Areas. Runoff from all disturbed areas will flow through a sedimentation pond or other sediment-control device (Section 7.2). Three factors indicate that these sediment-control devices will minimize or preclude potential flooding impacts to downstream areas as a result of mining operations:

1. The sediment-control facilities have been designed to be geotechnically stable. Thus, the potential is minimized for breaches of the sediment-control devices to occur that could cause downstream flooding.

2. By retaining sediment on-site in the sediment-control devices, the bottom elevations of stream channels downstream from the disturbed areas are not artificially raised. Thus, the hydraulic capacity of the stream channels is not altered.

3. The flow routing that occurs through the sediment control devices reduces peak flows from the disturbed areas. This precludes flooding impacts to downstream areas.

As discussed above the mine discharges directly to Jewkes Creek. The maximum discharge will be 523 gpm (1.17 cfs) with an average discharge of 200 to 300 gpm (0.45 to 0.67 cfs). The maximum discharge will occur only after mining through a water bearing fault and then only for a short period of time. Calculations presented in Appendix 7-4 indicate a channel capacity for Jewkes Creek of 38.7 cfs. Additional calculations in Appendix 7-4 indicate that the peak flow from the 100-year 6-hour storm event below the mine facilities would be 28.9 cfs including .a mine water

discharge of 1 cfs. The natural channel downstream of the mine facilities has a capacity nearly 10 cfs greater than the peak flow generated by a 100-year 6-hour storm event. Thus, even the maximum discharge from the mine of 1.17 cfs during the 100-year 6-hour storm event would not cause Jewkes Creek to exceed its channel capacity below the mine facilities. The addition of the discharged mine water is not expected to alter the natural channel. The maximum discharge from the mine is only about 3% of the natural channel capacity. The average discharge is less than 2% of the natural channel capacity. Thus, the potential for stream channel alteration is minimal.

Due to geologic structure, depth of cover and a relatively thin coal seam there is not expected to be surface subsidence under Beaver Creek. However, there is the potential of subsidence under Beaver Creek. If subsidence does occur it is expected to be uniform with little to no impact on Beaver Creek or other drainages in the area. However, at the edges of the graben, which bounds the mine workings, there is potential for a sharp drop at the faults. At the upstream fault a sharp drop under Beaver Creek may cause headcutting in the channel and potentially a loss of flow into the fault. In the event that a sharp drop occurs at the fault, the impacted section of the channel would need to be reconstructed to be erosionally stable. If stream flow is lost into the fault the fault scarp, in the channel area, would be excavated and backfilled with clay prior to reconstructing the channel. At the downstream fault a sharp drop would cause pending in the stream channel and potentially loss of stream flow into the fault. If this occurs the impacted section would be reconstructed to prevent erosion and loss of topsoil. If stream flow was being lost into the fault the channel area, would be excavated and backfilled with clay prior to reconstructing the channel. If subsidence fractures occur in Beaver Creek without vertical displacement and flow is lost into the fracture a mixture of soil and bentonite will be used to seal the fracture. In the event that stream channel mitigation is required HSR will submit designs to the Division for approval prior to commencing any construction activities. The need for mitigation activities will be assessed during each subsidence monitoring event.

7.4 Alluvial Valley Floor Determination

A reconnaissance investigation of the permit and adjacent areas was conducted to delineate alluvial deposits which might be considered to be alluvial valley floors. Identification of locations where unconsolidated stream-laid deposits occur was performed using surficial geology and soils maps of the area. Further, field reconnaissance and an analysis of aerial photographs of the mine permit and adjacent areas were conducted. Locations of stream-laid deposits thus identified are the same as those identified on Plate 6-1 as Qal (Recent Alluvium) and Qoa (Older Alluvium).

From a geomorphic standpoint, the rugged mountainous terrain of the permit and adjacent areas has resulted in drainages still in a youthful stage of development. The streams are confined in narrow, steep-sided, V-shaped valleys with steep channel gradients. Meanders normally associated with AVF development are absent except in a few isolated locations.

Information presented on Plate 6-1 indicates that alluvial deposits exist in the permit and adjacent areas along Beaver Creek, North Fork Gordon Creek, and Jewkes Creek, as well as short distances into tributaries of the above drainages. Alluvial deposits along Beaver Creek exhibit minor stream meandering and contain numerous beaver ponds. Some of the stream-laid deposits along Beaver Creek, particularly at the mouths of small tributary canyons, appear to be debris

flows. Soils in the valley exhibit localize signs of being flooded or water logged during a field visit to the site.

Alluvial deposits were also identified at the mouth of Jewkes Creek and along North Fork Gordon Creek. The alluvial deposits at these locations are below the coal outcrop and thus, could not be directly impacted by mine subsidence. The soils investigation showed the upper reaches of the alluvial deposit along Jewkes Creek and North Fork Gordon Creek to be disturbed and consisting of about 90 percent fill material (i.e., from road cuts and coal waste). Included in the area are small areas of Patmos and Podo soils as well as areas of rock outcrops. Even before disturbance, this area had limited range and wildlife capability. The valley floor is quite narrow along these reaches.

Agricultural developments are not found along North Fork Gordon Creek, Beaver Creek, or their tributaries in the permit and adjacent areas. The agricultural potential of the valley floors in the area is limited by the soil capability and the short growing season. The narrow valleys are occupied by the stream and the road and both break up the narrow valley so that development of hay meadows or improved pasture is impractical.

The valley floor along Beaver Creek, North Fork Gordon Creek, and their tributaries would be incapable of supporting agricultural activities without proper drainage. Even with adequate drainage, agricultural development would be restricted to grasses and pasture because of the high elevations and short growing seasons. Hence, given the extensive prior disturbance in the proposed disturbed area, the narrowness of the valleys, and climactic conditions in the area, the stream-laid deposits in the permit and adjacent areas are not considered to be alluvial valley floors. This conclusion is supported by the opinion of Mr. T.B. Hutchings, State Soil Scientist with the U.S. Soil Conservation Service (see Appendix

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truckload is collected, there will be not permanent storage on site for the debris collected during topsoil/growth medium removal.

8.8 Plans for Redistribution of Soils

Deep scarification of overburden and compacted areas (of no less than 12" depth), will be accomplished to ensure good overburden and redistributed topsoil contact to prevent slippage. The regraded material will be topographically conformed to the relative environmental conditions, ~~which will be approximate to the premining topography~~ with the highwalls being eliminated. A qualified soil scientist will be employed at the time of reclamation to evaluate the excavated soil around the portals to determine if this material could be used as additional topsoil to improve vegetation habitat by making deeper microsites. This soil would be recovered prior to the demolition of the portal covers.

Topsoil/growth medium will be placed over the reclaimed areas as illustrated on Plate B, Appendix 8-1 at a minimum thickness of 10 inches. The thickness of the topsoil/growth medium is based on the total available medium divided by the total area to be reclaimed within the disturbed area. As shown on Plate B Appendix 8-1, not all of the area within the disturbed area boundary will actually be disturbed under current mining plans (disturbed area 9.15 acres and areas to be recontoured and receive topsoil is 5.49 acres). If disturbance does occur in these areas, the soils will be salvaged as required by this M&RP. Soils will be placed to aid in the achievement of the reclamation groundcover success standards described in Section 9.8.

Soil will be redistributed using the wooden stake method, where a stake is marked to the depth of fill, then the soils will be added to accomplish that depth. The soil will then be harrowed to break up the cloddy surface and scarify to a depth of 18 inches (see Section 3.5.5.1). The regraded soils surface roughness will be maximized by pitting and gouging. Particular care will be taken not to compact soils placed in the riparian area.

The soil will then be sampled as stated in Section 8.9 to determine needed fertilization levels. The area will then be fertilized as required and mulched (Section 3.5.5.3). Seeding will then commence using the final reclamation seed mix listed in Table 3-3. Erosion control matting will be used where the slope grades are 2 1/2H:1V or steeper.

~~During reclamation, salvaged riparian soil (i.e., the 100-foot extension of Culvert UC-3) will be placed in the floodplain area of Jewkes Creek beginning at the upstream end. The riparian soil will be placed at a depth of 20 inches. The soil will be used in the floodplain areas until the stockpile has been depleted. The locations of the flood plains are shown on Plate 3-7.~~

8.8.1 Resoiled Areas

During 1997 and 1998, various areas and slopes within the disturbed area received topsoil as outlined on Appendix 8-1, Plate A. The soil was distributed, seeded, fertilized, and stabilized as described in Section 3.5.1. The resoiled areas were seeded with Seed Mix No. 1, mulched with a wood fiber, fertilizer, and tackifier. The seeding mixture was intended to protect and enhance the

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truckload is collected, there will be not permanent storage on site for the debris collected during topsoil/growth medium removal.

8.8 Plans for Redistribution of Soils

Deep scarification of overburden and compacted areas (of no less than 12" depth), will be accomplished to ensure good overburden and redistributed topsoil contact to prevent slippage. The regraded material will be topographically conformed to the relative environmental conditions, with the highwalls being eliminated. A qualified soil scientist will be employed at the time of reclamation to evaluate the excavated soil around the portals to determine if this material could be used as additional topsoil to improve vegetation habitat by making deeper microsites. This soil would be recovered prior to the demolition of the portal covers.

Topsoil/growth medium will be placed over the reclaimed areas as illustrated on Plate B, Appendix 8-1 at a minimum thickness of 10 inches. The thickness of the topsoil/growth medium is based on the total available medium divided by the total area to be reclaimed within the disturbed area. As shown on Plate B Appendix 8-1, not all of the area within the disturbed area boundary will actually be disturbed under current mining plans (disturbed area 9.15 acres and areas to be recontoured and receive topsoil is 5.49 acres). If disturbance does occur in these areas, the soils will be salvaged as required by this M&RP. Soils will be placed to aid in the achievement of the reclamation groundcover success standards described in Section 9.8.

Soil will be redistributed using the wooden stake method, where a stake is marked to the depth of fill, then the soils will be added to accomplish that depth. The soil will then be harrowed to break up the cloddy surface and scarify to a depth of 18 inches (see Section 3.5.5.1). The regraded soils surface roughness will be maximized by pitting and gouging. Particular care will be taken not to compact soils placed in the riparian area.

The soil will then be sampled as stated in Section 8.9 to determine needed fertilization levels. The area will then be fertilized as required and mulched (Section 3.5.5.3). Seeding will then commence using the final reclamation seed mix listed in Table 3-3. Erosion control matting will be used where the slope grades are 2 1/2H:1V or steeper.

8.8.1 Resoiled Areas

During 1997 and 1998, various areas and slopes within the disturbed area received topsoil as outlined on Appendix 8-1, Plate A. The soil was distributed, seeded, fertilized, and stabilized as described in Section 3.5.1. The resoiled areas were seeded with Seed Mix No. 1, mulched with a wood fiber, fertilizer, and tackifier. The seeding mixture was intended to protect and enhance the

Horizon Mine
Permit No. 007020

Chapter 9
Redline

During the summer of 1997, the Horizon Mine site received extensive precipitation, with several storm events testing the drainage capacity of the culverts within the disturbed area. Runoff from storms on August 4 and 6 blocked or bypassed culverts ranging in size from 18 to 48 inches within the disturbed and permit boundaries. During the storm events, the riparian vegetation above and below the pad area was flattened by runoff and in some places uprooted and carried downstream. The damage to the area included extensive erosion, displacement of culverts, straining of sediment control structures, and cutting of new stream channels. To prevent additional erosion and damage to the area, a single channel (containing Jewkes Creek) was defined and constructed within the disturbed area boundary as described in Section 7.2.3.2.

The Jewkes Creek channel was extended by Carbon County and Hidden Splendor Resources below the disturbed area boundary and joins the North Fork of Gordon Creek. The altered Jewkes Creek channel involves property owned by Hidden Splendor Resources and Carbon County and a commitment has been made to reestablish riparian vegetation in this area (Stream Channel Alteration Permits Numbers 97-91-06SA and 97-91-12SA). Horizon was requested by both parties to assist in the planting of riparian vegetation. Horizon agreed to provide labor, seed, and plants to complete the planting of the entire realigned channel (861 feet) both within (151 feet) and beyond (710 feet) the disturbed area boundary. The channel bottom width is approximately 10 feet within the disturbed area boundary and varies between 6 and 10 feet below the disturbed area boundary. The channel area receiving riparian mitigation outside the disturbed area boundary is approximately 0.13 acre. The reseeded area within the disturbed boundary is 0.034 acre.

The channel was planted in 1997 with the Revegetation Seed Mix {Appendix 3-9) approved by the Division of Water Rights (Stream Channel Alteration Permits Numbers 97-91-06SA and 97-91-12SA). ~~The reclamation riparian seed mix described in Section 3.5.5.2 will be planted in the reclamation channel during final reclamation within the disturbed area boundary, if the vegetation is not sufficient to meet revegetative success standards.~~

An area approximately 40 feet x 60 feet (0.055 acre) of preconstruction riparian vegetation below the sediment pond on the east side of Jewkes Creek was left as a mitigation requirement of UDOGM. This area-receives the annual precipitation for the area. However, due to the alteration of Jewkes Creek, the area will not receive significant water from the creek. The area was fenced until 1998 when according to Bill Malencik-DOGM the area was disturbed ~~d~~ring the culvert extension and the cattle still found ways to get into this area. The fence was removed with his knowledge. This area is no longer required to be fenced. The planting of riparian vegetation in the altered Jewkes Creek channel outside the disturbed area would compensate for this area, in addition to the area (0.068 acres) for disturbance in the extension of Culvert UC-3. At the request of UDOGM and the Division of Wildlife Resources and to satisfy mitigation requirements, a wetland (approximately 1.5 acres) owned by the Division of Wildlife Resources was fenced by Horizon in Coal Canyon one mile to the west of the mine site.

The protection of the riparian community within the disturbed area has been enhance by the realignment of the Consumers/Clear Creek county road and the Jewkes Creek channel. The realignment has moved the road approximately 200 feet west of the channel, where previously the road ran immediately adjacent to the stream channel.

The slopes that surround the valley bottoms are dominated by two major community types in its present natural condition: 1) big sagebrush/grass/rabbit brush (valley bottoms) and 2) oak brush/salina wildrye (side slopes). The Soil Conservation Service (George S. Cook, 1991) estimates that premining forage for the area were 950 lbs per acre for the big sagebrush/grass/rabbit brush community, 900 lbs per acre for the oak brush/salina wildrye communities and 1,500 lbs per acre for the semi-wet meadow range (1980).

9.6 Reference Areas

If needed and justified, reference areas will be established.

9.7 Vegetation Map

Plate 9-1 is the vegetation map of the permit area.

9.8 Success Monitoring and Bond Release

Transect areas were chosen and approved by the UDOGM to simulated the previously disturbed areas in their natural, undisturbed condition. The transects were sampled during the 1991 growing season by Mt. Nebo Scientific. Sampling methods followed UDOGM sampling guidelines (see Appendix 9-1). For bond release the sampling methods will be identical to those used in the baseline vegetation sampling, i.e. the UDOGM sampling guidelines contained in Appendix 9-1.

During 1995 Mt. Nebo Scientific sampled the Horizon disturbed area, transects were chosen and sampled. The transects are outlined on Plate 9-1. The riparian area along Jewkes Creek was sampled by Mt. Nebo Scientific in July of 1996. The total living cover of the surveyed riparian area was estimated by Mt. Nebo to be 71%, therefore postmining land use revegetation standards for the riparian zone within the disturbed area boundary, displaced by mine construction (Plate A. Appendix 9-2) will be met when the vegetation total living cover is 71%, corresponding with the 1996 sampling survey. This living cover will include grasses, forbs and shrubs. The 1996 survey listed the living cover to be comprised of 3.05% shrubs, with 66.19% grasses and the additional 30.76% of the cover being made up of forbs. Sampling and monitoring will be as outlined in this section.

~~Horizon commits to provide a reclamation channel design which will allow a reasonable likelihood of restablishing the riparian vegetation along Jewkes Creek which existed prior to the construction of the Horizon Mine.~~

The reclamation ground cover success will be monitored qualitatively every year of the 10 full years required. The ground cover will be monitored quantitatively in year 2, 3, 5, 9, and 10 during the 10 years of extended responsibility (see Table 9-3). The data collected will be submitted to UDOGM in an annual report.

At a minimum the reclamation vegetative ground cover ~~will equal the present ground cover, and~~ will be adequate to control erosion. Revegetative success standard will comply with UDOGM regulation R645-301-356.

Horizon Mine
Permit No. 007020

Chapter 9
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During the summer of 1997, the Horizon Mine site received extensive precipitation, with several storm events testing the drainage capacity of the culverts within the disturbed area. Runoff from storms on August 4 and 6 blocked or bypassed culverts ranging in size from 18 to 48 inches within the disturbed and permit boundaries. During the storm events, the riparian vegetation above and below the pad area was flattened by runoff and in some places uprooted and carried downstream. The damage to the area included extensive erosion, displacement of culverts, straining of sediment control structures, and cutting of new stream channels. To prevent additional erosion and damage to the area, a single channel (containing Jewkes Creek) was defined and constructed within the disturbed area boundary as described in Section 7.2.3.2.

The Jewkes Creek channel was extended by Carbon County and Hidden Splendor Resources below the disturbed area boundary and joins the North Fork of Gordon Creek. The altered Jewkes Creek channel involves property owned by Hidden Splendor Resources and Carbon County and a commitment has been made to reestablish riparian vegetation in this area (Stream Channel Alteration Permits Numbers 97-91-06SA and 97-91-12SA). Horizon was requested by both parties to assist in the planting of riparian vegetation. Horizon agreed to provide labor, seed, and plants to complete the planting of the entire realigned channel (861 feet) both within (151 feet) and beyond (710 feet) the disturbed area boundary. The channel bottom width is approximately 10 feet within the disturbed area boundary and varies between 6 and 10 feet below the disturbed area boundary. The channel area receiving riparian mitigation outside the disturbed area boundary is approximately 0.13 acre. The reseeded area within the disturbed boundary is 0.034 acre.

The channel was planted in 1997 with the Revegetation Seed Mix {Appendix 3-9) approved by the Division of Water Rights (Stream Channel Alteration Permits Numbers 97-91-06SA and 97-91-12SA).

An area approximately 40 feet x 60 feet (0.055 acre) of preconstruction riparian vegetation below the sediment pond on the east side of Jewkes Creek was left as a mitigation requirement of UDOGM. This area-receives the annual precipitation for the area. However, due to the alteration of Jewkes Creek, the area will not receive significant water from the creek. The area was fenced until 1998 when according to Bill Malencik-DOGM the area was disturbed d ring the culvert extension and the cattle still found ways to get into this area. The fence was removed with his knowledge. This area is no longer required to be fenced. The planting of riparian vegetation in the altered Jewkes Creek channel outside the disturbed area would compensate for this area, in addition to the area (0.068 acres) for disturbance in the extension of Culvert UC-3. At the request of UDOGM and the Division of Wildlife Resources and to satisfy mitigation requirements, a wetland (approximately 1.5 acres) owned by the Division of Wildlife Resources was fenced by Horizon in Coal Canyon one mile to the west of the mine site.

The protection of the riparian community within the disturbed area has been enhance by the realignment of the Consumers/Clear Creek county road and the Jewkes Creek channel. The realignment has moved the road approximately 200 feet west of the channel, where previously the road ran immediately adjacent to the stream channel.

Enhancement will include the application of mulch, fertilizer, tacifier and the planting of willows, sedges, and grasses. The channel has been designed to include meanders and a

estimates that premining forage for the area were 950 lbs per acre for the big sagebrush/grass/rabbit brush community, 900 lbs per acre for the oak brush/salina wildrye communities and 1,500 lbs per acre for the semi-wet meadow range (1980).

9.6 Reference Areas

If needed and justified, reference areas will be established.

9.7 Vegetation Map

Plate 9-1 is the vegetation map of the permit area.

9.8 Success Monitoring and Bond Release

Transect areas were chosen and approved by the UDOGM to simulated the previously disturbed areas in their natural, undisturbed condition. The transects were sampled during the 1991 growing season by Mt. Nebo Scientific. Sampling methods followed UDOGM sampling guidelines (see Appendix 9-1). For bond release the sampling methods will be identical to those used in the baseline vegetation sampling, i.e. the UDOGM sampling guidelines contained in Appendix 9-1.

During 1995 Mt. Nebo Scientific sampled the Horizon disturbed area, transects were chosen and sampled. The transects are outlined on Plate 9-1. The riparian area along Jewkes Creek was sampled by Mt. Nebo Scientific in July of 1996. The total living cover of the surveyed riparian area was estimated by Mt. Nebo to be 71%, therefore postmining land use revegetation standards for the riparian zone within the disturbed area boundary, displaced by mine construction (Plate A. Appendix 9-2) will be met when the vegetation total living cover is 71%, corresponding with the 1996 sampling survey. This living cover will include grasses, forbs and shrubs. The 1996 survey listed the living cover to be comprised of 3.05% shrubs, with 66.19% grasses and the additional 30.76% of the cover being made up of forbs. Sampling and monitoring will be as outlined in this section.

The reclamation ground cover success will be monitored qualitatively every year of the 10 full years required. The ground cover will be monitored quantitatively in year 2, 3, 5, 9, and 10 during the 10 years of extended responsibility (see Table 9-3). The data collected will be submitted to UDOGM in an annual report.

At a minimum the reclamation vegetative ground cover will be adequate to control erosion. Revegetative success standard will comply with UDOGM regulation R645-301-356.

Postmining land use revegetation standards will be met when the vegetation total living cover is 48% which corresponds with the 1995 sampling survey performed by Mt. Nebo Scientific. This living cover should include 59% woody species, with the additional 41% of the cover being made up of flora and grasses.

At the time of bond release, shrubs and trees will be healthy, and at a minimum 80 percent will have been in place for at least six growing seasons during the 10 year period of responsibility.

Horizon Mine
Permit No. 007020

Appendix 7-4
Redline

APPENDIX 7-4

DESIGN CALCULATIONS

LICENSED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
2/9/98
STATE OF UTAH

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
16 Jun 1997
STATE OF UTAH

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EFFECTIVE:
APR 07 1998 97F
UTAH DIVISION OIL, GAS AND MINING

EARTHFAX ENGINEERING, INC.
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PROJECT UC0458-07 PAGE 1 OF
COMPUTED TJS DATE 7/11/96
CHECKED DATE

DETERMINATION OF PEAK FLOWS
FOR OPERATIONAL DRAINAGES
AROUND
HORIZON NO. 1 MINE

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JUL 11 1997
97 AB
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PROJECT UC0458-07 PAGE 2 OF
COMPUTED TJS DATE 8/12/96
CHECKED DATE

DETERMINATION OF CURVE NUMBERS FOR OPERATIONAL WATERSHEDS.

Structure	Cover* & Soil Type	Hydrologic Condition	Soil Group	Curve Number**	Area (AC)	Weighted CN Value	Curve Number Used
DD-1	Bare Soil (Pad)	Poor	B+C	89	7.3	64	70
	Oak-Aspen Curecanti soil (Undisturbed area to the NW)	Fair	B	48	15.5		
	Pinyon-Juniper Senchert soil (Undisturbed area to the SE)	Fair	C	73	8.7		
UC-2 (Portal Canyon)	Oak-Aspen Curecanti soil	Fair	B	48	78.8	60	70
	Pinyon-Juniper Senchert soil	Fair	C	73	69.5		
UC-3 (Jewkes Creek)	Oak-Aspen Curecanti soil	Fair	B	48	243.4	56	70
	Pinyon-Juniper Senchert soil	Fair	C	73	112.7		

* Cover Type
- Oak-Aspen: Mountain Brush ~~Mixture of Oak~~ Brush, Aspen, Mountain Mahogany, Other Brush, Maple & Other Brush
- Pinyon-Juniper: Pinyon, Juniper, or Both with a Grass under story

** Curve Number values taken from SCS-TR-55 2nd Ed. (1986) Table 2.2d (Attached)

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7/11/96

Table 2-2d.—Runoff curve numbers for arid and semiarid rangelands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2]*Poor:* <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

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DETERMINATION OF CURVE NUMBERS FOR OPERATIONAL WATERSHEDS (CONT.)

WATERSHED I.D.	COVER + SOIL TYPE *	HYDROLOGIC CONDITION	SOIL GROUP	CURVE NUMBER **	AREA (AC)	WEIGHTED CN VALUE	CURVE NUMBER USED
DC-1	BARE SOIL	POOR	B+C	89	0.8	50.	70
	OAK-ASPEN CURECANTI SOIL	FAIR	B	48	14.9		
DC-2	BARE SOIL	POOR	B+C	89	1.1	89	90
DC-3	OAK-ASPEN CURECANTI SOIL	FAIR	B	48	0.6	61	70
	BARE SOIL	POOR	B+C	89	0.3		
SEDIMENT POND *** (Total)	BARE SOIL	POOR	B+C	89	9.2	66	70
	OAK-ASPEN CURECANTI SOIL	FAIR	B	48	15.5		
	PINYON-JUNIPER SENCHERT SOIL	FAIR	C	73	10.4		

*** ONLY THE MAIN DRAINAGES (PORTAL CANYON & JENKES CREEK) WILL BE DIVERTED AROUND THE POND. ALL OTHER DRAINAGE, BOTH DISTURBED & UNDISTURBED, WILL BE COLLECTED BY THE SEDIMENT POND.

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PORTAL CANYON

5 7/11/96

AREA

Map Area		Actual Area
6.46 sq. in.	6460000 sq. ft.	148.3 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 8905 Min. Elev. 7690 Difference 1215

	Elevation	Length (ft.)
0.25	7993.75	5100
0.5	8297.5	3500
0.75	8601.25	1400

Ave Watershed Slope= 47.0 %

Hydraulic Length

Map Length	Actual Length
4.5 inches	4500 feet

TIME OF CONCENTRATION

Curve Number = 70 S = 4.286 Lag 0.21 hrs

Time of Concentration = 0.34 hrs

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Horizon Mine
Sedimentation Pond Design.

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PROJECT MC 692-01 PAGE 1 OF
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Sedimentation Pond Design Evaluation
— Horizon Mine —

Contributing watersheds (Plate 7-5) WS-1, WS-2, WS-5, WS-6

The runoff flow depth is controlled by the Curve #. The area of each curve number will be determined.

Disturbed	CN = 90	7.97 Acres
	CN = 100 (pond)	0.4 Acre
Undisturbed *	CN = 70	12.8 Acres
	CN = 73	12.4 Acres.

* Although the oak-aspen areas have a CN of 57, a CN of 70 will be used to be conservative.

Design Runoff Vol: $Q = \frac{(P - 0.2S)^2}{P + 0.8S}$ $S = \frac{1000}{CN} - 10$ $P = 1.8$

10-yr, 24-hr storm depth = 1.8 in (Miller et. al, 1973)

Curve Number	Drainage Area (ac)	Runoff (in)	Runoff (ac-ft)
100	0.4	1.8	0.06
90	7.97	0.93	0.62
73	12.4	0.24	0.25
70	12.8	0.17	0.18
			1.11 acre-ft

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Pond Configuration

The pond has an emergency spillway and a decant.

Emergency Spillway.

Flowline elevation = 7573.9
BW = 9'
Depth = 1.1'
SS = 3:1
Crest length = 15'
Crest slope = 5%

Decant.

Diameter = 2"
Invert elevation = 7570.4
Outlet elevation = 7570.0
Length ≅ 50'

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Pond Capacity = 2.95 acre-ft See stage capacity curve on pg 4

minimum total storage = 1.11 AF + 1.19 AF = 2.30 AF
storm water — 3yr sediment (pg 3)

The pond has adequate storage

Max. sediment storage = 2.95 AF − 1.11 AF = 1.84 AF

max sediment elev. = 7570.4 *

* This is the invert for the decant. The decant has a gooseneck to skim off oil that has its inlet ~ 6" below the invert. Therefore, to not plug the decant the max. sediment storage is at an elevation of 7569.8. which corresponds to a sediment vol. of 1.65 AF

Sediment Cleanout vol = (0.6)(1.65) = 0.99 AF
Cleanout Elevation = 7566.9

The entire 10-yr 24-hr storm event of 1.11 AF can be stored between the decant and emergency spillway. Depending on the sediment elevation the entire storm event could also fit below the decant if the pond was empty.

Horizon Sedimentation Pond
Sediment Yield - Universal Soil Loss Equation

Average Sediment Density 90 lb/ft^3

Watershed	Area (acre)	R	K	L (ft)	S (%)	LS	VM	A (ton/ac/yr)	Sediment Yield (ac-ft/yr)
WS-1	9.3	15	0.3	900	61.3	71.52	0.23	3.88	0.0184
WS-2	5.4	15	0.3	1000	52.6	60.73	0.18	49.19	0.1355
WS-5	14.9	15	0.3	700	35.7	27.92	0.25	31.41	0.2388
WS-6	1.6	15	0.3	650	4.4	1.17	1	5.28	0.0043
								Total annual Sediment Yield	0.40
								Sediment Yield For 3 Years	1.19

Note: The VM factor has been area weighted based on the amount of disturbed and undisturbed area The disturbed area has a VM factor of 1, a VM factor of 0.1 for undisturbed, and VM factor of 0.5 for areas that are vegetated but have been disturbed.

Reference : Israelsen et. al., 1984

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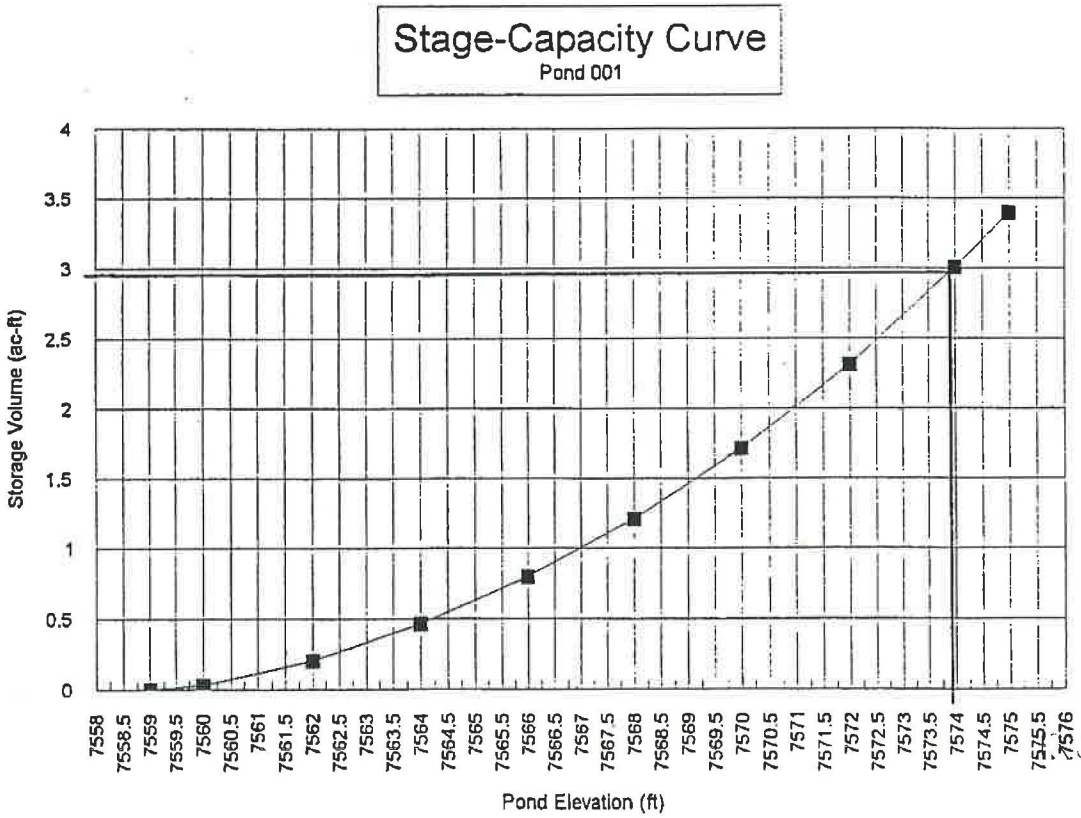
'Horizon Sedimtentation Pond

Stage-Capacity Table

Elevation (ft)	Area* (ft^2)	Average Area (ft^2)	Contour Interval (ft)	Incremental Volume (ft^3)	Cummulative Volume (ft^3)	Cummulative Volume (ac-ft)
7559	0					
		1407	1	1407	1407	0.03
7560	2814					
		3810	2	7620	9027	0.21
7562	4806					
		5605.5	2	11211	20238	0.46
7564	6405					
		7264	2	14528	34766	0.80
7566	8123					
		9059	2	18118	52884	1.21
7568	9995					
		10971	2	21942	74826	1.72
7570	11947					
		12995.5	2	25991	100817	2.31
7572	14044					
		15097	2	30194	131011	3.01
7574	16150					
		16700	1	16700	147711	3.39
7575	17250					

* Determined from the as-built topography of the pond



Pond Capacity
2.95 AF
at 7573.9

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The Hydraulic efficiency of the pond will be determined using SEDCAD+ (Warner and Schwab, 1992)

The capacity of the pond to handle the 25-yr 6-hr storm event under the 2 following conditions will be tested.

1) Emergency spillway and decant operating properly with water elevation of 7570.4 at the start of the storm.

2) Only emergency spillway is operational with the water elevation of 7573.9. at the start of the storm.

See pgs 7-22 for calculation results.

Case #	Peak inflow (cfs)	Peak outflow (cfs)	Peak Stage (ft)	
1	4.47	0.03 *	7572.12	ok
2	4.47	2.15	7574.04	ok

* SEDCAD would not allow the modelling of a 2" decant so I used a 3" decant instead. Even with the 3" decant the flow was very small & the peak stage is within a few tenths of a foot with the water not coming close to the emergency spillway. With such a small outflow and the ability to store the 10-yr 24-hr storm between the decant and emergency spillway the retention time will be well over 24 hrs.

Test stability of the emergency spillway

$Q_{25-6} = 2.15$ cfs
max slope = 50%
min slope = 5%
BW = 9'
SS = 3:1
$D_{50} = 4''$

max vel. = 3.40 fps ok
max flow depth = 0.22 ft ok

pgs 23+24

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The emergency spillway is stable under the worst case scenario of the design storm event.

Test stability of inlets to the Pond

DD-1I at inlet to pond. (not the same as the rest of the channel)

BW = 6'
Depth = 1.5'
SS = 2:1
D_{50} = 6"
Q_{25-6} = 3.72 SedCAD output WS-1,2,3
min slope = 20%
max slope = 50%

max velocity = 4.71 fps ok pgs 25-26
max flow depth = 0.15' ok

Channel is stable during the design event

DD-6 at pond inlet (not the same configuration as the rest of the ditch)

BW = 5'
Depth = 1.5'
SS = 2:1
D_{50} = 15"
Q_{25-6} = 1.06 cfs Sedcad output WS-4
min slope = 8.3%
max slope = 25%

max velocity = 2.46 fps pgs 27-28
max flow depth = 0.10'

Channel is stable during the design storm event.

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CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

HORIZON MINE SEDIMENTATION POND DECANT OPERATIONAL

by

Name: Layne Jensen

Company Name: EarthFax Engineering INC.
File Name: C:\HOR\P-1

Date: 02-25-2000

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P

Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-1 User: Layne Jensen
Date: 02-25-2000 Time: 16:59:13
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	9.30	70	M	0.083	0.000	0.000	0.0	0.09	0.39
111	2	5.40	70	M	0.098	0.000	0.000	0.0	0.05	0.22
111	3	14.90	77	F	0.072	0.000	0.000	0.0	0.31	3.13
111	4	1.60	90	F	0.126	0.000	0.000	0.0	0.10	1.06
		Type: Pond Label: pond								
111	Structure	31.20							0.55	
111	Total IN	31.20							0.55	4.47
111	Total OUT								0.12	0.03

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Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-1 User: Layne Jensen
Date: 02-25-2000 Time: 16:59:13
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

==========
POND INPUT/OUTPUT TABLE
==========

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

DISCHARGE OPTIONS:

	Trickle Tube	Emergency Spillway
Riser Diameter (in)	----	----
Riser Height (ft)	----	----
Barrel Diameter (in)	3.0	----
Barrel Length (ft)	50.00	----
Barrel Slope (%)	0.80	----
Manning's n of Pipe	0.010	----
Spillway Elevation	7570.4	----
Lowest Elevation of Holes	----	----
# of Holes/Elevation	----	----
Entrance Loss Coefficient	1.0	----
Tailwater Depth (ft)	0.0	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	7573.9
Crest Length (ft)	----	15.0
Z:1 (Left and Right)	-- --	3 3
Bottom Width (ft)	----	9.0

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POND RESULTS:

Permanent Pool (ac-ft)
1.8

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.55	4.47
OUT	0.12	0.03

Peak Elevation	Hydrograph Detention Time (hrs)
7572.1	0.00

****

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Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

Elevation	Trickle Tube (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
7559.00	0.0	0.0	0.0
7559.50	0.0	0.0	0.0
7560.00	0.0	0.0	0.0
7560.50	0.0	0.0	0.0
7561.00	0.0	0.0	0.0
7561.50	0.0	0.0	0.0
7562.00	0.0	0.0	0.0
7562.50	0.0	0.0	0.0
7563.00	0.0	0.0	0.0
7563.50	0.0	0.0	0.0
7564.00	0.0	0.0	0.0
7564.50	0.0	0.0	0.0
7565.00	0.0	0.0	0.0
7565.50	0.0	0.0	0.0
7566.00	0.0	0.0	0.0
7566.50	0.0	0.0	0.0
7567.00	0.0	0.0	0.0
7567.50	0.0	0.0	0.0
7568.00	0.0	0.0	0.0
7568.50	0.0	0.0	0.0
7569.00	0.0	0.0	0.0
7569.50	0.0	0.0	0.0
7570.00	0.0	0.0	0.0
7570.40	0.0	0.0	0.0
7570.50	0.0	0.0	0.0
7571.00	0.0	0.0	0.0
7571.50	0.0	0.0	0.0
7572.00	0.0	0.0	0.0
7572.50	0.0	0.0	0.0

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7573.00	0.1	0.0	0.1
7573.50	0.1	0.0	0.1
7573.90	0.1	0.0	0.1
7574.00	0.1	1.7	1.7
7574.50	0.1	9.9	10.0
7574.60	0.1	13.1	13.2
7574.70	0.1	17.1	17.2
7574.80	0.1	21.4	21.5
7574.90	0.1	26.0	26.1
7575.00	0.1	31.3	31.4

****

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-1 User: Layne Jensen
Date: 02-25-2000 Time: 16:59:13
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

==========
ELEVATION-AREA-CAPACITY-DISCHARGE TABLE
==========

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

SW#1: Trickle Tube
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
7559.00	0.00	0.00	0.00	0.00	
7559.50	0.50	0.02	0.00	0.00	
7560.00	1.00	0.06	0.02	0.00	
7560.50	1.50	0.08	0.06	0.00	
7561.00	2.00	0.09	0.10	0.00	
7561.50	2.50	0.10	0.14	0.00	
7562.00	3.00	0.11	0.19	0.00	
7562.50	3.50	0.12	0.25	0.00	
7563.00	4.00	0.13	0.31	0.00	
7563.50	4.50	0.14	0.38	0.00	
7564.00	5.00	0.15	0.45	0.00	
7564.50	5.50	0.16	0.53	0.00	
7565.00	6.00	0.17	0.61	0.00	
7565.50	6.50	0.18	0.69	0.00	
7566.00	7.00	0.19	0.78	0.00	
7566.50	7.50	0.20	0.88	0.00	
7567.00	8.00	0.21	0.98	0.00	
7567.50	8.50	0.22	1.09	0.00	
7568.00	9.00	0.23	1.20	0.00	
7568.50	9.50	0.24	1.32	0.00	
7569.00	10.00	0.25	1.44	0.00	
7569.50	10.50	0.26	1.57	0.00	
7570.00	11.00	0.27	1.70	0.00	
7570.40	11.40	0.28	1.81	0.00	Stage of SW#1
7570.50	11.50	0.29	1.84	0.00	
7571.00	12.00	0.30	1.99	0.01	
7571.50	12.50	0.31	2.14	0.02	
7572.00	13.00	0.32	2.30	0.03	

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7572.12	13.12	0.32	2.34	0.03	Peak Stage
7572.50	13.50	0.33	2.46	0.04	
7573.00	14.00	0.35	2.63	0.05	
7573.50	14.50	0.36	2.81	0.06	
7573.90	14.90	0.37	2.95	0.07	Stage of SW#2
7574.00	15.00	0.37	2.99	1.72	
7574.50	15.50	0.38	3.18	9.99	
7574.60	15.60	0.39	3.22	13.21	
7574.70	15.70	0.39	3.26	17.22	
7574.80	15.80	0.39	3.30	21.45	
7574.90	15.90	0.39	3.34	26.09	
7575.00	16.00	0.40	3.37	31.41	

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5

CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

HORIZON MINE SEDIMENTATION POND DECANT NOT OPERATIONAL

by

Name: Layne Jensen

Company Name: EarthFax Engineering INC.
File Name: C:\HOR\P-2A

Date: 02-26-2000

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Civil Software Design -- SEDCAD+ Version 3.1
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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	9.30	70	M	0.083	0.000	0.000	0.0	0.09	0.39
111	2	5.40	70	M	0.098	0.000	0.000	0.0	0.05	0.22
111	3	14.90	77	F	0.072	0.000	0.000	0.0	0.31	3.13
111	4	1.60	90	F	0.126	0.000	0.000	0.0	0.10	1.06
			Type: Pond		Label: pond					
111	Structure	31.20							0.55	
111	Total IN	31.20							0.55	4.47
111	Total OUT								0.55	2.15

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

==========
POND INPUT/OUTPUT TABLE
==========

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	7573.9
Crest Length (ft)	15.0
Z:1 (Left and Right)	0 0
Bottom Width (ft)	9.0

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POND RESULTS:

Permanent Pool (ac-ft)
3.0

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.55	4.47
OUT	0.55	2.15

Peak Elevation	Hydrograph Detention Time (hrs)
7574.0	0.00

****

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
7559.00	0.0	0.0
7559.50	0.0	0.0
7560.00	0.0	0.0
7560.50	0.0	0.0
7561.00	0.0	0.0
7561.50	0.0	0.0
7562.00	0.0	0.0
7562.50	0.0	0.0
7563.00	0.0	0.0
7563.50	0.0	0.0
7564.00	0.0	0.0
7564.50	0.0	0.0
7565.00	0.0	0.0
7565.50	0.0	0.0
7566.00	0.0	0.0
7566.50	0.0	0.0
7567.00	0.0	0.0
7567.50	0.0	0.0
7568.00	0.0	0.0
7568.50	0.0	0.0
7569.00	0.0	0.0
7569.50	0.0	0.0
7570.00	0.0	0.0
7570.50	0.0	0.0
7571.00	0.0	0.0
7571.50	0.0	0.0
7572.00	0.0	0.0
7572.50	0.0	0.0
7573.00	0.0	0.0

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7573.50	0.0	0.0
7573.90	0.0	0.0
7574.00	1.5	1.5
7574.50	9.0	9.0
7574.60	11.7	11.7
7574.70	14.9	14.9
7574.80	18.2	18.2
7574.90	21.8	21.8
7575.00	25.8	25.8

****

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

==========
ELEVATION-AREA-CAPACITY-DISCHARGE TABLE
==========

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
7559.00	0.00	0.00	0.00	0.00
7559.50	0.50	0.02	0.00	0.00
7560.00	1.00	0.06	0.02	0.00
7560.50	1.50	0.08	0.06	0.00
7561.00	2.00	0.09	0.10	0.00
7561.50	2.50	0.10	0.14	0.00
7562.00	3.00	0.11	0.19	0.00
7562.50	3.50	0.12	0.25	0.00
7563.00	4.00	0.13	0.31	0.00
7563.50	4.50	0.14	0.38	0.00
7564.00	5.00	0.15	0.45	0.00
7564.50	5.50	0.16	0.53	0.00
7565.00	6.00	0.17	0.61	0.00
7565.50	6.50	0.18	0.69	0.00
7566.00	7.00	0.19	0.78	0.00
7566.50	7.50	0.20	0.88	0.00
7567.00	8.00	0.21	0.98	0.00
7567.50	8.50	0.22	1.09	0.00
7568.00	9.00	0.23	1.20	0.00
7568.50	9.50	0.24	1.32	0.00
7569.00	10.00	0.25	1.44	0.00
7569.50	10.50	0.26	1.57	0.00
7570.00	11.00	0.27	1.70	0.00
7570.50	11.50	0.29	1.84	0.00
7571.00	12.00	0.30	1.99	0.00
7571.50	12.50	0.31	2.14	0.00
7572.00	13.00	0.32	2.30	0.00
7572.50	13.50	0.33	2.46	0.00
7573.00	14.00	0.35	2.63	0.00

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7573.50	14.50	0.36	2.81	0.00	
7573.90	14.90	0.37	2.95	0.00	Stage of SW#1
7574.00	15.00	0.37	2.99	1.49	
7574.04	15.04	0.37	3.01	2.15	Peak Stage
7574.50	15.50	0.38	3.18	8.96	
7574.60	15.60	0.39	3.22	11.65	
7574.70	15.70	0.39	3.26	14.91	
7574.80	15.80	0.39	3.30	18.25	
7574.90	15.90	0.39	3.34	21.80	
7575.00	16.00	0.40	3.37	25.76	

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Emergency Spillway Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.035 $D_{50} = 4''$
Slope	0.005000 ft/ft
Left Side Slope	3.00 H : V
Right Side Slope	3.00 H : V
Bottom Width	9.00 ft
Discharge	2.15 cfs

Results	
Depth	0.22 ft
Flow Area	2.1 ft²
Wetted Perimeter	10.37 ft
Top Width	10.30 ft
Critical Depth	0.12 ft
Critical Slope	0.037535 ft/ft
Velocity	1.03 ft/s
Velocity Head	0.02 ft
Specific Energy	0.23 ft
Froude Number	0.40
Flow Type	Subcritical

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Project Engineer: Tom Suchoski

Emergency Spillway Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.051	D_{50} = 4"
Slope	0.500000 ft/ft	
Left Side Slope	3.00 H : V	
Right Side Slope	3.00 H : V	
Bottom Width	9.00 ft	
Discharge	2.15 cfs	

Results		
Depth	0.07 ft	
Flow Area	0.6 ft²	
Wetted Perimeter	9.43 ft	
Top Width	9.41 ft	
Critical Depth	0.12 ft	
Critical Slope	0.078042 ft/ft	
Velocity	3.40 ft/s	< 5.0 fps ok
Velocity Head	0.18 ft	
Specific Energy	0.25 ft	
Froude Number	2.32	
Flow Type	Supercritical	

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DD-1I Pond inlet Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.047 D_{50} = 6"
Slope	0.200000 ft/ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Bottom Width	6.00 ft
Discharge	3.72 cfs

Results	
Depth	0.15 ft < 1.5' ok
Flow Area	1.0 ft²
Wetted Perimeter	6.68 ft
Top Width	6.61 ft
Critical Depth	0.22 ft
Critical Slope	0.055162 ft/ft
Velocity	3.88 ft/s
Velocity Head	0.23 ft
Specific Energy	0.39 ft
Froude Number	1.80
Flow Type	Supercritical

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DD-1I Pond inlet Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.054	D_{50} = 6"
Slope	0.500000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	6.00 ft	
Discharge	3.72 cfs	

Results		
Depth	0.13 ft	
Flow Area	0.8 ft²	
Wetted Perimeter	6.56 ft	
Top Width	6.50 ft	
Critical Depth	0.22 ft	
Critical Slope	0.073943 ft/ft	
Velocity	4.71 ft/s	< 5.0 fps ok
Velocity Head	0.35 ft	
Specific Energy	0.47 ft	
Froude Number	2.39	
Flow Type	Supercritical	

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© Haestad Methods, Inc.
EarthFax Engineering Inc
37 Brookside Road Waterbury, CT 06708 USA (203) 755-1666

DD-6 Pond inlet Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.047 @ 50 = 15"
Slope	0.083300 ft/ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Bottom Width	5.00 ft
Discharge	1.06 cfs

Results	
Depth	0.10 ft < 1.5' ok
Flow Area	0.5 ft²
Wetted Perimeter	5.47 ft
Top Width	5.42 ft
Critical Depth	0.11 ft
Critical Slope	0.069544 ft/ft
Velocity	1.95 ft/s
Velocity Head	0.06 ft
Specific Energy	0.16 ft
Froude Number	1.09
Flow Type	Supercritical

DIV OF OIL GAS & MIN

DD-6 Pond inlet Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.056 D_{50} = 15"
Slope	0.250000 ft/ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Bottom Width	5.00 ft
Discharge	1.06 cfs

Results	
Depth	0.08 ft
Flow Area	0.4 ft²
Wetted Perimeter	5.37 ft
Top Width	5.33 ft
Critical Depth	0.11 ft
Critical Slope	0.098949 ft/ft
Velocity	2.46 ft/s < 5.0 fps ok
Velocity Head	0.09 ft
Specific Energy	0.18 ft
Froude Number	1.52
Flow Type	Supercritical

DIV OF OIL GAS &

SUMMIT ENGINEERING INC.

May 8, 2002

David Miller
Lodestar Energy, Inc.
Mountain Operations
HC 35, Box 370
Helper, Utah 84526

RE: **Horizon Mine Site – Sedimentation Pond 1**
Mine Discharge Option

Dear Mr. Miller:

On March 21, 2002, you requested that I perform an engineering analysis on the above referenced structure in order to determine if any modifications would be necessary in order to accommodate pumped mine discharge. To facilitate this evaluation, you sent me the latest design documents for this structure, which were prepared by EarthFax Engineering, Inc., and information concerning the pump system for the mine discharge. From this information, and by use of the computer program SEDCAD4, I was able to make the following determination(s):

- The pump systems maximum discharge rate of 750 gpm is equivalent to 1.67 cfs based on the following conversion factor: 1 gpm = 2.228×10^{-3} cfs.
- To be conservative, the discharge rate of 1.67 cfs was rounded up to 2 cfs and entered into the SEDCAD4 computer model developed for this pond.
- The provided design documents for this pond considered two (2) options; the pond with a decant pipe and without the pipe. Also, the 10 yr.-24 hr. storm event was used in this analysis with a rainfall depth of 1.8 inches. The analysis provided considered these two (2) scenarios. ***Therefore, based on the results of the computer models, Pond 1 will not require any modifications to its existing configuration in order to accommodate mine discharge up to the maximum rate of 750 gpm.***

Please find enclosed the results of the SEDCAD4 computer analysis and a stage-storage curve for the pond for each of the above mentioned design cases.

If you require any additional information or have any questions, feel free to contact me at our Pikeville, KY office at (606) 432-1447.

Thank you in advance for the continued opportunity to serve you and your company.

Sincerely,

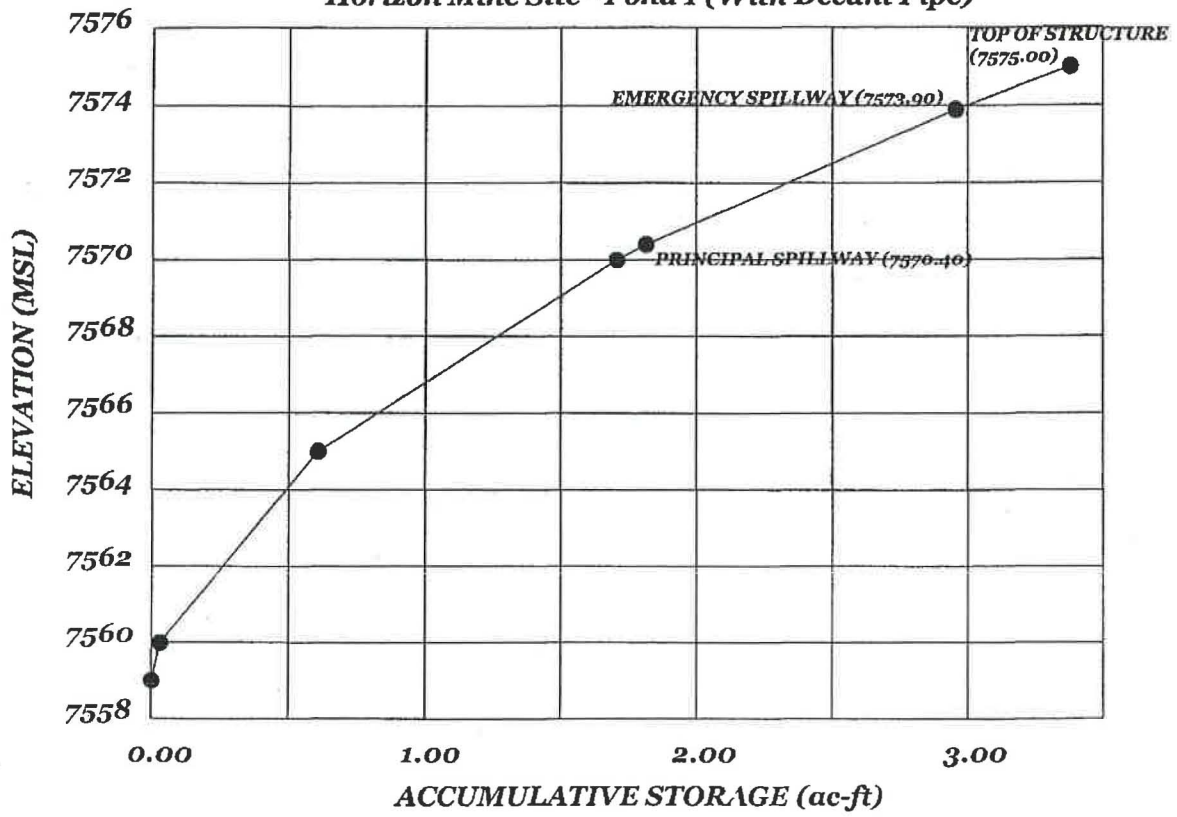
Michael J. Parker, E.I.T.
Project Engineer

DIV OF OIL GAS

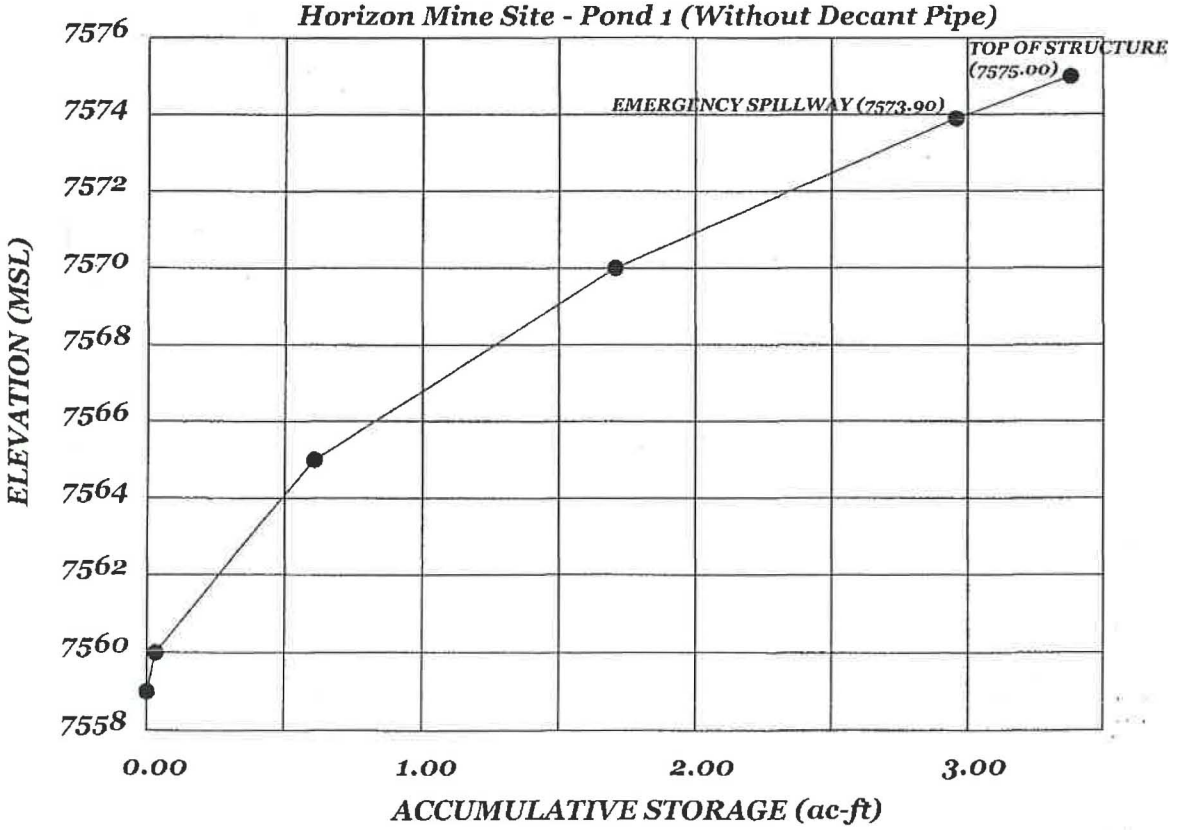
131 Summit Drive, Pikeville, Kentucky 41501 ▲ 606-432-1447 ▲ fax 606-432-1440 ▲ e-mail: summit@kymtnnet.org

STAGE STORAGE CURVE

Horizon Mine Site - Pond 1 (With Decant Pipe)



Horizon Mine Site - Pond 1 (Without Decant Pipe)



DIV OF OIL GAS & MINING

Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

With Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.600 inches

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	31.200	31.200	11.56	0.55
	Out			2.05	0.55

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Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,570.00
Initial Pool:	1.71 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
3.00	50.00	0.80	0.0100	7,570.40	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,570.65
Dewater Time:	0.26 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7,559.00	0.001	0.000	0.000	
7,559.01	0.001	0.000	0.000	
7,559.50	0.020	0.004	0.000	
7,560.00	0.060	0.023	0.000	
7,560.50	0.069	0.055	0.000	
7,561.00	0.078	0.092	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,561.50	0.087	0.133	0.000		
7,562.00	0.097	0.179	0.000		
7,562.50	0.108	0.230	0.000		
7,563.00	0.119	0.287	0.000		
7,563.50	0.131	0.350	0.000		
7,564.00	0.144	0.418	0.000		
7,564.50	0.157	0.493	0.000		
7,565.00	0.170	0.575	0.000		
7,565.50	0.181	0.663	0.000		
7,566.00	0.191	0.756	0.000		
7,566.50	0.203	0.854	0.000		
7,567.00	0.214	0.958	0.000		
7,567.50	0.226	1.068	0.000		
7,568.00	0.238	1.184	0.000		
7,568.50	0.251	1.307	0.000		
7,569.00	0.263	1.435	0.000		
7,569.50	0.277	1.570	0.000		
7,570.00	0.290	1.712	0.000		
7,570.40	0.298	1.829	2.000	4.95	Spillway #1
7,570.50	0.300	1.859	2.029	0.40	
7,570.65	0.303	1.906	2.053	0.95	Peak Stage
7,571.00	0.311	2.012	2.107		
7,571.50	0.321	2.170	2.121		
7,572.00	0.332	2.333	2.136		
7,572.50	0.343	2.502	2.150		
7,573.00	0.354	2.676	2.164		
7,573.50	0.365	2.856	2.179		
7,573.90	0.374	3.004	2.190		Spillway #2
7,574.00	0.377	3.041	3.845		
7,574.50	0.388	3.232	12.114		
7,575.00	0.400	3.430	33.545		

Detailed Discharge Table

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Elevation	Straight Pipe (cfs)	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,559.00	0.000	0.000	0.000	0.000
7,559.01	0.000	0.000	0.000	0.000
7,559.50	0.000	0.000	0.000	0.000
7,560.00	0.000	0.000	0.000	0.000
7,560.50	0.000	0.000	0.000	0.000
7,561.00	0.000	0.000	0.000	0.000
7,561.50	0.000	0.000	0.000	0.000
7,562.00	0.000	0.000	0.000	0.000
7,562.50	0.000	0.000	0.000	0.000
7,563.00	0.000	0.000	0.000	0.000
7,563.50	0.000	0.000	0.000	0.000
7,564.00	0.000	0.000	0.000	0.000
7,564.50	0.000	0.000	0.000	0.000
7,565.00	0.000	0.000	0.000	0.000
7,565.50	0.000	0.000	0.000	0.000
7,566.00	0.000	0.000	0.000	0.000
7,566.50	0.000	0.000	0.000	0.000
7,567.00	0.000	0.000	0.000	0.000
7,567.50	0.000	0.000	0.000	0.000
7,568.00	0.000	0.000	0.000	0.000
7,568.50	0.000	0.000	0.000	0.000
7,569.00	0.000	0.000	0.000	0.000
7,569.50	0.000	0.000	0.000	0.000
7,570.00	0.000	0.000	0.000	0.000
7,570.40	0.000	0.000	2.000	2.000
7,570.50	(1)>0.029	0.000	2.000	2.029
7,571.00	(5)>0.107	0.000	2.000	2.107
7,571.50	(5)>0.121	0.000	2.000	2.121
7,572.00	(5)>0.136	0.000	2.000	2.136
7,572.50	(5)>0.150	0.000	2.000	2.150
7,573.00	(5)>0.164	0.000	2.000	2.164
7,573.50	(5)>0.179	0.000	2.000	2.179
7,573.90	(5)>0.190	0.000	2.000	2.190
7,574.00	(5)>0.193	1.653	2.000	3.845
7,574.50	(5)>0.207	9.907	2.000	12.114
7,575.00	(5)>0.221	31.323	2.000	33.545

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.84	0.085
	2	5.400	0.098	0.000	0.000	70.000	M	1.07	0.049
	3	14.900	0.072	0.000	0.000	77.000	F	7.17	0.313
	4	1.600	0.126	0.000	0.000	90.000	F	1.61	0.102
	Σ	**31.200**						**11.56**	**0.549**

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Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

Without Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Particle Size Distribution:

Size (mm)	Disturbed	Undisturbed
3.0000	100.000%	100.000%
2.0000	93.000%	99.900%
1.0000	86.000%	98.000%
0.5000	78.000%	92.000%
0.3000	73.000%	87.000%
0.2000	67.000%	80.000%
0.1000	55.000%	70.000%
0.0500	44.000%	60.000%
0.0300	35.000%	50.000%
0.0200	27.000%	42.000%
0.0100	18.000%	32.000%
0.0050	14.000%	21.000%
0.0030	9.000%	15.000%
0.0010	3.000%	4.000%

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	31.200	31.200	9.86	0.76	21.5	46,866	29.80	13.17
	Out			2.72	0.76	1.8	2,194	0.00	0.00

The 24 hour Arithmetic Average (24AA) is under review. It is anticipated that the 24AA will be replaced by the peak settleable solids concentration (ml/l) with the addition of new sediment input factor values.

The 24AA is provided for your convenience during this transition period.

		24AA (ml/l)
#1	In	3.94
	Out	0.00

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Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	94.479%	100.000%
1.0000	87.502%	100.000%
0.5000	79.402%	100.000%
0.3000	74.324%	100.000%
0.2000	68.217%	100.000%
0.1000	56.054%	100.000%
0.0500	44.894%	100.000%
0.0300	35.740%	100.000%
0.0200	27.615%	100.000%
0.0100	18.461%	100.000%
0.0050	14.309%	100.000%
0.0030	9.218%	100.000%
0.0010	3.060%	35.903%

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Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,573.50
Initial Pool:	0.53 ac-ft
*Sediment Storage:	2.33 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,573.94
H'graph Detention Time:	0.87 hrs
Pond Model:	CSTRS
Dewater Time:	0.64 days
Trap Efficiency:	91.48 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,571.99	0.332	0.000	0.000		Top of Sed. Storage
7,572.00	0.332	0.003	0.000		
7,572.50	0.343	0.172	0.000		
7,573.00	0.354	0.346	0.000		
7,573.50	0.365	0.526	0.000		
7,573.90	0.374	0.674	2.000	14.95	Spillway #1
7,573.94	0.375	0.690	2.725	0.45	Peak Stage

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7,574.00	0.377	0.711	3.653	
7,574.50	0.388	0.902	11.907	
7,575.00	0.400	1.100	33.323	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,571.99	0.000	0.000	0.000
7,572.00	0.000	0.000	0.000
7,572.50	0.000	0.000	0.000
7,573.00	0.000	0.000	0.000
7,573.50	0.000	0.000	0.000
7,573.90	0.000	2.000	2.000
7,574.00	1.653	2.000	3.653
7,574.50	9.907	2.000	11.907
7,575.00	31.323	2.000	33.323

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.63	0.132
	2	5.400	0.098	0.000	0.000	70.000	M	0.95	0.077
	3	14.900	0.072	0.000	0.000	77.000	F	5.99	0.429
	4	1.600	0.126	0.000	0.000	90.000	F	1.36	0.123
	$\sum$	**31.200**						**9.86**	**0.760**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.170	100.00	50.00	0.0030	1.0000	2	0.2	2,609	1.41	0.53
	2	0.170	100.00	50.00	0.0030	1.0000	2	0.1	2,444	1.32	0.50
	3	0.220	100.00	20.00	0.1400	1.0000	1	17.0	65,267	41.74	18.34
	4	0.220	100.00	5.00	0.9000	1.0000	1	4.3	49,074	30.81	16.42
	$\sum$							**21.5**	**46,866**	**29.80**	**13.17**

Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

Without Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.600 inches

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	31.200	31.200	11.56	0.55
	Out			2.93	0.55

Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,573.50
Initial Pool:	2.86 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,573.96
Dewater Time:	0.30 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7,559.00	0.001	0.000	0.000	
7,559.01	0.001	0.000	0.000	
7,559.50	0.020	0.004	0.000	
7,560.00	0.060	0.023	0.000	
7,560.50	0.069	0.055	0.000	
7,561.00	0.078	0.092	0.000	
7,561.50	0.087	0.133	0.000	
7,562.00	0.097	0.179	0.000	
7,562.50	0.108	0.230	0.000	
7,563.00	0.119	0.287	0.000	
7,563.50	0.131	0.350	0.000	
7,564.00	0.144	0.418	0.000	
7,564.50	0.157	0.493	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,565.00	0.170	0.575	0.000		
7,565.50	0.181	0.663	0.000		
7,566.00	0.191	0.756	0.000		
7,566.50	0.203	0.854	0.000		
7,567.00	0.214	0.958	0.000		
7,567.50	0.226	1.068	0.000		
7,568.00	0.238	1.184	0.000		
7,568.50	0.251	1.307	0.000		
7,569.00	0.263	1.435	0.000		
7,569.50	0.277	1.570	0.000		
7,570.00	0.290	1.712	0.000		
7,570.40	0.298	1.829	0.000		
7,570.50	0.300	1.859	0.000		
7,571.00	0.311	2.012	0.000		
7,571.50	0.321	2.170	0.000		
7,572.00	0.332	2.333	0.000		
7,572.50	0.343	2.502	0.000		
7,573.00	0.354	2.676	0.000		
7,573.50	0.365	2.856	0.000		
7,573.90	0.374	3.004	2.000	6.85	Spillway #1
7,573.96	0.376	3.025	2.927	0.40	Peak Stage
7,574.00	0.377	3.041	3.653		
7,574.50	0.388	3.232	11.907		
7,575.00	0.400	3.430	33.323		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,559.00	0.000	0.000	0.000
7,559.01	0.000	0.000	0.000
7,559.50	0.000	0.000	0.000
7,560.00	0.000	0.000	0.000
7,560.50	0.000	0.000	0.000
7,561.00	0.000	0.000	0.000
7,561.50	0.000	0.000	0.000
7,562.00	0.000	0.000	0.000
7,562.50	0.000	0.000	0.000
7,563.00	0.000	0.000	0.000

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Elevation	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,563.50	0.000	0.000	0.000
7,564.00	0.000	0.000	0.000
7,564.50	0.000	0.000	0.000
7,565.00	0.000	0.000	0.000
7,565.50	0.000	0.000	0.000
7,566.00	0.000	0.000	0.000
7,566.50	0.000	0.000	0.000
7,567.00	0.000	0.000	0.000
7,567.50	0.000	0.000	0.000
7,568.00	0.000	0.000	0.000
7,568.50	0.000	0.000	0.000
7,569.00	0.000	0.000	0.000
7,569.50	0.000	0.000	0.000
7,570.00	0.000	0.000	0.000
7,570.40	0.000	0.000	0.000
7,570.50	0.000	0.000	0.000
7,571.00	0.000	0.000	0.000
7,571.50	0.000	0.000	0.000
7,572.00	0.000	0.000	0.000
7,572.50	0.000	0.000	0.000
7,573.00	0.000	0.000	0.000
7,573.50	0.000	0.000	0.000
7,573.90	0.000	2.000	2.000
7,574.00	1.653	2.000	3.653
7,574.50	9.907	2.000	11.907
7,575.00	31.323	2.000	33.323

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.84	0.085
	2	5.400	0.098	0.000	0.000	70.000	M	1.07	0.049
	3	14.900	0.072	0.000	0.000	77.000	F	7.17	0.313
	4	1.600	0.126	0.000	0.000	90.000	F	1.61	0.102
	$\sum$	**31.200**						**11.56**	**0.549**

Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

With Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Particle Size Distribution:

Size (mm)	Disturbed	Undisturbed
3.0000	100.000%	100.000%
2.0000	93.000%	99.900%
1.0000	86.000%	98.000%
0.5000	78.000%	92.000%
0.3000	73.000%	87.000%
0.2000	67.000%	80.000%
0.1000	55.000%	70.000%
0.0500	44.000%	60.000%
0.0300	35.000%	50.000%
0.0200	27.000%	42.000%
0.0100	18.000%	32.000%
0.0050	14.000%	21.000%
0.0030	9.000%	15.000%
0.0010	3.000%	4.000%

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Structure Networking:

Type	Stru #	(flows Into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	31.200	31.200	9.86	0.76	21.5	46,866	29.80	13.17
	Out			2.04	0.76	2.2	2,681	0.00	0.00

The 24 hour Arithmetic Average (24AA) is under review. It is anticipated that the 24AA will be replaced by the peak settleable solids concentration (ml/l) with the addition of new sediment input factor values.

The 24AA is provided for your convenience during this transition period.

		24AA (ml/l)
#1	In	3.94
	Out	0.00

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Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	94.479%	100.000%
1.0000	87.502%	100.000%
0.5000	79.402%	100.000%
0.3000	74.324%	100.000%
0.2000	68.217%	100.000%
0.1000	56.054%	100.000%
0.0500	44.894%	100.000%
0.0300	35.740%	100.000%
0.0200	27.615%	100.000%
0.0100	18.461%	100.000%
0.0050	14.309%	100.000%
0.0030	9.218%	90.890%
0.0010	3.060%	30.171%

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Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,570.00
Initial Pool:	0.41 ac-ft
*Sediment Storage:	1.30 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
3.00	50.00	0.80	0.0100	7,570.40	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,570.60
H'graph Detention Time:	0.78 hrs
Pond Model:	CSTRS
Dewater Time:	0.60 days
Trap Efficiency:	89.86 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,568.49	0.250	0.000	0.000		Top of Sed. Storage
7,568.50	0.251	0.002	0.000		
7,569.00	0.263	0.130	0.000		
7,569.50	0.277	0.265	0.000		
7,570.00	0.290	0.407	0.000		
7,570.40	0.298	0.524	2.000	13.50	Spillway #1
7,570.50	0.300	0.554	2.029	0.35	
7,570.60	0.302	0.584	2.044	0.50	Peak Stage
7,571.00	0.311	0.707	2.107		
7,571.50	0.321	0.865	2.121		
7,572.00	0.332	1.028	2.136		
7,572.50	0.343	1.197	2.150		
7,573.00	0.354	1.371	2.164		
7,573.50	0.365	1.551	2.179		
7,573.90	0.374	1.699	2.190		Spillway #2
7,574.00	0.377	1.736	3.845		
7,574.50	0.388	1.928	12.114		
7,575.00	0.400	2.125	33.545		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,568.49	0.000	0.000	0.000	0.000
7,568.50	0.000	0.000	0.000	0.000
7,569.00	0.000	0.000	0.000	0.000
7,569.50	0.000	0.000	0.000	0.000
7,570.00	0.000	0.000	0.000	0.000
7,570.40	0.000	0.000	2.000	2.000
7,570.50	(1)>0.029	0.000	2.000	2.029
7,571.00	(5)>0.107	0.000	2.000	2.107
7,571.50	(5)>0.121	0.000	2.000	2.121
7,572.00	(5)>0.136	0.000	2.000	2.136
7,572.50	(5)>0.150	0.000	2.000	2.150
7,573.00	(5)>0.164	0.000	2.000	2.164
7,573.50	(5)>0.179	0.000	2.000	2.179
7,573.90	(5)>0.190	0.000	2.000	2.190
7,574.00	(5)>0.193	1.653	2.000	3.845
7,574.50	(5)>0.207	9.907	2.000	12.114

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Elevation	Straight Pipe (cfs)	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,575.00	(5)>0.221	31.323	2.000	33.545

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.63	0.132
	2	5.400	0.098	0.000	0.000	70.000	M	0.95	0.077
	3	14.900	0.072	0.000	0.000	77.000	F	5.99	0.429
	4	1.600	0.126	0.000	0.000	90.000	F	1.36	0.123
	$\sum$	**31.200**						**9.86**	**0.760**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.170	100.00	50.00	0.0030	1.0000	2	0.2	2,609	1.41	0.53
	2	0.170	100.00	50.00	0.0030	1.0000	2	0.1	2,444	1.32	0.50
	3	0.220	100.00	20.00	0.1400	1.0000	1	17.0	65,267	41.74	18.34
	4	0.220	100.00	5.00	0.9000	1.0000	1	4.3	49,074	30.81	16.42
	$\sum$							**21.5**	**46,866**	**29.80**	**13.17**

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PROJECT UC0458-07 PAGE 16 OF
COMPUTED TAS DATE 7/11/96
CHECKED DATE

Revised - TAN 11/25/97
- LOJ 2/9/97

DETERMINATION OF RECLAIMED CHANNEL SIZING

PORTAL CANYON - RD-1

CHANNEL SHAPE: TRAPEZOIDAL

BOTTOM WIDTH = 8.0

SIDESLOPE = 2H:1V

MANNING'S n = 0.035 (d_{50} [illegible]")

MIN. CHANNEL SLOPE = 0.0[illegible] FT/FT

MAX. CHANNEL SLOPE = [illegible]167 FT/FT

DISCHARGE = 9.[illegible] CFS

MAX. DEPTH SECTION ([illegible] slope)

FLOW DEPTH = 0.32 FT
FLOW AREA = 2.74 FT^2
VELOCITY = 3.63 FPS

See pg 7 of this section

MAX. VELOCITY SECTION (max slope)

FLOW DEPTH = 0.20 FT
FLOW AREA = 1.72 FT^2
VELOCITY = 5.79 FPS

See pg 8 of this section

Acceptable w/ d_{50} = 6"

Delete

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7/

RD-1 Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	Based on d_{50} = 6" riprap
Channel Slope	0.038000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	9.95	cfs

Results		
Depth	0.32	ft ← Max. flow depth. For a channel depth of [illegible] ft this leaves a freeboard of [illegible]
Flow Area	2.74	ft²
Wetted Perimeter	9.42	ft
Top Width	9.27	ft
Critical Depth	0.35	ft
Critical Slope	0.026543	ft/ft
Velocity	3.63	ft/s
Velocity Head	0.21	ft
Specific Energy	0.52	ft
Froude Number	[illegible]	
Flow is super[illegible]		

Delete

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Revised LDJ 2-9-98 P/

RD-1 Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.167000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	9.95	cfs

Results		
Depth	0.20	ft
Flow Area	1.72	ft²
Wetted Perimeter	8.91	ft
Top Width	8.82	ft
Critical Depth	0.35	ft
Critical Slope	0.026541	ft/ft
Velocity	5.79	ft/s
Velocity Head	0.52	ft
Specific Energy	0.73	ft
Froude Number	0.31	
Flow is supercritical.		

ex. locity Acceptable with a d_{50} = 6" riprap (see operational hydrology calcs)

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Jewkes Creek

The reclamation channel in Jewkes Creek has been divided into two sections:

RD-2 → upstream from Portal Creek

RD-3 → downstream from Portal Creek

One of the goals of reclamation is to re-establish the riparian vegetation which currently [illegible] along Jewkes Creek (see Figure 2 of Appendix 9-2[illegible] also [illegible] 10 of this calc.). As indicated [illegible] the riparian vegetation extends for a width of 20 to 40 feet fro[illegible] approximately 90 ft downstream from the confluence of Portal Creek to a point approximately 250 ft above the confluence of Portal Creek (i.e., upstream from the disturbed-area boundary). Another area of widened riparian vegetation begins at a point approximately 300 ft downstream from the confluence of Portal Creek to the edge of the County Road (i.e., extending approximately 130 ft downstream from the disturbed-area boundary). The riparian vegetation community [illegible] less than 10 ft wide through the remainder of the disturbed area.

To assist in re-establishment of the riparian community, the design of RD-[illegible] and RD-[illegible] will incorporate the following features:

- Work soil into the riprap after placement to allow a base for establishment of vegetation within riprapped sections.
- Place loose-rock check dams in sections where the riparian community is wider, thereby spreading the [illegible] flow onto the flood plain.
- Place erosion-control matting on overflow areas to protect against erosion.
- Design channels to safely convey the peak flow resulting from the 100-yr, 6-hr precipitation event. In those sections where check dams will be placed, design the notch in the check dam to convey the peak flow from the 10-yr, 6-hr event, with the flood plain area conveying the difference between the 100-yr, 6-hr peak and the 10-yr, 6-hr peak.
- In sections where check dams will be installed, design the underlying channel to convey the 100-yr, 6-hr peak, thus providing protection in case of a major event.

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RD-2

Base channel:

Design Q = 19.75 cfs (100-yr, 6-hr)
Bottom width = 8 ft (2:1 side slopes)
Min slope = 1.3% Max. slope = 8.7%
D_{50} = 6" (n = 0.035)

Max velocity = 6.06 ft/s
Max flow depth = 0.65 ft
{ See pgs 12 [illegible] Acceptable
Design depth = 1.0 ft (min)
Increase to 2 [illegible] for constructability.

Check dam:

Design Q = 9.46 cfs (10-yr, 6-h[illegible]
Bottom width = 4 ft [illegible] side slo[illegible]
Max slope = (0.7)(0.[illegible]) = 0.061 [illegible] = (0.7)(0.013) = 0.009 ft/ft.
(Slope of upst[illegible] de[illegible] = (0.7)(channel slope) — see Heede, 1976).
D_{50} = 9" (n = [illegible]) See pg 11a
Max veloci[illegible] = 4 [illegible] ft/s
Max flow d[illegible]th 0.71 [illegible]
(See pg 12a2 and 12a3. Acceptable. With notch depth of 0.5 ft, a small amt of water will flow onto flood plain during this event.

Flood plain:

Design Q [illegible] 19.75 cfs − 9.46 cfs = 10.29 cfs
Bo[illegible]dth = 30 ft (typical of current riparian zone)
Max [illegible]ope = 0.087 ft/ft
Min slope = 0.013 ft/ft
No riprap (soil along banks, sediment behind check dams) (n = 0.030)
{ Max velocity = 3.24 ft/s < 5.0 ft/s [illegible]
Max flow depth = 0.19 ft
→ See pg 12b and 12c of this calc.

See pg 23 of this calc. for typical design

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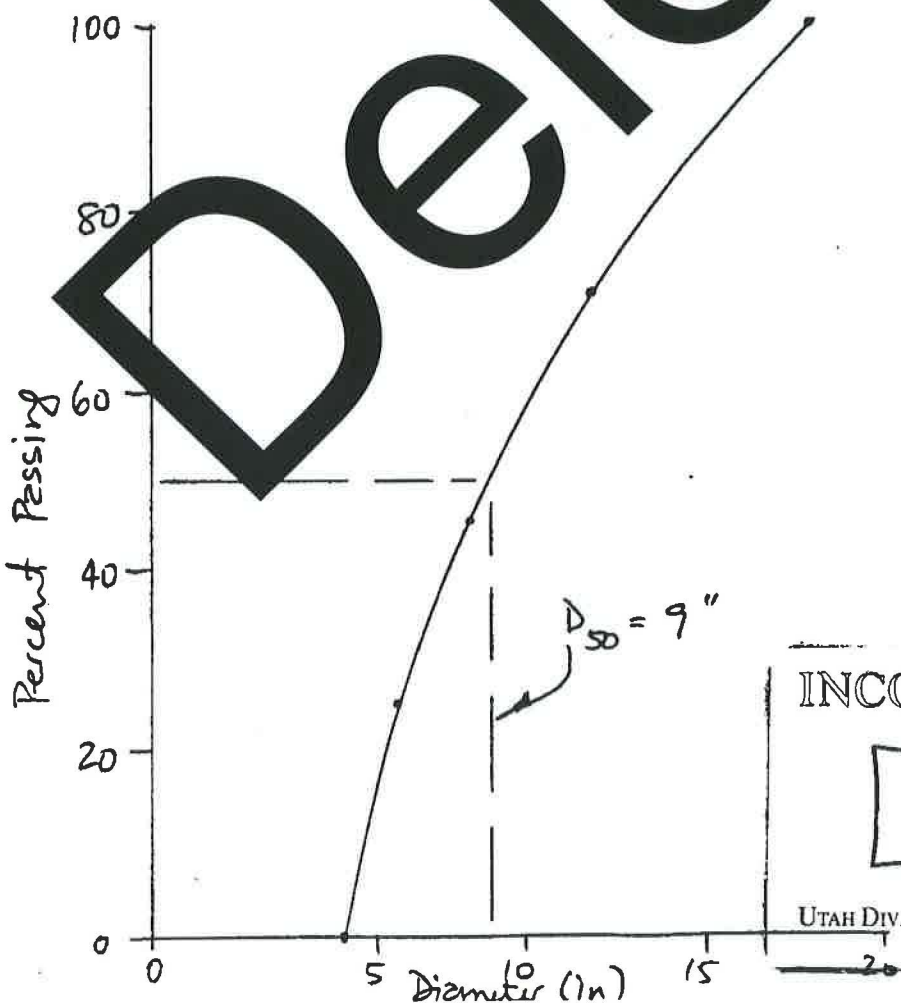
PROJECT UC-572-02 PAGE 11a OF
COMPUTED TDSW DATE 9 Feb 1998
CHECKED DATE

Loose-rock check dam gradation recommendation (Heede, 1976):

For flow up to $1 m^3/s$ (35.3 cfs)
For dam height of 1-2 m (3.3 - 6.6 ft)
} Appropriate for range of conditions at the Horizon site

Gradation:

Size (cm)	Size (in)	Percent	Cumulative Percent
10-14	3.9-5.5	25	[illegible]
15-19	5.9-7.5	20	[illegible]
20-30	7.9-11.8	[illegible]	[illegible]
31-45	12.2-17.7	30	100



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12/

RD-2 Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	d_{50} = 6"
Channel Slope	0.087000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	19.75	cfs

Results		
Depth	0.37	ft
Flow Area	3.26	ft²
Wetted Perimeter	9.67	ft
Top Width	9.49	ft
Critical Depth	0.55	ft
Critical Slope	0.023431	ft/ft
Velocity	6.06	ft/s
Velocity Head	0.57	ft
Specific Energy	0.94	ft
Froude Number	1.82	
Flow is supercritical.		

for a d_{50} = 6" riprap

Delete

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RD-2 Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	$D_{50} = 6''$
Channel Slope	0.013000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	19.75	cfs

Results		
Depth	0.65	ft < 1.0'
Flow Area	6.05	ft²
Wetted Perimeter	10.91	ft
Top Width	10.60	ft
Critical Depth	0.55	ft
Critical Slope	0.023431	ft/ft
Velocity	3.27	ft/s
Velocity Head	0.17	ft
Specific Energy	0.82	
Froude Number	0.76	
Flow is subcriti		

f[illegible]board [illegible] 0.3[illegible] OK as is [illegible] channel depth should b[illegible] 2.0' [illegible] constructability

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12a2

RD-2, Check Dam Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.038	
Channel Slope	0.061000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	9.46	cfs

Results		
Depth	0.41	ft
Flow Area	2.00	ft²
Wetted Perimeter	5.85	ft
Top Width	5.66	ft
Critical Depth	0.51	ft
Critical Slope	0.029509	ft/ft
Velocity	4.72	ft/s
Velocity Head	0.35	ft
Specific Energy	0.76	ft
Froude Number	1.40	
Flow is supercritical.		

Delete

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12a3/

RD-2, Check Dam Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.038	
Channel Slope	0.009000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	9.46	cfs

Results		
Depth	0.71	ft
Flow Area	3.86	ft²
Wetted Perimeter	7.18	ft
Top Width	6.85	ft
Critical Depth	0.51	ft
Critical Slope	0.029507	ft/ft
Velocity	2.45	ft/s
Velocity Head	0.09	ft
Specific Energy	0.80	ft
Froude Number	0.58	
Flow is subcritical		

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RD-2, Flood Plain, Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.087000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	30.00	ft
Discharge	10.29	cfs

Results		
Depth	0.11	ft
Flow Area	3.18	ft²
Wetted Perimeter	30.47	ft
Top Width	30.42	ft
Critical Depth	0.15	ft
Critical Slope	0.024649	ft/ft
Velocity	3.24	ft/s
Velocity Head	0.16	ft
Specific Energy	0.27	ft
Froude Number	1.77	
Flow is supercriti		

Delete

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12c/

RD-2, Flood Plain, Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.013000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	30.00	ft
Discharge	10.29	cfs

Results		
Depth	0.19	ft
Flow Area	5.65	ft²
Wetted Perimeter	30.83	ft
Top Width	30.74	ft
Critical Depth	0.15	ft
Critical Slope	0.024650	ft/ft
Velocity	1.82	ft/s
Velocity Head	0.05	ft
Specific Energy	0.24	
Froude Number	0.75	
Flow is subcritical		

Delete

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RD-3

Base channel:

Design Q = 30.21 cfs (100-yr, 6-hr)
Bottom width = 8 ft (2:1 side slopes)
Max slope = 0.1 ft/ft
Min slope = 0.022 ft/ft
D_{50} = 6" (n = 0.035)
Max velocity = 7.38 ft/s } See pg 14 and [illegible] of this calc. Acceptable.
Max flow depth = 0.71 ft } Min design depth 1.0 ft. Increase to 2.0 for [illegible] reliability

Check dam:

Design Q = 14.55 cfs (10-[illegible] hr)
Bottom width = 4 ft (2:1 side slopes)
Max slope = (0.7)(0.1) = 0.07 ft/ft
Min slope = (0.7)(0.022) = [illegible] ft/ft
D_{50} = 9" (n = [illegible]) See pg 11a
Max velocity = 5.[illegible] ft/s } See pg 14b & 14c of this calc. Acceptable.
Max flow depth = 0.7[illegible] ft } Design w/ notch depth of 8". (no freeboard)

Sod plain:

Design Q = 30.21 cfs − 14.55 cfs = 15.66 cfs
Bottom width = 30 ft (typical of current condition)
Max slope = 0.10 ft/ft } see above
Min slope = 0.022 ft/ft
No riprap → n = 0.030
Max velocity = 3.99 ft/s < 5 ft/s
Max flow depth = 0.20 ft
→ See pg 14d and 14e of this calc.

See pg 23 of this calc. for typical design.

Delete

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revised WJT 2-9-97

14/

RD-3, Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	D_{50} = 6"
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	30.21	cfs

Results		
Depth	0.46	ft
Flow Area	4.10	ft²
Wetted Perimeter	10.05	ft
Top Width	9.84	ft
Critical Depth	0.72	ft
Critical Slope	0.021787	ft/ft
Velocity	7.38	ft/s
Velocity Head	0.85	ft
Specific Energy	1.30	
Froude Number	2.02	
Flow is supercriti		

D_{50} = 6" maximum allowable velocity = 7.5 fps OK

Delete

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RD-3, Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	$D_{50} = 6''$
Channel Slope	0.022000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	30.21	cfs

Results			
Depth	0.71	ft	<1.0' OK [illegible] the [illegible]nnel should be
Flow Area	6.73	ft²	2' [illegible] for constructability
Wetted Perimeter	11.19	ft	
Top Width	10.86	ft	
Critical Depth	0.72	ft	
Critical Slope	0.021787	ft/ft	
Velocity	4.49	ft/s	
Velocity Head	0.31	ft	
Specific Energy	1.03	[illegible]	
Froude Number	1.00		
Flow is supercrit[illegible]			

Delete

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RD-3, Check Dam Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.038	
Channel Slope	0.070000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	14.55	cfs

Results		
Depth	0.51	ft
Flow Area	2.56	ft²
Wetted Perimeter	6.28	ft
Top Width	6.04	ft
Critical Depth	0.66	ft
Critical Slope	0.027642	ft/ft
Velocity	5.69	ft/s
Velocity Head	0.50	ft
Specific Energy	1.01	ft
Froude Number	1.54	
Flow is supercrit		

Delete

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14c/

RD-3, Check Dam Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.038	
Channel Slope	0.015000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	4.00	ft
Discharge	14.55	cfs

Results		
Depth	0.78	ft
Flow Area	4.36	ft²
Wetted Perimeter	7.50	ft
Top Width	7.13	ft
Critical Depth	0.66	ft
Critical Slope	0.027642	ft/ft
Velocity	3.34	ft/s
Velocity Head	0.17	ft
Specific Energy	0.96	ft
Froude Number	0.75	
Flow is subcritic		

Delete

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14d/

RD-3, Flood Plain, Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	30.00	ft
Discharge	15.66	cfs

Results		
Depth	0.13	ft
Flow Area	3.93	ft²
Wetted Perimeter	30.58	ft
Top Width	30.52	ft
Critical Depth	0.20	ft
Critical Slope	0.022511	ft/ft
Velocity	3.99	ft/s
Velocity Head	0.25	ft
Specific Energy	0.38	
Froude Number	1.96	
Flow is supercri		

Delete

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14e/

RD-3, Flood plain, Minimum slope
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.022000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	30.00	ft
Discharge	15.66	cfs

Results		
Depth	0.20	ft
Flow Area	6.21	ft²
Wetted Perimeter	30.91	ft
Top Width	30.82	ft
Critical Depth	0.20	ft
Critical Slope	0.022508	ft/ft
Velocity	2.52	ft/s
Velocity Head	0.10	ft
Specific Energy	0.30	ft
Froude Number	0.99	
Flow is subcritic		

Delete

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Check dam design

- Design spillway cross sections as indicated on pg 11-14e. See standard design on pg 15a of this calc.
- Use D_{50} = 9" riprap for dam construction
- Source of design equations → Heede (1976)
- Check dam spacing:

According to Heede (1976), check dams in channels w/ a gradient of less than 20% should be spaced to place each upstream check dam at the downstream extent of the sediment deposited behind the downstream check dam, assuming a sediment gradient of 0.7 times the channel gradient. Based on this, check dam spacing should be as follows:

RD-2 → Sediment gradient = (0.7)(0.087 ft/ft) = 0.061 ft/ft
Min sediment gradient = (0.7)(0.013) = 0.009 ft/ft

With a 2.0' channel depth and a 0.5' notch depth, the sediment will fill to at the check dam. Based on this fill depth

Max. slope spacing = 1.5 ft / 0.061 ft/ft = 24.6 ft
Min. slope spacing = 1.5 ft / 0.009 ft/ft = 166.7 ft

RD-3 → Sediment gradient = (0.7)(0.1 ft/ft) max
= 0.07 ft/ft max
= (0.7)(0.022 ft/ft) min
= 0.015 ft/ft min

With a channel depth of 2.0' and a notch depth of 0.67', the sediment will accumulate to a depth of 1.33'. This gives a spacing of:

Max slope spacing = 1.33 ft / 0.070 ft/ft
= 19 ft

Min slope spacing = 1.33 ft / 0.015 ft/ft
= 88.7 ft

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- Check dam keys → not required since the entire channel will be lined with a dual filter blanket.
- Check dam aprons:

Apron length = (1.5)(Dam crest height) — See Heede (1976)

RD-2 → Apron length = (1.5)(1.5 ft)
= 2.25 ft

RD-3 → Apron length = (1.5)(1.5 ft)
= 2.0 ft

Design both w/ an apron length of 2.5 ft.

Since the entire downstream section will be a riprap-lined channel, there is no need to install a special apron. However, the sill needs to be placed at the indicated distance downstream from the toe of the check dam. According to Heede (1976), this sill should have a height of approx. 6 inches. Hence, after installation of the riprap channel and the check dam, a 6-inch high layer of riprap should be placed across the channel bottom at a distance of 2.5 ft downstream from the toe of the check dam.

- Check dam base protection → provided by riprap in channel.

See typical design cross sections on pg 23-24 of this calc.

Reference

Heede, B.H. 1976. Gully Development and Control: The Status of Our Knowledge. USDA Forest Service Research Paper RM-169. Rocky Mountain Forest and Range Experiment Station, USDA Forest Service. Fort Collins

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RIPRAP GRADATIONS

$D_{50} = 0.5$ FT

$D_{100} = D_{50} * 2.0^{*} = 12''$

$D_{50} = D_{50} * 1.0 = 6''$

$D_{20} = D_{50} * 0.5 = 3''$

$D_{0} = D_{50} * 0.2 = 1.5''$

* MULTIPLIERS BASED ON DISTRIBUTION PROPOSED IN FIG. 3.17 FROM BARFIELD, WARNER, + HAAN (1980).

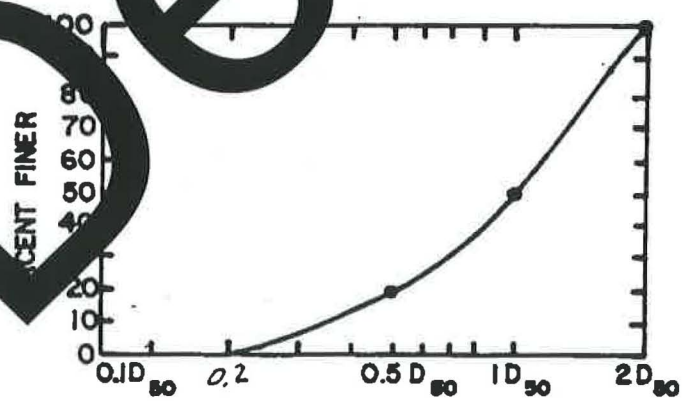

Figure 3.17. Suggested size distribution of riprap. (After Simons and Senturk, 1977).

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Filter blanket requirement for reclamation channels:

According to the SCS soil survey for the area, the native soils which will comprise the base soil in the Portal Canyon reclaimed channel are comprised of the Pathead - Curecanti family association. The finer grained (conservative) portion of these soils average the following gradation:

Sieve No.	Percent Passing
4 (0.19")	90
10 (0.079")	85
40 (0.017")	[illegible]
200 (0.0030")	55

The soils in the Jewkes Creek channel bottom consist of Shupert - Winetti complex. The finer grained (conservative) portion of these soils average the following gradation:

Sieve No.	Percent Passing
[illegible]	95
10	90
[illegible]	80
2[illegible]	62

See the combined native soil curve on pg 17 of this calc.

Stability criteria

$$\frac{D_{15}\,(\text{riprap})}{D_{85}\,(\text{base})} < 5 < \frac{D_{15}\,(\text{riprap})}{D_{15}\,(\text{base})} \leq 40$$ (HEC-11, Federal Hwy Admin)

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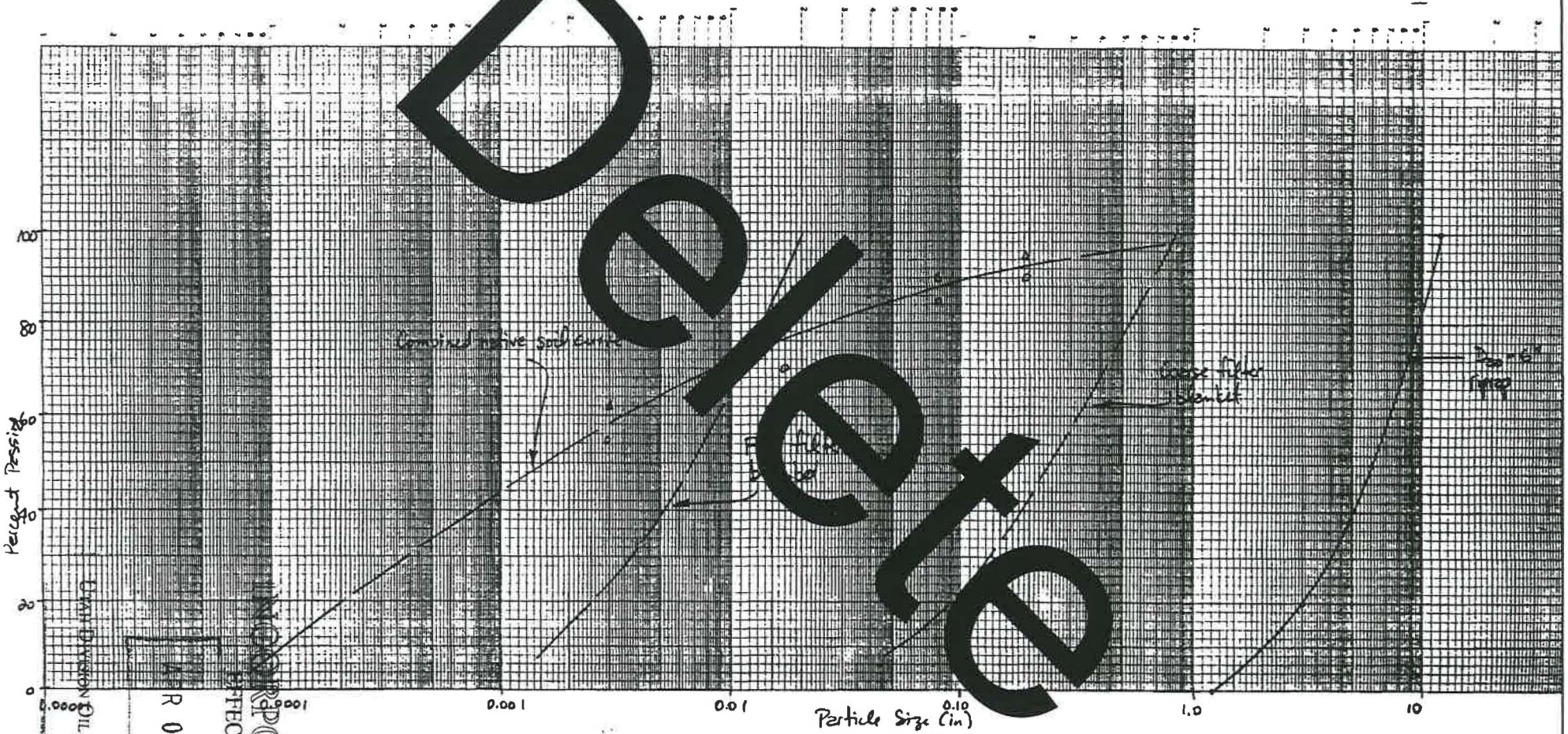

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17

Two filter blanket layers required (see pg 17).

$$\frac{D_{15}\text{ (riprap)}}{D_{85}\text{ (coarse)}} = \frac{2.50\text{ in}}{0.60\text{ in}} = 4.2 < 5 \quad \text{OK}$$

$$\frac{D_{15}\text{ (riprap)}}{D_{15}\text{ (coarse)}} = \frac{2.50\text{ in}}{0.07\text{ in}} = 35.7 < 40 \quad \text{OK}$$

$$\frac{D_{15}\text{ (coarse)}}{D_{85}\text{ (fine)}} = \frac{0.07\text{ in}}{0.015\text{ in}} = 4.7 < 5 \quad \text{OK}$$

$$\frac{D_{15}\text{ (coarse)}}{D_{15}\text{ (fine)}} = \frac{0.07\text{ in}}{0.002\text{ in}} = 35.[illegible] < 40 \quad \text{OK}$$

$$\frac{D_{15}\text{ (fine)}}{D_{85}\text{ (native)}} = \frac{0.002\text{ in}}{0.05[illegible]} = 0.04 < 5 \quad \text{OK}$$

$$\frac{D_{15}\text{ (fine)}}{D_{15}\text{ (native)}} = \frac{0.002\text{ in}}{0.00015\text{ in}} = 13.3 < 40 \quad \text{OK}$$

Delete

Adequate as designed.

In accordance with the recommendations of HEC-11:

Riprap layer thickness → 12"

Filter blanket layer thickness → [illegible]

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Comparison with Natural Channel Capacity

Capacity of Portal Canyon Creek:

q = 13.1 cfs (see pg 41 of prev. calc.) — Represents upstream capacity. Downstream end of creek will have been altered during mining

Capacity of Jewkes Creek:

Above disturbance → q = 27.6 cfs (see pg [illegible] of prev. calc.)

Below disturbance → q = [illegible] cfs (see pg 39 of prev. calc.)

Under conditions of minimum slope (max. flow depth):

Bankful capacity of RD → [illegible] (see pg 20 of this calc.)

Flood plain capacity of RD → [illegible].05 cfs (see pg 21 of this calc.)

Flood plain capacity of RD [illegible] 150.6 cfs (see pg 22 of this calc.)

→ Based on [illegible] floodplain with of 20 ft and flow depth of 1.0 ft.

In all cases, the design capacity exceeds the natural capacity. Hence, the requirements of R645-301-742.322 are met.

Delete

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RD-1, Minimum Slope, Bankfull Capacity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.038000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft

Results		
Discharge	71.43	cfs
Flow Area	10.00	ft²
Wetted Perimeter	12.47	ft
Top Width	12.00	ft
Critical Depth	1.22	ft
Critical Slope	0.019010	ft/ft
Velocity	7.14	ft/s
Velocity Head	0.79	ft
Specific Energy	1.79	
Froude Number	1.38	
Flow is supercri		

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RD-2, Minimum Slope, Bankfull Capacity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.013300	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	20.00	ft

Results		
Discharge	117.05	cfs
Flow Area	22.00	ft²
Wetted Perimeter	24.47	ft
Top Width	24.00	ft
Critical Depth	0.99	ft
Critical Slope	0.013908	ft/ft
Velocity	5.32	ft/s
Velocity Head	0.44	ft
Specific Energy	1.44	
Froude Number	0.98	
Flow is subcritic		

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RD-3, Minimum slope, Bankful capacity
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channels - Capacity
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.022000	ft/ft
Depth	1.00	ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	20.00	ft

Results		
Discharge	150.55	cfs
Flow Area	22.00	ft²
Wetted Perimeter	24.47	ft
Top Width	24.00	ft
Critical Depth	1.16	ft
Critical Slope	0.013284	ft/ft
Velocity	6.84	ft/s
Velocity Head	0.73	f
Specific Energy	1.73	
Froude Number	1.26	
Flow is supercri		

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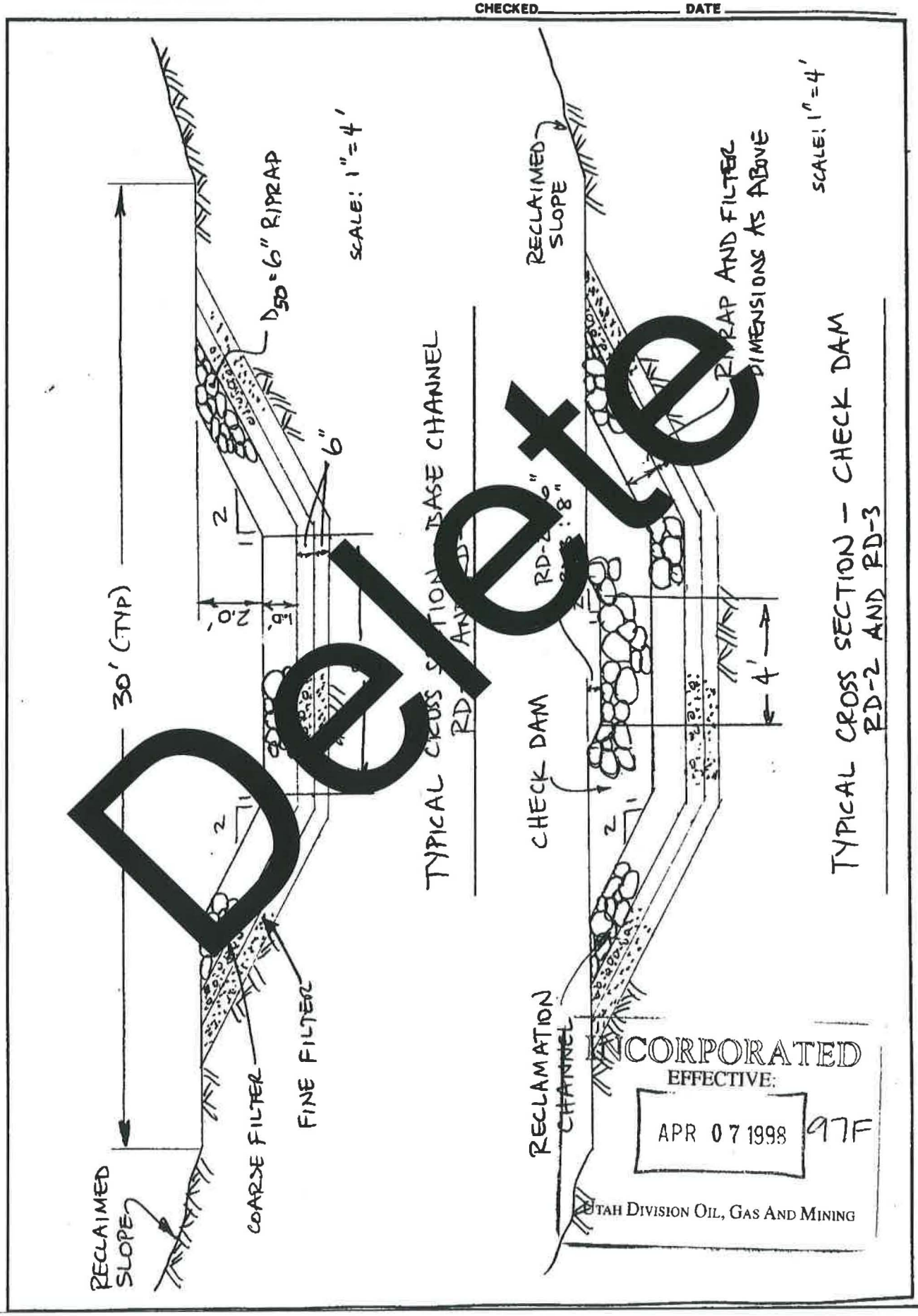
PROJECT UC-572-02 PAGE 23 OF
COMPUTED RDW DATE 12 Jun 1997
CHECKED DATE



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COMPUTED PGW DATE 13 Jun 1997
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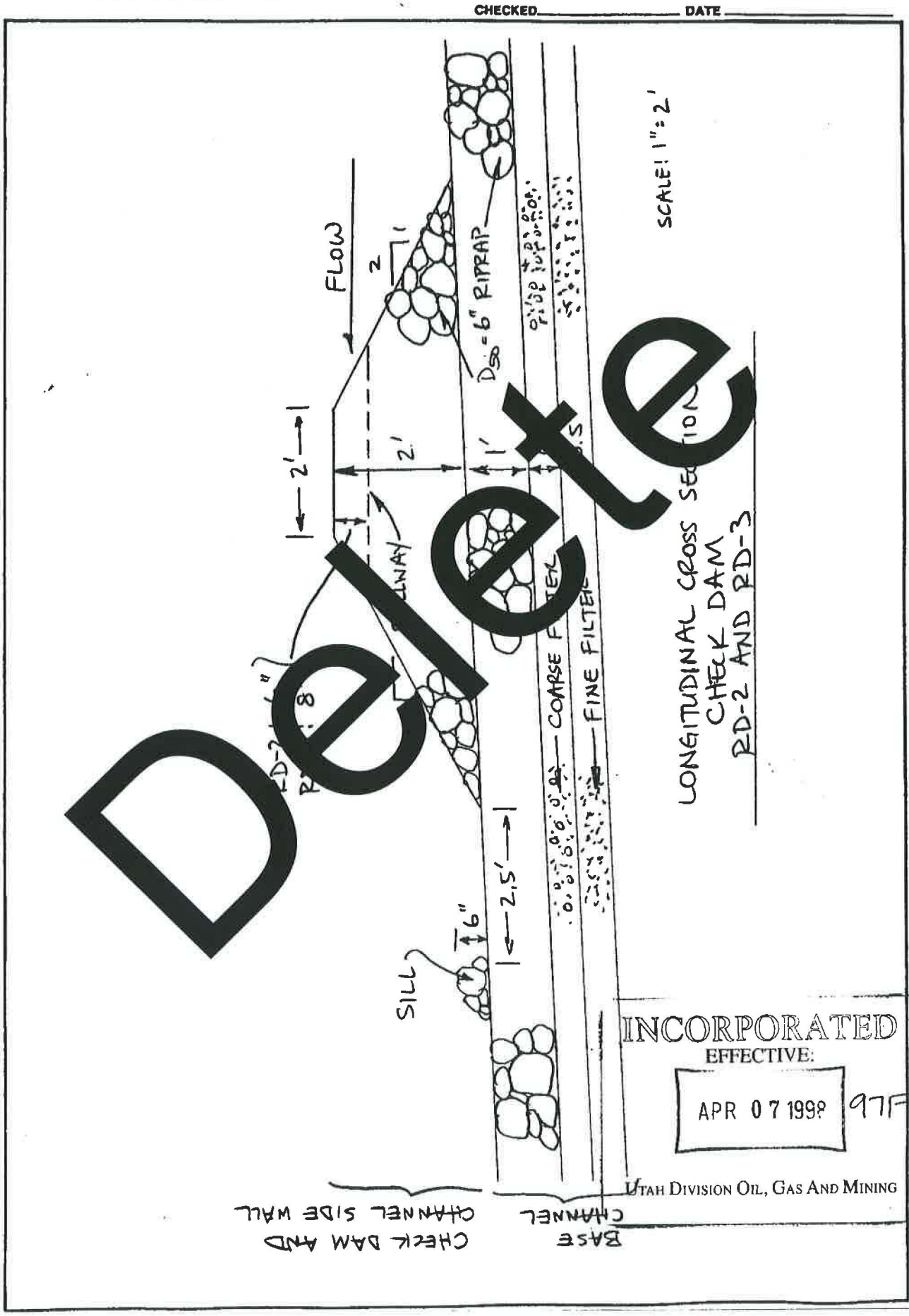

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PROJECT PSW PAGE 25 OF
COMPUTED UC-572-02 DATE 25 Nov 1997
revised ~~CHECKED~~ LDJ DATE 2-9-98

Evaluation of reclamation channel stability under conditions where discharge is equal to the maximum natural channel capacity:

RD-1 → $Q_{nat} = 13.1$ cfs

Resulting max velocity (in max. slope section):

$V_{max} = 6.42$ ft/s (see pg 26 of this section)

Permissible velocity = 7.7 ft/s (see pg 27 of this section for 2:1 sloped $d_{50} = 6''$). [illegible] riprap is adequate.

RD-2 → $Q_{nat} = 27.6$ cfs

Base channel $V_{max} = 6.83$ ft/s — OK (see pg 28)

Flood plain → $Q = 27.6 - 9.5 = 18.1$ cfs

Check-dam portion

$V_{max} =$ [illegible] ft/s — OK (see pg 29)

Check dam → same as evaluation w/ 100-yr, 6-hr event (all excess is forced on to the flood plain).

RD-3 → $Q_{nat} = 38.7$ cfs

Base channel $V_{max} = 8.04$ ft/s — OK (see pg 30)

Flood plain → $Q = 38.7 - 14.6 = 24.1$ cfs

Q_{nat} check dam

$V_{max} = 4.73$ ft/s — OK (see pg 31)

Check dam → same as prev. evaluation.

Conclusion → Reclamation channels will be stable even if the flow is equal to the maximum capacity of the natural channels adjacent to the reclaimed sections.

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RD-1, Maximum Slope Q=Qnat
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.167000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	13.10	cfs

Results		
Depth	0.24	ft
Flow Area	2.04	ft²
Wetted Perimeter	9.08	ft
Top Width	8.96	ft
Critical Depth	0.42	ft
Critical Slope	0.025222	ft/ft
Velocity	6.42	ft/s
Velocity Head	0.64	ft
Specific Energy	0.88	ft
Froude Number	2.37	
Flow is supercri		

Delete

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PROJECT UC-572-02 PAGE 27 OF
COMPUTED TBW DATE 25 Nov 1997
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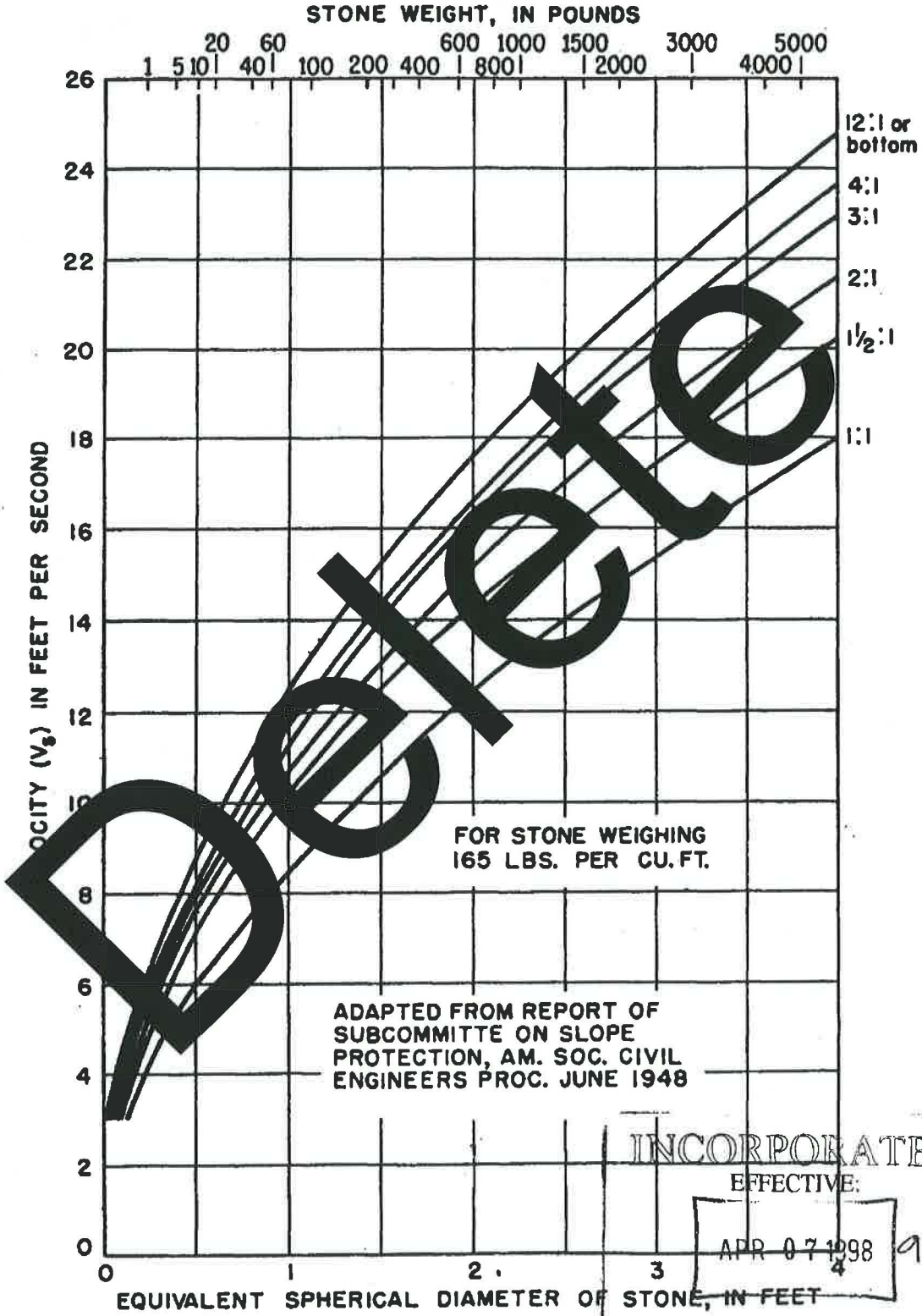

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FIG. 2-SIZE OF STONE THAT WILL RESIST DISPLACEMENT FOR VARIOUS VELOCITIES AND SIDE SLOPES

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RD-2, Maximum Slope Q=Qnat
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.087000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	27.60	cfs

Results		
Depth	0.45	ft
Flow Area	4.04	ft²
Wetted Perimeter	10.03	ft
Top Width	9.81	ft
Critical Depth	0.68	ft
Critical Slope	0.022121	ft/ft
Velocity	6.83	ft/s
Velocity Head	0.73	ft
Specific Energy	1.18	ft
Froude Number	1.88	
Flow is supercritic		

Delete

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RD-2, Flood Plain Maximum Slope Q=Qnat
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.087000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	30.00	ft
Discharge	18.10	cfs

Results		
Depth	0.15	ft
Flow Area	4.47	ft²
Wetted Perimeter	30.66	ft
Top Width	30.59	ft
Critical Depth	0.22	ft
Critical Slope	0.021820	ft/ft
Velocity	4.05	ft/s
Velocity Head	0.25	ft
Specific Energy	0.40	ft
Froude Number	1.87	
Flow is supercritic		

Delete

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RD-3, Maximum Slope Q=Qnat
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	8.00	ft
Discharge	38.70	cfs

Results		
Depth	0.53	ft
Flow Area	4.81	ft²
Wetted Perimeter	10.37	ft
Top Width	10.12	ft
Critical Depth	0.84	ft
Critical Slope	0.020918	ft/ft
Velocity	8.04	ft/s
Velocity Head	1.01	ft
Specific Energy	1.54	f
Froude Number	2.06	
Flow is supercriti		

Delete

This is slightly over the maximum velocity allowed for D_{50} = 6" riprap. However, this will not be a problem due to the check dams in the channel. The check dams will stabilize the channel by causing sediment to fill in around the riprap and promote vegetation growth in the channel. The sediment and plants will hold the riprap in place. The check dams will also reduce the slope of the channel and slow the runoff velocity ∴ The channel [illegible] under the maximum normal flow.

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RD-3, Flood Plain Maximum Slope Q=Qnat
Worksheet for Trapezoidal Channel

Project Description	
Project File	untitled.fm2
Worksheet	Horizon Reclamation Channel Design
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Channel Slope	0.100000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	30.00	ft
Discharge	24.10	cfs

Results		
Depth	0.17	ft
Flow Area	5.10	ft²
Wetted Perimeter	30.75	ft
Top Width	30.67	ft
Critical Depth	0.27	ft
Critical Slope	0.020519	ft/ft
Velocity	4.73	ft/s
Velocity Head	0.35	ft
Specific Energy	0.52	ft
Froude Number	2.04	
Flow is supercriti		

Delete

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PROJECT UCO4SB-07 PAGE 1 OF
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EVALUATION OF SEDIMENT YIELD
FROM RECLAIMED SURFACE

COMPARISON OF TREATMENTS

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EVALUATION OF SEDIMENT YIELD FROM RECLAIMED SITE.

DETERMINATION BASED ON UNIVERSAL SOIL LOSS EQUATION

- CALCULATE EXPECTED EROSION FROM:
  - DISTURBED SURFACE (BARE GROUND)
  - RIPPED SURFACE
  - MULCHED & RIPPED SURFACE
  - MULCHED + RIPPED SURFACE W/ SILT FENCE
  - UNDISTURBED SURFACE W/ SHRUB-GRASS VEG. TYPE FOR COVER + DENSITY REQUIRED FOR BOND RELEASE

EQUATION:

$$A = R\ LS\ K\ C\ P$$

WHERE:

A = COMPUTED SOIL LOSS PER UNIT AREA (TONS/AC/YR)

R = RAIN FALL FACTOR (ANNUAL)

LS = LAND SLOPE FACTOR

K = SOIL ERODIBILITY FACTOR

C = COVER FACTOR

P = PRACTICE FACTOR

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RAINFALL FACTOR = 15 (FROM ISRAELSEN, ET.AL., 1984)
(FIG. ATTACHED)

LS FACTOR BASED ON

$$LS = \left(\frac{\lambda}{72.6}\right)^{M}\left(\frac{430X^2 + 30X + 0.43}{6.613}\right)$$

WHERE:

λ = SLOPE LENGTH (FT)

X = SIN θ

θ = SLOPE ANGLE (DEG) = ATAN $\left(\frac{RISE}{RUN}\right)$

M = SLOPE EXPONENT

SLOPE $\leq$ 3% $M = 0.3$

SLOPE $\geq$ 5% $M = 0.5$

SLOPE $>$ 3% & $<$ 5% $M = 0.4$

K FACTOR = 0.31 (FROM ISRAELSEN, ET.AL., 1984)

C FACTOR:	VALUE*
FOR BARE SOIL:	0.94
FOR RIPPED SOIL:	0.8
FOR MULCHED + RIPPED SOIL (2 TONS PER AC)	0.06
FOR EROSION MATTING:	0.10
FOR UNDISTURBED WATERSHED W/ 50% COVER NO APPRECIABLE CANOPY	0.11

* VALUES DETERMINED FROM: ~~BARFIELD, ET. AL. (1981)~~

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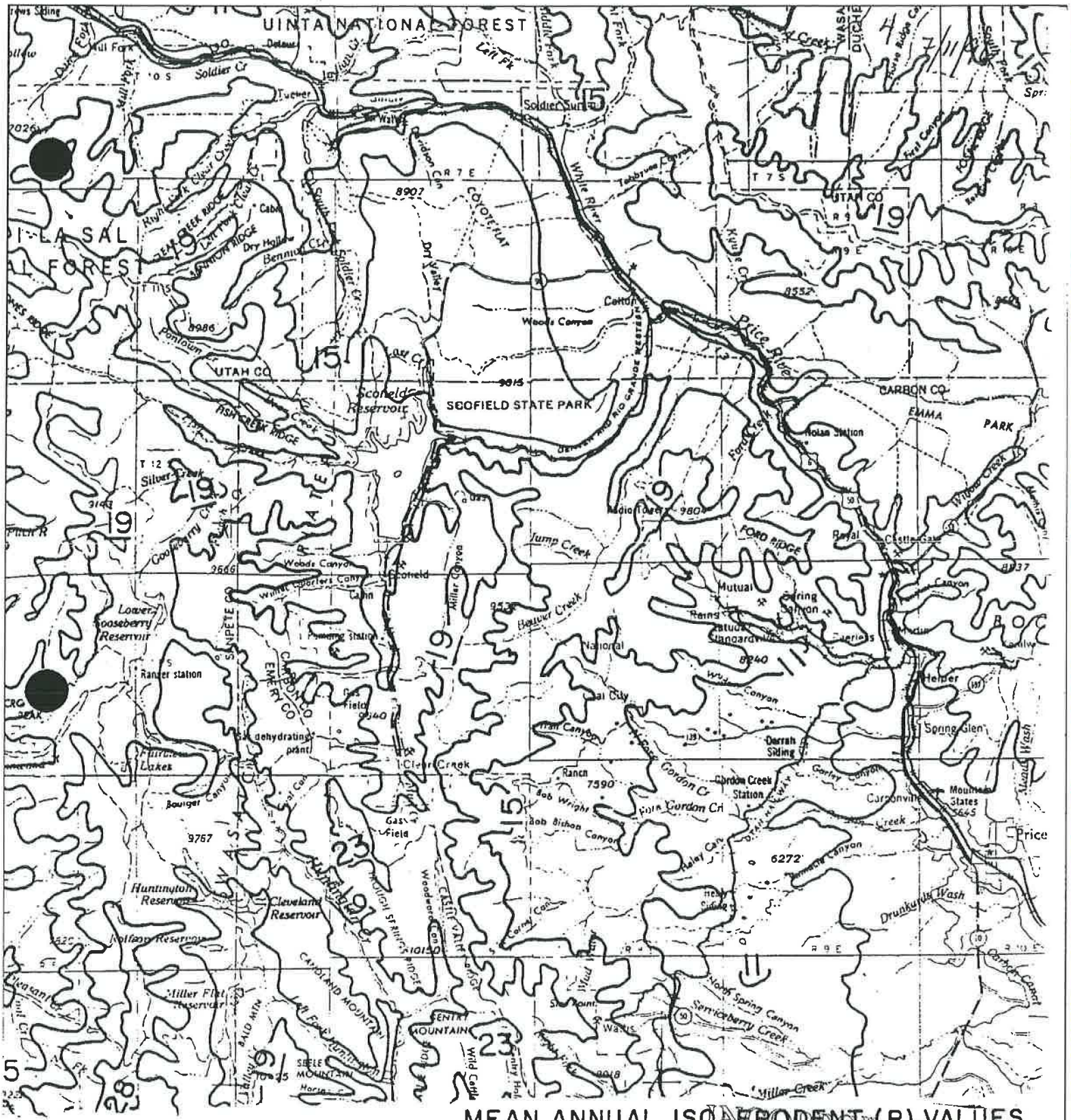

Note:
R values shown are for rain and snowmelt together. R value for snowmelt alone = R_s = 0.23881 R + [redacted]4328.

MEAN ANNUAL ISOERODENT (R) VALUES

Units of R
English R = foot tons/acre/hour
Metric Rm = meter tonnes/hectare/hour
Rm = 1.735 x R

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UTAH WATER RESEARCH LABORATORY UTAH STATE UNIVERSITY LOGAN, UTAH 1983

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PROJECT UC0458-07 PAGE 5 OF
COMPUTED TJS DATE 7/11/96
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EROSION FROM MULCHED + RIPPED SURFACE W/ SILT FENCE:

AS LONG AS INSTALLED ACCORDING TO MANUFACTURES SPECIFICATION, SILT FENCES HAVE A 75% RETENTION EFFICIENCY.

BASED ON MIRAFI TECHNICAL NOTE, R.G. CARROLL, JR. "SILT FENCES FOR SEDIMENTATION CONTROL IN MINING" PUB NO. 81-17.

+

WYANT, D.C. 1980. EVALUATION OF FILTER FABRIC FOR USE AS SILT FENCES. VHTRC 80-R49. VIRGINIA HIGHWAY AND TRANSPORTATION RESEARCH COUNCIL. CHARLOTTESVILLE, VIRGINIA.

SILT FENCES RETAIN APPROXIMATELY 75% OF SEDIMENT.

THEREFORE:

SED. PRODUCTION = (MULCHED + RIPPED PROD. X 0.25)

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ALTERNATIVE SEDIMENT CONTROL SUMMARY - Horizon No. 1 Mine

WATERSHED	Area (Ac)	Rainfall Factor	Height of Rise	Field Slope Length (ft)	Slope Angle (%)	Slope Angl (deg)	Slope Factor m	LS Factor	K Factor	Undisturbed Sed. Prod. w/no Mining (Tons)	Sediment to Stream with Reclaimed Area Treated With Following Options: Bare ground (Tons)	Ripped (Tons)	Mulched (Tons)	Silt fence (Tons)	Silt trapped by silt fence (Tons)	Silt trapped by silt fence (Cu Ft)
10 YR - 6 HR STORM EVENT																
PORTAL CANYON																
NORTH SIDE																
RECLAIMED AREA	3.3	18.0	42.0	145.0	29.0	16.2	0.5	9.0	0.31	18.2	155.6	132.4	9.9	2.0	7.0	155.6
UNDISTURBED AREA	15.5	18.0	560.0	850.0	65.9	33.4	0.5	76.1	0.31	724.0	724.0	724.0	724.0	181.0	543.0	12066.7
SUBTOTAL:										742.3	879.6	856.5	734.0	183.0	550.0	12222.2
SOUTH SIDE																
RECLAIMED AREA	4.4	18.0	42.0	70.0	60.0	31.0	0.5	19.3	0.31	52.0	444.4	378.2	28.4	7.0	21.0	466.7
UNDISTURBED AREA	7.9	18.0	600.0	850.0	70.6	35.2	0.5	83.2	0.31	403.3	403.3	403.3	403.3	101.0	302.0	6711.1
SUBTOTAL:										455.3	847.7	781.5	431.6	108.0	323.0	7177.8
TOTAL SEDMENT TO STREAM										1197.5	1727.3	1638.0	1165.6	291.0		
JEWKES CREEK																
NORTH SIDE																
RECLAIMED AREA	0.5	18.0	36.0	150.0	24.0	13.5	0.5	6.7	0.31	2.1	17.6	15.0	1.1	0.0	1.0	22.2
UNDISTURBED AREA	3.2	18.0	140.0	150.0	93.3	43.0	0.5	48.1	0.31	94.4	94.4	94.4	94.4	24.0	71.0	1577.8
SUBTOTAL:										96.4	112.0	109.4	95.5	24.0	72.0	1600.0
SOUTH SIDE																
RECLAIMED AREA	1.8	18.0	80.0	180.0	44.4	24.0	0.5	19.9	0.31	22.0	187.8	159.8	12.0	3.0	9.0	200.0
UNDISTURBED AREA	9.0	18.0	160.0	250.0	64.0	32.6	0.5	39.7	0.31	219.4	219.4	219.4	219.4	55.0	165.0	3666.7
SUBTOTAL:										241.4	407.2	379.3	231.4	58.0	174.0	3866.7
TOTAL SEDMENT TO STREAM										337.8	519.2	488.6	326.9	82.0		
ANNUAL EROSION											(Tons)	(Tons)	(Tons)	(Tons)	(Tons)	(Cu Ft)
PORTAL CANYON																
NORTH SIDE																
RECLAIMED AREA	3.3	15.0	42.0	145.0	29.0	16.2	0.5	9.0	0.31	15.2	129.7	110.3	8.3	2.0	6.0	133.3
UNDISTURBED AREA	15.5	15.0	560.0	850.0	65.9	33.4	0.5	76.1	0.31	603.4	603.4	603.4	603.4	151.0	453.0	10066.7
SUBTOTAL:										618.5	733.0	713.7	611.6	153.0	459.0	10200.0
SOUTH SIDE																
RECLAIMED AREA	4.4	15.0	42.0	70.0	60.0	31.0	0.5	19.3	0.31	43.3	370.4	315.2	23.6	6.0	18.0	400.0
UNDISTURBED AREA	7.9	15.0	600.0	850.0	70.6	35.2	0.5	83.2	0.31	336.1	336.1	336.1	336.1	84.0	252.0	5600.0
SUBTOTAL:										379.4	706.4	651.3	359.7	90.0	270.0	6000.0
TOTAL SEDMENT TO STREAM										997.9	1439.4	1365.0	971.4	243.0		
JEWKES CREEK																
NORTH SIDE																
RECLAIMED AREA	0.5	15.0	36.0	150.0	24.0	13.5	0.5	6.7	0.31	1.7	14.7	12.5	0.9	0.0	1.0	22.2
UNDISTURBED AREA	3.2	15.0	140.0	150.0	93.3	43.0	0.5	48.1	0.31	78.7	78.7	78.7	78.7	20.0	59.0	1311.1
SUBTOTAL:										80.4	93.3	91.1	79.6	20.0	60.0	1333.3
SOUTH SIDE																
RECLAIMED AREA	1.8	15.0	80.0	180.0	44.4	24.0	0.5	19.9	0.31	18.3	156.5	133.2	10.0	2.0	7.0	155.6
UNDISTURBED AREA	9.0	15.0	160.0	250.0	64.0	32.6	0.5	39.7	0.31	182.9	182.9	182.9	182.9	46.0	137.0	3044.4
SUBTOTAL:										201.2	339.4	316.0	192.8	48.0	144.0	3200.0
TOTAL SEDMENT TO STREAM										281.5	432.7	407.2	272.4	68.0		

INPUTS

SOIL CONDITION	C FACTORS	P Factor
Bare ground and seed	0.94	
Ripped and seeded	0.8	
Mulched, ripped, & seeded	0.06	
Silt Fence w/mulch, ripped, and seed	0.015	
Undisturbed	0.11	
ERODIBILITY FACTOR, K	0.31	
RAINFALL FACTORS		
10-yr 6-hr storm	18	
Annual	15	

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REFERENCES:

ISRAELSEN, C.E, J.E. FLETCHER, F.W. HAWS, E.K. ISRAELSEN, 1984. EROSION & SEDIMENTATION IN UTAH: A GUIDE FOR CONTROL. UTAH WATER RESEARCH LABORATORY, USU. UWRL/H-84/03. LOGAN, UTAH.

BARFIELD, B.J., R.C. WARNER, & C.T. HAAN. 1981. APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS. OKLAHOMA TECHNICAL PRESS. STILLWATER, OKLAHOMA.

BASED ON PREVIOUS CALCULATIONS, THE MULCHED, RIPPED, & SEEDED WATERSHEDS PRODUCE LESS SEDIMENT THAN AN UNDISTURBED WATERSHED AT THE SAME SITE.

FOR ADDITIONAL PROTECTION, A SILT FENCE WILL BE INSTALLED ALONG THE RECLAIMED CHANNELS AS INDICATED ON ATTACHED FIGURE.

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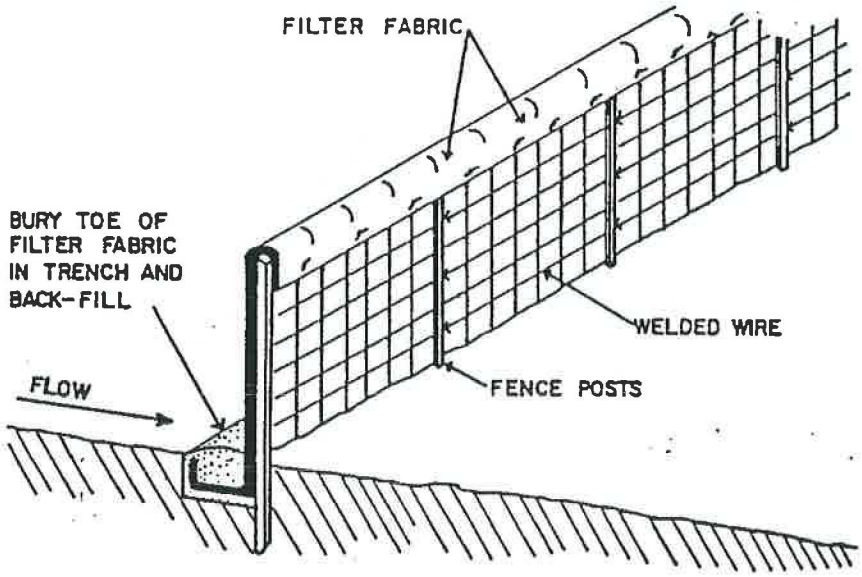
APPENDIX 6E



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Horizon Mine
Permit No. 007020

Appendix 7-4
Revised Copy

APPENDIX 7-4

DESIGN CALCULATIONS

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Horizon Mine
Sedimentation Pond Design.

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Sedimentation Pond Design Evaluation
— Horizon Mine —

Contributing watersheds (Plate 7-5) WS-1, WS-2, WS-5, WS-6

The runoff flow depth is controlled by the curve #. The area of each curve number will be determined.

Disturbed	CN = 90	7.97 Acres
	CN = 100 (pond)	0.4 Acre
Undisturbed *	CN = 70	12.8 Acres
	CN = 73	12.4 Acres.

* Although the oak-aspen areas have a CN of 57, a CN of 70 will be used to be conservative.

Design Runoff Vol: $Q = \frac{(P-0.2S)^2}{P+0.8S}$ $S = \frac{1000}{CN} - 10$ $P = 1.8$

10-yr, 24-hr storm depth = 1.8 in (Miller et. al, 1973)

Curve Number	Drainage Area (ac)	Runoff (in)	Runoff (ac-ft)
100	0.4	1.8	0.06
90	7.97	0.93	0.62
73	12.4	0.24	0.25
70	12.8	0.17	0.18
			1.11 acre-ft

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Pond Configuration

The pond has an emergency spillway and a decant.

Emergency Spillway.

Flowline elevation = 7573.9
BW = 9'
Depth = 1.1'
SS = 3:1
Crest length = 15'
Crest slope = 5%

Decant.

Diameter = 2"
Invert elevation = 7570.4
Outlet elevation = 7570.0
Length ≅ 50'

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Pond Capacity = 2.95 acre-ft See stage capacity curve on pg 4

minimum total storage = 1.11 AF + 1.19 AF = 2.30 AF
storm water — 3yr sediment (pg 3)

The pond has adequate storage.

Max. sediment storage = 2.95 AF − 1.11 AF = 1.84 AF

max sediment elev. = 7570.4 *

* This is the invert for the decant. The decant has a goosenecck to skim off oil that has its inlet ~ 6" below the invert. Therefore, to not plug the decant the max. sediment storage is at an elevation of 7569.8. which corresponds to a sediment vol. of 1.65 AF

Sediment Cleanout vol = (0.6)(1.65) = 0.99 AF
Cleanout Elevation = 7566.9

The entire 10-yr 24-hr storm event of 1.11 AF can be stored between the decant and emergency spillway. Depending on the sediment elevation the entire storm event could also fit below the decant if the pond was empty.

Horizon Sedimentation Pond
Sediment Yield - Universal Soil Loss Equation

Average Sediment Density 90 lb/ft^3

Watershed	Area (acre)	R	K	L (ft)	S (%)	LS	VM	A (ton/ac/yr)	Sediment Yield (ac-ft/yr)
WS-1	9.3	15	0.3	900	61.3	71.52	0.23	3.88	0.0184
WS-2	5.4	15	0.3	1000	52.6	60.73	0.18	49.19	0.1355
WS-5	14.9	15	0.3	700	35.7	27.92	0.25	31.41	0.2388
WS-6	1.6	15	0.3	650	4.4	1.17	1	5.28	0.0043
								Total annual Sediment Yield	0.40
								Sediment Yield For 3 Years	1.19

Note: The VM factor has been area weighted based on the amount of disturbed and undisturbed area The disturbed area has a VM factor of 1, a VM factor of 0.1 for undisturbed, and VM factor of 0.5 for areas that are vegetated but have been disturbed.

Reference : Israelsen et. al., 1984

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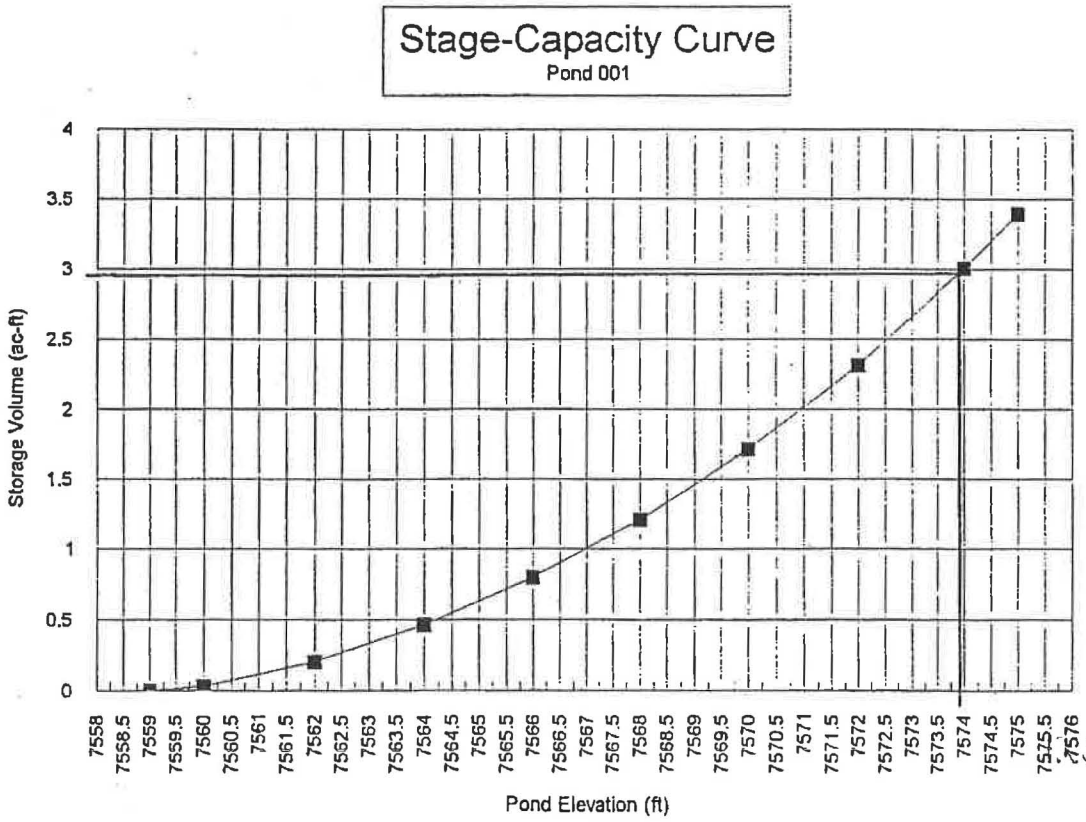
'Horizon Sedimtentation Pond

Stage-Capacity Table

Elevation (ft)	Area* (ft^2)	Average Area (ft^2)	Contour Interval (ft)	Incremental Volume (ft^3)	Cummulative Volume (ft^3)	Cummulative Volume (ac-ft)
7559	0					
		1407	1	1407	1407	0.03
7560	2814					
		3810	2	7620	9027	0.21
7562	4806					
		5605.5	2	11211	20238	0.46
7564	6405					
		7264	2	14528	34766	0.80
7566	8123					
		9059	2	18118	52884	1.21
7568	9995					
		10971	2	21942	74826	1.72
7570	11947					
		12995.5	2	25991	100817	2.31
7572	14044					
		15097	2	30194	131011	3.01
7574	16150					
		16700	1	16700	147711	3.39
7575	17250					

* Determined from the as-built topography of the pond



Pond Capacity
2.95 AF
at 7573.9

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The Hydraulic efficiency of the pond will be determined using SEDCAD+ (Warner and Schwab, 1992)

The capacity of the pond to handle the 25-yr 6-hr storm event under the 2 following conditions will be tested.

1) Emergency spillway and decant operating properly with water elevation of 7570.4 at the start of the storm.

2) Only emergency spillway is operational with the water elevation of 7573.9 at the start of the storm.

See pgs 7-22 for calculation results.

Case #	Peak inflow (cfs)	Peak outflow (cfs)	Peak Stage (ft)	
1	4.47	0.03 *	7572.12	ok
2	4.47	2.15	7574.04	ok

* SEDCAD would not allow the modelling of a 2" decant so I used a 3" decant instead. Even with the 3" decant the flow was very small & the peak stage is within a few tenths of a foot with the water not coming close to the emergency spillway. With such a small outflow and the ability to store the 10-yr 24-hr storm between the decant and emergency spillway the retention time will be well over 24 hrs.

Test stability of the emergency spillway

$Q_{25-6} = 2.15$ cfs
max slope = 50%
min slope = 5%
BW = 9'
SS = 3:1
$D_{50} = 4''$

max vel. = 3.40 fps ok
max flow depth = 0.22 ft ok

pgs 23+24

The emergency spillway is stable under the worst case scenario of the design storm event.

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Test stability of inlets to the Pond

DD-1I at inlet to pond. (not the same as the rest of the channel)

BW = 6'
Depth = 1.5'
SS = 2:1
D_{50} = 6"
Q_{25-6} = 3.72 SedCAD output WS-1,2,7
min slope = 20%
max slope = 50%

max velocity = 4.71 fps ok pgs 25-26
max flow depth = 0.15' ok

Channel is stable during the design event

DD-6 at pond inlet (not the same configuration as the rest of the ditch)

BW = 5'
Depth = 1.5'
SS = 2:1
D_{50} = 15"
Q_{25-6} = 1.06 cfs SedCad output WS-4
min slope = 8.3%
max slope = 25%

max velocity = 2.46 fps. pgs 27-28
max flow depth = 0.10'

Channel is stable during the design storm event.

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CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

HORIZON MINE SEDIMENTATION POND DECANT OPERATIONAL

by

Name: Layne Jensen

Company Name: EarthFax Engineering INC.
File Name: C:\HOR\P-1

Date: 02-25-2000

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Civil Software Design -- SEDCAD+ Version 3.1
Copyright (C) 1987-1992. Pamela J. Schwab. All rights reserved.

Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-1 User: Layne Jensen
Date: 02-25-2000 Time: 16:59:13
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	9.30	70	M	0.083	0.000	0.000	0.0	0.09	0.39
111	2	5.40	70	M	0.098	0.000	0.000	0.0	0.05	0.22
111	3	14.90	77	F	0.072	0.000	0.000	0.0	0.31	3.13
111	4	1.60	90	F	0.126	0.000	0.000	0.0	0.10	1.06
			Type: Pond		Label: pond					
111	Structure	31.20							0.55	
111	Total IN	31.20							0.55	4.47
111	Total OUT								0.12	0.03

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-1 User: Layne Jensen
Date: 02-25-2000 Time: 16:59:13
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

==========
POND INPUT/OUTPUT TABLE
==========

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

DISCHARGE OPTIONS:

	Trickle Tube	Emergency Spillway
Riser Diameter (in)	----	----
Riser Height (ft)	----	----
Barrel Diameter (in)	3.0	----
Barrel Length (ft)	50.00	----
Barrel Slope (%)	0.80	----
Manning's n of Pipe	0.010	----
Spillway Elevation	7570.4	----
Lowest Elevation of Holes	----	----
# of Holes/Elevation	----	----
Entrance Loss Coefficient	1.0	----
Tailwater Depth (ft)	0.0	----
Notch Angle (degrees)	----	----
Weir Width (ft)	----	----
Siphon Crest Elevation	----	----
Siphon Tube Diameter (in)	----	----
Siphon Tube Length (ft)	----	----
Manning's n of Siphon	----	----
Siphon Inlet Elevation	----	----
Siphon Outlet Elevation	----	----
Emergency Spillway Elevation	----	7573.9
Crest Length (ft)	----	15.0
Z:1 (Left and Right)	-- --	3 3
Bottom Width (ft)	----	9.0

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POND RESULTS:

Permanent Pool (ac-ft)
1.8

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.55	4.47
OUT	0.12	0.03

Peak Elevation	Hydrograph Detention Time (hrs)
7572.1	0.00

****

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-1 User: Layne Jensen
Date: 02-25-2000 Time: 16:59:13
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

Elevation	Trickle Tube (cfs)	Emergency Spillway (cfs)	Total Discharge (cfs)
7559.00	0.0	0.0	0.0
7559.50	0.0	0.0	0.0
7560.00	0.0	0.0	0.0
7560.50	0.0	0.0	0.0
7561.00	0.0	0.0	0.0
7561.50	0.0	0.0	0.0
7562.00	0.0	0.0	0.0
7562.50	0.0	0.0	0.0
7563.00	0.0	0.0	0.0
7563.50	0.0	0.0	0.0
7564.00	0.0	0.0	0.0
7564.50	0.0	0.0	0.0
7565.00	0.0	0.0	0.0
7565.50	0.0	0.0	0.0
7566.00	0.0	0.0	0.0
7566.50	0.0	0.0	0.0
7567.00	0.0	0.0	0.0
7567.50	0.0	0.0	0.0
7568.00	0.0	0.0	0.0
7568.50	0.0	0.0	0.0
7569.00	0.0	0.0	0.0
7569.50	0.0	0.0	0.0
7570.00	0.0	0.0	0.0
7570.40	0.0	0.0	0.0
7570.50	0.0	0.0	0.0
7571.00	0.0	0.0	0.0
7571.50	0.0	0.0	0.0
7572.00	0.0	0.0	0.0
7572.50	0.0	0.0	0.0

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7573.00	0.1	0.0	0.1
7573.50	0.1	0.0	0.1
7573.90	0.1	0.0	0.1
7574.00	0.1	1.7	1.7
7574.50	0.1	9.9	10.0
7574.60	0.1	13.1	13.2
7574.70	0.1	17.1	17.2
7574.80	0.1	21.4	21.5
7574.90	0.1	26.0	26.1
7575.00	0.1	31.3	31.4

****

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-1 User: Layne Jensen
Date: 02-25-2000 Time: 16:59:13
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-AREA-CAPACITY-DISCHARGE TABLE

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

SW#1: Trickle Tube
SW#2: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	
7559.00	0.00	0.00	0.00	0.00	
7559.50	0.50	0.02	0.00	0.00	
7560.00	1.00	0.06	0.02	0.00	
7560.50	1.50	0.08	0.06	0.00	
7561.00	2.00	0.09	0.10	0.00	
7561.50	2.50	0.10	0.14	0.00	
7562.00	3.00	0.11	0.19	0.00	
7562.50	3.50	0.12	0.25	0.00	
7563.00	4.00	0.13	0.31	0.00	
7563.50	4.50	0.14	0.38	0.00	
7564.00	5.00	0.15	0.45	0.00	
7564.50	5.50	0.16	0.53	0.00	
7565.00	6.00	0.17	0.61	0.00	
7565.50	6.50	0.18	0.69	0.00	
7566.00	7.00	0.19	0.78	0.00	
7566.50	7.50	0.20	0.88	0.00	
7567.00	8.00	0.21	0.98	0.00	
7567.50	8.50	0.22	1.09	0.00	
7568.00	9.00	0.23	1.20	0.00	
7568.50	9.50	0.24	1.32	0.00	
7569.00	10.00	0.25	1.44	0.00	
7569.50	10.50	0.26	1.57	0.00	
7570.00	11.00	0.27	1.70	0.00	
7570.40	11.40	0.28	1.81	0.00	Stage of SW#1
7570.50	11.50	0.29	1.84	0.00	
7571.00	12.00	0.30	1.99	0.01	
7571.50	12.50	0.31	2.14	0.02	
7572.00	13.00	0.32	2.30	0.03	

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7572.12	13.12	0.32	2.34	0.03	Peak Stage
7572.50	13.50	0.33	2.46	0.04	
7573.00	14.00	0.35	2.63	0.05	
7573.50	14.50	0.36	2.81	0.06	
7573.90	14.90	0.37	2.95	0.07	Stage of SW#2
7574.00	15.00	0.37	2.99	1.72	
7574.50	15.50	0.38	3.18	9.99	
7574.60	15.60	0.39	3.22	13.21	
7574.70	15.70	0.39	3.26	17.22	
7574.80	15.80	0.39	3.30	21.45	
7574.90	15.90	0.39	3.34	26.09	
7575.00	16.00	0.40	3.37	31.41	

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CIVIL SOFTWARE DESIGN

SEDCAD+ Version 3

HORIZON MINE SEDIMENTATION POND DECANT NOT OPERATIONAL

by

Name: Layne Jensen

Company Name: EarthFax Engineering INC.
File Name: C:\HOR\P-2A

Date: 02-26-2000

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

SUBWATERSHED/STRUCTURE INPUT/OUTPUT TABLE

-Hydrology-

JBS	SWS	Area (ac)	CN	UHS	Tc (hrs)	K (hrs)	X	Base-Flow (cfs)	Runoff Volume (ac-ft)	Peak Discharge (cfs)
111	1	9.30	70	M	0.083	0.000	0.000	0.0	0.09	0.39
111	2	5.40	70	M	0.098	0.000	0.000	0.0	0.05	0.22
111	3	14.90	77	F	0.072	0.000	0.000	0.0	0.31	3.13
111	4	1.60	90	F	0.126	0.000	0.000	0.0	0.10	1.06
			Type: Pond		Label: pond					
111	Structure	31.20							0.55	
111	Total IN	31.20							0.55	4.47
111	Total OUT								0.55	2.15

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

==========
POND INPUT/OUTPUT TABLE
==========

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

DISCHARGE OPTIONS:

	Emergency Spillway
Riser Diameter (in)	----
Riser Height (ft)	----
Barrel Diameter (in)	----
Barrel Length (ft)	----
Barrel Slope (%)	----
Manning's n of Pipe	----
Spillway Elevation	----
Lowest Elevation of Holes	----
# of Holes/Elevation	----
Entrance Loss Coefficient	----
Tailwater Depth (ft)	----
Notch Angle (degrees)	----
Weir Width (ft)	----
Siphon Crest Elevation	----
Siphon Tube Diameter (in)	----
Siphon Tube Length (ft)	----
Manning's n of Siphon	----
Siphon Inlet Elevation	----
Siphon Outlet Elevation	----
Emergency Spillway Elevation	7573.9
Crest Length (ft)	15.0
Z:1 (Left and Right)	0 0
Bottom Width (ft)	9.0

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POND RESULTS:

Permanent Pool (ac-ft)
3.0

	Runoff Volume (ac-ft)	Peak Discharge (cfs)
IN	0.55	4.47
OUT	0.55	2.15

Peak Elevation	Hydrograph Detention Time (hrs)
7574.0	0.00

****

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

ELEVATION-DISCHARGE TABLE

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

Elevation	Emergency Spillway (cfs)	Total Discharge (cfs)
7559.00	0.0	0.0
7559.50	0.0	0.0
7560.00	0.0	0.0
7560.50	0.0	0.0
7561.00	0.0	0.0
7561.50	0.0	0.0
7562.00	0.0	0.0
7562.50	0.0	0.0
7563.00	0.0	0.0
7563.50	0.0	0.0
7564.00	0.0	0.0
7564.50	0.0	0.0
7565.00	0.0	0.0
7565.50	0.0	0.0
7566.00	0.0	0.0
7566.50	0.0	0.0
7567.00	0.0	0.0
7567.50	0.0	0.0
7568.00	0.0	0.0
7568.50	0.0	0.0
7569.00	0.0	0.0
7569.50	0.0	0.0
7570.00	0.0	0.0
7570.50	0.0	0.0
7571.00	0.0	0.0
7571.50	0.0	0.0
7572.00	0.0	0.0
7572.50	0.0	0.0
7573.00	0.0	0.0

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7573.50	0.0	0.0
7573.90	0.0	0.0
7574.00	1.5	1.5
7574.50	9.0	9.0
7574.60	11.7	11.7
7574.70	14.9	14.9
7574.80	18.2	18.2
7574.90	21.8	21.8
7575.00	25.8	25.8

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Company Name: EarthFax Engineering INC.
Filename: C:\HOR\P-2A User: Layne Jensen
Date: 02-26-2000 Time: 16:39:06
Horizon Mine Sedimentation Pond Decant Operational
Storm: 1.60 inches, 25 year- 6 hour, SCS 6 Hour
Hydrograph Convolution Interval: 0.1 hr

==========
ELEVATION-AREA-CAPACITY-DISCHARGE TABLE
==========

J1, B1, S1
pond

Drainage Area from J1, B1, S1, SWS(s)1-4: 31.2 acres
Total Contributing Drainage Area: 31.2 acres

SW#1: Emergency Spillway

Elev	Stage (ft)	Area (ac)	Capacity (ac-ft)	Discharge (cfs)
7559.00	0.00	0.00	0.00	0.00
7559.50	0.50	0.02	0.00	0.00
7560.00	1.00	0.06	0.02	0.00
7560.50	1.50	0.08	0.06	0.00
7561.00	2.00	0.09	0.10	0.00
7561.50	2.50	0.10	0.14	0.00
7562.00	3.00	0.11	0.19	0.00
7562.50	3.50	0.12	0.25	0.00
7563.00	4.00	0.13	0.31	0.00
7563.50	4.50	0.14	0.38	0.00
7564.00	5.00	0.15	0.45	0.00
7564.50	5.50	0.16	0.53	0.00
7565.00	6.00	0.17	0.61	0.00
7565.50	6.50	0.18	0.69	0.00
7566.00	7.00	0.19	0.78	0.00
7566.50	7.50	0.20	0.88	0.00
7567.00	8.00	0.21	0.98	0.00
7567.50	8.50	0.22	1.09	0.00
7568.00	9.00	0.23	1.20	0.00
7568.50	9.50	0.24	1.32	0.00
7569.00	10.00	0.25	1.44	0.00
7569.50	10.50	0.26	1.57	0.00
7570.00	11.00	0.27	1.70	0.00
7570.50	11.50	0.29	1.84	0.00
7571.00	12.00	0.30	1.99	0.00
7571.50	12.50	0.31	2.14	0.00
7572.00	13.00	0.32	2.30	0.00
7572.50	13.50	0.33	2.46	0.00
7573.00	14.00	0.35	2.63	0.00

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7573.50	14.50	0.36	2.81	0.00	
7573.90	14.90	0.37	2.95	0.00	Stage of SW#1
7574.00	15.00	0.37	2.99	1.49	
7574.04	15.04	0.37	3.01	2.15	Peak Stage
7574.50	15.50	0.38	3.18	8.96	
7574.60	15.60	0.39	3.22	11.65	
7574.70	15.70	0.39	3.26	14.91	
7574.80	15.80	0.39	3.30	18.25	
7574.90	15.90	0.39	3.34	21.80	
7575.00	16.00	0.40	3.37	25.76	

****

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Emergency Spillway Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	$D_{50} = 4''$
Slope	0.005000	ft/ft
Left Side Slope	3.00	H : V
Right Side Slope	3.00	H : V
Bottom Width	9.00	ft
Discharge	2.15	cfs

Results		
Depth	0.22	ft
Flow Area	2.1	ft²
Wetted Perimeter	10.37	ft
Top Width	10.30	ft
Critical Depth	0.12	ft
Critical Slope	0.037535	ft/ft
Velocity	1.03	ft/s
Velocity Head	0.02	ft
Specific Energy	0.23	ft
Froude Number	0.40	
Flow Type	Subcritical	

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Emergency Spillway Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.051 D_{50} = 4"
Slope	0.500000 ft/ft
Left Side Slope	3.00 H : V
Right Side Slope	3.00 H : V
Bottom Width	9.00 ft
Discharge	2.15 cfs

Results	
Depth	0.07 ft
Flow Area	0.6 ft²
Wetted Perimeter	9.43 ft
Top Width	9.41 ft
Critical Depth	0.12 ft
Critical Slope	0.078042 ft/ft
Velocity	3.40 ft/s < 5.0 fps ok
Velocity Head	0.18 ft
Specific Energy	0.25 ft
Froude Number	2.32
Flow Type	Supercritical

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DD-1I Pond inlet Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.047	D_{50} = 6"
Slope	0.200000 ft/ft	
Left Side Slope	2.00 H : V	
Right Side Slope	2.00 H : V	
Bottom Width	6.00 ft	
Discharge	3.72 cfs	

Results		
Depth	0.15 ft	< 1.5' ok
Flow Area	1.0 ft²	
Wetted Perimeter	6.68 ft	
Top Width	6.61 ft	
Critical Depth	0.22 ft	
Critical Slope	0.055162 ft/ft	
Velocity	3.88 ft/s	
Velocity Head	0.23 ft	
Specific Energy	0.39 ft	
Froude Number	1.80	
Flow Type	Supercritical	

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DD-1I Pond inlet Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.054 $P_{50} = 6''$
Slope	0.500000 ft/ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Bottom Width	6.00 ft
Discharge	3.72 cfs

Results	
Depth	0.13 ft
Flow Area	0.8 ft²
Wetted Perimeter	6.56 ft
Top Width	6.50 ft
Critical Depth	0.22 ft
Critical Slope	0.073943 ft/ft
Velocity	4.71 ft/s < 5.0 fps ok
Velocity Head	0.35 ft
Specific Energy	0.47 ft
Froude Number	2.39
Flow Type	Supercritical

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DD-6 Pond inlet Minimum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.047 @ 50 = 15"
Slope	0.083300 ft/ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Bottom Width	5.00 ft
Discharge	1.06 cfs

Results	
Depth	0.10 ft < 1.5' ok
Flow Area	0.5 ft²
Wetted Perimeter	5.47 ft
Top Width	5.42 ft
Critical Depth	0.11 ft
Critical Slope	0.069544 ft/ft
Velocity	1.95 ft/s
Velocity Head	0.06 ft
Specific Energy	0.16 ft
Froude Number	1.09
Flow Type	Supercritical

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DD-6 Pond Inlet Maximum Slope
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Horizon Sed. Pond
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data	
Mannings Coefficient	0.056 D_{50} = 15"
Slope	0.250000 ft/ft
Left Side Slope	2.00 H : V
Right Side Slope	2.00 H : V
Bottom Width	5.00 ft
Discharge	1.06 cfs

Results	
Depth	0.08 ft
Flow Area	0.4 ft²
Wetted Perimeter	5.37 ft
Top Width	5.33 ft
Critical Depth	0.11 ft
Critical Slope	0.098949 ft/ft
Velocity	2.46 ft/s < 5.0 fps ok
Velocity Head	0.09 ft
Specific Energy	0.18 ft
Froude Number	1.52
Flow Type	Supercritical

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SUMMIT ENGINEERING INC.

May 8, 2002

David Miller
Lodestar Energy, Inc.
Mountain Operations
HC 35, Box 370
Helper, Utah 84526

RE: **Horizon Mine Site – Sedimentation Pond 1**
Mine Discharge Option

Dear Mr. Miller:

On March 21, 2002, you requested that I perform an engineering analysis on the above referenced structure in order to determine if any modifications would be necessary in order to accommodate pumped mine discharge. To facilitate this evaluation, you sent me the latest design documents for this structure, which were prepared by EarthFax Engineering, Inc., and information concerning the pump system for the mine discharge. From this information, and by use of the computer program SEDCAD4, I was able to make the following determination(s):

- The pump systems maximum discharge rate of 750 gpm is equivalent to 1.67 cfs based on the following conversion factor: 1 gpm = 2.228×10^{-3} cfs.
- To be conservative, the discharge rate of 1.67 cfs was rounded up to 2 cfs and entered into the SEDCAD4 computer model developed for this pond.
- The provided design documents for this pond considered two (2) options; the pond with a decant pipe and without the pipe. Also, the 10 yr.-24 hr. storm event was used in this analysis with a rainfall depth of 1.8 inches. The analysis provided considered these two (2) scenarios. ***Therefore, based on the results of the computer models, Pond 1 will not require any modifications to its existing configuration in order to accommodate mine discharge up to the maximum rate of 750 gpm.***

Please find enclosed the results of the SEDCAD4 computer analysis and a stage-storage curve for the pond for each of the above mentioned design cases.

If you require any additional information or have any questions, feel free to contact me at our Pikeville, KY office at (606) 432-1447.

Thank you in advance for the continued opportunity to serve you and your company.

Sincerely,

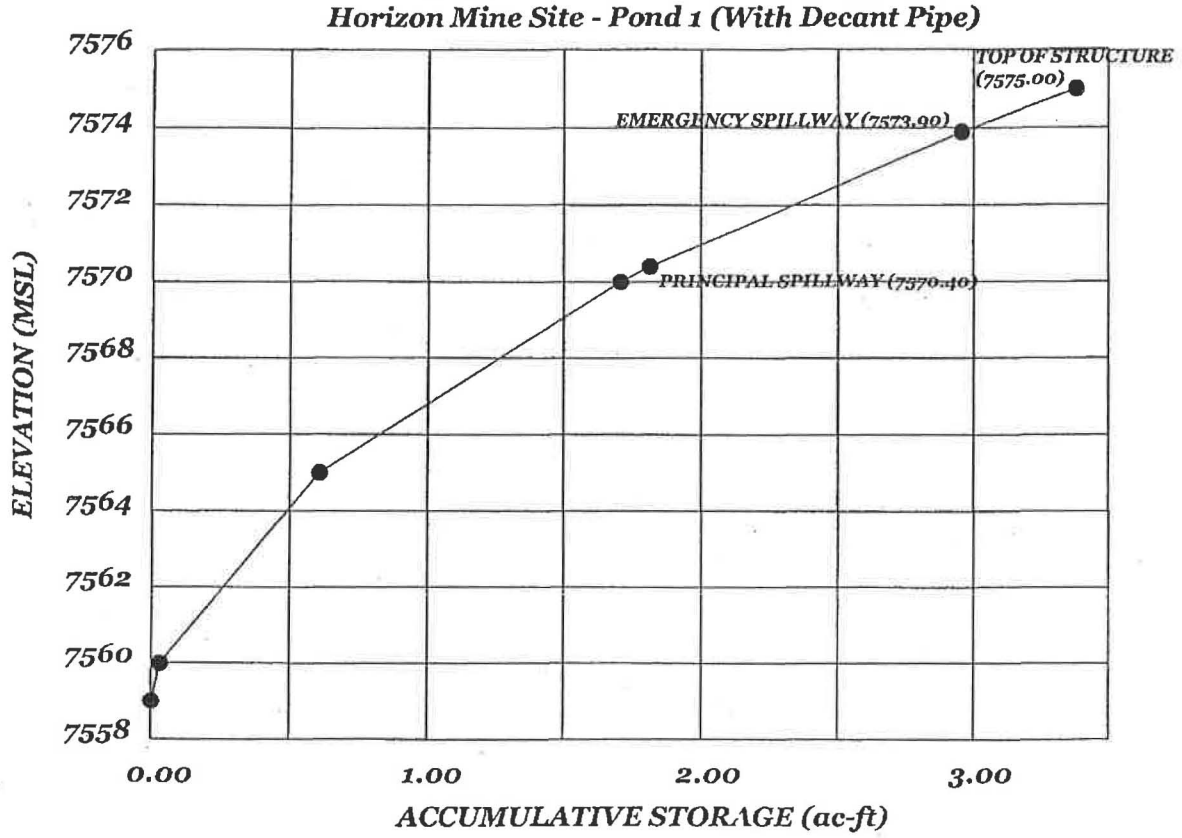
Michael J. Parker, E.I.T.
Project Engineer

DIV OF OIL GAS

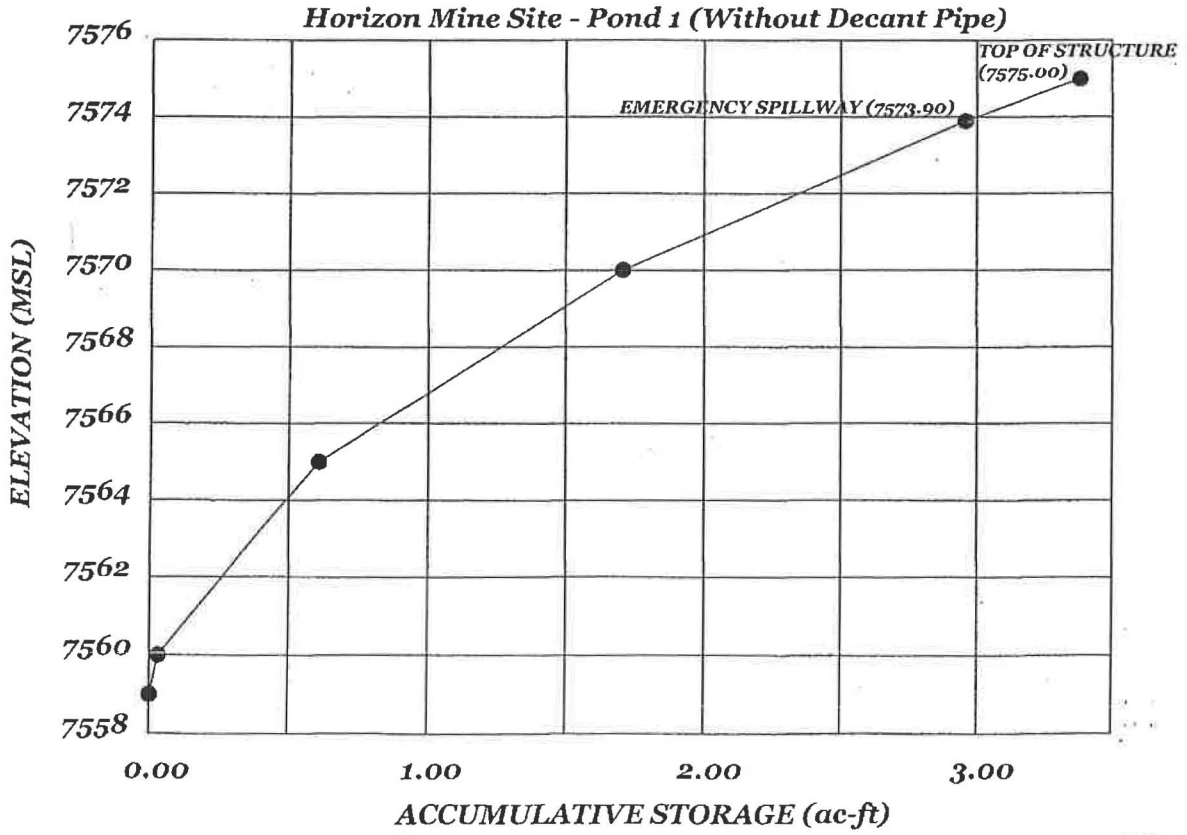
131 Summit Drive, Pikeville, Kentucky 41501 ▲ 606-432-1447 ▲ fax 606-432-1440 ▲ e-mail: summit@kymtnnet.org

STAGE STORAGE CURVE

Horizon Mine Site - Pond 1 (With Decant Pipe)



Horizon Mine Site - Pond 1 (Without Decant Pipe)



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Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

With Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.600 inches

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	31.200	31.200	11.56	0.55
	Out			2.05	0.55

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Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,570.00
Initial Pool:	1.71 ac-ft

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
3.00	50.00	0.80	0.0100	7,570.40	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,570.65
Dewater Time:	0.26 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7,559.00	0.001	0.000	0.000	
7,559.01	0.001	0.000	0.000	
7,559.50	0.020	0.004	0.000	
7,560.00	0.060	0.023	0.000	
7,560.50	0.069	0.055	0.000	
7,561.00	0.078	0.092	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,561.50	0.087	0.133	0.000		
7,562.00	0.097	0.179	0.000		
7,562.50	0.108	0.230	0.000		
7,563.00	0.119	0.287	0.000		
7,563.50	0.131	0.350	0.000		
7,564.00	0.144	0.418	0.000		
7,564.50	0.157	0.493	0.000		
7,565.00	0.170	0.575	0.000		
7,565.50	0.181	0.663	0.000		
7,566.00	0.191	0.756	0.000		
7,566.50	0.203	0.854	0.000		
7,567.00	0.214	0.958	0.000		
7,567.50	0.226	1.068	0.000		
7,568.00	0.238	1.184	0.000		
7,568.50	0.251	1.307	0.000		
7,569.00	0.263	1.435	0.000		
7,569.50	0.277	1.570	0.000		
7,570.00	0.290	1.712	0.000		
7,570.40	0.298	1.829	2.000	4.95	Spillway #1
7,570.50	0.300	1.859	2.029	0.40	
7,570.65	0.303	1.906	2.053	0.95	Peak Stage
7,571.00	0.311	2.012	2.107		
7,571.50	0.321	2.170	2.121		
7,572.00	0.332	2.333	2.136		
7,572.50	0.343	2.502	2.150		
7,573.00	0.354	2.676	2.164		
7,573.50	0.365	2.856	2.179		
7,573.90	0.374	3.004	2.190		Spillway #2
7,574.00	0.377	3.041	3.845		
7,574.50	0.388	3.232	12.114		
7,575.00	0.400	3.430	33.545		

Detailed Discharge Table

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Elevation	Straight Pipe (cfs)	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,559.00	0.000	0.000	0.000	0.000
7,559.01	0.000	0.000	0.000	0.000
7,559.50	0.000	0.000	0.000	0.000
7,560.00	0.000	0.000	0.000	0.000
7,560.50	0.000	0.000	0.000	0.000
7,561.00	0.000	0.000	0.000	0.000
7,561.50	0.000	0.000	0.000	0.000
7,562.00	0.000	0.000	0.000	0.000
7,562.50	0.000	0.000	0.000	0.000
7,563.00	0.000	0.000	0.000	0.000
7,563.50	0.000	0.000	0.000	0.000
7,564.00	0.000	0.000	0.000	0.000
7,564.50	0.000	0.000	0.000	0.000
7,565.00	0.000	0.000	0.000	0.000
7,565.50	0.000	0.000	0.000	0.000
7,566.00	0.000	0.000	0.000	0.000
7,566.50	0.000	0.000	0.000	0.000
7,567.00	0.000	0.000	0.000	0.000
7,567.50	0.000	0.000	0.000	0.000
7,568.00	0.000	0.000	0.000	0.000
7,568.50	0.000	0.000	0.000	0.000
7,569.00	0.000	0.000	0.000	0.000
7,569.50	0.000	0.000	0.000	0.000
7,570.00	0.000	0.000	0.000	0.000
7,570.40	0.000	0.000	2.000	2.000
7,570.50	(1)>0.029	0.000	2.000	2.029
7,571.00	(5)>0.107	0.000	2.000	2.107
7,571.50	(5)>0.121	0.000	2.000	2.121
7,572.00	(5)>0.136	0.000	2.000	2.136
7,572.50	(5)>0.150	0.000	2.000	2.150
7,573.00	(5)>0.164	0.000	2.000	2.164
7,573.50	(5)>0.179	0.000	2.000	2.179
7,573.90	(5)>0.190	0.000	2.000	2.190
7,574.00	(5)>0.193	1.653	2.000	3.845
7,574.50	(5)>0.207	9.907	2.000	12.114
7,575.00	(5)>0.221	31.323	2.000	33.545

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.84	0.085
	2	5.400	0.098	0.000	0.000	70.000	M	1.07	0.049
	3	14.900	0.072	0.000	0.000	77.000	F	7.17	0.313
	4	1.600	0.126	0.000	0.000	90.000	F	1.61	0.102
	Σ	**31.200**						**11.56**	**0.549**

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Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

Without Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Particle Size Distribution:

Size (mm)	Disturbed	Undisturbed
3.0000	100.000%	100.000%
2.0000	93.000%	99.900%
1.0000	86.000%	98.000%
0.5000	78.000%	92.000%
0.3000	73.000%	87.000%
0.2000	67.000%	80.000%
0.1000	55.000%	70.000%
0.0500	44.000%	60.000%
0.0300	35.000%	50.000%
0.0200	27.000%	42.000%
0.0100	18.000%	32.000%
0.0050	14.000%	21.000%
0.0030	9.000%	15.000%
0.0010	3.000%	4.000%

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Structure Networking:

Type	Stru #	(flows Into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	31.200	31.200	9.86	0.76	21.5	46,866	29.80	13.17
	Out			2.72	0.76	1.8	2,194	0.00	0.00

The 24 hour Arithmetic Average (24AA) is under review. It is anticipated that the 24AA will be replaced by the peak settleable solids concentration (ml/l) with the addition of new sediment input factor values.

The 24AA is provided for your convenience during this transition period.

		24AA (ml/l)
#1	In	3.94
	Out	0.00

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Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	94.479%	100.000%
1.0000	87.502%	100.000%
0.5000	79.402%	100.000%
0.3000	74.324%	100.000%
0.2000	68.217%	100.000%
0.1000	56.054%	100.000%
0.0500	44.894%	100.000%
0.0300	35.740%	100.000%
0.0200	27.615%	100.000%
0.0100	18.461%	100.000%
0.0050	14.309%	100.000%
0.0030	9.218%	100.000%
0.0010	3.060%	35.903%

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Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,573.50
Initial Pool:	0.53 ac-ft
*Sediment Storage:	2.33 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,573.94
H'graph Detention Time:	0.87 hrs
Pond Model:	CSTRS
Dewater Time:	0.64 days
Trap Efficiency:	91.48 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,571.99	0.332	0.000	0.000		Top of Sed. Storage
7,572.00	0.332	0.003	0.000		
7,572.50	0.343	0.172	0.000		
7,573.00	0.354	0.346	0.000		
7,573.50	0.365	0.526	0.000		
7,573.90	0.374	0.674	2.000	14.95	Spillway #1
7,573.94	0.375	0.690	2.725	0.45	Peak Stage

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7,574.00	0.377	0.711	3.653	
7,574.50	0.388	0.902	11.907	
7,575.00	0.400	1.100	33.323	

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,571.99	0.000	0.000	0.000
7,572.00	0.000	0.000	0.000
7,572.50	0.000	0.000	0.000
7,573.00	0.000	0.000	0.000
7,573.50	0.000	0.000	0.000
7,573.90	0.000	2.000	2.000
7,574.00	1.653	2.000	3.653
7,574.50	9.907	2.000	11.907
7,575.00	31.323	2.000	33.323

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.63	0.132
	2	5.400	0.098	0.000	0.000	70.000	M	0.95	0.077
	3	14.900	0.072	0.000	0.000	77.000	F	5.99	0.429
	4	1.600	0.126	0.000	0.000	90.000	F	1.36	0.123
	Σ	**31.200**						**9.86**	**0.760**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.170	100.00	50.00	0.0030	1.0000	2	0.2	2,609	1.41	0.53
	2	0.170	100.00	50.00	0.0030	1.0000	2	0.1	2,444	1.32	0.50
	3	0.220	100.00	20.00	0.1400	1.0000	1	17.0	65,267	41.74	18.34
	4	0.220	100.00	5.00	0.9000	1.0000	1	4.3	49,074	30.81	16.42
	Σ							**21.5**	**46,866**	**29.80**	**13.17**

Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

Without Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

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General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	25 yr - 6 hr
Rainfall Depth:	1.600 inches

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)
#1	In	31.200	31.200	11.56	0.55
	Out			2.93	0.55

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Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,573.50
Initial Pool:	2.86 ac-ft

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,573.96
Dewater Time:	0.30 days

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)
7,559.00	0.001	0.000	0.000	
7,559.01	0.001	0.000	0.000	
7,559.50	0.020	0.004	0.000	
7,560.00	0.060	0.023	0.000	
7,560.50	0.069	0.055	0.000	
7,561.00	0.078	0.092	0.000	
7,561.50	0.087	0.133	0.000	
7,562.00	0.097	0.179	0.000	
7,562.50	0.108	0.230	0.000	
7,563.00	0.119	0.287	0.000	
7,563.50	0.131	0.350	0.000	
7,564.00	0.144	0.418	0.000	
7,564.50	0.157	0.493	0.000	

Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,565.00	0.170	0.575	0.000		
7,565.50	0.181	0.663	0.000		
7,566.00	0.191	0.756	0.000		
7,566.50	0.203	0.854	0.000		
7,567.00	0.214	0.958	0.000		
7,567.50	0.226	1.068	0.000		
7,568.00	0.238	1.184	0.000		
7,568.50	0.251	1.307	0.000		
7,569.00	0.263	1.435	0.000		
7,569.50	0.277	1.570	0.000		
7,570.00	0.290	1.712	0.000		
7,570.40	0.298	1.829	0.000		
7,570.50	0.300	1.859	0.000		
7,571.00	0.311	2.012	0.000		
7,571.50	0.321	2.170	0.000		
7,572.00	0.332	2.333	0.000		
7,572.50	0.343	2.502	0.000		
7,573.00	0.354	2.676	0.000		
7,573.50	0.365	2.856	0.000		
7,573.90	0.374	3.004	2.000	6.85	Spillway #1
7,573.96	0.376	3.025	2.927	0.40	Peak Stage
7,574.00	0.377	3.041	3.653		
7,574.50	0.388	3.232	11.907		
7,575.00	0.400	3.430	33.323		

Detailed Discharge Table

Elevation	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,559.00	0.000	0.000	0.000
7,559.01	0.000	0.000	0.000
7,559.50	0.000	0.000	0.000
7,560.00	0.000	0.000	0.000
7,560.50	0.000	0.000	0.000
7,561.00	0.000	0.000	0.000
7,561.50	0.000	0.000	0.000
7,562.00	0.000	0.000	0.000
7,562.50	0.000	0.000	0.000
7,563.00	0.000	0.000	0.000

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Elevation	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,563.50	0.000	0.000	0.000
7,564.00	0.000	0.000	0.000
7,564.50	0.000	0.000	0.000
7,565.00	0.000	0.000	0.000
7,565.50	0.000	0.000	0.000
7,566.00	0.000	0.000	0.000
7,566.50	0.000	0.000	0.000
7,567.00	0.000	0.000	0.000
7,567.50	0.000	0.000	0.000
7,568.00	0.000	0.000	0.000
7,568.50	0.000	0.000	0.000
7,569.00	0.000	0.000	0.000
7,569.50	0.000	0.000	0.000
7,570.00	0.000	0.000	0.000
7,570.40	0.000	0.000	0.000
7,570.50	0.000	0.000	0.000
7,571.00	0.000	0.000	0.000
7,571.50	0.000	0.000	0.000
7,572.00	0.000	0.000	0.000
7,572.50	0.000	0.000	0.000
7,573.00	0.000	0.000	0.000
7,573.50	0.000	0.000	0.000
7,573.90	0.000	2.000	2.000
7,574.00	1.653	2.000	3.653
7,574.50	9.907	2.000	11.907
7,575.00	31.323	2.000	33.323

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Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.84	0.085
	2	5.400	0.098	0.000	0.000	70.000	M	1.07	0.049
	3	14.900	0.072	0.000	0.000	77.000	F	7.17	0.313
	4	1.600	0.126	0.000	0.000	90.000	F	1.61	0.102
	$\sum$	**31.200**						**11.56**	**0.549**

Lodestar Energy, Inc.
Horizon Mine Site
Sedimentation Pond 1

Mine Discharge Option

With Decant Pipe Spillway

Michael J. Parker

Summit Engineering, Inc.
131 Summit Drive
Pikeville, KY 41501

Phone: (606) 432-1447
Email: mparker@summit-engr.com

General Information

Storm Information:

Storm Type:	NRCS Type II
Design Storm:	10 yr - 24 hr
Rainfall Depth:	1.800 inches

Particle Size Distribution:

Size (mm)	Disturbed	Undisturbed
3.0000	100.000%	100.000%
2.0000	93.000%	99.900%
1.0000	86.000%	98.000%
0.5000	78.000%	92.000%
0.3000	73.000%	87.000%
0.2000	67.000%	80.000%
0.1000	55.000%	70.000%
0.0500	44.000%	60.000%
0.0300	35.000%	50.000%
0.0200	27.000%	42.000%
0.0100	18.000%	32.000%
0.0050	14.000%	21.000%
0.0030	9.000%	15.000%
0.0010	3.000%	4.000%

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Structure Networking:

Type	Stru #	(flows into)	Stru #	Musk. K (hrs)	Musk. X	Description
Pond	#1	==>	End	0.000	0.000	Pond 1

#1
Pond

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Structure Summary:

		Immediate Contributing Area (ac)	Total Contributing Area (ac)	Peak Discharge (cfs)	Total Runoff Volume (ac-ft)	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc. (ml/l)	24VW (ml/l)
#1	In	31.200	31.200	9.86	0.76	21.5	46,866	29.80	13.17
	Out			2.04	0.76	2.2	2,681	0.00	0.00

The 24 hour Arithmetic Average (24AA) is under review. It is anticipated that the 24AA will be replaced by the peak settleable solids concentration (ml/l) with the addition of new sediment input factor values.

The 24AA is provided for your convenience during this transition period.

		24AA (ml/l)
#1	In	3.94
	Out	0.00

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Particle Size Distribution(s) at Each Structure

Structure #1:

Size (mm)	In	Out
3.0000	100.000%	100.000%
2.0000	94.479%	100.000%
1.0000	87.502%	100.000%
0.5000	79.402%	100.000%
0.3000	74.324%	100.000%
0.2000	68.217%	100.000%
0.1000	56.054%	100.000%
0.0500	44.894%	100.000%
0.0300	35.740%	100.000%
0.0200	27.615%	100.000%
0.0100	18.461%	100.000%
0.0050	14.309%	100.000%
0.0030	9.218%	90.890%
0.0010	3.060%	30.171%

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Structure Detail:

Structure #1 (Pond)

Pond 1

Pond Inputs:

Initial Pool Elev:	7,570.00
Initial Pool:	0.41 ac-ft
*Sediment Storage:	1.30 ac-ft
Dead Space:	20.00 %

**Sediment capacity was entered by user*

Straight Pipe

Barrel Diameter (in)	Barrel Length (ft)	Barrel Slope (%)	Manning's n	Spillway Elev	Entrance Loss Coefficient	Tailwater Depth (ft)
3.00	50.00	0.80	0.0100	7,570.40	0.90	0.00

Emergency Spillway

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Spillway Elev	Crest Length (ft)	Left Sideslope	Right Sideslope	Bottom Width (ft)
7,573.90	15.00	3.00:1	3.00:1	9.00

Pond Results:

Peak Elevation:	7,570.60
H'graph Detention Time:	0.78 hrs
Pond Model:	CSTRS
Dewater Time:	0.60 days
Trap Efficiency:	89.86 %

Dewatering time is calculated from peak stage to lowest spillway

Elevation-Capacity-Discharge Table

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Elevation	Area (ac)	Capacity (ac-ft)	Discharge (cfs)	Dewater Time (hrs)	
7,568.49	0.250	0.000	0.000		Top of Sed. Storage
7,568.50	0.251	0.002	0.000		
7,569.00	0.263	0.130	0.000		
7,569.50	0.277	0.265	0.000		
7,570.00	0.290	0.407	0.000		
7,570.40	0.298	0.524	2.000	13.50	Spillway #1
7,570.50	0.300	0.554	2.029	0.35	
7,570.60	0.302	0.584	2.044	0.50	Peak Stage
7,571.00	0.311	0.707	2.107		
7,571.50	0.321	0.865	2.121		
7,572.00	0.332	1.028	2.136		
7,572.50	0.343	1.197	2.150		
7,573.00	0.354	1.371	2.164		
7,573.50	0.365	1.551	2.179		
7,573.90	0.374	1.699	2.190		Spillway #2
7,574.00	0.377	1.736	3.845		
7,574.50	0.388	1.928	12.114		
7,575.00	0.400	2.125	33.545		

Detailed Discharge Table

Elevation	Straight Pipe (cfs)	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,568.49	0.000	0.000	0.000	0.000
7,568.50	0.000	0.000	0.000	0.000
7,569.00	0.000	0.000	0.000	0.000
7,569.50	0.000	0.000	0.000	0.000
7,570.00	0.000	0.000	0.000	0.000
7,570.40	0.000	0.000	2.000	2.000
7,570.50	(1)>0.029	0.000	2.000	2.029
7,571.00	(5)>0.107	0.000	2.000	2.107
7,571.50	(5)>0.121	0.000	2.000	2.121
7,572.00	(5)>0.136	0.000	2.000	2.136
7,572.50	(5)>0.150	0.000	2.000	2.150
7,573.00	(5)>0.164	0.000	2.000	2.164
7,573.50	(5)>0.179	0.000	2.000	2.179
7,573.90	(5)>0.190	0.000	2.000	2.190
7,574.00	(5)>0.193	1.653	2.000	3.845
7,574.50	(5)>0.207	9.907	2.000	12.114

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Elevation	Straight Pipe (cfs)	Emergency Spillway (cfs)	User-input discharge (cfs)	Combined Total Discharge (cfs)
7,575.00	(5)>0.221	31.323	2.000	33.545

Subwatershed Hydrology Detail:

Stru #	SWS #	SWS Area (ac)	Time of Conc (hrs)	Musk K (hrs)	Musk X	Curve Number	UHS	Peak Discharge (cfs)	Runoff Volume (ac-ft)
#1	1	9.300	0.083	0.000	0.000	70.000	M	1.63	0.132
	2	5.400	0.098	0.000	0.000	70.000	M	0.95	0.077
	3	14.900	0.072	0.000	0.000	77.000	F	5.99	0.429
	4	1.600	0.126	0.000	0.000	90.000	F	1.36	0.123
	Σ	**31.200**						**9.86**	**0.760**

Subwatershed Sedimentology Detail:

Stru #	SWS #	Soil K	L (ft)	S (%)	C	P	PS #	Sediment (tons)	Peak Sediment Conc. (mg/l)	Peak Settleable Conc (ml/l)	24VW (ml/l)
#1	1	0.170	100.00	50.00	0.0030	1.0000	2	0.2	2,609	1.41	0.53
	2	0.170	100.00	50.00	0.0030	1.0000	2	0.1	2,444	1.32	0.50
	3	0.220	100.00	20.00	0.1400	1.0000	1	17.0	65,267	41.74	18.34
	4	0.220	100.00	5.00	0.9000	1.0000	1	4.3	49,074	30.81	16.42
	Σ							**21.5**	**46,866**	**29.80**	**13.17**

DIV OF OIL GAS

APPENDIX 7-4

DESIGN CALCULATIONS

LICENSED PROFESSIONAL ENGINEER
No. 168246
RICHARD B. WHITE
2/9/98
STATE OF UTAH

REGISTERED PROFESSIONAL ENGINEER
No. 7102
RICHARD B. WHITE
16 Jun 1997
STATE OF UTAH

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DETERMINATION OF PEAK FLOWS
FOR OPERATIONAL DRAINAGES
AROUND
HORIZON. NO. 1 MINE

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DETERMINATION OF CURVE NUMBERS FOR OPERATIONAL WATERSHEDS.

Structure	Cover* & Soil Type	Hydrologic Condition	Soil Group	Curve Number**	Area (AC)	Weighted CN Value	Curve Number Used
DD-1	Bare Soil (Pad)	Poor	B+C	89	7.3	64	70
	Oak-Aspen Curecanti soil (Undisturbed area to the NW)	Fair	B	48	15.5		
	Pinyon-Juniper Senchert soil (Undisturbed area to the SE)	Fair	C	73	8.7		
UC-2 (Portal Canyon)	Oak-Aspen Curecanti soil	Fair	B	48	78.8	60	70
	Pinyon-Juniper Senchert soil	Fair	C	73	69.5		
UC-3 (Jewkes Creek)	Oak-Aspen Curecanti soil	Fair	B	48	243.4	56	70
	Pinyon-Juniper Senchert soil	Fair	C	73	112.7		

* Cover Type
- Oak-Aspen: Mountain Brush ~~Mixture of Oak~~ Brush, Aspen, Mountain Mahogany, Other Brush, Maple & Other Brush
- Pinyon-Juniper: Pinyon, Juniper, or Both with a Grass under story

** Curve Number values taken from SCS-TR-55 2nd Ed. (1986) Table 2.2d (Attached)

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Table 2-2d.—Runoff curve numbers for arid and semiarid rangelands[1]

Cover description		Curve numbers for hydrologic soil group—			
Cover type	Hydrologic condition[2]	A[3]	B	C	D
Herbaceous—mixture of grass, weeds, and low-growing brush, with brush the minor element.	Poor		80	87	93
	Fair		71	81	89
	Good		62	74	85
Oak-aspen—mountain brush mixture of oak brush, aspen, mountain mahogany, bitter brush, maple, and other brush.	Poor		66	74	79
	Fair		48	57	63
	Good		30	41	48
Pinyon-juniper—pinyon, juniper, or both; grass understory.	Poor		75	85	89
	Fair		58	73	80
	Good		41	61	71
Sagebrush with grass understory.	Poor		67	80	85
	Fair		51	63	70
	Good		35	47	55
Desert shrub—major plants include saltbush, greasewood, creosotebush, blackbrush, bursage, palo verde, mesquite, and cactus.	Poor	63	77	85	88
	Fair	55	72	81	86
	Good	49	68	79	84

[1]Average runoff condition, and $I_a = 0.2S$. For range in humid regions, use table 2-2c.

[2]*Poor:* <30% ground cover (litter, grass, and brush overstory).
Fair: 30 to 70% ground cover.
Good: >70% ground cover.

[3]Curve numbers for group A have been developed only for desert shrub.

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DETERMINATION OF CURVE NUMBERS FOR OPERATIONAL WATERSHEDS (CONT.)

WATERSHED I.D.	COVER+ SOIL TYPE*	HYDROLOGIC CONDITION	SOIL GROUP	CURVE NUMBER**	AREA (AC)	WEIGHTED CN VALUE	CURVE NUMBER USED
DC-1	BARE SOIL	POOR	B+C	89	0.8	50.	70
	OAK-ASPEN CURECANTI SOIL	FAIR	B	48	14.9		
DC-2	BARE SOIL	POOR	B+C	89	1.1	89	90
DC-3	OAK-ASPEN CURECANTI SOIL	FAIR	B	48	0.6	61	70
	BARE SOIL	POOR	B+C	89	0.3		
SEDIMENT POND*** (Total)	BARE SOIL	POOR	B+C	89	9.2	66	70
	OAK-ASPEN CURECANTI SOIL	FAIR	B.	48	15.5		
	PINYON-JUNIPER SENCHERT SOIL	FAIR	C	73	10.4		

*** ONLY THE MAIN DRAINAGES (PORTAL CANYON + HEWKES CREEK) WILL BE DIVERTED AROUND THE POND. ALL OTHER DRAINAGE, BOTH DISTURBED + UNDISTURBED, WILL BE COLLECTED BY THE SEDIMENT POND.

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PORTAL CANYON

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AREA

Map Area		Actual Area		
6.46 sq. in.		6460000 sq. ft.		148.3 acres

AVERAGE WATERSHED SLOPE

Max. Elev. 8905 Min. Elev. 7690 Difference 1215

	Elevation	Length (ft.)
0.25	7993.75	5100
0.5	8297.5	3500
0.75	8601.25	1400

Ave Watershed Slope= 47.0 %

Hydraulic Length

Map Length	Actual Length
4.5 inches	4500 feet

TIME OF CONCENTRATION

Curve Number = 70 S = 4.286 Lag 0.21 hrs

Time of Concentration = 0.34 hrs

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EVALUATION OF SEDIMENT YIELD
FROM RECLAIMED SURFACE

COMPARISON OF TREATMENTS

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EVALUATION OF SEDIMENT YIELD FROM RECLAIMED SITE.

DETERMINATION BASED ON UNIVERSAL SOIL LOSS EQUATION

- CALCULATE EXPECTED EROSION FROM:
  - DISTURBED SURFACE (BARE GROUND)
  - RIPPED SURFACE
  - MULCHED & RIPPED SURFACE
  - MULCHED + RIPPED SURFACE W/ SILT FENCE
  - UNDISTURBED SURFACE W/ SHRUB-GRASS VEG. TYPE FOR COVER + DENSITY REQUIRED FOR BOND RELEASE

EQUATION:

$$A = R\ LS\ K\ C\ P$$

WHERE:

A = COMPUTED SOIL LOSS PER UNIT AREA (TONS/AC/YR)

R = RAIN FALL FACTOR (ANNUAL)

LS = LAND SLOPE FACTOR

K = SOIL ERODIBILITY FACTOR

C = COVER FACTOR

P = PRACTICE FACTOR

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RAINFALL FACTOR = 15 (FROM ISRAELSEN, ET.AL., 1984)
(FIG. ATTACHED)

LS FACTOR BASED ON

$$LS = \left(\frac{\lambda}{72.6}\right)^{M}\left(\frac{430X^2 + 30X + 0.43}{6.613}\right)$$

WHERE:

λ = SLOPE LENGTH (FT)

X = $\sin\theta$

θ = SLOPE ANGLE (DEG) = $\text{ATAN}\left(\frac{\text{RISE}}{\text{RUN}}\right)$

M = SLOPE EXPONENT

SLOPE $\leq$ 3% $M = 0.3$

SLOPE $\geq$ 5% $M = 0.5$

SLOPE $>$ 3% & $<$ 5% $M = 0.4$

K FACTOR = 0.31 (FROM ISRAELSEN, ET.AL., 1984)

C FACTOR:	VALUE*
FOR BARE SOIL:	0.94
FOR RIPPED SOIL:	0.8
FOR MULCHED + RIPPED SOIL (2 TONS PER AC)	0.06
FOR EROSION MATTING:	0.10
FOR UNDISTURBED WATERSHED W/ 50% COVER NO APPRECIABLE CANOPY	0.11

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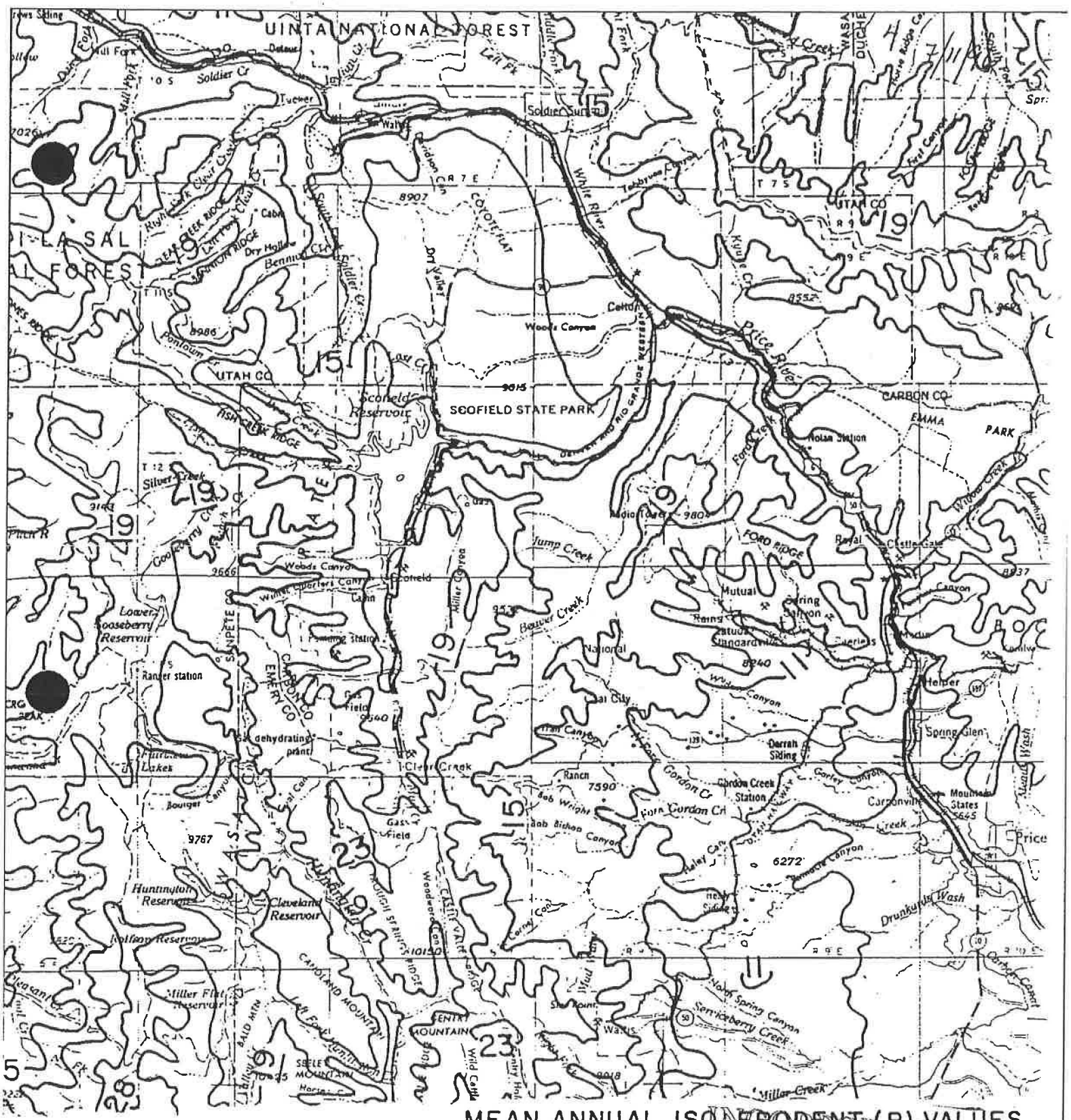
* VALUES DETERMINED FROM: ~~BAREFIELD, ET.AL. (1981)~~



Note:
R values shown are for rain and snowmelt together. R value for snowmelt alone = R_s = 0.23881 R + [illegible]4328.

MEAN ANNUAL ISOERODENT (R) VALUES

Units of R
English R = foot tons/acre/hour
Metric Rm = meter tonnes/hectare/hour
Rm = 1.7135 x R

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UTAH WATER RESEARCH LABORATORY UTAH STATE UNIVERSITY LOGAN, UTAH 1983

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EROSION FROM MULCHED + RIPPED SURFACE W/ SILT FENCE:

AS LONG AS INSTALLED ACCORDING TO MANUFACTURES SPECIFICATION, SILT FENCES HAVE A 75% RETENTION EFFICIENCY.

BASED ON MIRAFI TECHNICAL NOTE, R.G. CARROLL, JR. "SILT FENCES FOR SEDIMENTATION CONTROL IN MINING" PUB NO. 81-17.

+

WYANT, D.C. 1980. EVALUATION OF FILTER FABRIC FOR USE AS SILT FENCES. VHTRC 80-R49. VIRGINIA HIGHWAY AND TRANSPORTATION RESEARCH COUNCIL. CHARLOTTESVILLE, VIRGINIA.

SILT FENCES RETAIN APPROXIMATELY 75% OF SEDIMENT.

THEREFORE:

SED. PRODUCTION = (MULCHED + RIPPED PROD. X 0.25)

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ALTERNATIVE SEDIMENT CONTROL SUMMARY - Horizon No. 1 Mine

WATERSHED	Area (Ac)	Rainfall Factor	Height of Rise	Field Slope Length (ft)	Slope Angle (%)	Slope Angl (deg)	Slope Factor m	LS Factor	K Factor	Undisturbed Sed. Prod. w/no Mining (Tons)	Sediment to Stream with Reclaimed Area Treated With Following Options: Bare ground (Tons)	Ripped (Tons)	Mulched (Tons)	Silt fence (Tons)	Silt trapped by silt fence (Tons)	Silt trapped by silt fence (Cu Ft)
10 YR - 6 HR STORM EVENT																
PORTAL CANYON																
NORTH SIDE																
RECLAIMED AREA	3.3	18.0	42.0	145.0	29.0	16.2	0.5	9.0	0.31	18.2	155.6	132.4	9.9	2.0	7.0	155.6
UNDISTURBED AREA	15.5	18.0	560.0	850.0	65.9	33.4	0.5	76.1	0.31	724.0	724.0	724.0	724.0	181.0	543.0	12066.7
SUBTOTAL:										742.3	879.6	856.5	734.0	183.0	550.0	12222.2
SOUTH SIDE																
RECLAIMED AREA	4.4	18.0	42.0	70.0	60.0	31.0	0.5	19.3	0.31	52.0	444.4	378.2	28.4	7.0	21.0	466.7
UNDISTURBED AREA	7.9	18.0	600.0	850.0	70.6	35.2	0.5	83.2	0.31	403.3	403.3	403.3	403.3	101.0	302.0	6711.1
SUBTOTAL:										455.3	847.7	781.5	431.6	108.0	323.0	7177.8
TOTAL SEDMENT TO STREAM										1197.5	1727.3	1638.0	1165.6	291.0		
JEWKES CREEK																
NORTH SIDE																
RECLAIMED AREA	0.5	18.0	36.0	150.0	24.0	13.5	0.5	6.7	0.31	2.1	17.6	15.0	1.1	0.0	1.0	22.2
UNDISTURBED AREA	3.2	18.0	140.0	150.0	93.3	43.0	0.5	48.1	0.31	94.4	94.4	94.4	94.4	24.0	71.0	1577.8
SUBTOTAL:										96.4	112.0	109.4	95.5	24.0	72.0	1600.0
SOUTH SIDE																
RECLAIMED AREA	1.8	18.0	80.0	180.0	44.4	24.0	0.5	19.9	0.31	22.0	187.8	159.8	12.0	3.0	9.0	200.0
UNDISTURBED AREA	9.0	18.0	160.0	250.0	64.0	32.6	0.5	39.7	0.31	219.4	219.4	219.4	219.4	55.0	165.0	3666.7
SUBTOTAL:										241.4	407.2	379.3	231.4	58.0	174.0	3866.7
TOTAL SEDMENT TO STREAM										337.8	519.2	488.6	326.9	82.0		
ANNUAL EROSION											(Tons)	(Tons)	(Tons)	(Tons)	(Tons)	(Cu Ft)
PORTAL CANYON																
NORTH SIDE																
RECLAIMED AREA	3.3	15.0	42.0	145.0	29.0	16.2	0.5	9.0	0.31	15.2	129.7	110.3	8.3	2.0	6.0	133.3
UNDISTURBED AREA	15.5	15.0	560.0	850.0	65.9	33.4	0.5	76.1	0.31	603.4	603.4	603.4	603.4	151.0	453.0	10066.7
SUBTOTAL:										618.5	733.0	713.7	611.6	153.0	459.0	10200.0
SOUTH SIDE																
RECLAIMED AREA	4.4	15.0	42.0	70.0	60.0	31.0	0.5	19.3	0.31	43.3	370.4	315.2	23.6	6.0	18.0	400.0
UNDISTURBED AREA	7.9	15.0	600.0	850.0	70.6	35.2	0.5	83.2	0.31	336.1	336.1	336.1	336.1	84.0	252.0	5600.0
SUBTOTAL:										379.4	706.4	651.3	359.7	90.0	270.0	6000.0
TOTAL SEDMENT TO STREAM										997.9	1439.4	1365.0	971.4	243.0		
JEWKES CREEK																
NORTH SIDE																
RECLAIMED AREA	0.5	15.0	36.0	150.0	24.0	13.5	0.5	6.7	0.31	1.7	14.7	12.5	0.9	0.0	1.0	22.2
UNDISTURBED AREA	3.2	15.0	140.0	150.0	93.3	43.0	0.5	48.1	0.31	78.7	78.7	78.7	78.7	20.0	59.0	1311.1
SUBTOTAL:										80.4	93.3	91.1	79.6	20.0	60.0	1333.3
SOUTH SIDE																
RECLAIMED AREA	1.8	15.0	80.0	180.0	44.4	24.0	0.5	19.9	0.31	18.3	156.5	133.2	10.0	2.0	7.0	155.6
UNDISTURBED AREA	9.0	15.0	160.0	250.0	64.0	32.6	0.5	39.7	0.31	182.9	182.9	182.9	182.9	46.0	137.0	3044.4
SUBTOTAL:										201.2	339.4	316.0	192.8	48.0	144.0	3200.0
TOTAL SEDMENT TO STREAM										281.5	432.7	407.2	272.4	68.0		

INPUTS

SOIL CONDITION	C FACTORS	P Factor
Bare ground and seed	0.94	
Ripped and seeded	0.8	
Mulched, ripped, & seeded	0.06	
Silt Fence w/mulch, ripped, and seed	0.015	
Undisturbed	0.11	
ERODIBILITY FACTOR, K	0.31	
RAINFALL FACTORS		
10-yr 6-hr storm	18	
Annual	15	

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REFERENCES:

ISRAELSEN, C.E, J.E. FLETCHER, F.W. HAWS, E.K. ISRAELSEN, 1984. EROSION & SEDIMENTATION IN UTAH: A GUIDE FOR CONTROL. UTAH WATER RESEARCH LABORATORY, USU. UWRL/H-84/03. LOGAN, UTAH.

BARFIELD, B.J., R.C. WARNER, & C.T. HAAN. 1981. APPLIED HYDROLOGY AND SEDIMENTOLOGY FOR DISTURBED AREAS. OKLAHOMA TECHNICAL PRESS. STILLWATER, OKLAHOMA.

BASED ON PREVIOUS CALCULATIONS, THE MULCHED, RIPPED, & SEEDED WATERSHEDS PRODUCE LESS SEDIMENT THAN AN UNDISTURBED WATERSHED AT THE SAME SITE.

FOR ADDITIONAL PROTECTION, A SILT FENCE WILL BE INSTALLED ALONG THE RECLAIMED CHANNELS AS INDICATED ON ATTACHED FIGURE.

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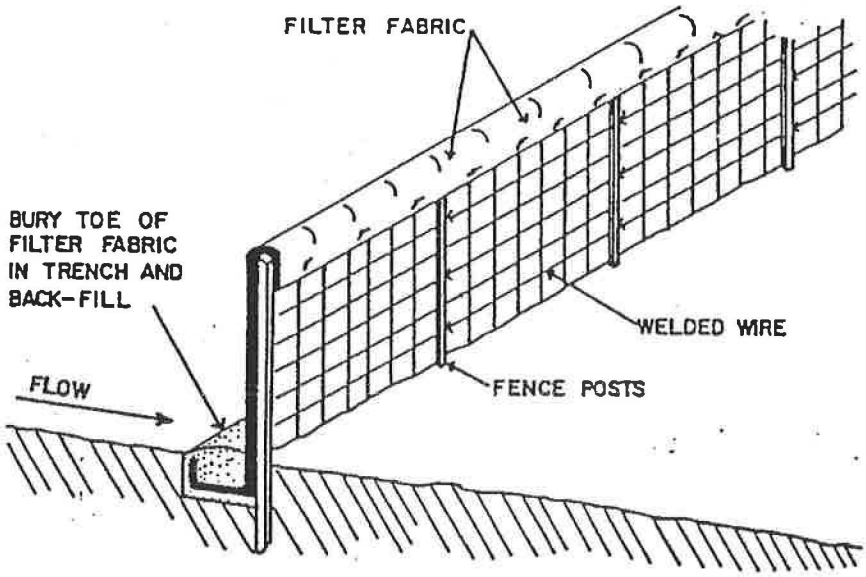
APPENDIX 6E



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