Deer Creek Coal Mine
North Rilda Canyon
Portal Facilities

PACIFICORP
A MIDAMERICAN ENERGY HOLDINGS COMPANY

ENERGY WEST
MINING COMPANY
A SUBSIDIARY OF PACIFICORP

Ammendment to Update the Deer Creek Mining and Reclamation Permit, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah

Revision June 2010

Volume 11B

C/015/018 Incoming

#3585

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

P.O. Box 310
15 North Main Street
Huntington, Utah 84528

June 30, 2010

HAND DELIVERED

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

Subj: Amendment to Update the Deer Creek Mining and Reclamation Permit, Volume 11, North Rilda Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

PacifiCorp, by and through its wholly-owned subsidiary, Energy West Mining Company ("Energy West"), as mine operator, hereby submits an amendment to update Volume 11, Volume 11 Appendix Volume A, and Volume 11 Appendix Volume B. The amendment includes an update as to the as-built conditions of the site since its completion in 2008.

Energy West is submitting this amendment to update Volume 11 in three parts and requests the each submittal receive a conditional approval by the Division. Submittals will be as follows:

Submittal 1 – Update Volume 11, Volume 11 Appendix Volume A, Volume 11 Appendix Volume B – text, maps, and data,

Submittal 2 – Update bonding calculations for the Rilda facilities (to include Chapter 800 Bonding),

Submittal 3 - Reduce the permit area for the Deer Creek Mine to include only those areas that are currently bonded.

Once the three submittals have been conditionally approved, the Division can give their final approval for this comprehensive amendment.

Updates for this first submittal for **Volume 11** include changes in Chapters 200 Soils through 700 Hydrology. Amended maps are also included in this volume; however, only two copies will have the PE signature. This signature signifies the design has been reviewed by a professional engineer. Once final approval has been granted, signatures for all "Clean Copy" maps will be provided.

Appendix Volume A includes two soil map updates (with PE signatures as stated above) as well as the comprehensive macro-invertebrate surveys in Rilda Creek. These surveys were performed by the Division of Wildlife Resources and a private contractor. Both surveys compliment each other and contain the same findings [construction of the Rilda facilities had no impact on water quality of the Rilda Creek]. The surveys were conducted between 2004 and 2008.

COPY

Appendix Volume B includes an updated hydrological design (Appendix B) for the facilities as built. Maps for the hydrology portion of the permit (with PE signatures as stated above) are included in this appendix. The entire Appendix B was revised, therefore, Energy West requests to remove the existing contents and replace with the updated version of Appendix B.

The required C1/C2 forms are included with this submittal. Seven (7) revised copies of Volume 11, Volume 11 Appendix Volume A, and Volume 11 Appendix Volume B are included. It is Energy West's hopes that by submitting this large permit revision in three parts, the burden of review will be reduced and the revisions will be focused and organized.

If you have any questions or concerns regarding this submittal, please contact Dennis Oakley at (435) 687-4825.

Sincerely,

Kenneth S. Fleck

Kenneth Fleck
Geology and Environmental Affairs Manager

Enclosures C1/C2 Forms
Volume 11
Volume 11 Appendix Volume A
Volume 11 Appendix Volume B

APPLICATION FOR COAL PERMIT PROCESSING

COPY

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

Permittee: PacifiCorp

Mine: Deer Creek Mine **Permit Number:** C/015/0018

Title: Amendment to Update the Deer Creek Mining and Reclamation Permit, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

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

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

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

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

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

Kenneth Fleck — Print Name

Kenneth S. Fleck — Manager of Environmental Affairs — Sign Name, Position, Date

Subscribed and sworn to before me this 29 day of JUNE, 20 10

Notary Public

My commission Expires: 8-28, 2013

Attest: State of Utah } ss:
County of Emery

NOTARY PUBLIC
Sidney K Larsen
579971
My Commission Expires
August 28, 2013
STATE OF UTAH

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

Form DOGM- C1 (Revised March 12, 2002)

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

COPY

Permittee: PacifiCorp
Mine: Deer Creek **Permit Number:** C/015/0018
Title: Amendment to Update the Deer Creek Mining and Reclamation Permit, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

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

			DESCRIPTION OF MAP, TEXT, OR MATERIAL TO BE CHANGED
☐ Add	☒ Replace	☐ Remove	Volume 11, Introduction Tab, Text Section, Add Red-line text and remove Strikeout text
☐ Add	☒ Replace	☐ Remove	Volume 11, Introduction Tab, Replace Figures A, B, and C
☐ Add	☐ Replace	☒ Remove	Volume 11, General Tab, Remove Tab, and entire contents
☐ Add	☒ Replace	☐ Remove	Volume 11, Soils Tab, Text Section, Add Red-line text and remove Strikeout text
☐ Add	☒ Replace	☐ Remove	Volume 11, Biology Tab, Text Section, Add Red-line text and remove Strikeout text
☐ Add	☒ Replace	☐ Remove	Volume11, R645-301-300 Biology Maps Tab, Replace Maps Table of Contents cover sheet
☐ Add	☒ Replace	☐ Remove	Volume 11, R645-301-300 Biology Maps Tab, Replace Maps 300-1, 300-2, 300-3, 300-4, 300-5 and 300-6
☐ Add	☒ Replace	☐ Remove	Volume 11, Land Use and Air Quality Tab, Text Section, Add Red-line text and remove Strikeout text
☐ Add	☒ Replace	☐ Remove	Volume 11, Land Use and Air Quality Tab, R645-301-400 Maps Tab, Replace Maps Table of Contents coversheet
☐ Add	☒ Replace	☐ Remove	Volume 11, R645-301-400 Land Use and Air Quality Maps Tab, Replace Map 400-1
☐ Add	☒ Replace	☐ Remove	Volume 11, Engineering Tab, Text Section, Add Red-line text and remove Strikeout text
☐ Add	☐ Replace	☒ Remove	Volume 11, Engineering Tab, Remove Appendix A
☐ Add	☒ Replace	☐ Remove	Volume 11, R645-301-500 Engineering Figures Tab, Replace FigureR645-301-500c
☐ Add	☒ Replace	☐ Remove	Volume 11, R645-301-500 Engineering Figures Tab, Replace FigureR645-301-500d
☐ Add	☒ Replace	☐ Remove	Volume 11, R645-301-500 Engineering Maps Tab, Replace Replace Maps Table of Contents cover sheet
☐ Add	☒ Replace	☐ Remove	Volume 11, R645-301-500 Engineering Maps Tab, Replace maps, 500-1 (1of 3 thru 3 of 3), 500-3, 500-4 (1 of 4 thru 4 of 4), 500-5,
☐ Add	☐ Replace	☒ Remove	Volume 11, R645-301-500 Engineering Maps Tab, Remove maps 500-4 (5 of 5)
☒ Add	☐ Replace	☐ Remove	Volume 11, R645-301-500 Engineering Maps Tab, Add Rilda Facility Plans Package
☐ Add	☒ Replace	☐ Remove	Volume 11, Geology Tab, Text Section, Add Red-line text and remove Strikeout text
☐ Add	☒ Replace	☐ Remove	Volume 11, Geology Tab, Geology Maps Tab, Replace Maps Table of Contents cover sheet
☒ Add	☐ Replace	☐ Remove	Volume 11, Hydrology Tab, Add Red-line text and remove Strikeout text
☐ Add	☒ Replace	☐ Remove	Volume 11, Appendix Volume A, Soils, Appendix C, Replace Maps 200-1 and 200-2
☒ Add	☐ Replace	☐ Remove	Volume 11, Appendix Volume A, Biology, Appendix D, Add Macroinvertebrate Comprehensive Report (2004 - 2008)
☒ Add	☐ Replace	☐ Remove	Volume 11, Appendix Volume A, Biology, Appendix D, Add Macroinvertebrate Reports 2009
☐ Add	☒ Replace	☐ Remove	Volume 11, Appendix Volume B, Hydrology, Appendix B, Text Section, replace entire section.
☐ Add	☒ Replace	☐ Remove	Volume 11, Appendix Volume B, Hydrology, Appendix B, Figures Section, replace entire section.
☐ Add	☒ Replace	☐ Remove	Volume 11, Appendix Volume B, Hydrology, Appendix B, Tables Section, replace entire section.
☒ Add	☐ Replace	☐ Remove	Volume 11, Appendix Volume B, Hydrology, Appendix B, Appendicies Section, Add Appendicies 1-6.

☐ Add	☐ Replace	☒ Remove	Volume 11, Appendix Volume B, Hydrology, Appendix B, Remove Appendix 1, Computer Backup.
☐ Add	☒ Replace	☐ Remove	Volume 11, Appendix Volume B, Hydrology, Appendix B, Replace Maps 700-1, 700-2, 700-3, 700-4.
☐ Add	☐ Replace	☒ Remove	Volume 11, Appendix Volume B, Hydrology, Appendix B, Remove Maps 700-5 and 700-6.

Any other specific or special instruction required for insertion of this proposal into the Mining and Reclamation Plan.	**Received by Oil, Gas & Mining**
	COPY

Form DOGM - C2 (Revised March 12, 2002)

PacifiCorp

Energy West Mining Company

Deer Creek Mine

C/015/0018

Amendment Update the Deer Creek Mining and Reclamation Plan, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

Seven (7) Redline/Strikeout Copies – Volume 11, Appendix Volume B, Hydrology Tab, Appendix B

RECEIVED
JUN 30 2010
DIV. OF OIL, GAS & MINING

Text Section – Replace Entire Text Section

DRAINAGE AND SEDIMENT CONTROL PLAN

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DRAINAGE AND SEDIMENT CONTROL PLAN

INTRODUCTION

The Rilda Canyon Portal Facility is a satellite component of the Deer Creek Mine located in Rilda Canyon in an area previously disturbed by coal mining activities. The facilities are situated in the canyon bottom near the Rilda Canyon Springs. Drainage and Sediment Control for the Rilda Canyon Portal Facilities has been designed to conform to the recommendations of the Forest Service, the North Emery Water Users Special Services District, and the State of Utah R645 - Coal Mining Rules (Revised March, 2009).

Initially, DOGM approved a mining and reclamation plan for a conceptual portal facility that would have been constructed in multiple stages. However; because adverse geologic conditions intercepted underground shortenrd the life of mine estimations, the economic feasibility for constructing a facility as originally planned did not evolve.

In the original plan, development included two portal breakouts, fan, substation, bathhouse/office/warehouse, covered material storage, water treatment plant, water storage tank, sewer treatment system, runoff collection tank, parking area, paved access road, mine yard, and sediment pond.

The actual as-built development was constructed much smaller. As-built facilities include two portal breakouts (one ventilation portal and one travel access portal), fan, substation, covered material storage, covered oil storage area, rock dust silo, paved access road and mine yard, sediment basin, and sediment pond.

Construction of the facilities began in 2006 and was completed in 2009. No construction was conducted between the months of December 1st and April 15th throughout the construction years.

The plan has been divided into the following sections:

- Design of Drainage Control Structures for the As-Built Construction
- As-Built Design of Sediment Control Structures
- Design of Drainage Control Structures for Reclamation

Refer to Volume 11, R645-301-500 Engineering, Maps Section to review the Jones and DeMille Engineering design drawings.

The general concepts followed in developing the facilities are as follows:

- A portion of the Mine Site yard will be paved with asphalt and/or concrete;
- The Mine Site and county road will be sloped to the north away from the stream;
- Natural runoff from the south-facing hillside will be diverted around and/or beneath the Disturbed Area via properly sized ditches and culverts;
- Runoff from the disturbed area will be collected in a combination of drop inlets, culverts, and ditches and channeled to a runoff collection basin below the facilities. The runoff collection basin overflows into a pipe system, then flows to the sedimentation pond located below the North Emery Water Users Special Services District spring collection area;
- A barrier or chain link fence will be installed along the south side of the Mine Site for security and safety concerns, as well as, providing a barrier for wind blown trash.

DESIGN OF DRAINAGE CONTROL STRUCTURES FOR AS-BUILT CONSTRUCTION

Design Parameters

2.1 Precipitation

2.2 Flow

2.3 Velocity

2.4 Drainage Area

2.5 Slopes, Lengths

2.6 Runoff

2.7 Runoff Curve Numbers

2.8 Culvert Sizing

2.9 Culverts

2.10 Ditches

2.11 Alternate Sediment Control Areas (ASCA)

Design Parameters

2.1 Precipitation

Design Storm Events – (from Blackhawk Engineering)

The source for the collection of precipitation data:

1) Precipitation - Frequency Atlas of the Western United States, Volume VI-Utah, NOAA Atlas 2
2) Richardson, Arlo E. "Estimated Return Periods for Short Duration Precipitation in Utah", Clear Creek Summit Station, NOAA Climatologist Utah State University, 1971.

Selected Source: Clear Creek Summit Station

Precipitation amounts listed in the Clear Creek Summit Station closely matches values depicted in the NOAA Atlas 2.

For a complete discussion related to the design storm events relative to Rilda Canyon refer to Volume 2 Appendix VII.

Frequency - Duration	Precipitation
10 year - 6 hour	1.55"
10 year - 24 hour	2.45"
25 year - 6 hour	1.88"
100 year - 6 hour	2.07"

Disturbed ditch and culvert designs for runoff controls are based on the 10 year - 24 hour event of 2.45" and the 25 year - 6 hour event of 1.88", where required. Diversion ditches and culverts have been designed and built for the 10 year - 24 hour event at the request of the Division. Undisturbed culvert designs are based on the 10 year - 24 hour event of 2.45". The sediment pond spillway is designed based on the 25 year – 6 hour event of 1.88".

It should be noted that all hydrologic structures are have been constructed larger than the minimum design requirements, as an added safety measure. Maintenance requirements, however, are expected to be as required by regulation. Hydrologic calculations in the Tables Section demonstrate the ability of all constructed ditches and culverts to handle the design flows.

The sedimentation pond has been designed and built to contain the runoff from a 10 year - 24 hour event of 2.45" as required by the Division. The pond was originally planned to contain the runoff from the full mining facility of approximately 9 acres. In anticipation of constructing the full blown facility, as well as, satisfying water users concerns, PacifiCorp elected to build the pond as originally designed. However; because the facility construction was scaled back, only approximately 3.5 acres contribute runoff to the pond. Reclamation designs are based on the 100 year - 6 hour event of 2.07", where applicable for permanent structures.

All ASCA areas utilize best management practices (BMP's) to control and limit sediment and erosion impacts to off-site areas. Map 700-2 show locations of all ASCA's and

associated BMP used for treatment. Refer to the BMP Section for all treatment selections, specifications, and performance expectations of the BMP's utilized.

2.2 Flow

Peak flows, velocities, and runoff volumes were calculated using the computer program "Office of Surface Mining Watershed Model", Storm Version 6.21 by Gary E. McIntosh. All flow is based on the SCS - TR55 Method for Type II storms. Refer to the area hydrographs in Appendix 1 – Drainage Area Hydrograph Data for all disturbed and undisturbed area flow modeling.

Time of concentration of storm events was calculated for each drainage area using the following formula:

$$t_c = \frac{t_L}{0.6}$$

where: t_c = Time of Concentration (hrs.)

$$t_L = \frac{L^{0.8}(S+1)^{0.7}}{1900\,Y^{0.5}}$$

L = Hydraulic Length of Watershed (ft.)

Y = Average Land Slope (%)

$$S = \frac{1000}{CN} - 10$$

CN = Runoff Curve Number

2.3 Velocity

Flow velocities for each ditch structure were calculated by means of the "Flow Master" computer program using the Manning's formula:

$$V = \frac{1.49}{n} R^{\frac{2}{3}} S^{\frac{1}{2}}$$

where: V = Velocity (fps)
R = Hydraulic Radius (ft.)
S = Slope (ft. per ft.)
n = Manning's n

Note: The following Manning's "n" were used in the calculations:

Structure	Manning's n
Culverts (cmp)	0.024
Rip-rapped or Natural Drainage Channels	0.040
Unlined Disturbed Area Ditches	0.013
Paved Disturbed Area Ditches	0.013

2.4 Drainage Areas

All drainage areas were computed directly from Maps 700-1, (Drainage Area Map) and 700-2 (Minesite Drainage Plan).

2.5 Slopes, Lengths

All slopes and hydraulic lengths were measured directly from the topography on Maps 700-1, 700-2.

2.6 Runoff

Runoff was calculated using the SCS Formula for Type II Storm:

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

where: Q = Runoff in inches
P = Precipitation in inches
S = $\frac{1000}{CN} - 10$
CN = Runoff Curve Number

2.7 Runoff Curve Number

As defined in Barfield, Haan and Hayes (Design Hydrology and Sedimentology for Small Catchments, 1994) curve number of an area indicates the runoff potential of an area. In previous studies of Rilda Canyon (refer to Volume 3 Appendix VII), the SCS curve number was evaluated based on the soil types, review of aerial photography and vegetation research. Based on the review, the north facing slopes were found to be heavily vegetated with a conifer-grass complex, whereas the south facing slopes were found to be less well vegetated with sage, grass and a mixture of pinyon and juniper. The percent cover for north facing slopes was estimated at 80% and 40% for the south facing slopes. Soils were mostly

classified as Type C and some Type B. Corresponding SCS curve numbers as estimated using the SCS Engineering Handbook - Section 4 are:

Conifer & Grass	with 80% cover	curve number = 62
Sage & Grass	With 40% cover	curve number = 68

Curve numbers for the various soil types have been discussed with the soil scientist retained for the project (refer to R645-301-200 Soils Section). The United States Forest Service (Hydrologic Basin Report) and previous research conducted for Rilda Canyon (refer to Volume 3 Appendix VII) was also consulted to ensure a consistent use of curve numbers.

The following table shows the slope perspective and resulting runoff curve number for each:

Description	Runoff Curve Number	
	SCS curve number was evaluated based on the soil types, review of aerial photography and vegetation research	Curve number selected for runoff estimation (adjusted to be conservative)
South Facing Slope - vegetated with sage, grass and a mixture of pinyon and juniper	68	70
Disturbed Area	90	90
Pave/Buildings	95	95

Since the main mine facility is paved, a Runoff Curve Number of 95 was used this disturbed area calculation. All other disturbed areas used a CN of 90 for runoff calculations. These areas included the boulder pile area (DA-3), the sediment basin area (DA-4), and the sediment pond area, designated DA-5.

2.8 Culvert Sizing

All culvert sizes were verified using the "Haestad Methods, Flowmaster, Version 5.13" Computer Program. Refer to tables 8 and 9 for sizing information and Appendix 2 – Culvert Design – Operational for computer program output data. The tables include the calculations for the standard as-built culverts installed. The tables also indicate the culverts percentage of full to demonstrate that the culvert will provide sufficient capacity for the designed runoff conditions. The results also provide the full flow capacity of each of the existing culverts.

During the initial planning process, minimum culvert sizing was based on the following Manning's Equation:

$$D = \left(\frac{2.16Qn}{\sqrt{S}} \right)^{0.35}$$

where:

D	=	Required Diameter (ft.)
Q	=	QP - Peak Discharge (cfs)
n	=	Roughness Factor (0.024 for cmp)
S	=	Slope (ft. per ft.)

Using the above formula, minimum required culvert sizes were calculated for each applicable area. Culverts were then selected (standardized to either 18" or 24") above the required

minimum, and these sizes were checked for adequacy against the Culvert Nomograph included as Figure 1 of this report. However, to show the efficiency of each of the standard culverts installed, Flowmaster, as described above, is used to present all data calculations.

2.9 Culverts

Culverts have been sized according to the calculations previously described, and are shown on Map 700-2, Minesite Hydrology. Culverts carrying undisturbed drainages are designated with UC-number (i.e. UC-1). Calculations for all undisturbed area culverts are also included in the Tables Section. Refer to Table 8 for all data calculations. All undisturbed area drainage is intercepted by concrete or riprapped ditches. From these armored ditches, runoff flows into drop drains or culvert inlets and is directed away from the disturbed facilities.

Riprap is placed at the outlet structure of the undisturbed culverts to control erosion and slow the flow into the Rilda Creek. Refer to typical outlet protection in Figure 2 or Jones & Demille Engineering Drawings in the Engineering Maps Section. Culvert inlets will be inspected routinely to ensure flow is not inhibited by debris.

It should be noted that all undisturbed area culverts are adequately sized to handle expected runoff from a 10 year - 24 hour event, which is larger than the 100 year- 6 hour event for maximum protection of the mine area, and undisturbed drainage. This is well in excess of the 10 year - 6 hour event required by the regulations and is used as an extra measure of control.

Disturbed area culverts and ditches are shown on the Minesite Drainage Plan, Map 700-2. Culverts carrying disturbed drainage are designated with a DC-number (i.e. DC-1). Calculations for all disturbed area culverts and ditches are also included with this report, along with design criteria. Refer to Table 7 for ditch data calculations and Table 9 for culvert data calculations. Disturbed drainage areas draining to culverts and ditches are marked with a DA-number (i.e. DA-1).

Culverts will be inspected regularly, and cleaned as necessary to provide for passage of design flows. Inlets and outlets shall also be maintained so as to prevent plugging or undue restriction of water flow.

All culverts are temporary, and will be removed upon final reclamation.

2.10 Ditches

Ditches are shown on the Minesite Drainage Plan, Map 700-2, and are designated with a DD-number (i.e., DD-1). A typical ditch design is shown in Figure 3. All ditches were sized using the "Haestad Methods, Flowmaster, Version 5.13 Computer Program. Refer to tables for sizing information and Appendix 3- Ditch Design – Operational for computer program output data.

All ditches are designed to carry the expected runoff from a 10 year - 24 hour event with a minimum freeboard of 0.5' (Refer to Table 7 and Figure 3). The 0.5' freeboard represents a minimum factor of safety for containing flow in a controlled manner.

Ditches which exhibit expected flow velocities of 5 fps or greater are typically lined with a rock riprapped erosion protection liner. No disturbed ditch at the Rilda facilities exhibit flow velocity characteristics greater than 5 fps. However, all disturbed ditches (except DD-5) are riprapped lined for added protection. A typical design is shown in Figure 3. Ditch slopes have been determined from Map 700-2.

All ditches will be inspected regularly, and maintained to the minimum dimensions to provide adequate capacity for the design flow. All ditches are temporary and will be removed as described under the reclamation hydrology section. (Section 4)

2.11 Alternate Sediment Control Areas (ASCA)

There are 5 Alternate Sediment Control Areas on this site. These areas are labeled ASCA-1, ASCA-2, ASCA-3, ASCA-4, and ASCA-5 on the Map 700-2, Minesite Drainage Plan. Refer to Appendix 4 - BMP Utilization for Sediment and Erosion Control to review typical details for all best management practices used at the Rilda Canyon Facilities.

ASCA-1: Mine Pad Outslope - Located on the south facing slope below the new road/pad area at the site. This area is approximately 0.57 acres, and sediment control is accomplished by re-vegetation of the disturbed slope and silt fence along the entire length of the toe of the disturbed slope. Silt fence will be removed once construction is completed and vegetation is established.

ASCA-2: Rock Check Dam – Undisturbed runoff is intercepted through a series of concrete (UD-4) and riprapped (UD-5) ditches and is routed to the undisturbed culvert (UC-3) that is installed under the access road to discharge into the Rilda Creek. An area of 0.06 acres is hard armored on the west side of diversion. Because of the long flow path adjacent to, and through the disturbed areas, a rock check dam has been placed at the inlet end of culvert UC-3 to capture any additional sediment that may enter into the diversion. The check dam is inspected routinely to ensure proper operation.

ASCA-3: Basin/Outslope - This area is on the south facing slope below the collection basin. The area is approximately 0.29 acres and is completely covered with large rock. A permeable cover has been placed below the riprap to control erosion and facilitate infiltration.

ASCA-4: Sediment Pond Outslope - This is the south facing area between the sediment pond and the county road. The area is approximately 0.36 acres and is completely covered with large rock. A permeable cover has been placed below the riprap to control erosion and facilitate infiltration. Runoff from this area collects in the County road bar ditch and is diverted into the disturbed culvert DC-4. Emery County Road Special Services District maintains responsibility for this diversion and culvert.

ASCA-5: Topsoil Storage Area - This area is located approximately 600' east and 300'

south of the facilities. This is an area of 0.51 acres. The outslope of the pile is constructed with 2:1 slopes. Sediment control is accomplished through the use of deep pocks throughout the entire pile. A native seed mix was hand broadcast on the pile to influence vegetation growth. A diversion ditch is constructed on the bottom end of the pile to catch any runoff. The flowline of the diversion ditch flows into a rock check dam for final treatment. The BMP on the east side of the pile utilizes a fiber roll to treat runoff off-site.

DESIGN OF SEDIMENT CONTROL STRUCTURES

3.1 Design and Construction Specifications for Sediment Pond

a) All construction of sedimentation ponds have been performed under the direction of a qualified, registered professional engineer.

ii. The pond is considered a full containment facility (refer to Map 700-3 in Maps Section). No discharge into the Rilda Creek is expected to occur as a result of the design storm events (one 10yr/24hr storms). The pond has been constructed with an emergency spillway that consists of an open-channel spillway with a bottom width of 8' and 2h:1v side slopes (refer to Jones and DeMille Engineering Drawings in R645-301-500 Maps Section for complete construction details). The open-channel spillway is constructed of rip-rap with a liner. Emergency by-pass will flow into disturbed diversion culvert DC-4. This culvert is the responsibility of the Emery County Road Special Services District #1.

iii. The area of pond construction was examined for substitute topsoil, and where present in removable quantities, such soil was removed separately and stored in the topsoil storage location.

Note – During construction of the pond, excavated soil was tested and found to be suitable for use as a substitute topsoil. Approximately 2,137 cy (calculated from field survey) of soil is segregated and stored at the topsoil

storage pile location. Topsoil was segregated from substitute topsoil using a colored marker fabric to distinguish between the two types of soils.

iv. In areas where fill was placed for the pond impoundment structures, natural ground was removed to a depth of at least 12" below the base of the structure.

v. Native materials were used where practical. Fill was placed in lifts not exceeding 15" and compacted prior to placement of next lift. Compaction of all fill materials was at least 95%.

vi. Rip-rap or other protection (culverts, concrete, etc.) was placed at all inlets and outlets to prevent scouring. Rip-rap consists of substantial (non-slaking) rock material of adequate size.

vii. Decanting of the pond, as required, will be accomplished by use of a portable pump with an inverted inlet, and pumping capacity of 100 gpm or greater.

viii. Slope of the embankments were not constructed steeper than 2h:1v, inside or outside, with a total of the inslope and outslope not less than 5h:1v, except where areas of the pond are incised.

ix. The outslope of the impoundments have been hard armored to help prevent erosion and promote stability.

x. Top width of the embankments are not less than (H+35)/5, where H = Height of Dam in feet.

3.2 Soil Loss

The RUSLE2 Model was used to estimate soil loss from unpaved disturbed areas. Program outputs are found in Appendix 5 – Soil Loss Calculations (RUSLE) – Operational. All soil loss from these areas was assumed to be delivered to, and deposited in the sedimentation pond, neglecting any deposition in the collection basin. No soil loss is calculated from the paved Mine Site area.

Also, since most undisturbed area drainages are diverted, no soil loss is expected to reach the sediment pond from those areas. One exception is the undisturbed areas above the sediment basin and sediment pond. These areas deliver overland flow, without diversion around the facility, into the pond.

RUSLE2 utilizes four main factors that affect soil erosion by rainfall and overland flow. These factors are: climate, soil, topography and land use condition.

Climate or weather consists of temperature extremes and rainfall extremes. In colder climates, decomposition or vegetative and organic materials that cover the soil limits erosion. Rainfall varies depending on location and time of year. Rainfall amounts and rainfall intensity are the two main factors that determine erosivity.

RUSLE2 uses an erosivity index known as the R-value to describe erosivity. The R-

value is an average annual sum of the individual storm erosivity index. The R-value for the Rilda Canyon location in Emery County is R=10. This value is found within the RUSLE2 database.

Soils vary in their inherent susceptibility to erosion. This susceptibility is known as soil erodibility. The index used by RUSLE2 for soil erodibility is the K-value. The K-value associated with the soils found at the Rilda Canyon facility utilizes a generic silty clay loam that is low to moderate OM and very slow permeability. For conservative measures, the percent rock cover was set at zero with exception of area DA-3. This area is considered a boulder storage area.

Three important topographic factors that determine erosion are steepness, length, and profile shape of the overland flow path. Erosion increases as the length and steepness of the flow path increases because of the accumulation and potential energy of the runoff. Profile shapes used to model erosion at the Rilda Canyon Portal facilities are uniform and concave slopes. Slope lengths and steepness (% grade) was obtained from topography maps.

Land use conditions refer to the cover management practices on the slope as well as the supporting practices that might be applied in addition to cover management conditions. Cover management refers to whether the soil is bare, covered by mulch (disturbed) or vegetation (undisturbed), whether the soil is rough or smooth, or if the immediate subsurface consists of roots or other organic matter. Supporting practice include contouring, terraces, diversions, traps that retain sediment and slow down

overland flow. Land use condition inputs for modeling Rilda utilizes a variety of cover management and supporting practices depending on whether the land is disturbed or undisturbed. Refer to the Hydrologic Data Section to review the RUSLE2 Profile Erosion Calculations Record for each area modeled at the Rilda Canyon Portal facilities.

Three disturbed areas and three undisturbed areas that report to the sediment pond, were modeled for sediment loss. The disturbed areas include; DA-3, basin DA-4, sediment pond area DA-5; and the undisturbed areas UA-6, UA-8, and UA-9a. The only areas that weren't modeled for sediment loss were the mine site pad area and access road, DA-1 and DA-2. No sediment production is expected from these areas since it consists of a concrete or asphalt covering.

A summary of the combined total soil loss for these six areas is 29.44 tons/acre/year as shown in the table below.

Site Location	Area (ac)	Sediment Load (tons/ac/yr)	Contribution (tons/yr)	Volume* (ac-ft/yr)
DA-3	0.43	0.24	0.11	5.05×10^{-5}
DA-4	0.21	2.2	0.46	2.12×10^{-4}
UA-6	2.8	3.5	9.8	4.5×10^{-3}
UA-8	0.48	13.00	0.52	2.39×10^{-4}
DA-4	0.21	2.20	0.46	2.11×10^{-4}
DA-5	0.70	3.70	2.59	1.19×10^{-3}
Total	**5.30**	**29.44**	**156.03**	**7.16×10^{-2}**

* Based on a density of 100 pounds per cubic foot of sediment.

More detailed calculations are found in the Tables Section, Table 10.

3.3 Sediment Pond Volume

Table 10 shows the volumes calculated from the precipitation, runoff and sediment loss data for a 10 year - 24 hour precipitation event. The volumes were calculated based on the disturbed areas runoff values, developed using the design parameters described in this section. Stage volume data are found in Table 11. An as-built drawing of the pond is found in the Maps Section as Map 700-3. Design of the pond utilized the design drawings by Jones and DeMille Engineering (refer to R645-301-500 Engineering, Maps Section).

3.4 Sediment Pond Summary

a) The Sediment pond has been built to contain the disturbed area (and contributing undisturbed area) runoff from at least one 10 year - 24 hour precipitation event, along with a minimum of 3 years of sediment storage capacity. Runoff to the pond will be directed by various ditches and culverts as described in the plan.

b) The required volume for the sediment pond is calculated at 0.89 acre feet (based on the volume of one10 year - 24 hour precipitation events totaling 2.45"). Sediment storage volume is estimated at 0.22 ac-ft for three years accumulation. The sediment pond size is a single cell with a total as-built volume of approximately 1.71 acre feet at the emergency spillway, which is more than adequate to handle the storage of the designed storm plus 0.22 acre feet of sediment.

c) The pond is considered a "no discharge" facility. An 8' wide open channel emergency spillway is provided as an emergency overflow by-pass.

d) The pond inlets are protected from erosion utilizing riprap. The emergency spillway will discharge directly to the undisturbed culvert DC-4, and to the main canyon drainage.

e) The pond is temporary, and will be removed upon final reclamation of the mine site.

f) The pond has been constructed according to the design criteria listed under "Construction Specifications for Sedimentation Ponds".

g) The emergency spillway has been built to carry a flow depth of approximately 2.5 feet.

3.5 Temporary Sediment Control

The primary means of the sediment control during construction of the minesite was provided by temporary sediment control practices; including sediment basins, silt fences, straw bales, or other best management practices. Temporary sediment controls were installed before any construction activity took place at the site including any timber and vegetation removal, or any other construction related activity.

The following temporary sediment control practices are employed for the Rilda portal mine site:

A temporary sediment basin was constructed at the lower end of the facilities site, as shown on Plates 700-1 and 700-2. All disturbed drainage from the facilities site is directed to this basin, with the exception of the ASCA areas. Those areas are treated with separate sediment controls including; hard armor, vegetation, silt fences, straw bales, or other sediment control devices (Refer to Appendix 5 – BMP Utilization for Sediment and Erosion Control for installation specifications). The dam embankment was designed and built to create a substantial sediment trap behind (upstream from) the temporary dam. The basin has been fitted with an open riser which extends vertically and terminates at an elevation several feet lower than the top of the dam

(refer to Figure 4 for details). The riser allows any silt-laden runoff water to impound behind the dam. Outfall from the temporary basin is routed through an existing culvert (DC-3) installed along the access road to the sediment pond. In the unlikely event that a storm (beyond the Rilda hydrological design parameters) exceeds the capacity of the primary riser, an emergency spillway was installed. Overflow from the spillway will flow into the access road ditch, into the roadway culverts, and finally into the Rilda Creek.

The culvert (DC-3) and sediment pond was constructed after the construction of the temporary basin. Temporary sediment controls were installed below the area of the sediment pond prior to start of construction on the pond. These controls consisted of silt fence, straw bales, or other sediment control devices (Refer to Appendix 5 – BMP Utilization for Sediment and Erosion Control for installation specifications).

It should be noted that the temporary sediment basin will be inspected regularly to ensure proper functioning. If it is found that the basin is in need of cleaning, all runoff will be directed to the sediment pond. Sediment from the basin will be loaded in trucks and transported to the Deer Creek waste rock site for permanent disposal. ASCA Areas - As previously mentioned, ASCA areas are treated with separate sediment controls, including hard armor, vegetation, silt fences, straw bales, or other sediment control devices. There are five ASCA areas at the Rilda Canyon Portal Facilities. These areas are shown on Map 700-2. BMP specifications are found in the Appendix 5 – BMP Utilization for Sediment and Erosion Control.

Installation of hard armor ASCA's included a permeable liner installed on graded bare ground. Riprap was placed by mechanical means until the entire liner was covered. Care was taken not to cut or damage the liner.

Because the facilities disturbed area is within the boundaries of the United States Forest Service, best management practices utilizing revegetation uses an approved seed mix. The ground was first roughened by pocking techniques prior to broadcasting seed. Once the seed was broadcast, a hydromulch with tackifier was applied to all bare slopes to protect the surface from erosion. Once vegetation is established on these sites, silt fences, or other sediment control devises may be removed with Division approval.

DESIGN OF DRAINAGE CONTROL STRUCTURES FOR RECLAMATION

Reclamation Hydrology

Reclamation Hydrology

4.1 General

The general focus of the reclamation of the Rilda Canyon Portal facilities is to return the area to its close approximate original contour. All structures will be removed and hauled off-site. Backfilling and grading techniques will be used to re-create the hill slopes and drainages that once existed in this part of the canyon.

The County Road will be returned to its original location after final reclamation. Roadway culverts will be re-installed to control and divert runoff from upland areas. Undisturbed culverts will be removed and replaced with reclaimed channels sized to carry the runoff from a 100 year - 6 hour storm. All other hydrologic controls, including the sediment pond, will be removed.

Reclaimed channels are noted with an RC-Letter (i.e. RC-1). Channels are shown on Map 700-4, "Minesite Reclamation". Typical channel cross-section for each side channel is shown on Figure 5. Sizing calculations for each of the reclamation channels are shown in Table 13. All reclaimed channels were sized using the "Haestad Methods, Flowmaster, Version 5.13 Computer Program. Refer to Appendix 6- Channel Design – Reclamation for program outputs.

4.2 Reclaimed Area Drainage Control

During final reclamation, all previously installed drainage controls, including the sediment basin and sediment pond, will be removed. The reclaimed area will be roughened by

discontinuous tilling and/or "gouging" the area with a trackhoe bucket. The roughening will create furrows or depressions at approximately 18"-36" deep throughout the reclaimed area. In addition, straw or wood mulch will be used in final seeding of the area. Roughening will continue throughout the entire reclaimed area. The reclaimed area, including channels will be reseeded according to the approved plan.

The RUSLE2 Model was used to estimate sediment yield from the reclaimed areas. Program outputs are found in Appendix 7 – Soil Loss Calculations (RUSLE) – Reclamation. All soil loss from these areas was assumed to be delivered to, and deposited in the road side ditch where it is diverted to road culvert and into Rilda Creek. RUSLE2 parameters have been previously discussed in Section 3.2

One flow path for the reclaimed area was evaluated. This flow path is representative of the entire reclaimed site. Sediment delivery to the road side ditch is expected to contribute 5.9 tons/ac/yr. This value multiplied by 5.4 acres (does not include road) totals 31.9 tons/yr or 0.42 acre feet per year. The sediment volume is based on a density of 100 pounds per cubic foot of sediment. This sediment contribution relates well to the background sediment delivery values. It should be noted; however, that RUSLE's capacity to model soil loss from areas roughened by "pocking" as described above is somewhat limited. Soil loss quantities realized may be much less than what the modeling illustrates.

Summary

The above discussion indicates the sediment contribution from the reclaimed areas of the minesite will be approximately 0.42 acre feet per year, as compared to 0.07 acre feet per year

for the disturbed area. Note that the disturbed area is generally hard armored with rock riprap and asphalt/pavement. When the reclaimed areas are calculated as undisturbed, the total minesite sediment contribution increases to 0.87 acre feet per year, verses the 0.42 acre feet per year. This indicates the proposed reclamation process will actually reduce the expected sediment contribution over natural, undisturbed conditions. This is primarily due to the extensive roughening and use of wood fiber mulch to reduce runoff.

4.3 Restored Channels

As mentioned in Section 4.1, undisturbed drainage culverts will be removed. As the County Road is reconstructed, 24" CMP culverts will be replaced in the locations shown on Map 7-4. As indicated on Table 8, the undisturbed (18" CMP) culverts have sufficient capacity to carry the flow from the operational 10yr/24hr storm event. No calculations, therefore, are needed to install 24" CMP culverts for final reclamation.

As shown on Table 13, all channels are adequately sized to carry the projected runoff with at least 0.5' of freeboard. See Figure 5 for a typical section of the reclaimed channels for construction. Riprap sizing and gradation calculations are shown in Table 14. These calculations utilize United States Army Corp of Engineers Engineering Manual EM 1110-2-1601 for steep slope riprap design. Table 14 also includes general riprap gradation and weight limits for rock.

4.4 Sediment Pond

As discussed in Section 4.1, the sediment pond will be removed during final reclamation. Sediment control for the reclamation will be accomplished by extensive roughening/gouging

and revegetation of the reclaimed area. See Map 700-4 "Minesite Reclamation" for location and reclamation details. Channel RC-3 will be constructed through the area. Design criteria for the channel are found on Table 13 and 14, and Figure 5.

PacifiCorp

Energy West Mining Company

Deer Creek Mine

C/015/0018

Amendment Update the Deer Creek Mining and Reclamation Plan, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

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Figures Section – Replace Entire Figures Section

Deer Creek Coal Mine
Rilda Canyon
Portal Facilities

Hydrology
Figures Section

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R645-301-700

HYDROLOGY

Contents

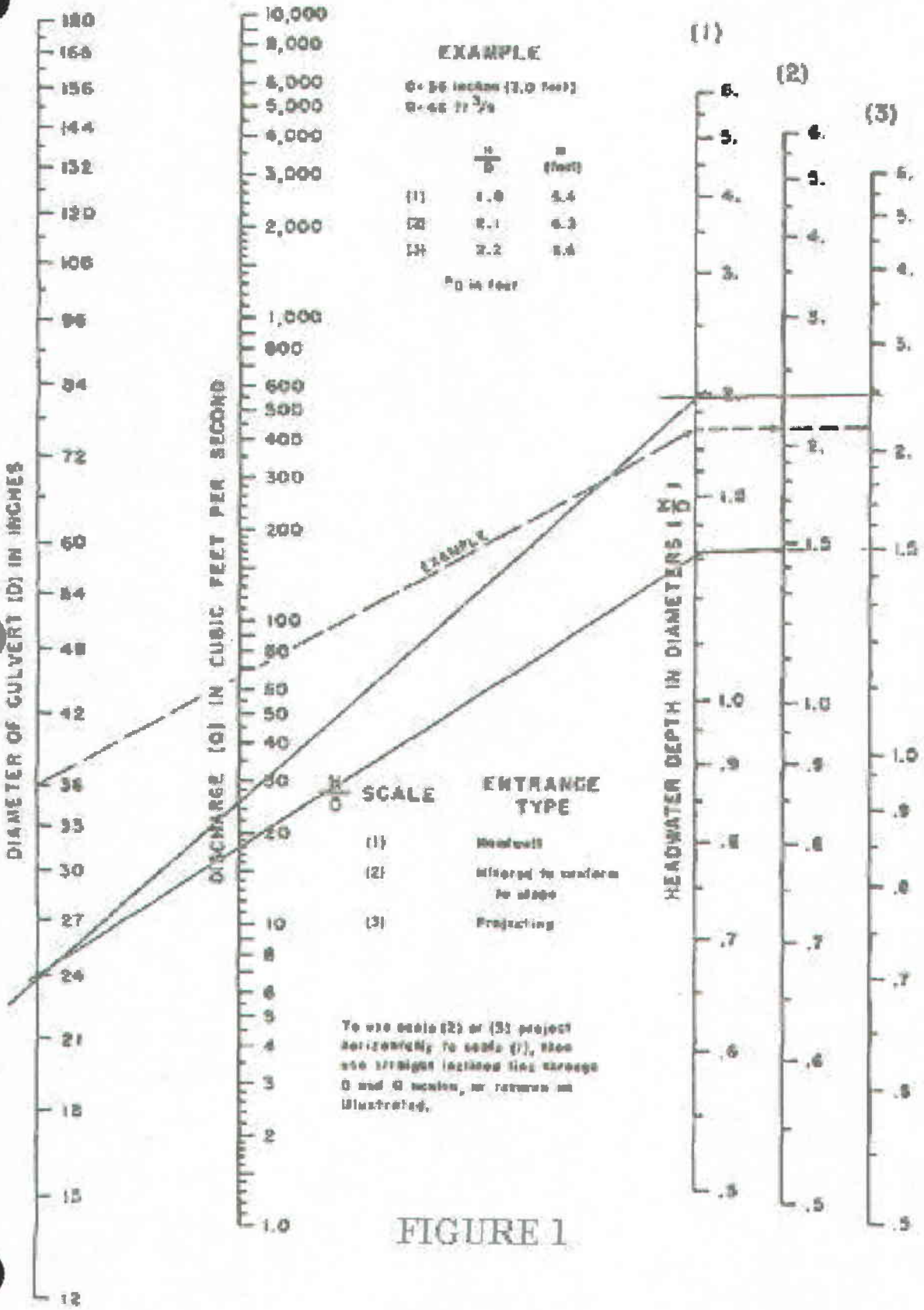
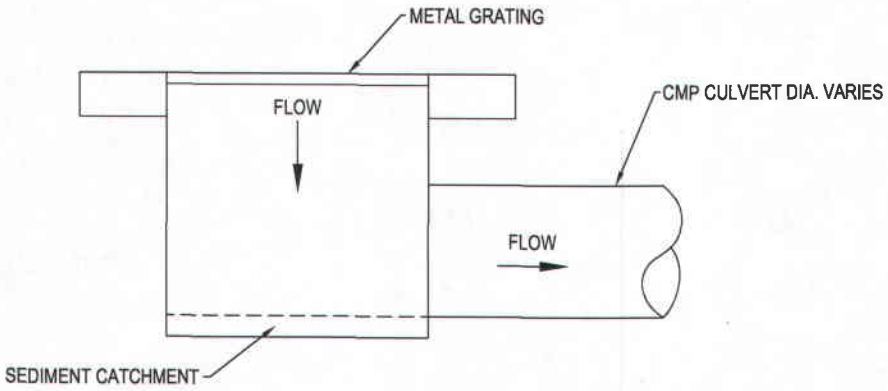
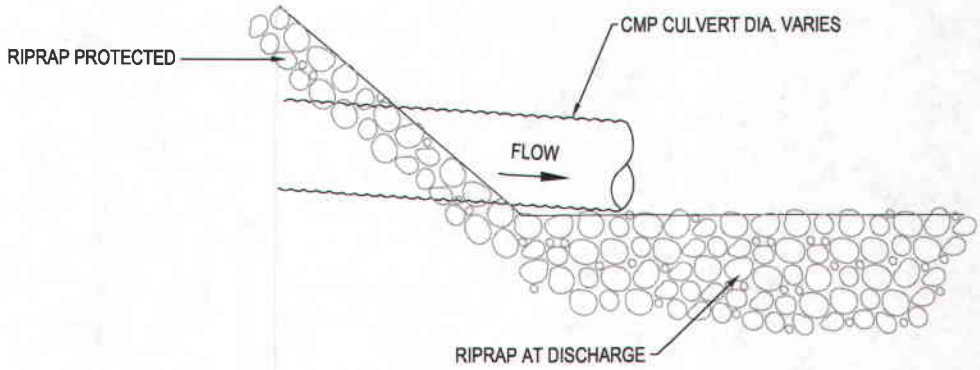


FIGURE 1

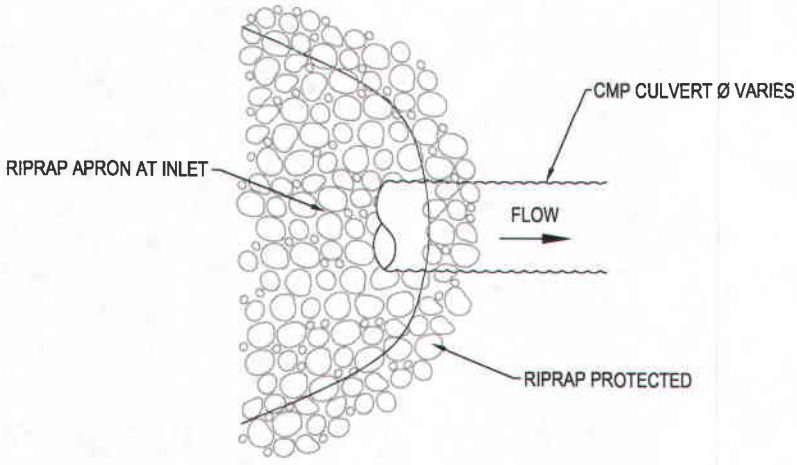
—Headwater depth for corrugated-metal pipe culverts with entrance control. From FHWA. 288-0-2909.



UNDISTURBED CULVERT DROP INLET
TYPICAL SECTION



UNDISTURBED CULVERT OUTLET
TYPICAL SECTION



UNDISTURBED CULVERT INLET
TYPICAL SECTION

Refer to Jones & DeMille
Construction Drawings in
Engineering Maps Section for Details

CAD FILE NAME/DISK#: DRAINAGE STRUCTURES FIGURES

ENERGY WEST MINING COMPANY
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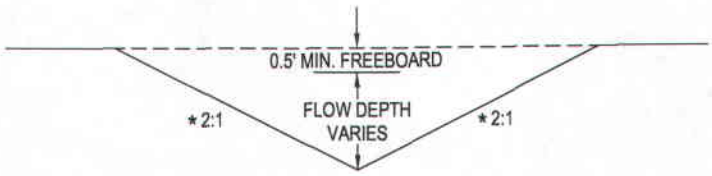
DEER CREEK MINE
RILDA CANYON FACILITIES
UNDISTURBED CULVERT INLET

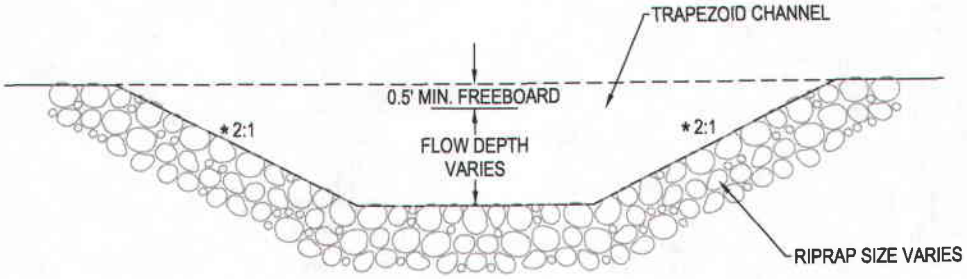
DRAWN BY:	K. LARSEN	FIGURE 2	
SCALE:	NONE	DRAWING #:	
DATE:	MAY 10, 2010	SHEET 1 OF 1	REV.



UNDISTURBED & DISTURBED DITCH
TYPICAL SECTION
(UNLINED DITCH)

Note: Flows based on a 10 year - 24 hour event.

* Used for calculation only. Side slopes may vary; however, minimum flow area will be maintained.



UNDISTURBED & DISTURBED DITCH
TYPICAL SECTION
(LINED DITCH)

Refer to Jones & DeMille
Construction Drawings in
Engineering Maps Section for Details

CAD FILE NAME/DISK#: DRAINAGE STRUCTURES FIGURES

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DEER CREEK MINE
RILDA CANYON FACILITIES
UNDISTURBED & DISTURBED DITCH

DRAWN BY:	K. LARSEN	FIGURE 3	
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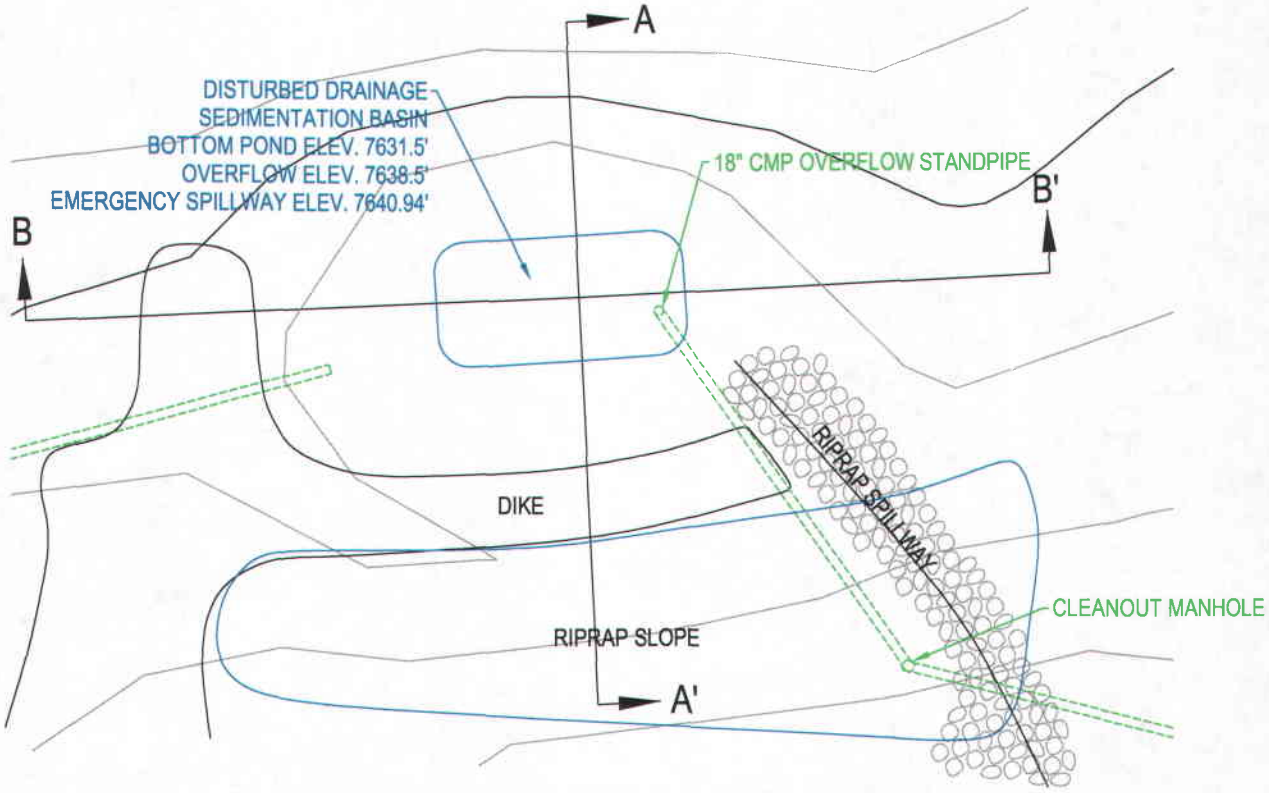
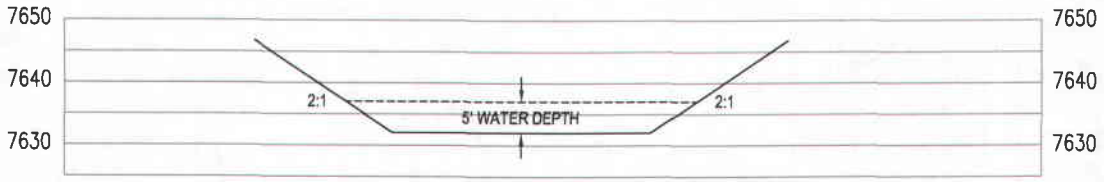
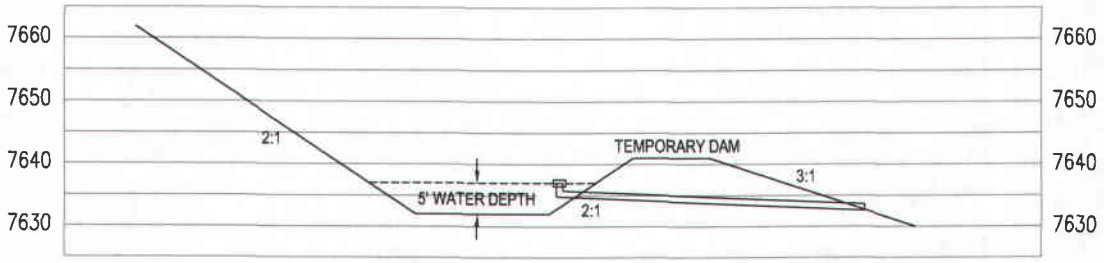
DATE:	MAY 10, 2010	SHEET 1 OF 1	REV.



PLAN VIEW - TEMPORARY SEDIMENT BASIN
TYPICAL SECTION



SECTION B - B'



SECTION A - A'

CAD FILE NAME/DISK#: DRAINAGE STRUCTURES FIGURES

ENERGY WEST MINING COMPANY
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DEER CREEK MINE
RILDA CANYON FACILITIES
TEMPORARY SEDIMENTATION BASIN

DRAWN BY:	K. LARSEN	FIGURE 4	
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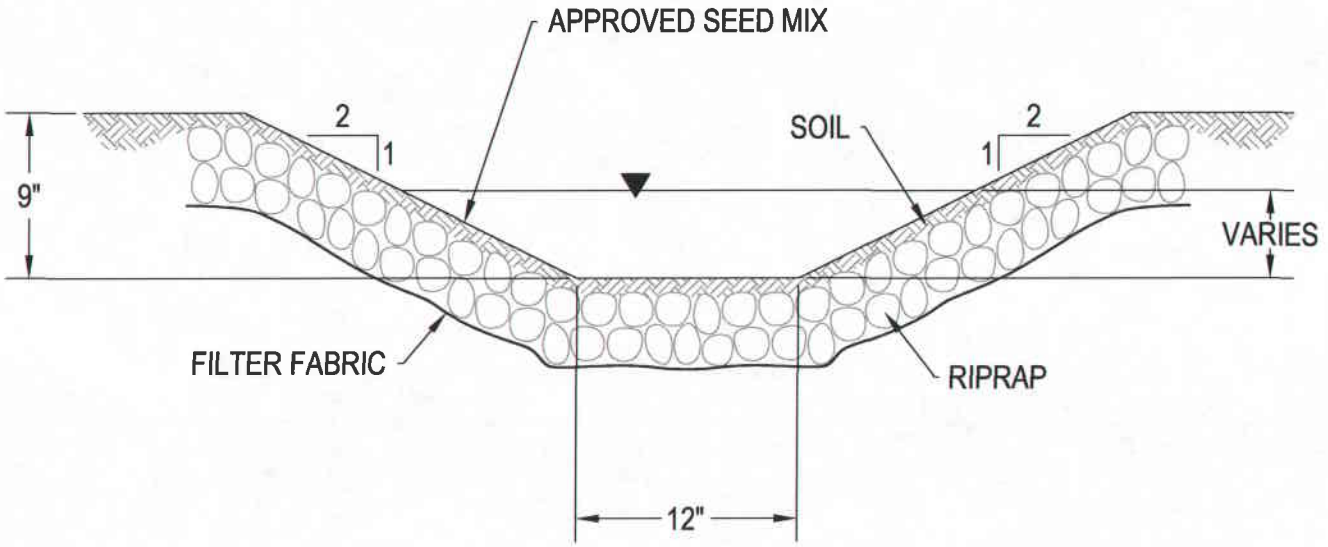
DATE:	MAY 12, 2010	SHEET 1 OF 1	REV.



RECLAMATION CHANNELS - TYPICAL CROSS SECTION

REFER TO APPENDIX 6 AND TABLES
13 & 14 FOR DESIGN REQUIREMENTS

CAD FILE NAME/DISK#: FIGURE 5 RECLAMATION CHANNEL CROSS SECTION

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

DEER CREEK MINE
RECLAMATION CHANNELS
TYPICAL CROSS SECTION

DRAWN BY:	K. LARSEN	FIGURE 5	
SCALE:	NONE	DRAWING #:	
DATE:	JUNE 25, 2010	SHEET 1 OF 1	REV. ___

PacifiCorp

Energy West Mining Company

Deer Creek Mine

C/015/0018

Amendment Update the Deer Creek Mining and Reclamation Plan, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

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Deer Creek Coal Mine
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Table 1

Drainage Areas Description

Drainage	Area (ac)	Type	Drains To:	Runoff CN
UA-1	0.70	Undisturbed	UD-1	70
UA-2	3.86	Undisturbed	UD-2	70
UA-3	6.87	Undisturbed	UD-3	70
UA-4	22.67	Undisturbed	UD-4	70
UA-5	5.80	Undisturbed	UD-5 & UD-6	70
UA-6	2.81	Undisturbed	Sediment basin then DD-3	70
UA6a	0.31	Undisturbed	UD-6	70
UA-7	89.64	Undisturbed	UD-7	70
UA-8	0.14	Undisturbed	Sediment Pond	70
UA-9	19.91	Undisturbed	Sediment Pond	70
UA-9a	1.01	Undisturbed	Sediment Pond	70
DA-1	1.79	Paved or Unpaved Disturbed	Basin	95
DA-2	0.37	Paved or Unpaved Disturbed	Basin	95
DA-3	0.43	Paved or Unpaved Disturbed	Basin	95
DA-4	0.21	Sediment Basin	Itself	90
DA-5	0.70	Sediment Pond	Itself	90
ASCA#1	0.57	Outslope off Hilfiker	Rilda Creek	70
ASCA#2	0.06	Disturbed	DD-2	90
ASCA#3	0.29	Disturbed	DD-3	90
ASCA#4	0.36	Disturbed	DD-4	90
ASCA#5	0.51	Disturbed	DD-5	86

UA = Undisturbed Area
DA = Disturbed Area
ASCA = Alternate Sediment Control Area

Table 2

Drainage Structures

Structure	Drainage from:	Remarks
UC-1	UD-1 & UD-2	UA-1 flow to UD-1, UA-2 flows to UD-2
UC-2	UD-3	UA-3 flows to UD-3
UC-3	UD-4, UD-5, & UD-6	Existing Emery County road culvert (18"), UD-4 flows to UD-5, UD-6 flows to UD-5
UC-4	DD-3	Existing Emery County road culvert (18"), DD-3 flows through rock check dam and drains into UD-7 to UC-4. Flows to creek.
UC-5*	UD-7**	Existing Emery County road culvert (18"), UA-7 drains into UD-7/UC-4 and road ditch/UC-5. Flow continues to creek.
UC-6*	UA-9	Undisturbed flow from UA-9 above pond
UD-1	UA-1	Flows into UC-1
UD-2	UA-2	Flows into UC-1
UD-3	UA-3	Flows into UC-2
UD-4	UA-4	Flows into UD-5
UD-5	UD-4, UA-4, UA-5	Flows into UC-3
UD-6	UA-6a	Flows into UC-3
UD-7	UA-7, ASCA #3, DA-4 Overflow	Flows into UC-4
DC-1	DA-1	Drains to DA-4 (Sediment Basin)
DC-2	DA-1, DA-2 and DA-3	Drains to DA-4 (Sediment Basin)
DC-3	DA-4	Basin Overflow, Drains to DA-5 (Sediment Pond)
DC-4	DA-5	Pond Overflow, Drains to Creek
DD-1	DA-2 and DA-3	Drains to Sediment Basin
DD-2	ASCA #2	Drains to UC-3
DD-3	ASCA #3	Drains through sediment constrol structure to UD-7 then into UC-4
DD-4	ASCA #4	Drains through sediment constrol structure to DC-4
DD-5	Topsoil Pile/ASCA #5	Drains through sediment control structure than to creek.

* Culvert not part of hydrological design.

** Undisturbed diversion not part of hydrological design.

UC = Undisturbed Culvert
UD = Undisturbed Ditch
DC = Disturbed Culvert
DD = Disturbed Ditch

Table 3

Drainage Summary*
Undisturbed/Disturbed

Drainage Area	Storm Event				
	10yr/6hr 1.55"	10yr/24hr 2.45"		25yr/6hr 1.88"	100yr/6hr 2.07"
	Peak Flow (cfs)	Peak Flow (cfs)	Runoff (ac.ft.)	Peak Flow (cfs)	Peak Flow (cfs)
UA-1	0.02	0.12	0.03	0.04	0.05
UA-2	0.1	0.63	0.15	0.19	0.26
UA-3	0.18	0.99	0.26	0.35	0.45
UA-4	0.51	2.55	0.86	1.04	1.34
UA-5	0.15	0.92	0.22	0.29	0.39
UA-6	0.07	0.49	0.11	0.14	0.19
UA-6a	0.01	0.06	0.01	0.02	0.02
UA-7	1.83	7.97	3.4	3.74	4.85
UA-8	0	0.03	0.01	0.01	0.01
UA-9	0.42	2.1	0.72	0.94	1.21
UA-9a	0.02	0.18	0.04	0.05	0.07
DA-1	1.27	2.48	0.29	1.65	1.87
DA-2	0.22	0.44	0.06	0.29	0.33
DA-3	0.17	0.34	0.06	0.22	0.25
DA-4	0.04	0.1	0.02	0.06	0.07
DA-5	0.13	0.36	0.09	0.2	0.24
ASCA#1	0.01	0.09	0.02	-	-
ASCA#2	0.02	0.09	0.01	-	-
ASCA#3	0.1	0.19	0.04	-	-
ASCA#4	0.08	0.23	0.05	-	-
ASCA#5	0.08	0.22	0.04	-	-

* Refer to hydrographs in Appendix 1. Hydrographs produced using STORM ver. 6.21

Table 4

Drainage Structure Flow Summary

Structure	10yr/6hr (cfs)	10yr/24hr (cfs)	25yr/6hr (cfs)	100yr/6hr (cfs)	Remarks
UC-1	0.12	0.75	0.23	0.31	Drainage from UD-1 and UD-2
UC-2	0.18	0.99	0.35	0.45	Drainage UD-3
UC-3**	0.66	3.47	1.33	1.73	Drainage from UD-4, UD-5, UD-6, and insignificant flow from DD-2*
UC-4**	1.93	7.97	3.74	4.85	Existing Emery County Road Culvert, Drainage from DD-3** and UA-7 (UD-7)
UC-5**	NA	NA	NA	NA	Existing Emery County Road Culvert, Drainage from UA-7 and mine access road runoff that by-passes UC-4.
UC-6	0.42	2.10	0.94	1.21	Contributions from UA-9
UD-1	0.02	0.12	0.04	0.05	Drainage from UA-1
UD-2	0.10	0.63	0.19	0.26	Drainage from UA-2
UD-3	0.18	0.99	0.35	0.45	Drainage from UA-3
UD-4	0.51	2.55	1.04	1.34	Drainage from UA-4
UD-5	0.66	3.47	1.33	1.73	Drainage from UA-5 and UD-4
UD-6	0.01	0.06	0.02	0.02	Drainage from UA-6a
UD-7	1.93	8.16	3.74	4.85	Drainage from UA-7, DA-4, & DD-3***. Flows contributed from DA-4 are only if storm exceeds basin design.
DC-1	1.27	2.48	1.65	1.87	Flow from DA-1
DC-2	1.66	3.26	2.16	2.45	Flow from DA-1, DA-2 and DA-3
DC-3	1.77	3.85	2.36	2.71	Sediment Basin overflow, contributions from DA-1, DA-2, DA-3, DA-4, UA-6
DC-4**	1.98	4.47	2.57	2.96	Sediment Pond overflow, contributions from DC-3, DD-4, DA-5, and UA-8
DD-1	0.39	0.78	0.51	0.58	Contributions from DA-2 and DA-3
DD-2*	0.02	0.09	-	-	Drainage from ASCA #2
DD-3	0.10	0.19	-	-	Drainage from ASCA #3
DD-4	0.08	0.23	-	-	Drainage from ASCA #4
DD-5	0.08	0.22	-	-	Drainage from ASCA #5

* Insignificant contribution, not figured into design.

** Existing Emery County road culvert. Cannot be changed.

*** ASCA flows not calculated for 25 or 100 year event

Table 5

Drainage Area Data

Undisturbed Drainage Area Data

Drainage Area	Acreage (ac)	Hydraulic Length (ft)	High Elevation	Low Elevation	Change Elevation	% Slope	Runoff CN
UA-1	0.70	418.7	7950	7710	240	57.32	70
UA-2	3.86	1077.3	8475	7710	765	71.01	70
UA-3	6.87	1451.3	8800	7710	1090	75.11	70
UA-4	22.67	2345.4	9240	7700	1540	65.66	70
UA-5	5.80	1202.9	8500	7660	840	69.83	70
UA-6	2.81	813.2	8225	7650	575	70.71	70
UA-6a	0.31	300.7	7875	7655	220	73.16	70
UA-7	89.64	3460.8	9255	7610	1645	47.53	70
UA-8	0.14	308	7670	7510	160	51.95	70
UA-9	19.91	2397.6	8850	7510	1340	55.89	70
UA-9a	1.01	347.3	7835	7560	275	79.18	70

Disturbed Drainage Area Data

Drainage Area	Acreage (ac)	Hydraulic Length (ft)	High Elevation	Low Elevation	Change Elevation	% Slope	Runoff CN
DA-1	1.79	549	7710	7700	10	1.82	95
DA-2	0.37	509.4	7695	7645	50	9.82	95
DA-3	0.43	300.6	7695	7652	43	14.30	95
DA-4	0.21	61.7	7665	7637	28	45.38	90
DA-5	0.70	92	7580	7503	77	83.70	90

ASCA Drainage Area Data

Drainage Area	Acreage (ac)	Hydraulic Length (ft)	High Elevation	Low Elevation	Change Elevation	% Slope	Runoff CN
ASCA #1	0.57	37	7679	7662	17	45.95	70
ASCA #2	0.06	63.5	7652	7648	4	6.30	90
ASCA #3	0.29	100	7660	7643	17	17.00	90
ASCA #4	0.36	120	7555	7523	32	26.67	90
ASCA #5	0.51	122	7582	7558	24	19.67	86

Table 6

As- Built Undisturbed Ditch Construction Summary

Undisturbed Ditch As-Built Size

Ditch ID	Shape	Top Width (ft)	Bottom Width (ft)	Depth (in)	Side Slopes (H:V)	Mannings n
UD-1	Rectangular	n\a	5	17	n/a	Concrete
UD-2	Rectangular	n\a	5	17	n/a	Concrete
UD-3	Rectangular	n\a	5	17	n/a	Concrete
UD-4	Rectangular	n\a	5	17	n/a	Concrete
UD-5	Trapezoid	11	3	30	3:1	Rock
UD-6	Trapezoid	11	3	30	3:1	Rock

Undisturbed Ditch As-Built Design Summary

			10yr/6hr Event					10yr/24hr Event					
Ditch ID	Ditch Slope (%)	Ditch Length (ft)	10yr/6hr Event (in)	Peak Flow (10/6 cfs)	Velocity (ft/s)	Flow Area (ft^2)	Flow Depth (ft)	10yr/24hr Event (in)	Peak Flow (10yr/24hr cfs)	Velocity (ft/s)	Flow Area (ft^2)	Flow Depth (ft)	Full Flow Capacity (cfs)
UD-1	5.7	122	1.55	0.02	0.8	0.03	0.01	2.45	0.12	1.63	0.07	0.01	180.8
UD-2	5.0	99	1.55	0.10	1.46	0.07	0.01	2.45	0.63	3.03	0.21	0.04	169.3
UD-3	5.4	93	1.55	0.18	1.89	0.1	0.02	2.45	0.99	3.71	0.27	0.05	175.9
UD-4	4.5	277	1.55	0.51	2.7	0.19	0.04	2.45	2.55	5.09	0.5	0.1	160.6
UD-5	12.8	390	1.55	0.66	1.15	0.58	0.16	2.45	3.47	1.95	1.78	0.42	435.7
UD-6	3.8	104.5	1.55	0.01	0.36	0.03	0.01	2.45	0.06	0.72	0.08	0.03	266.8

Table 7

As-Built Disturbed Ditch Construction Summary

Disturbed Ditch As-Built Size

Ditch ID	Shape	Top Width (ft)	Bottom Width (ft)	Depth (ft)	Side Slopes (H:V)	Mannings n
DD-1	Triangular	6.0	-	1.0	3:1	Rock
DD-2*	Triangular	6.0	-	1.0	3:1	Rock
DD-3	Triangular	3.0	-	1.0	1.5:1	Rock
DD-4	Trapezoid	5.5	1.0	0.8	4:1	Rock
DD-5	Trapezoid	7.0	1.5	1.0	4:1	Grass/Rock

Disturbed Ditch As-Built Size

Ditch ID	Ditch Slope (%)	Ditch Length (ft)	10yr/6hr Event					10yr/24hr Event				Flow Capacity (cfs)
			10yr/6hr Event (in)	Peak Flow (10/6 cfs)	Velocity (ft/s)	Flow Area (ft^2)	Flow Depth (ft)	Peak Flow (10yr/24hr cfs)	Velocity (ft/s)	Flow Area (ft^2)	Flow Depth (ft)	
DD-1	10.7	281	1.55	0.39	2.69	0.15	0.22	0.78	3.20	0.24	0.29	22.2
DD-2*	6.3	63.5	1.55	n/a	-	-	-	n/a	-	-	-	
DD-3	7.4	785	1.55	0.10	1.86	0.05	0.19	0.19	2.18	0.09	0.24	8.5
DD-4	7.1	630	1.55	0.08	1.25	0.06	0.05	0.23	1.74	0.13	0.10	19.3
DD-5	1.4	145	1.55	0.08	0.66	0.12	0.07	0.22	0.92	0.24	0.12	16.5

* Insignificant flow. See ASCA data in Table 5.

Table 8

Undisturbed Culvert Data

Undisturbed Culvert As-Built Size

Culvert ID	Length (ft)	Slope (%)	Mannings n	Type Material	Inside Diameter (in)
UC-1	77	6.5	0.24	CMP	18
UC-2	308	2.9	0.24	CMP	18
UC-3	48	4.1	0.24	CMP	24
UC-4	35	5.7	0.24	CMP	36
UC-5	35	5.7	0.24	CMP	24

Undisturbed Culvert Design Summary

	10yr/6hr Storm Event			10yr/24hr Storm Event			25yr/6hr Storm Event			100yr/6hr Storm Event				
Culvert ID	Peak Flow (cfs)	Velocity (fps)	Percent Full	Peak Flow (cfs)	Velocity (fps)	Percent Full	Peak Flow (cfs)	Velocity (fps)	Percent Full	Peak Flow (cfs)	Velocity (fps)	Percent Full	Constructed Diameter (ft)	Flow Capacity (cfs)
UC-1	0.12	2.49	6.45	0.75	4.32	15.46	0.23	3.03	8.78	0.31	3.32	10.11	1.5	14.5
UC-2	0.18	2.12	9.46	0.99	3.53	21.59	0.35	2.59	13.00	0.45	2.80	14.67	1.5	9.7
UC-3	0.66	3.41	11.22	3.47	5.57	25.26	1.33	4.20	15.73	1.73	4.54	17.88	2*	24.8
UC-4	1.93	5.00	10.34	7.97	7.62	20.54	3.74	6.09	14.19	4.85	6.58	16.10	3.0	86.3
UC-5**	1.93	5.27	17.40	7.97	7.93	35.67	3.74	6.40	24.15	4.85	6.89	27.54	2.0	29.3

* Existing Emery County road culvert. Cannot be changed.

** This is a redundant culvert that was installed prior to facility construction by the Emery County. If UC-4 is plugged, flow will be routed to this culvert.

Table 9

Disturbed Culvert Data

Disturbed Culvert As-Built Size

Culvert ID	Length (ft)	Slope (%)	Mannings n	Type
DC-1	387.15	6.5	0.024	CMP
DC-2	205.73	2.8	0.009	HDPE
DC-3	1662.2	6.9	0.009	HDPE
DC-4*	50	6.9	0.009	HDPE

Disturbed Culvert Design Summary

	10yr/6hr Storm Event			10yr/24hr Storm Event			25yr/6hr Storm Event			100yr/6hr Storm Event				
Culvert ID	Peak Flow (cfs)	Velocity (fps)	Percent Full	Peak Flow (cfs)	Velocity (fps)	Percent Full	Peak Flow (cfs)	Velocity (fps)	Percent Full	Peak Flow (cfs)	Velocity (fps)	Percent Full	Constructed Diameter (ft)	Flow Capacity (cfs)
DC-1	1.27	5.05	20	2.48	6.13	27.98	1.65	5.45	22.77	1.87	5.65	24.24	1.5	14.5
DC-2	1.66	8.11	17.33	3.26	9.88	24.2	2.16	8.76	19.72	2.45	9.09	20.98	1.5	25.4
DC-3	1.77	11.35	14.36	3.85	14.28	21	2.36	12.36	16.51	2.71	12.88	17.66	1.5	39.9
DC-4*	1.98	6.47	15.37	4.47	8.22	22.93	2.57	6.99	17.45	2.96	7.29	18.7	2	38.8

* DC-4 is an existing Emery County culvert and cannot be changed.

Table 10

Sediment Pond Design

1	Use 2.45" for 10yr/24hr Storm Event.	
2	Disturbed/Undisturbed Area Draining to Pond =	7.46 acres
3	Runoff Curve Number = CN = 90 (disturbed); 95 (paved)	
4	Disturbed Area Runoff = (from Table 3, 10yr/24hr)	0.68 ac-ft
5	Sediment Storage Volume for 3 years (RUSLE)	0.21 ac-ft
6	Total Required Pond Volume*	0.89 ac-ft
7	As-Built Pond Volume at Spillway	1.71 ac-ft
8	Peak Flow (25yr/6hr Storm Event)	2.62 cfs

* Accounts for the storage of one 10yr/24hr storm plus sediment storage

Sediment Volume Calculations (refer to RUSLE2 Profile Erosion Calculation Records)

Note: Contributions from Areas 1,2, and 4, are retained in sediment basin.

	Location	Area (ac)	Sediment Delivery (tons/ac/yr)	Yearly Contribution from Location (tons/yr)	Volume (ac ft/yr)
1	DA-3	0.43	0.24	0.10	4.74E-05
2	DA-4	0.21	2.2	0.46	2.12E-04
3	DA-5	0.70	3.7	2.59	1.19E-03
4	UA-6	2.81	3.5	9.84	4.52E-03
5	UA-8	0.14	13	1.82	8.36E-04
6	UA-9a	1.01	6.8	6.868	3.15E-03
Total		**5.30**	**29.44**	**156.03**	**7.16E-02**

Assume no sediment contributions from paved areas (i.e. DA-1 & DA-2)

Assume a sediment density of 100 lbs/ft3

Sediment Volume after 1 year - 7.16E-02 ac-ft

Sediment Volume after 3 year - 2.15E-01 ac-ft

Volume of sediment before clean out required (40% of total pond volume) - 0.684 ac-ft

Years estimated before clean out - 9.5 yrs.

Table 11

Sediment Pond - Stage Volume Data

Elevation	Area	Volume Cubic Feet	Volume Acre Feet	Accumulated Volume	Remarks
7500.5	294.64	0.00	0.00	0.00	Bottom of Pond
7502	1701.13	1496.83	0.03	0.03	
7504	2568.19	4269.32	0.10	0.13	
7506	3365.71	5933.90	0.14	0.27	
7508	4214.90	2449.36	0.06	0.44	
7510	5179.39	9394.29	0.22	0.66	Sediment Clean Out Elev.
7512	6265.74	11445.13	0.26	0.92	
7514	7418.50	13684.24	0.31	1.23	
7516.5	9008.91	20534.26	0.47	1.71	Emergency Spillway
7518	9949.24	14218.61	0.33	2.03	
7519	10679.99	10314.61	0.24	2.27	Top of Dike

Table 12

Sediment Pond
Emergency Open-Channel Spillway
Stage Discharge Data

Stage (ft)	Discharge (cfs)
0.00	0.00
0.20	2.41
0.29	4.21
0.40	6.81
0.60	12.52
0.80	19.27
1.00	26.94

Discharge calculation based on the Sharp Crested Rectangular Weir Formula

$Q = CLH^{1.5}$

where C = weir coefficient = 3.367
L = bottom width = 8.0'
H = height of stage flow

* The flow of a 25yr/6hr storm event will pass through the spillway at a depth of 0.2115 ft.

Table 13

Reclamation Channel Sizing*

Channel ID	Contributing Areas	Velocity (ft/sec)	Total** Flow (CFS)	Channel Shape	Average Slope (%)	Flow Area (ft^2)	Bottom Width (ft)	Required Depth (ft)	Designed*** Depth (ft)	Side Slopes (h:v)	Mannings n
RC-1	UA-4	7.34	2.55	Trap	32%	0.35	1.0	0.24	0.75	2:1	0.035
RC-2	UA-5	4.01	0.92	Trap	14%	0.23	1.0	0.17	0.75	2:1	0.035
RC-3	UA-8, UA-9	5.67	2.13	Trap	18%	0.38	1.0	0.25	0.75	2:1	0.035

* Minimal sizing design. As-built demensions may vary to blend channel construction into the reconstructed land surface.
** The design utilizes the larger 10yr/24 event of 2.45" precipitation for channel sizing.
*** Design depth allows for a 0.5 foot freeboard.

Table 14

Reclamation Channels - Riprap Sizing*

Channel ID	Slope (ft/ft)	Flow (cfs)	Bottom Width (ft)	Gravitational Constant (ft/sec2)	D_{30} (ft)	D_{30} (in)	Required SF** of 1.3 (in)	Construction Requirements (in)	Channel Thickness (in)
RC-1	0.32	2.55	1	32.2	0.71	8.5	11.0	12	18
RC-2	0.135	0.92	1	32.2	0.22	2.7	3.5	4	6
RC-3	0.179	2.13	1	32.2	0.45	5.4	7.1	8	12

* Riprap sizing is based on the Steep Slope Riprap Design from USACE Hydraulics Design on Flood Control Channels, Engineer Manual 1110-2-1601, July 1991.

** Safety Factor

Riprap Specifications (Table 3-1 in EM 1110-2-1601)
Specific Weight = 165 lbs/cf

Limits of stone weight (lbs) for percent lighter by weight								
D_{100} (max)	100		50		15		D_{30} min	D_{90} min
(in)	Max	Min	Max	Min	Max	Min	(ft)	(ft)
9	36	15	11	7	5	2	0.37	0.53
12	86	35	26	17	13	5	0.48	0.7
15	169	67	50	34	25	11	0.61	0.88
18	292	117	86	58	43	18	0.73	1.06
21	463	185	137	93	69	29	0.85	1.23
24	691	276	205	138	102	43	0.97	1.4
27	984	394	292	197	146	62	1.1	1.59
30	1350	540	400	270	200	84	1.22	1.77
33	1797	719	532	359	266	112	1.34	1.96
36	2331	933	691	467	346	146	1.46	2.11
42	3704	1482	1098	741	549	232	1.7	2.47
48	5529	2212	1638	1106	819	346	1.95	2.82
54	7873	3149	2335	1575	1168	492	2.19	3.17

Note: Use a filter fabric material beneath riprap.

PacifiCorp

Energy West Mining Company

Deer Creek Mine

C/015/0018

Amendment Update the Deer Creek Mining and Reclamation Plan, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

Seven (7) Redline/Strikeout Copies – Volume 11, Appendix Volume B, Hydrology Tab, Appendix B

Remove Appendix 1 – Computer Backup

PacifiCorp

Energy West Mining Company

Deer Creek Mine

C/015/0018

Amendment Update the Deer Creek Mining and Reclamation Plan, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

Seven (7) Redline/Strikeout Copies – Volume 11, Appendix Volume B, Hydrology Tab, Appendix B

Add Appendicies 1-6

Deer Creek Coal Mine
Rilda Canyon
Portal Facilities

Hydrology Appendicies Section

Permit No. C/015/018
December 2004
Amended June 2010 2010

Volume 11
Appendix Volume
Appendix B

R645-301-700

HYDROLOGY

Contents

Appendix 1

Drainage Areas Hydrograph Data

WATERSHED HYDROGRAPH FOR 10YR/6HR STORM EVENT (DISTURBED AREA)

Project Title = DA-1 (10yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-1
Curve number = 95.0
Area = 1.8 acres
Hydraulic length = 549.00 feet
Elevation change = 10.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Disturbed

-- Total Area = 1.8 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 1.27 cfs
Discharge volume = 0.16 acre ft

Project Title = DA-2 (10yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-2
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 509.40 feet
Elevation change = 35.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.22 cfs
Discharge volume = 0.03 acre ft

Project Title = DA-3 (10yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-3
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 300.60 feet
Elevation change = 43.0 feet
Concentration time = 0.01 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.17 cfs
Discharge volume = 0.03 acre ft

Project Title = DA-4 (10yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-4
Curve number = 90.0
Area = 0.2 acres
Hydraulic length = 61.70 feet
Elevation change = 28.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.2 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.04 cfs
Discharge volume = 0.01 acre ft

Project Title = DA-5 (10yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-5
Curve number = 90.0
Area = 0.7 acres
Hydraulic length = 92.00 feet
Elevation change = 77.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.7 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.13 cfs
Discharge volume = 0.04 acre ft

WATERSHED HYDROGRAPH FOR 10YR/24HR STORM EVENT (DISTURBED AREA)

Project Title = DA-1 (10yr/24hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-1
Curve number = 95.0
Area = 1.8 acres
Hydraulic length = 549.00 feet
Elevation change = 10.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Disturbed

-- Total Area = 1.8 acres

-- Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 2.48 cfs
Discharge volume = 0.29 acre ft

Project Title = DA-2 (10yr/24hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-2
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 509.40 feet
Elevation change = 35.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.44 cfs
Discharge volume = 0.06 acre ft

Project Title = DA-3 (10yr/24hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-3
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 300.60 feet
Elevation change = 43.0 feet
Concentration time = 0.01 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.34 cfs
Discharge volume = 0.06 acre ft

Project Title = DA-4 (10yr/24hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-4
Curve number = 90.0
Area = 0.2 acres
Hydraulic length = 61.70 feet
Elevation change = 28.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.2 acres

-- Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.10 cfs
Discharge volume = 0.02 acre ft

Project Title = DA-5 (10yr/24hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-5
Curve number = 90.0
Area = 0.7 acres
Hydraulic length = 92.00 feet
Elevation change = 77.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.7 acres

-- Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.36 cfs
Discharge volume = 0.09 acre ft

WATERSHED HYDROGRAPH FOR 25YR/6HR STORM EVENT (DISTURBED AREA)

Project Title = DA-1 (25yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-1
Curve number = 95.0
Area = 1.8 acres
Hydraulic length = 549.00 feet
Elevation change = 10.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Disturbed

-- Total Area = 1.8 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 1.65 cfs
Discharge volume = 0.21 acre ft

Project Title = DA-2 (25yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-2
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 509.40 feet
Elevation change = 35.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.29 cfs
Discharge volume = 0.05 acre ft

Project Title = DA-3 (25yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-3
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 300.60 feet
Elevation change = 43.0 feet
Concentration time = 0.01 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.22 cfs
Discharge volume = 0.05 acre ft

Project Title = DA-4 (25yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-4
Curve number = 90.0
Area = 0.2 acres
Hydraulic length = 61.70 feet
Elevation change = 28.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.2 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.06 cfs
Discharge volume = 0.02 acre ft

Project Title = DA-5 (25yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-5
Curve number = 90.0
Area = 0.7 acres
Hydraulic length = 92.00 feet
Elevation change = 77.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.7 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.20 cfs
Discharge volume = 0.06 acre ft

WATERSHED HYDROGRAPH FOR 100YR/6HR STORM EVENT (DISTURBED AREA)

Project Title = DA-1 (100yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-1
Curve number = 95.0
Area = 1.8 acres
Hydraulic length = 549.00 feet
Elevation change = 10.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Disturbed

-- Total Area = 1.8 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 1.87 cfs
Discharge volume = 0.23 acre ft

Project Title = DA-2 (100yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-2
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 509.40 feet
Elevation change = 35.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.33 cfs
Discharge volume = 0.05 acre ft

Project Title = DA-3 (100yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-3
Curve number = 95.0
Area = 0.4 acres
Hydraulic length = 300.60 feet
Elevation change = 43.0 feet
Concentration time = 0.01 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.4 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.25 cfs
Discharge volume = 0.05 acre ft

Project Title = DA-4 (100yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-4
Curve number = 90.0
Area = 0.2 acres
Hydraulic length = 61.70 feet
Elevation change = 28.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.2 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.07 cfs
Discharge volume = 0.02 acre ft

Project Title = DA-5 (100yr/6hr)

Inflow into structure # 1
Structure type: Null

-- Watershed data for watershed DA-5
Curve number = 90.0
Area = 0.7 acres
Hydraulic length = 92.00 feet
Elevation change = 77.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.7 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.24 cfs
Discharge volume = 0.07 acre ft

WATERSHED HYDROGRAPH FOR 10YR/6HR STORM EVENT (ASCA AREAS)

Project Title = ASCA #1(10yr/6hr)

Disturbed flow treated by Silt fence or Straw log
Structure type: Null

--Watershed data for watershed ASCA #1
Curve number = 70.0
Area = 0.57 acres
Hydraulic length = 37.0 feet
Elevation change = 17.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.57 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.01 cfs
Discharge volume = 0.00 acre ft

Project Title = ASCA #2 (10yr/6hr)

Inflow into structure – UC-3, Treated by Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #2
Curve number = 90.0
Area = 0.06 acres
Hydraulic length = 63.0 feet
Elevation change = 9.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = .06 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.02 cfs
Discharge volume = 0.01 acre ft

Project Title = ASCA #3 (10yr/6hr)

Inflow into structure – DD-3, Treated by Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #3
Curve number = 90.0
Area = 0.29 acres
Hydraulic length = 100.0 feet
Elevation change = 17.0 feet
Concentration time = 0.02 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.29 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.10 cfs
Discharge volume = 0.02 acre ft

Project Title = ASCA #4 (10yr/6hr)

Inflow into structure – DD-4, Treated by Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #4
Curve number = 90.0
Area = 0.36 acres
Hydraulic length = 120.0 feet
Elevation change = 32.0 feet
Concentration time = 0.01 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.36 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.08 cfs
Discharge volume = 0.02 acre ft

Project Title = ASCA #5 (10yr/6hr)

Inflow into structure – DD-5, Treated by Straw log and Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #5
Curve number = 86.0
Area = 0.51 acres
Hydraulic length = 122.0 feet
Elevation change = 24.0 feet
Concentration time = 0.02 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.51 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.09 cfs
Discharge volume = 0.02 acre ft

WATERSHED HYDROGRAPH FOR 10YR/24HR STORM EVENT (ASCA AREAS)

Project Title = ASCA #1(10yr/24hr)

Disturbed flow treated by Silt fence or Straw log
Structure type: Null

--Watershed data for watershed ASCA #1
Curve number = 70.0
Area = 0.57 acres
Hydraulic length = 37.0 feet
Elevation change = 17.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.57 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.09cfs
Discharge volume = 0.02 acre ft

Project Title = ASCA #2 (10yr/24hr)

Inflow into structure – UC-3, Treated by Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #2
Curve number = 90.0
Area = 0.06 acres
Hydraulic length = 63.0 feet
Elevation change = 9.0 feet
Concentration time = 0.00 hours
Unit hydrograph type = Disturbed

-- Total Area = .06 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.06 cfs
Discharge volume = 0.01 acre ft

Project Title = ASCA #3 (10yr/24hr)

Inflow into structure – DD-3, Treated by Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #3
Curve number = 90.0
Area = 0.29 acres
Hydraulic length = 100.0 feet
Elevation change = 17.0 feet
Concentration time = 0.01 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.29 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.19 cfs
Discharge volume = 0.04 acre ft

Project Title = ASCA #4 (10yr/24hr)

Inflow into structure – DD-4, Treated by Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #4
Curve number = 90.0
Area = 0.36 acres
Hydraulic length = 120.0 feet
Elevation change = 32.0 feet
Concentration time = 0.01 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.36 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.23 cfs
Discharge volume = 0.05 acre ft

Project Title = ASCA #5 (10yr/24hr)

Inflow into structure – DD-5, Treated be Rock Check Dam
Structure type: Null

--Watershed data for watershed ASCA #5
Curve number = 86.0
Area = 0.51 acres
Hydraulic length = 122.0 feet
Elevation change = 24.0 feet
Concentration time = 0.02 hours
Unit hydrograph type = Disturbed

-- Total Area = 0.51 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.33 cfs
Discharge volume = 0.05 acre ft

WATERSHED HYDROGRAPH FOR 10YR/6HR STORM EVENT (UNDISTURBED AREA)

Project Title = UA-1 (10yr/6hr)
Inflow into structure - UD-1, UC-1
Structure type: Null

--Watershed data for watershed UA-1
Curve number = 70.0
Area = 0.7 acres
Hydraulic length = 418.70 feet
Elevation change = 240.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Forested

-- Total Area = 0.7 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.02 cfs
Discharge volume = 0.01 acre ft

Project Title = UA-2 (10yr/6hr)
Inflow into structure - UD-2
Structure type: Null

--Watershed data for watershed UA-2, UC-1
Curve number = 70.0
Area = 3.9 acres
Hydraulic length = 1077.30 feet
Elevation change = 765.0 feet
Concentration time = 0.14 hours
Unit hydrograph type = Forested

-- Total Area = 3.9 acres

Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.10 cfs
Discharge volume = 0.03 acre ft

Project Title = UA-3 (10yr/6hr)

Inflow into structure - UD-3, UC-2
Structure type: Null

-- Watershed data for watershed UA-3
Curve number = 70.0
Area = 6.9 acres
Hydraulic length = 1451.30 feet
Elevation change = 1090.0 feet
Concentration time = 0.18 hours
Unit hydrograph type = Forested

-- Total Area = 6.9 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.18 cfs
Discharge volume = 0.05 acre ft

Project Title = UA-4 (10yr/6hr)

Inflow into structure - UD-4
Structure type: Null

--Watershed data for watershed UA-4
Curve number = 70.0
Area = 22.7 acres
Hydraulic length = 2645.40 feet
Elevation change = 1540.0 feet
Concentration time = 0.38 hours
Unit hydrograph type = Forested

-- Total Area = 22.7 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.51 cfs
Discharge volume = 0.16 acre ft

Project Title = UA-5 (10yr/6hr)

Inflow into structure - UD-5, UD-6, UC-3

Structure type: Null

Watershed data for watershed UA-5

Curve number = 70.0
Area = 5.8 acres
Hydraulic length = 1202.90 feet
Elevation change = 840.0 feet
Concentration time = 0.16 hours
Unit hydrograph type = Forested

-- Total Area = 5.8 acres

--Storm data

Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.15 cfs
Discharge volume = 0.04 acre ft

Project Title = UA-6 (10yr/6hr)

Inflow into structure - Sediment Basin

Structure type: Null

Watershed data for watershed UA-6

Curve number = 70.0
Area = 2.81 acres
Hydraulic length = 813.20 feet
Elevation change = 575.0 feet
Concentration time = 0.11 hours
Unit hydrograph type = Forested

-- Total Area = 2.81 acres

--Storm data

Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.07 cfs
Discharge volume = 0.02 acre ft

Project Title = UA-6a (10yr/6hr)

Inflow into structure – UD-6
Structure type: Null

Watershed data for watershed UA-6a
Curve number = 70.0
Area = 0.3 acres
Hydraulic length = 300.7 feet
Elevation change = 220 feet
Concentration time = 0.041 hours
Unit hydrograph type = Forested

-- Total Area = 0.3 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.01 cfs
Discharge volume = 0.00 acre ft

Project Title = UA-7 (10yr/6hr)

Inflow into structure - UD-7, UD-4
Structure type: Null

-- Watershed data for watershed UA-7
Curve number = 70.0
Area = 89.6 acres
Hydraulic length = 3460.80 feet
Elevation change = 1645.0 feet
Concentration time = 0.55 hours
Unit hydrograph type = Forested

-- Total Area = 89.6 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 1.83 cfs
Discharge volume = 0.63 acre ft

Project Title = UA-8 (10yr/6hr)

Inflow into structure – Sediment Pond
Structure type: Null

Watershed data for watershed UA-8
Curve number = 70.0
Area = 0.14 acres
Hydraulic length = 190.2 feet
Elevation change = 101.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Forested

-- Total Area = 0.14 acres

-- Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.00 cfs
Discharge volume = 0.00 acre ft

Project Title = UA-9 (10yr/6hr)

Inflow into structure – UC-6
Structure type: Null

--Watershed data for watershed UA-9
Curve number = 70.0
Area = 19.9 acres
Hydraulic length = 2244.8 feet
Elevation change = 1400.0 feet
Concentration time = 0.31 hours
Unit hydrograph type = Forested

-- Total Area = 19.9 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.42 cfs
Discharge volume = 0.12 acre ft

Project Title = UA-9a (10yr/6hr)

Inflow into structure – Sediment Pond
Structure type: Null

--Watershed data for watershed UA-9a
Curve number = 70.0
Area = 1.01 acres
Hydraulic length = 398.8 feet
Elevation change = 298.0 feet
Concentration time = 0.05 hours
Unit hydrograph type = Forested

-- Total Area = 1.01 acres

--Storm data
Total precipitation = 1.5 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.02 cfs
Discharge volume = 0.01 acre ft

WATERSHED HYDROGRAPH FOR 10YR/24HR STORM EVENT (UNDISTURBED AREA)

Project Title = UA-1 (10yr/24hr)

Inflow into structure - UD-1, UC-1
Structure type: Null

--Watershed data for watershed UA-1
Curve number = 70.0
Area = 0.7 acres
Hydraulic length = 418.70 feet
Elevation change = 240.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Forested

-- Total Area = 0.7 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.12 cfs
Discharge volume = 0.03 acre ft

Project Title = UA-2 (10yr/24hr)

Inflow into structure - UD-2
Structure type: Null

--Watershed data for watershed UA-2
Curve number = 70.0
Area = 3.9 acres
Hydraulic length = 1077.30 feet
Elevation change = 765.0 feet
Concentration time = 0.14 hours
Unit hydrograph type = Forested

-- Total Area = 3.9 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.63 cfs
Discharge volume = 0.15 acre ft

Project Title = UA-3 (10yr/24hr)

Inflow into structure - UD-3, UC-2
Structure type: Null

--Watershed data for watershed UA-3
Curve number = 70.0
Area = 6.9 acres
Hydraulic length = 1451.30 feet
Elevation change = 1090.0 feet
Concentration time = 0.18 hours
Unit hydrograph type = Forested

-- Total Area = 6.9 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.99 cfs
Discharge volume = 0.26 acre ft

Project Title = UA-4 (10yr/24hr)

Inflow into structure - UD-41
Structure type: Null

--Watershed data for watershed UA-4
Area = 22.7 acres
Hydraulic length = 2345.40 feet
Elevation change = 1540.0 feet
Concentration time = 0.32 hours
Unit hydrograph type = Forested

-- Total Area = 22.7 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 2.55 cfs
Discharge volume = 0.86 acre ft

Project Title = UA-5 (10yr/24hr)

Inflow into structure - UD-5, UD-6, UC-3
Structure type: Null

--Watershed data for watershed UA-5
Curve number = 70.0
Area = 5.8 acres
Hydraulic length = 1202.90 feet
Elevation change = 840.0 feet
Concentration time = 0.16 hours
Unit hydrograph type = Forested

-- Total Area = 5.8 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.92 cfs
Discharge volume = 0.22 acre ft

Project Title = UA-6 (10yr/24hr)

Inflow into structure - Sediment Basin
Structure type: Null

--Watershed data for watershed UA-6
Curve number = 70.0
Area = 2.81 acres
Hydraulic length = 813.20 feet
Elevation change = 575.0 feet
Concentration time = 0.11 hours
Unit hydrograph type = Forested

-- Total Area = 2.81 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.49 cfs
Discharge volume = 0.11 acre ft

Project Title = UA-6a (10yr/24hr)

Inflow into structure – UD-6
Structure type: Null

--Watershed data for watershed UA-6a
Curve number = 70.0
Area = 0.3 acres
Hydraulic length = 300.7 feet
Elevation change = 220 feet
Concentration time = 0.04 hours
Unit hydrograph type = Forested

-- Total Area = 0.3 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.06 cfs
Discharge volume = 0.01 acre ft

Project Title = UA-7 (10yr/24hr)

Inflow into structure - UD-7, UD-4
Structure type: Null

--Watershed data for watershed UA-7
Curve number = 70.0
Area = 89.6 acres
Hydraulic length = 3460.80 feet
Elevation change = 1645.0 feet
Concentration time = 0.55 hours
Unit hydrograph type = Forested

-- Total Area = 89.6 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 7.97 cfs
Discharge volume = 3.40 acre ft

Project Title = UA-8 (10yr/24hr)

Inflow into structure – Sediment Pond
Structure type: Null

--Watershed data for watershed UA-8
Curve number = 70.0
Area = 0.14 acres
Hydraulic length = 190.200 feet
Elevation change = 101.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Forested

-- Total Area = 0.14 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.03 cfs
Discharge volume = 0.01 acre ft

Project Title = UA-9 (10yr/24hr)

Inflow into structure – UC-6
Structure type: Null

--Watershed data for watershed UA-9
Curve number = 70.0
Area = 19.9 acres
Hydraulic length = 2244.8 feet
Elevation change = 1400.0 feet
Concentration time = 0.31 hours
Unit hydrograph type = Forested

-- Total Area = 19.9 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 2.10 cfs
Discharge volume = 0.72 acre ft

Project Title = UA-9a (10yr/24hr)

Inflow into structure – Sediment Pond
Structure type: Null

--Watershed data for watershed UA-9
Curve number = 70.0
Area = 1.01 acres
Hydraulic length = 398.8 feet
Elevation change = 298.0 feet
Concentration time = 0.05 hours
Unit hydrograph type = Forested

-- Total Area = 1.01 acres

--Storm data
Total precipitation = 2.5 inches
Storm type = SCS Type 2 storm, 24 hour storm
Peak Discharge = 0.18 cfs
Discharge volume = 0.04 acre ft

WATERSHED HYDROGRAPH FOR 25YR/6HR STORM EVENT (UNDISTURBED AREA)

Project Title = UA-1 (25/6hr)

Inflow into structure - UD-1, UC-1
Structure type: Null

-- Watershed data for watershed UA-1
Curve number = 70.0
Area = 0.7 acres
Hydraulic length = 418.70 feet
Elevation change = 240.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Forested

-- Total Area = 0.7 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.04 cfs
Discharge volume = 0.01 acre ft

Project Title = UA-2 (25yr/6hr)

Inflow into structure - UD-2
Structure type: Null

-- Watershed data for watershed UA-2
Curve number = 70.0
Area = 3.9 acres
Hydraulic length = 1077.30 feet
Elevation change = 765.0 feet
Concentration time = 0.14 hours
Unit hydrograph type = Forested

-- Total Area = 3.9 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.19 cfs
Discharge volume = 0.06 acre ft

Project Title = UA-3 (25yr/6hr)

Inflow into structure - UD-3, UC-2
Structure type: Null

-- Watershed data for watershed UA-3
Curve number = 70.0
Area = 6.9 acres
Hydraulic length = 1451.30 feet
Elevation change = 1090.0 feet
Concentration time = 0.18 hours
Unit hydrograph type = Forested

-- Total Area = 6.9 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.35 cfs
Discharge volume = 0.11 acre ft

Project Title = UA-4 (25yr/6hr)

Inflow into structure - UD-4
Structure type: Null

-- Watershed data for watershed UA-4
Curve number = 70.0
Area = 22.7 acres
Hydraulic length = 2645.40 feet
Elevation change = 1540.0 feet
Concentration time = 0.38 hours
Unit hydrograph type = Forested

-- Total Area = 22.7 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 1.04 cfs
Discharge volume = 0.37 acre ft

Project Title = UA-5 (25yr/6hr)

Inflow into structure - UD-5, UD-6, UC-3
Structure type: Null

-- Watershed data for watershed UA-5
Curve number = 70.0
Area = 5.8 acres
Hydraulic length = 1202.90 feet
Elevation change = 840.0 feet
Concentration time = 0.16 hours
Unit hydrograph type = Forested

-- Total Area = 5.8 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.29 cfs
Discharge volume = 0.10 acre ft

Project Title = UA-6 (25yr/6hr)

Inflow into structure - Sediment Basin
Structure type: Null

-- Watershed data for watershed UA-6
Curve number = 70.0
Area = 2.81 acres
Hydraulic length = 813.20 feet
Elevation change = 575.0 feet
Concentration time = 0.11 hours
Unit hydrograph type = Forested

-- Total Area = 2.81 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.14 cfs
Discharge volume = 0.05 acre ft

Project Title = UA-6a (25yr/6hr)

Inflow into structure – UD-6
Structure type: Null

-- Watershed data for watershed UA-6a
Curve number = 70.0
Area = 0.3 acres
Hydraulic length = 300.7 feet
Elevation change = 220 feet
Concentration time = 0.04 hours
Unit hydrograph type = Forested

-- Total Area = 0.3 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.02 cfs
Discharge volume = 0.01 acre ft

Project Title = UA-7 (25yr/6hr)

Inflow into structure - UD-7, UD-4
Structure type: Null

-- Watershed data for watershed UA-7
Curve number = 70.0
Area = 89.6 acres
Hydraulic length = 3460.80 feet
Elevation change = 1645.0 feet
Concentration time = 0.55 hours
Unit hydrograph type = Forested

-- Total Area = 89.6 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 3.74 cfs
Discharge volume = 1.47 acre ft

Project Title = UA-8 (25yr/6hr)

Inflow into structure – Sediment Pond
Structure type: Null

-- Watershed data for watershed UA-8
Curve number = 70.0
Area = 0.14 acres
Hydraulic length = 190.2 feet
Elevation change = 101.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Forested

-- Total Area = 0.14 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.01 cfs
Discharge volume = 0.00 acre ft

Project Title = UA-9 (25yr/6hr)

Inflow into structure – UC-6
Structure type: Null

-- Watershed data for watershed UA-9
Curve number = 70.0
Area = 19.9 acres
Hydraulic length = 2244.8 feet
Elevation change = 1400.0 feet
Concentration time = 0.31 hours
Unit hydrograph type = Forested

-- Total Area = 19.9 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.94 cfs
Discharge volume = 0.33 acre ft

Project Title = UA-9a (25yr/6hr)

Inflow into structure – Sediment Pond
Structure type: Null

-- Watershed data for watershed UA-9a
Curve number = 70.0
Area = 1.01 acres
Hydraulic length = 398.8 feet
Elevation change = 298.0 feet
Concentration time = 0.05 hours
Unit hydrograph type = Forested

-- Total Area = 1.01 acres

-- Storm data
Total precipitation = 1.9 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.05 cfs
Discharge volume = 0.02 acre ft

WATERSHED HYDROGRAPH FOR 100YR/6HR STORM EVENT (UNDISTURBED AREA)

Project Title = UA-1 (100yr/6hr)

Inflow into structure - UD-1, UC-1
Structure type: Null

-- Watershed data for watershed # UA-1
Curve number = 70.0
Area = 0.7 acres
Hydraulic length = 418.70 feet
Elevation change = 240.0 feet
Concentration time = 0.06 hours
Unit hydrograph type = Forested

-- Total Area = 0.7 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.05 cfs
Discharge volume = 0.02 acre ft

Project Title = UA-2 (100yr/6hr)

Inflow into structure - UD-2
Structure type: Null

--Watershed data for watershed UA-2
Curve number = 70.0
Area = 3.9 acres
Hydraulic length = 1077.30 feet
Elevation change = 765.0 feet
Concentration time = 0.14 hours
Unit hydrograph type = Forested

-- Total Area = 3.9 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.26 cfs
Discharge volume = 0.09 acre ft

Project Title = UA-3 (100yr/6hr)

Inflow into structure - UD-3, UC-2
Structure type: Null

-- Watershed data for watershed UA-3
Curve number = 70.0
Area = 6.9 acres
Hydraulic length = 1451.30 feet
Elevation change = 1090.0 feet
Concentration time = 0.18 hours
Unit hydrograph type = Forested

-- Total Area = 6.9 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.45 cfs
Discharge volume = 0.15 acre ft

Project Title = UA-4 (100yr/6hr)

Inflow into structure - UD-4
Structure type: Null

--Watershed data for watershed UA-4
Curve number = 70.0
Area = 22.7 acres
Hydraulic length = 2645.40 feet
Elevation change = 1540.0 feet
Concentration time = 0.38 hours
Unit hydrograph type = Forested

-- Total Area = 22.7 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 1.34 cfs
Discharge volume = 0.51 acre ft

Project Title = UA-5 (100yr/6hr)

Inflow into structure - UD-5, UD-6, UC-3
Structure type: Null

-- Watershed data for watershed UA-5
Curve number = 70.0
Area = 5.8 acres
Hydraulic length = 1202.90 feet
Elevation change = 840.0 feet
Concentration time = 0.16 hours
Unit hydrograph type = Forested

-- Total Area = 5.8 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.39 cfs
Discharge volume = 0.13 acre ft

Project Title = UA-6 (100yr/6hr)

Inflow into structure - Sediment Basin
Structure type: Null

-- Watershed data for watershed UA-6
Curve number = 70.0
Area = 2.81 acres
Hydraulic length = 813.20 feet
Elevation change = 575.0 feet
Concentration time = 0.11 hours
Unit hydrograph type = Forested

-- Total Area = 2.81 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.19 cfs
Discharge volume = 0.06 acre ft

Project Title = UA-6a (100yr/6hr)

Inflow into structure – UD-6
Structure type: Null

-- Watershed data for watershed UA-6a
Curve number = 70.0
Area = 0.3 acres
Hydraulic length = 300.7 feet
Elevation change = 220 feet
Concentration time = 0.04 hours
Unit hydrograph type = Forested

-- Total Area = 0.3 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.02 cfs
Discharge volume = 0.01 acre ft

Project Title = UA-7 (100yr/6hr)

Inflow into structure - UD-7, UD-4
Structure type: Null

-- Watershed data for watershed UA-7
Curve number = 70.0
Area = 89.6 acres
Hydraulic length = 3460.80 feet
Elevation change = 1645.0 feet
Concentration time = 0.55 hours
Unit hydrograph type = Forested

-- Total Area = 89.6 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 4.85 cfs
Discharge volume = 2.00 acre ft

Project Title = UA-8 (100yr/6hr)

Inflow into structure – Sediment Pond
Structure type: Null

--Watershed data for watershed UA-8
Curve number = 70.0
Area = 0.14 acres
Hydraulic length = 190.2 feet
Elevation change = 101.0 feet
Concentration time = 0.03 hours
Unit hydrograph type = Forested

-- Total Area = 0.14 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.01 cfs
Discharge volume = 0.00 acre ft

Project Title = UA-9 (100yr/6hr)

Inflow into structure – UC-6
Structure type: Null

-- Watershed data for watershed UA-9
Curve number = 70.0
Area = 19.9 acres
Hydraulic length = 2244.8 feet
Elevation change = 1400.0 feet
Concentration time = 0.31 hours
Unit hydrograph type = Forested

-- Total Area = 19.9 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 1.21 cfs
Discharge volume = 0.44 acre ft

Project Title = UA-9a (100yr/6hr)

Inflow into structure – Sediment Pond
Structure type: Null

-- Watershed data for watershed UA-9a
Curve number = 70.0
Area = 1.01 acres
Hydraulic length = 398.8 feet
Elevation change = 298.0 feet
Concentration time = 0.05 hours
Unit hydrograph type = Forested

-- Total Area = 1.01 acres

-- Storm data
Total precipitation = 2.1 inches
Storm type = SCS 6 hour design storm
Peak Discharge = 0.07 cfs
Discharge volume = 0.02 acre ft

Appendix 2

Culvert Design – Operational

UC-1: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-1: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.5000	%
Diameter	1.500	ft
Discharge	0.12	cfs

Results		
Depth	0.10	ft
Flow Area	0.05	ft^2
Wetted Perimeter	0.77	ft
Top Width	0.74	ft
Critical Depth	0.13	ft
Percent Full	6.45	
Critical Slope	0.020547	ft/ft
Velocity	2.49	ft/s
Velocity Head	0.10	ft
Specific Energy	0.19	ft
Froude Number	1.71	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.000004	ft/ft
Flow is supercritical.		

UC-1: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-1: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.5000	%
Diameter	1.500	ft
Discharge	0.75	cfs

Results		
Depth	2.8	in
Flow Area	0.17	ft^2
Wetted Perimeter	1.21	ft
Top Width	1.08	ft
Critical Depth	0.32	ft
Percent Full	15.46	
Critical Slope	0.017052	ft/ft
Velocity	4.32	ft/s
Velocity Head	0.29	ft
Specific Energy	0.52	ft
Froude Number	1.90	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.000174	ft/ft
Flow is supercritical.		

UC-1: 25yr-6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-1: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.5000	%
Diameter	1.500	ft
Discharge	0.23	cfs

Results		
Depth	1.6	in
Flow Area	0.08	ft^2
Wetted Perimeter	0.90	ft
Top Width	0.85	ft
Critical Depth	0.18	ft
Percent Full	8.78	
Critical Slope	0.018973	ft/ft
Velocity	3.03	ft/s
Velocity Head	0.14	ft
Specific Energy	0.27	ft
Froude Number	1.79	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.000016	ft/ft
Flow is supercritical.		

UC-1: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-1: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.5000	%
Diameter	1.500	ft
Discharge	0.31	cfs

Results		
Depth	1.8	in
Flow Area	0.09	ft^2
Wetted Perimeter	0.97	ft
Top Width	0.90	ft
Critical Depth	0.21	ft
Percent Full	10.11	
Critical Slope	0.018365	ft/ft
Velocity	3.32	ft/s
Velocity Head	0.17	ft
Specific Energy	0.32	ft
Froude Number	1.82	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.000030	ft/ft
Flow is supercritical.		

UC-2: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-2: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	2.9000	%
Diameter	1.500	ft
Discharge	0.18	cfs

Results		
Depth	1.7	in
Flow Area	0.08	ft^2
Wetted Perimeter	0.94	ft
Top Width	0.88	ft
Critical Depth	0.16	ft
Percent Full	9.46	
Critical Slope	0.019524	ft/ft
Velocity	2.12	ft/s
Velocity Head	0.07	ft
Specific Energy	0.21	ft
Froude Number	1.20	
Maximum Discharge	10.42	cfs
Full Flow Capacity	9.69	cfs
Full Flow Slope	0.000010	ft/ft
Flow is supercritical.		

UC-2: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-2: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	2.9000	%
Diameter	1.500	ft
Discharge	0.99	cfs

Results		
Depth	3.9	in
Flow Area	0.28	ft^2
Wetted Perimeter	1.45	ft
Top Width	1.23	ft
Critical Depth	0.37	ft
Percent Full	21.59	
Critical Slope	0.016825	ft/ft
Velocity	3.53	ft/s
Velocity Head	0.19	ft
Specific Energy	0.52	ft
Froude Number	1.30	
Maximum Discharge	10.42	cfs
Full Flow Capacity	9.69	cfs
Full Flow Slope	0.000303	ft/ft
Flow is supercritical.		

UC-2: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-2: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	2.9000	%
Diameter	1.500	ft
Discharge	0.35	cfs

Results		
Depth	2.3	in
Flow Area	0.13	ft^2
Wetted Perimeter	1.11	ft
Top Width	1.01	ft
Critical Depth	0.22	ft
Percent Full	13.00	
Critical Slope	0.018137	ft/ft
Velocity	2.59	ft/s
Velocity Head	0.10	ft
Specific Energy	0.30	ft
Froude Number	1.25	
Maximum Discharge	10.42	cfs
Full Flow Capacity	9.69	cfs
Full Flow Slope	0.000038	ft/ft
Flow is supercritical.		

UC-2: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-2: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	2.9000	%
Diameter	1.500	ft
Discharge	0.45	cfs

Results		
Depth	2.6	in
Flow Area	0.16	ft^2
Wetted Perimeter	1.18	ft
Top Width	1.06	ft
Critical Depth	0.25	ft
Percent Full	14.67	
Critical Slope	0.017713	ft/ft
Velocity	2.80	ft/s
Velocity Head	0.12	ft
Specific Energy	0.34	ft
Froude Number	1.27	
Maximum Discharge	10.42	cfs
Full Flow Capacity	9.69	cfs
Full Flow Slope	0.000063	ft/ft
Flow is supercritical.		

UC-3: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-3: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	4.1000	%
Diameter	2.000	ft
Discharge	0.66	cfs

Results		
Depth	2.7	in
Flow Area	0.19	ft^2
Wetted Perimeter	1.37	ft
Top Width	1.26	ft
Critical Depth	0.28	ft
Percent Full	11.22	
Critical Slope	0.016621	ft/ft
Velocity	3.41	ft/s
Velocity Head	0.18	ft
Specific Energy	0.40	ft
Froude Number	1.53	
Maximum Discharge	26.69	cfs
Full Flow Capacity	24.81	cfs
Full Flow Slope	0.000029	ft/ft
Flow is supercritical.		

UC-3: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-3: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	4.1000	%
Diameter	2.000	ft
Discharge	3.47	cfs

Results		
Depth	6.1	in
Flow Area	0.62	ft^2
Wetted Perimeter	2.11	ft
Top Width	1.74	ft
Critical Depth	0.65	ft
Percent Full	25.26	
Critical Slope	0.015214	ft/ft
Velocity	5.57	ft/s
Velocity Head	0.48	ft
Specific Energy	0.99	ft
Froude Number	1.64	
Maximum Discharge	26.69	cfs
Full Flow Capacity	24.81	cfs
Full Flow Slope	0.000802	ft/ft
Flow is supercritical.		

UC-3: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-3: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	4.1000	%
Diameter	2.000	ft
Discharge	1.33	cfs

Results		
Depth	3.8	in
Flow Area	0.32	ft^2
Wetted Perimeter	1.63	ft
Top Width	1.46	ft
Critical Depth	0.40	ft
Percent Full	15.73	
Critical Slope	0.015638	ft/ft
Velocity	4.20	ft/s
Velocity Head	0.27	ft
Specific Energy	0.59	ft
Froude Number	1.59	
Maximum Discharge	26.69	cfs
Full Flow Capacity	24.81	cfs
Full Flow Slope	0.000118	ft/ft
Flow is supercritical.		

UC-3: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-3: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	4.1000	%
Diameter	2.000	ft
Discharge	1.73	cfs

Results		
Depth	4.3	in
Flow Area	0.38	ft^2
Wetted Perimeter	1.75	ft
Top Width	1.53	ft
Critical Depth	0.46	ft
Percent Full	17.88	
Critical Slope	0.015395	ft/ft
Velocity	4.54	ft/s
Velocity Head	0.32	ft
Specific Energy	0.68	ft
Froude Number	1.61	
Maximum Discharge	26.69	cfs
Full Flow Capacity	24.81	cfs
Full Flow Slope	0.000199	ft/ft
Flow is supercritical.		

UC-4: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-4: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	3.000	ft
Discharge	1.93	cfs

Results		
Depth	3.7	in
Flow Area	0.39	ft^2
Wetted Perimeter	1.96	ft
Top Width	1.83	ft
Critical Depth	0.43	ft
Percent Full	10.34	
Critical Slope	0.014433	ft/ft
Velocity	5.00	ft/s
Velocity Head	0.39	ft
Specific Energy	0.70	ft
Froude Number	1.92	
Maximum Discharge	92.78	cfs
Full Flow Capacity	86.25	cfs
Full Flow Slope	0.000029	ft/ft
Flow is supercritical.		

UC-4: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-4:10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	3.000	ft
Discharge	7.97	cfs

Results		
Depth	7.4	in
Flow Area	1.05	ft^2
Wetted Perimeter	2.82	ft
Top Width	2.42	ft
Critical Depth	0.89	ft
Percent Full	20.54	
Critical Slope	0.013263	ft/ft
Velocity	7.62	ft/s
Velocity Head	0.90	ft
Specific Energy	1.52	ft
Froude Number	2.05	
Maximum Discharge	92.78	cfs
Full Flow Capacity	86.25	cfs
Full Flow Slope	0.000487	ft/ft
Flow is supercritical.		

UC-4: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-4: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	3.000	ft
Discharge	3.74	cfs

Results		
Depth	5.1	in
Flow Area	0.61	ft^2
Wetted Perimeter	2.32	ft
Top Width	2.09	ft
Critical Depth	0.60	ft
Percent Full	14.19	
Critical Slope	0.013643	ft/ft
Velocity	6.09	ft/s
Velocity Head	0.58	ft
Specific Energy	1.00	ft
Froude Number	1.98	
Maximum Discharge	92.78	cfs
Full Flow Capacity	86.25	cfs
Full Flow Slope	0.000107	ft/ft
Flow is supercritical.		

UC-4: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-4: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	3.000	ft
Discharge	4.85	cfs

Results		
Depth	5.8	in
Flow Area	0.74	ft^2
Wetted Perimeter	2.48	ft
Top Width	2.21	ft
Critical Depth	0.69	ft
Percent Full	16.10	
Critical Slope	0.013438	ft/ft
Velocity	6.58	ft/s
Velocity Head	0.67	ft
Specific Energy	1.16	ft
Froude Number	2.01	
Maximum Discharge	92.78	cfs
Full Flow Capacity	86.25	cfs
Full Flow Slope	0.000180	ft/ft
Flow is supercritical.		

UC-5: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-5: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	24.00	in
Discharge	1.93	cfs

Results		
Depth	0.35	ft
Flow Area	0.37	ft^2
Wetted Perimeter	1.72	ft
Top Width	1.52	ft
Critical Depth	0.48	ft
Percent Full	17.40	
Critical Slope	0.015318	ft/ft
Velocity	5.27	ft/s
Velocity Head	0.43	ft
Specific Energy	0.78	ft
Froude Number	1.89	
Maximum Discharge	31.47	cfs
Full Flow Capacity	29.25	cfs
Full Flow Slope	0.000248	ft/ft
Flow is supercritical.		

UC-5: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-5: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	24.00	in
Discharge	7.97	cfs

Results		
Depth	0.71	ft
Flow Area	1.01	ft^2
Wetted Perimeter	2.56	ft
Top Width	1.92	ft
Critical Depth	1.00	ft
Percent Full	35.67	
Critical Slope	0.016646	ft/ft
Velocity	7.93	ft/s
Velocity Head	0.98	ft
Specific Energy	1.69	ft
Froude Number	1.93	
Maximum Discharge	31.47	cfs
Full Flow Capacity	29.25	cfs
Full Flow Slope	0.004231	ft/ft
Flow is supercritical.		

UC-5: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-5: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	24.00	in
Discharge	3.74	cfs

Results		
Depth	0.48	ft
Flow Area	0.58	ft^2
Wetted Perimeter	2.05	ft
Top Width	1.71	ft
Critical Depth	0.68	ft
Percent Full	24.15	
Critical Slope	0.015248	ft/ft
Velocity	6.40	ft/s
Velocity Head	0.64	ft
Specific Energy	1.12	ft
Froude Number	1.93	
Maximum Discharge	31.47	cfs
Full Flow Capacity	29.25	cfs
Full Flow Slope	0.000932	ft/ft
Flow is supercritical.		

UC-5: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\u culver.fm2
Worksheet	UC-5: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	5.7000	%
Diameter	24.00	in
Discharge	4.85	cfs

Results		
Depth	0.55	ft
Flow Area	0.70	ft^2
Wetted Perimeter	2.21	ft
Top Width	1.79	ft
Critical Depth	0.78	ft
Percent Full	27.54	
Critical Slope	0.015479	ft/ft
Velocity	6.89	ft/s
Velocity Head	0.74	ft
Specific Energy	1.29	ft
Froude Number	1.94	
Maximum Discharge	31.47	cfs
Full Flow Capacity	29.25	cfs
Full Flow Slope	0.001567	ft/ft
Flow is supercritical.		

DC-1: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-1: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.50	%
Diameter	1.500	ft
Discharge	1.27	cfs

Results		
Depth	3.6	in
Flow Area	0.25	ft^2
Wetted Perimeter	1.39	ft
Top Width	1.20	ft
Critical Depth	0.42	ft
Percent Full	20.00	
Critical Slope	0.016722	ft/ft
Velocity	5.05	ft/s
Velocity Head	0.40	ft
Specific Energy	0.70	ft
Froude Number	1.94	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.000498	ft/ft
Flow is supercritical.		

DC-1: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-1: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.5000	%
Diameter	1.500	ft
Discharge	2.48	cfs

Results		
Depth	5.0	in
Flow Area	0.40	ft^2
Wetted Perimeter	1.67	ft
Top Width	1.35	ft
Critical Depth	0.60	ft
Percent Full	27.98	
Critical Slope	0.017109	ft/ft
Velocity	6.13	ft/s
Velocity Head	0.58	ft
Specific Energy	1.00	ft
Froude Number	1.97	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.001900	ft/ft
Flow is supercritical.		

DC-1: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-1: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.5000	%
Diameter	1.500	ft
Discharge	1.65	cfs

Results		
Depth	4.1	in
Flow Area	0.30	ft^2
Wetted Perimeter	1.49	ft
Top Width	1.26	ft
Critical Depth	0.48	ft
Percent Full	22.77	
Critical Slope	0.016737	ft/ft
Velocity	5.45	ft/s
Velocity Head	0.46	ft
Specific Energy	0.80	ft
Froude Number	1.96	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.000841	ft/ft
Flow is supercritical.		

DC-1: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-1:100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	6.5000	%
Diameter	1.500	ft
Discharge	1.87	cfs

Results		
Depth	4.4	in
Flow Area	0.33	ft^2
Wetted Perimeter	1.54	ft
Top Width	1.29	ft
Critical Depth	0.52	ft
Percent Full	24.25	
Critical Slope	0.016800	ft/ft
Velocity	5.65	ft/s
Velocity Head	0.50	ft
Specific Energy	0.86	ft
Froude Number	1.96	
Maximum Discharge	15.60	cfs
Full Flow Capacity	14.51	cfs
Full Flow Slope	0.001080	ft/ft
Flow is supercritical.		

DC-2: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-2: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	2.80	%
Diameter	1.500	ft
Discharge	1.66	cfs

Results		
Depth	3.1	in
Flow Area	0.20	ft^2
Wetted Perimeter	1.29	ft
Top Width	1.14	ft
Critical Depth	0.48	ft
Percent Full	17.33	
Critical Slope	0.002354	ft/ft
Velocity	8.11	ft/s
Velocity Head	1.02	ft
Specific Energy	1.28	ft
Froude Number	3.37	
Maximum Discharge	27.31	cfs
Full Flow Capacity	25.39	cfs
Full Flow Slope	0.000120	ft/ft
Flow is supercritical.		

DC-2: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-2: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	2.8000	%
Diameter	1.500	ft
Discharge	3.26	cfs

Results		
Depth	4.4	in
Flow Area	0.33	ft^2
Wetted Perimeter	1.54	ft
Top Width	1.28	ft
Critical Depth	0.69	ft
Percent Full	24.20	
Critical Slope	0.002491	ft/ft
Velocity	9.88	ft/s
Velocity Head	1.52	ft
Specific Energy	1.88	ft
Froude Number	3.44	
Maximum Discharge	27.31	cfs
Full Flow Capacity	25.39	cfs
Full Flow Slope	0.000462	ft/ft
Flow is supercritical.		

DC-2: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-2: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	2.8000	%
Diameter	1.500	ft
Discharge	2.16	cfs

Results		
Depth	3.5	in
Flow Area	0.25	ft^2
Wetted Perimeter	1.38	ft
Top Width	1.19	ft
Critical Depth	0.56	ft
Percent Full	19.72	
Critical Slope	0.002380	ft/ft
Velocity	8.76	ft/s
Velocity Head	1.19	ft
Specific Energy	1.49	ft
Froude Number	3.40	
Maximum Discharge	27.31	cfs
Full Flow Capacity	25.39	cfs
Full Flow Slope	0.000203	ft/ft
Flow is supercritical.		

DC-2: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-2: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	2.8000	%
Diameter	1.500	ft
Discharge	2.45	cfs

Results		
Depth	3.8	in
Flow Area	0.27	ft^2
Wetted Perimeter	1.43	ft
Top Width	1.22	ft
Critical Depth	0.59	ft
Percent Full	20.98	
Critical Slope	0.002403	ft/ft
Velocity	9.09	ft/s
Velocity Head	1.28	ft
Specific Energy	1.60	ft
Froude Number	3.41	
Maximum Discharge	27.31	cfs
Full Flow Capacity	25.39	cfs
Full Flow Slope	0.000261	ft/ft
Flow is supercritical.		

DC-3: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-3: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	6.90	%
Diameter	1.500	ft
Discharge	1.77	cfs

Results		
Depth	2.6	in
Flow Area	0.16	ft^2
Wetted Perimeter	1.17	ft
Top Width	1.05	ft
Critical Depth	0.50	ft
Percent Full	14.36	
Critical Slope	0.002358	ft/ft
Velocity	11.35	ft/s
Velocity Head	2.00	ft
Specific Energy	2.22	ft
Froude Number	5.19	
Maximum Discharge	42.87	cfs
Full Flow Capacity	39.85	cfs
Full Flow Slope	0.000136	ft/ft
Flow is supercritical.		

DC-3: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-3: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	6.9000	%
Diameter	1.500	ft
Discharge	3.85	cfs

Results		
Depth	3.8	in
Flow Area	0.27	ft^2
Wetted Perimeter	1.43	ft
Top Width	1.22	ft
Critical Depth	0.75	ft
Percent Full	21.00	
Critical Slope	0.002572	ft/ft
Velocity	14.28	ft/s
Velocity Head	3.17	ft
Specific Energy	3.48	ft
Froude Number	5.36	
Maximum Discharge	42.87	cfs
Full Flow Capacity	39.85	cfs
Full Flow Slope	0.000644	ft/ft
Flow is supercritical.		

DC-3: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-3: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	6.9000	%
Diameter	1.500	ft
Discharge	2.36	cfs

Results		
Depth	3.0	in
Flow Area	0.19	ft^2
Wetted Perimeter	1.26	ft
Top Width	1.11	ft
Critical Depth	0.58	ft
Percent Full	16.51	
Critical Slope	0.002395	ft/ft
Velocity	12.36	ft/s
Velocity Head	2.37	ft
Specific Energy	2.62	ft
Froude Number	5.26	
Maximum Discharge	42.87	cfs
Full Flow Capacity	39.85	cfs
Full Flow Slope	0.000242	ft/ft
Flow is supercritical.		

DC-3: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-3: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.009	
Channel Slope	6.9000	%
Diameter	1.500	ft
Discharge	2.71	cfs

Results		
Depth	3.2	in
Flow Area	0.21	ft^2
Wetted Perimeter	1.30	ft
Top Width	1.14	ft
Critical Depth	0.62	ft
Percent Full	17.66	
Critical Slope	0.002428	ft/ft
Velocity	12.88	ft/s
Velocity Head	2.58	ft
Specific Energy	2.84	ft
Froude Number	5.29	
Maximum Discharge	42.87	cfs
Full Flow Capacity	39.85	cfs
Full Flow Slope	0.000319	ft/ft
Flow is supercritical.		

DC-4: 10yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-4: 10yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.100000	ft/ft
Diameter	24.00	in
Discharge	4.47	cfs

Results		
Depth	0.46	ft
Flow Area	0.54	ft^2
Wetted Perimeter	2.00	ft
Top Width	1.68	ft
Critical Depth	0.74	ft
Percent Full	22.93	
Critical Slope	0.015385	ft/ft
Velocity	8.22	ft/s
Velocity Head	1.05	ft
Specific Energy	1.51	ft
Froude Number	2.55	
Maximum Discharge	41.68	cfs
Full Flow Capacity	38.75	cfs
Full Flow Slope	0.001331	ft/ft
Flow is supercritical.		

DC-4: 10yr/24hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-4: 10yr/24hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.100000	ft/ft
Diameter	24.00	in
Discharge	4.47	cfs

Results		
Depth	0.46	ft
Flow Area	0.54	ft^2
Wetted Perimeter	2.00	ft
Top Width	1.68	ft
Critical Depth	0.74	ft
Percent Full	22.93	
Critical Slope	0.015385	ft/ft
Velocity	8.22	ft/s
Velocity Head	1.05	ft
Specific Energy	1.51	ft
Froude Number	2.55	
Maximum Discharge	41.68	cfs
Full Flow Capacity	38.75	cfs
Full Flow Slope	0.001331	ft/ft
Flow is supercritical.		

DC-4: 25yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-4: 25yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.100000	ft/ft
Diameter	24.00	in
Discharge	2.57	cfs

Results		
Depth	0.35	ft
Flow Area	0.37	ft^2
Wetted Perimeter	1.72	ft
Top Width	1.52	ft
Critical Depth	0.56	ft
Percent Full	17.45	
Critical Slope	0.015195	ft/ft
Velocity	6.99	ft/s
Velocity Head	0.76	ft
Specific Energy	1.11	ft
Froude Number	2.50	
Maximum Discharge	41.68	cfs
Full Flow Capacity	38.75	cfs
Full Flow Slope	0.000440	ft/ft
Flow is supercritical.		

DC-4: 100yr/6hr Storm Event
Worksheet for Circular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\d culver.fm2
Worksheet	DC-4: 100yr/6hr Storm Event
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Channel Slope	0.100000	ft/ft
Diameter	24.00	in
Discharge	2.96	cfs

Results		
Depth	0.37	ft
Flow Area	0.41	ft^2
Wetted Perimeter	1.79	ft
Top Width	1.56	ft
Critical Depth	0.60	ft
Percent Full	18.70	
Critical Slope	0.015183	ft/ft
Velocity	7.29	ft/s
Velocity Head	0.83	ft
Specific Energy	1.20	ft
Froude Number	2.52	
Maximum Discharge	41.68	cfs
Full Flow Capacity	38.75	cfs
Full Flow Slope	0.000584	ft/ft
Flow is supercritical.		

Appendix 3

Ditch Design – Operational

DD-1: 10yr/6hr Storm Event
Worksheet for Triangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-1: 10yr/6hr Storm Event
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	10.7000	%
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	0.39	cfs

Results		
Depth	0.22	ft
Flow Area	0.15	ft^2
Wetted Perimeter	1.39	ft
Top Width	1.32	ft
Critical Depth	0.25	ft
Critical Slope	0.049756	ft/ft
Velocity	2.69	ft/s
Velocity Head	0.11	ft
Specific Energy	0.33	ft
Froude Number	1.43	
Flow is supercritical.		

DD-1: 10yr/24hr Storm Event
Worksheet for Triangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-1: 10yr/24hr Storm Event
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	10.7000	%
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Discharge	0.78	cfs

Results		
Depth	0.29	ft
Flow Area	0.24	ft^2
Wetted Perimeter	1.80	ft
Top Width	1.71	ft
Critical Depth	0.33	ft
Critical Slope	0.045382	ft/ft
Velocity	3.20	ft/s
Velocity Head	0.16	ft
Specific Energy	0.44	ft
Froude Number	1.49	
Flow is supercritical.		

DD-3: 10yr/6hr Storm Event
Worksheet for Triangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-3:10yr/6hr Storm Event
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	7.4000	%
Left Side Slope	1.500000	H : V
Right Side Slope	1.500000	H : V
Discharge	0.10	cfs

Results		
Depth	0.19	ft
Flow Area	0.05	ft^2
Wetted Perimeter	0.68	ft
Top Width	0.57	ft
Critical Depth	0.19	ft
Critical Slope	0.064813	ft/ft
Velocity	1.86	ft/s
Velocity Head	0.05	ft
Specific Energy	0.24	ft
Froude Number	1.06	
Flow is supercritical.		

DD-3: 10yr/24hr Storm Event
Worksheet for Triangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-3: 10yr/24hr Storm Event
Flow Element	Triangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	7.4000	%
Left Side Slope	1.500000	H : V
Right Side Slope	1.500000	H : V
Discharge	0.19	cfs

Results		
Depth	0.24	ft
Flow Area	0.09	ft^2
Wetted Perimeter	0.87	ft
Top Width	0.72	ft
Critical Depth	0.25	ft
Critical Slope	0.059497	ft/ft
Velocity	2.18	ft/s
Velocity Head	0.07	ft
Specific Energy	0.31	ft
Froude Number	1.11	
Flow is supercritical.		

DD-4: 10yr/6hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-4: 10yr/6hr Storm Event
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	7.1000	%
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	1.00	ft
Discharge	0.08	cfs

Results		
Depth	0.05	ft
Flow Area	0.06	ft^2
Wetted Perimeter	1.44	ft
Top Width	1.42	ft
Critical Depth	0.05	ft
Critical Slope	0.065890	ft/ft
Velocity	1.25	ft/s
Velocity Head	0.02	ft
Specific Energy	0.08	ft
Froude Number	1.03	
Flow is supercritical.		

DD-4: 10yr/24hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-4: 10yr/24hr Storm Event
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	7.1000	%
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	1.00	ft
Discharge	0.23	cfs

Results		
Depth	0.10	ft
Flow Area	0.13	ft^2
Wetted Perimeter	1.79	ft
Top Width	1.76	ft
Critical Depth	0.10	ft
Critical Slope	0.055296	ft/ft
Velocity	1.74	ft/s
Velocity Head	0.05	ft
Specific Energy	0.14	ft
Froude Number	1.12	
Flow is supercritical.		

DD-5: 10yr/6hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-5: 10yr/6hr Storm Event
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	1.4000	%
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	1.50	ft
Discharge	0.08	cfs

Results		
Depth	0.07	ft
Flow Area	0.12	ft^2
Wetted Perimeter	2.06	ft
Top Width	2.04	ft
Critical Depth	0.04	ft
Critical Slope	0.069349	ft/ft
Velocity	0.66	ft/s
Velocity Head	0.01	ft
Specific Energy	0.07	ft
Froude Number	0.48	
Flow is subcritical.		

DD-5: 10yr/24hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\ditches.fm2
Worksheet	DD-5: 10yr/24hr Storm Event
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	1.4000	%
Left Side Slope	4.000000	H : V
Right Side Slope	4.000000	H : V
Bottom Width	1.50	ft
Discharge	0.22	cfs

Results		
Depth	0.12	ft
Flow Area	0.24	ft²
Wetted Perimeter	2.49	ft
Top Width	2.46	ft
Critical Depth	0.08	ft
Critical Slope	0.057580	ft/ft
Velocity	0.92	ft/s
Velocity Head	0.01	ft
Specific Energy	0.13	ft
Froude Number	0.52	
Flow is subcritical.		

UD-1: 10yr/6hr Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-1: 10yr/6hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	5.7000	%
Bottom Width	5.00	ft
Discharge	0.02	cfs

Results		
Depth	0.01	ft
Flow Area	0.03	ft^2
Wetted Perimeter	5.01	ft
Top Width	5.00	ft
Critical Depth	0.01	ft
Critical Slope	0.012405	ft/ft
Velocity	0.80	ft/s
Velocity Head	0.01	ft
Specific Energy	0.01	ft
Froude Number	1.99	
Flow is supercritical.		

Notes:

UD-1: 10yr/6hr Strom Event

Depth of flow was solved for ditch UD-1 to insure sufficent flow capacity.

UD-1: 10yr/24hr Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-1: 10yr/24hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	5.7000	%
Bottom Width	5.00	ft
Discharge	0.12	cfs

Results		
Depth	0.01	ft
Flow Area	0.07	ft^2
Wetted Perimeter	5.03	ft
Top Width	5.00	ft
Critical Depth	0.03	ft
Critical Slope	0.008412	ft/ft
Velocity	1.63	ft/s
Velocity Head	0.04	ft
Specific Energy	0.06	ft
Froude Number	2.37	
Flow is supercritical.		

Notes:

UD-1: 10yr/24hr Storm Event

Depth of flow was solved for ditch UD-1. Total capacity of ditch is 180.63 cfs (no free board) at a depth of 17".

UD-2: 10yr/6hr Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-2:10yr/6hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	5.0000	%
Bottom Width	5.00	ft
Discharge	0.10	cfs

Results		
Depth	0.01	ft
Flow Area	0.07	ft^2
Wetted Perimeter	5.03	ft
Top Width	5.00	ft
Critical Depth	0.02	ft
Critical Slope	0.008746	ft/ft
Velocity	1.46	ft/s
Velocity Head	0.03	ft
Specific Energy	0.05	ft
Froude Number	2.20	
Flow is supercritical.		

Notes:

UD-2: 10yr/6hr Strom Event

Depth of flow was solved for ditch UD-2 to insure sufficent flow capacity.

UD-2: 10yr/24hr Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-2: 10yr/24hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	5.0000	%
Bottom Width	5.00	ft
Discharge	0.63	cfs

Results		
Depth	0.04	ft
Flow Area	0.21	ft^2
Wetted Perimeter	5.08	ft
Top Width	5.00	ft
Critical Depth	0.08	ft
Critical Slope	0.005982	ft/ft
Velocity	3.03	ft/s
Velocity Head	0.14	ft
Specific Energy	0.18	ft
Froude Number	2.62	
Flow is supercritical.		

Notes:

UD-2: 10yr/24hr Storm Event

Depth of flow was solved for ditch UD-2. Total capacity of ditch is 169.18 cfs (no free board) at a depth of 17".

UD-3: 10yr/6hr Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-3 10yr/6hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	5.4000	%
Bottom Width	5.00	ft
Discharge	0.18	cfs

Results		
Depth	0.02	ft
Flow Area	0.10	ft^2
Wetted Perimeter	5.04	ft
Top Width	5.00	ft
Critical Depth	0.03	ft
Critical Slope	0.007720	ft/ft
Velocity	1.89	ft/s
Velocity Head	0.06	ft
Specific Energy	0.07	ft
Froude Number	2.41	
Flow is supercritical.		

Notes:

UD-3: 10yr/6hr Strom Event

Depth of flow was solved for ditch UD-3 to insure sufficent flow capacity.

UD-3: 10yr/24 Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-3: 10yr/24hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	5.4000	%
Bottom Width	5.00	ft
Discharge	0.99	cfs

Results		
Depth	0.05	ft
Flow Area	0.27	ft^2
Wetted Perimeter	5.11	ft
Top Width	5.00	ft
Critical Depth	0.11	ft
Critical Slope	0.005488	ft/ft
Velocity	3.71	ft/s
Velocity Head	0.21	ft
Specific Energy	0.27	ft
Froude Number	2.83	
Flow is supercritical.		

Notes:

UD-3: 10yr/24hr Storm Event

Depth of flow was solved for ditch UD-3. Total capacity of ditch is 175.81 cfs (no free board) at a depth of 17".

UD-4: 10yr/6hr Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-4: 10yr/6hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	4.5000	%
Bottom Width	5.00	ft
Discharge	0.51	cfs

Results		
Depth	0.04	ft
Flow Area	0.19	ft^2
Wetted Perimeter	5.08	ft
Top Width	5.00	ft
Critical Depth	0.07	ft
Critical Slope	0.006236	ft/ft
Velocity	2.70	ft/s
Velocity Head	0.11	ft
Specific Energy	0.15	ft
Froude Number	2.45	
Flow is supercritical.		

Notes:

UD-4: 10yr/6hr Storm Event
Depth of flow was solved for ditch UD-4 to insure sufficient flow capacity.

UD-4: 10yr/24hr Storm Event
Worksheet for Rectangular Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-4: 10yr/24hr
Flow Element	Rectangular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.013	
Channel Slope	4.5000	%
Bottom Width	5.00	ft
Discharge	2.55	cfs

Results		
Depth	0.10	ft
Flow Area	0.50	ft^2
Wetted Perimeter	5.20	ft
Top Width	5.00	ft
Critical Depth	0.20	ft
Critical Slope	0.004662	ft/ft
Velocity	5.09	ft/s
Velocity Head	0.40	ft
Specific Energy	0.50	ft
Froude Number	2.84	
Flow is supercritical.		

Notes:

UD-4: 10yr/24hr Storm Event
Depth of flow was solved for ditch UD-4 to insure sufficient flow capacity.

UD-5: 10yr/6hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-5: 10yr/6hr
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	12.8000	%
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	3.00	ft
Discharge	0.66	cfs

Results		
Depth	0.08	ft
Flow Area	0.27	ft^2
Wetted Perimeter	3.53	ft
Top Width	3.50	ft
Critical Depth	0.11	ft
Critical Slope	0.050824	ft/ft
Velocity	2.41	ft/s
Velocity Head	0.09	ft
Specific Energy	0.17	ft
Froude Number	1.52	
Flow is supercritical.		

UD-5: 10yr/24hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-5: 10yr/24hr
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	12.8000	%
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	3.00	ft
Discharge	3.47	cfs

Results		
Depth	0.22	ft
Flow Area	0.81	ft²
Wetted Perimeter	4.40	ft
Top Width	4.32	ft
Critical Depth	0.31	ft
Critical Slope	0.037976	ft/ft
Velocity	4.30	ft/s
Velocity Head	0.29	ft
Specific Energy	0.51	ft
Froude Number	1.75	
Flow is supercritical.		

UD-6: 10yr/6hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-6: 10yr/6hr
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	4.8000	%
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	3.00	ft
Discharge	0.01	cfs

Results		
Depth	0.01	ft
Flow Area	0.03	ft²
Wetted Perimeter	3.06	ft
Top Width	3.06	ft
Critical Depth	0.01	ft
Critical Slope	0.122573	ft/ft
Velocity	0.36	ft/s
Velocity Head	0.2e-2	ft
Specific Energy	0.01	ft
Froude Number	0.66	
Flow is subcritical.		

UD-6: 10yr/24hr Storm Event
Worksheet for Trapezoidal Channel

Project Description	
Project File	e:\volume 11 hydro\appendix b\channel design\undistur.fm2
Worksheet	UD-6: 10yr/24hr
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.040	
Channel Slope	4.8000	%
Left Side Slope	3.000000	H : V
Right Side Slope	3.000000	H : V
Bottom Width	3.00	ft
Discharge	0.06	cfs

Results		
Depth	0.03	ft
Flow Area	0.08	ft^2
Wetted Perimeter	3.17	ft
Top Width	3.16	ft
Critical Depth	0.02	ft
Critical Slope	0.082912	ft/ft
Velocity	0.72	ft/s
Velocity Head	0.01	ft
Specific Energy	0.04	ft
Froude Number	0.78	
Flow is subcritical.		

Appendix 4

BMP Utilization for Sediment and Erosion Control

BMP PSC100: SURFACE ROUGHENING

Other Names:
Deep Gouging, Pocking

Practice:
Requires track-hoe or similar machine to roughen the exposed surface area disturbed during construction in a random and discontinuous fashion use the bucket of the machine. Pockmarks created are up to three (3) feet in diameter and one and one-half (1 ½) feet deep.

Benefits:
Pockmarks are designed to capture or trap precipitation and promote infiltration of water. The gouging techniques serve to control erosion through water retention, thus enhancing vegetation growth.

Limitations:
This technique should not be used on slopes greater than 2 horizontal and 1 vertical. Other methods are available for the stabilization of these types of slopes.

BMP PSC200: SEEDING

Other Names:
N/A

Practice:
This BMP is a permanent form of erosion control of disturbed surfaces. Seed mixes can be applied using one of the three listed methods;

1) Hand Broadcasting – This method requires carrying a seed bucket or seed bag into the disturbed area. The seeder grabs a handful of seed and throws in a circular motion releasing the seed simultaneously. Distribution should be as even as possible.
2) Mechanical Broadcasting – This method requires the use of a Traux brand or similar mechanical applicator. This rotary type applicator is carried by the seeder. The seeder hand cranks the device and walks back and forth across the disturbed area spreading the seed as even as possible. Use manufactures instructions for applying seed.
3) Hydroseeding – This method requires the use of a hydromulching machine. Seed is mixed in a water solution in the tank of the hydromulching machine in a pre-determined amount (i.e.4lbs/ac.). A small amount of wood fiber mulch (500lbs/ac.) should be added to the solution to aid in identifying the area sprayed. Spray the solution over the entire disturbed area and apply as evenly as possible.

Benefits:
An even distribution of seed mix will allow a consistent vegetative growth to control erosion. Mechanical and hydroseeding provides a more consistent coverage.

Limitations:
Vegetative erosion control could take some time to establish. Temporary erosion control practices must be left in place during establishment.

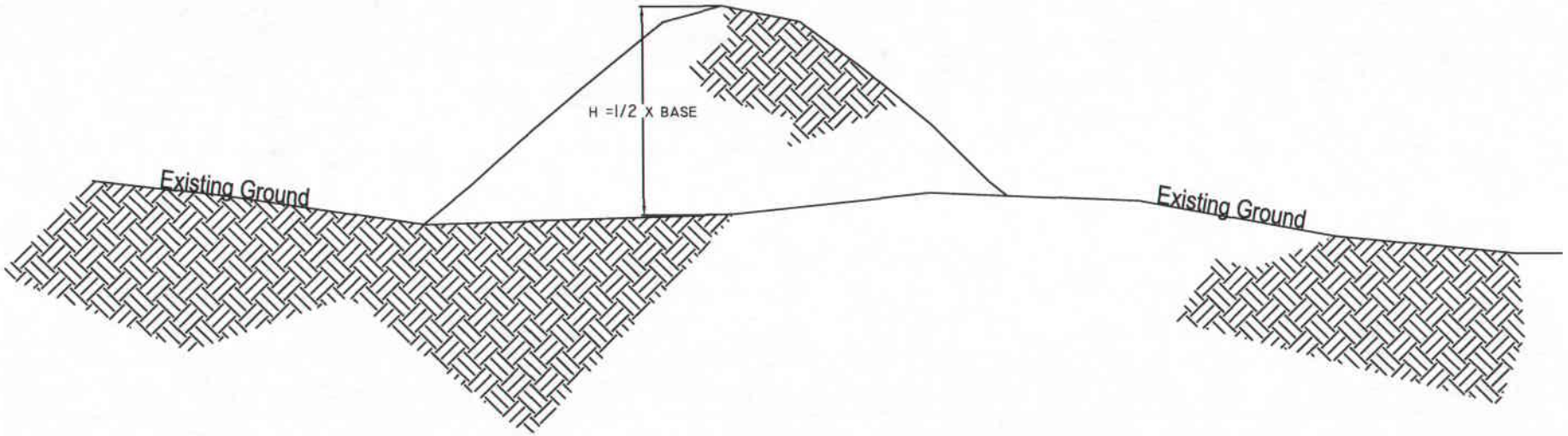
BMP PSC300: Hydromulching

Other Names:
N/A

Practice:
Hydraulic mulches can be made of recycled newsprint, magazines, wood or other wood/ paper waste sources. This type of mulch is to be mixed in a hydraulic application machine(hydromulcher) and applied as a liquid slurry that contains the recommended rates hydromulch for the site. It can be specified with or without a tackifier. Apply at rate of 1.5 to 2 tons per acre.

Benefits:
An even distribution of hydromulch retains soil moisture and keeps seed from blowing away. Hydromulch applications also reduce interrill erosion the occurs from raindrop impacts.

Limitations:
May be too expensive for small or very remote sites; must dry for at least 24 hours before rainfall.



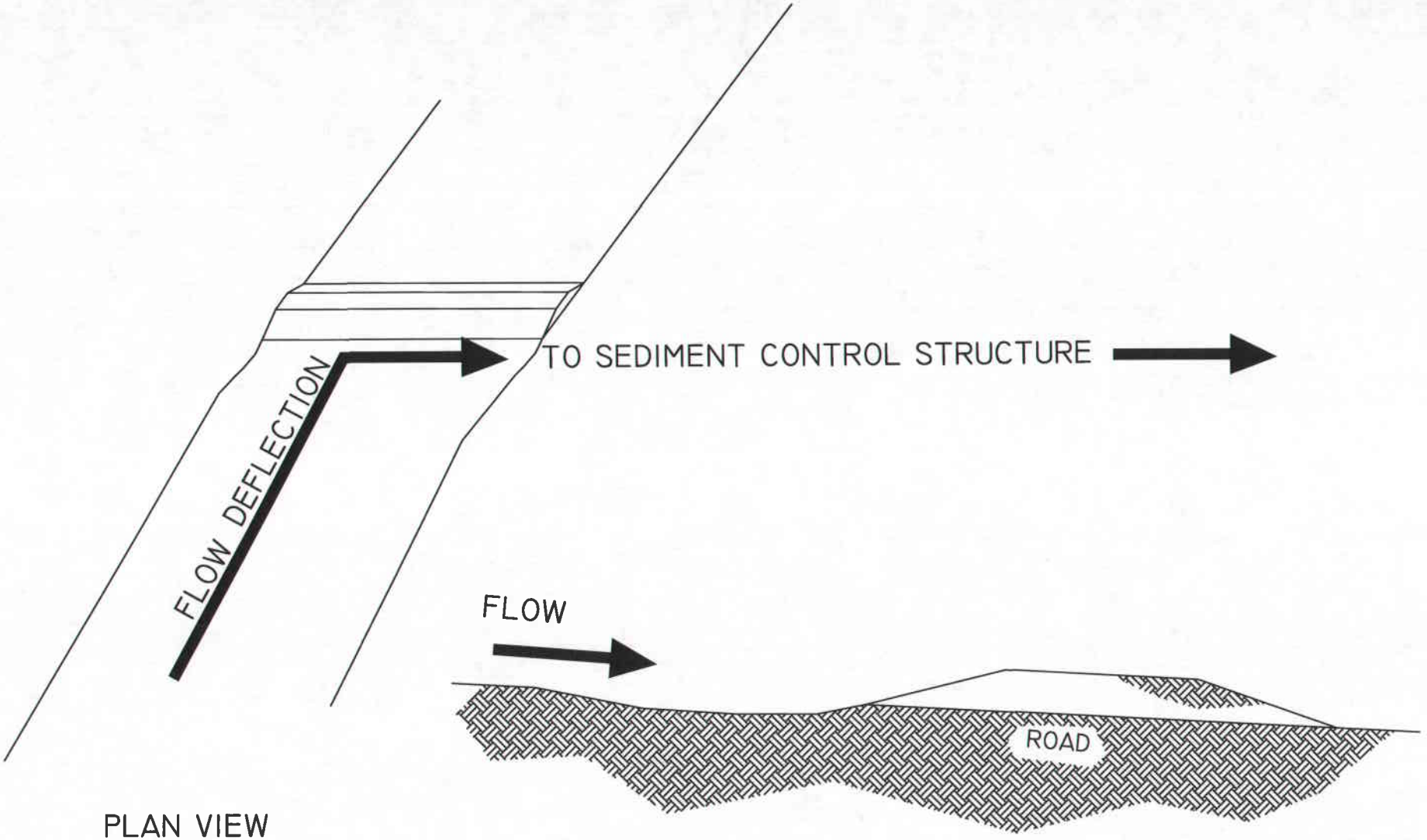
NOTES:
HEIGHT EQUALS 1/2 WIDTH OF BASE
BERM IS SLIGHTLY COMPACTED FOR STABILITY
USE FOR SEDIMENT CONTAINMENT

CAD FILE NAME/DISK#: D202

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

BERM
SWPPP BMP'S
TYPICAL DRAWING

DRAWN BY:	DENNIS OAKLEY	D202	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1	REV.



PLAN VIEW
ROAD

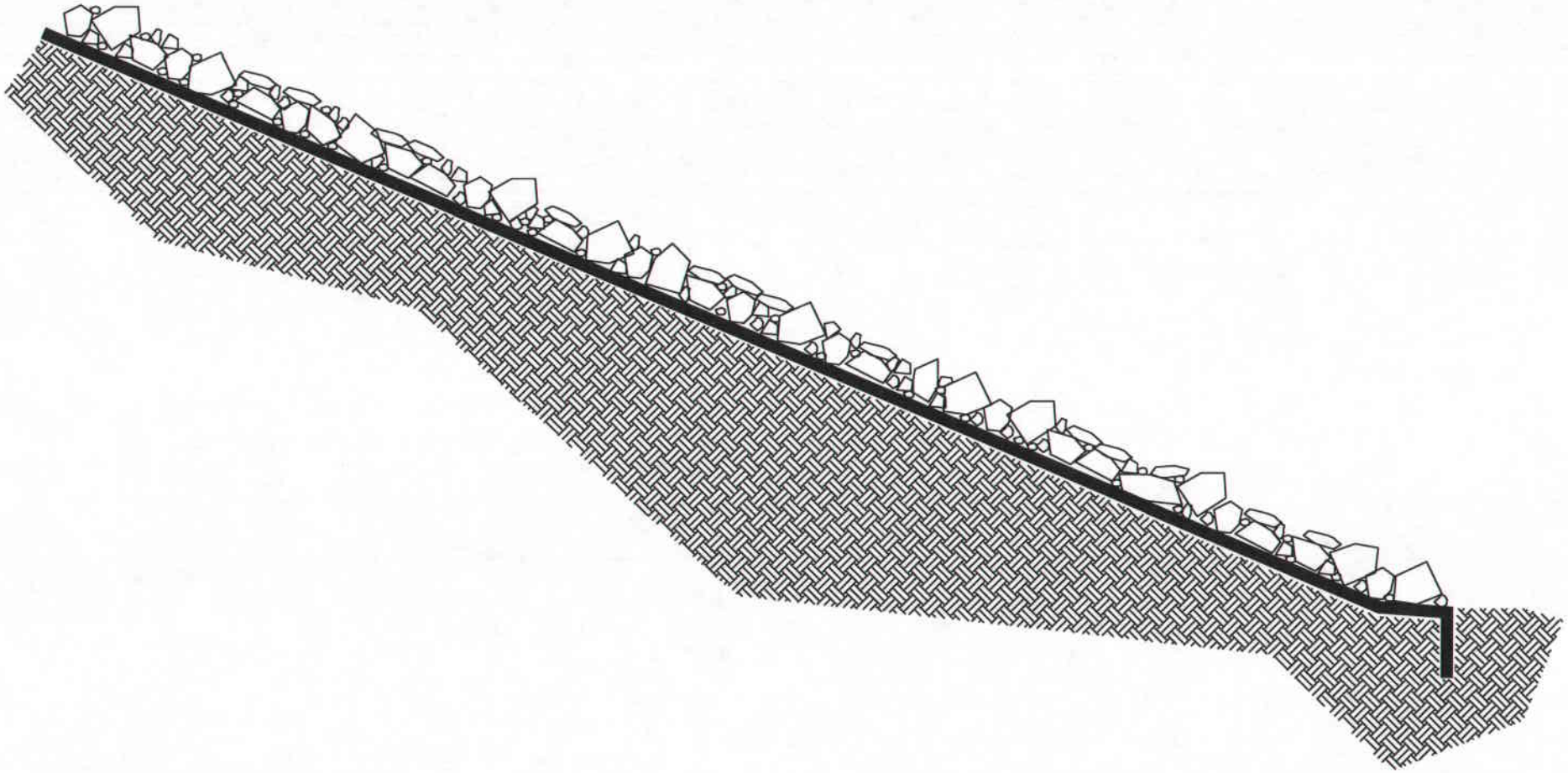
NOTES:
HEIGHT SHOULD ALLOW VEHICLE PASSAGE
WATER BAR DIVERTS WATER OFF ROADWAY

CAD FILE NAME/DISK#: D203

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

WATER BAR
SWPPP BMP'S
TYPICAL DRAWING

DRAWN BY:	DENNIS OAKLEY	D203	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1 of 1	REV. ---



NOTES:

USE STONE SIZES FROM 2" UP TO 8"
SLOPE PROTECTION SHOULD NOT EXCEED 2H:IV
USE FILTER CLOTH BETWEEN RIPRAP AND GROUND
FILTER CLOTH SHOULD BE PROTECTED AGAINST PUNCTURES, TEARS, ETC.

CAD FILE NAME/DISK#: HA230

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

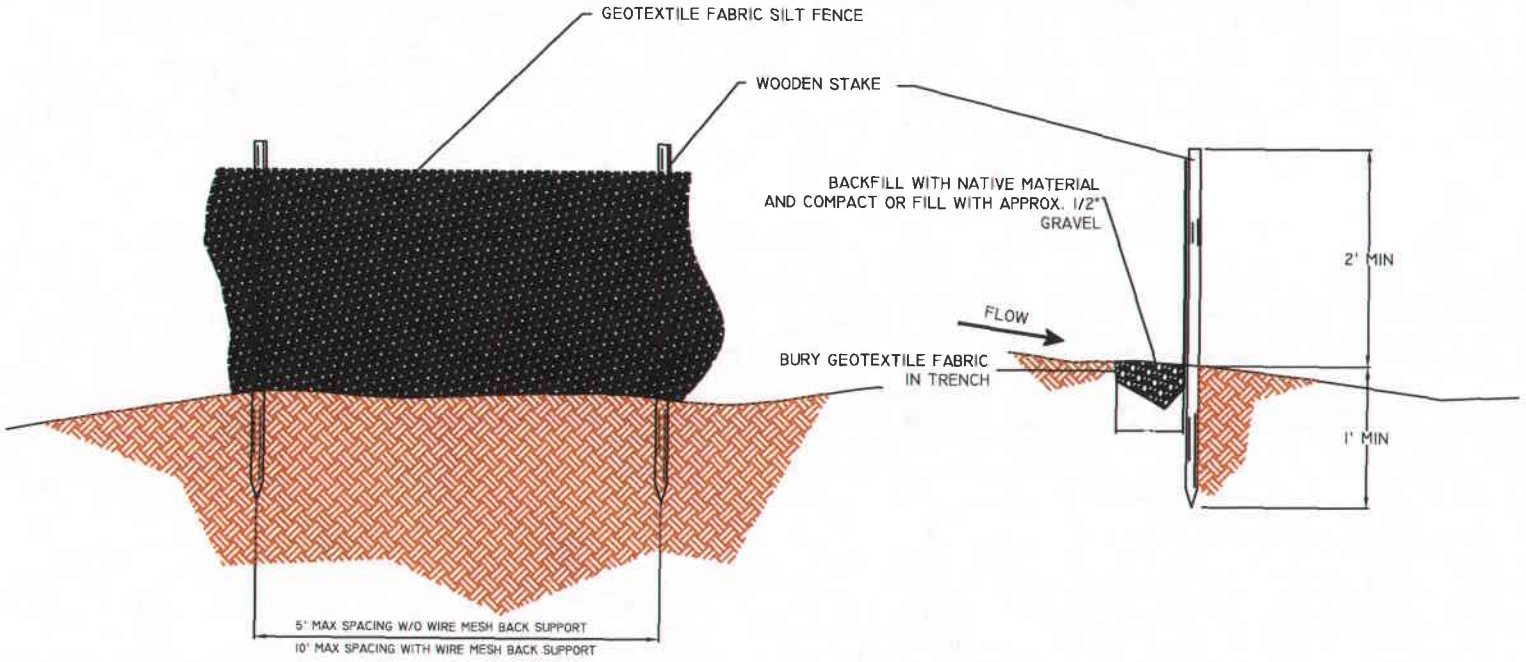
HARD ARMOR – RIPRAP
SWPPP BMP'S
TYPICAL DRAWING

DRAWN BY:	DENNIS OAKLEY	HA230	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1	REV. ---

NOTES:
INSTALL SILT FENCE ALONG CONTOURS WHEN EVER POSSIBLE

WRAP ENDS SLIGHTLY UP-SLOPE TO PREVENT SEDIMENT
FLOWING AROUND ENDS

PERFORM MAINTENANCE MONTHLY AND IMMEDIATELY AFTER STORMS



CAD FILE NAME/DISK#: SC110

ENERGY WEST MINING COMPANY
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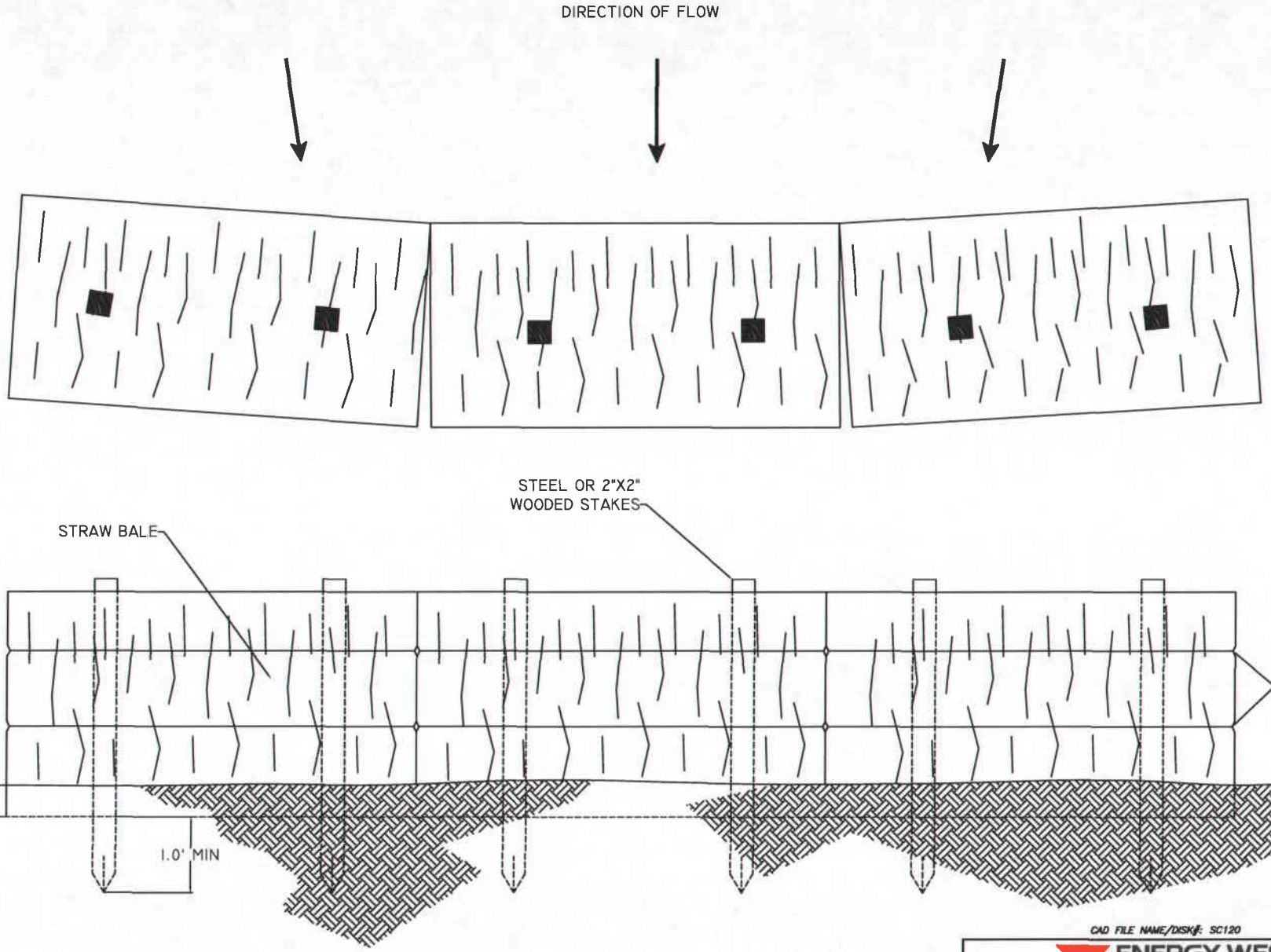
SILT FENCE DETAIL
SWPPP BMP'S
TYPICAL DRAWING

DRAWN BY:	DENNIS OAKLEY	SC110	
SCALE:	NONE	DRAWING #:	
DATE:	3/7/2007	SHEET 1	REV.



CAD FILE NAME/DISK#: SC120

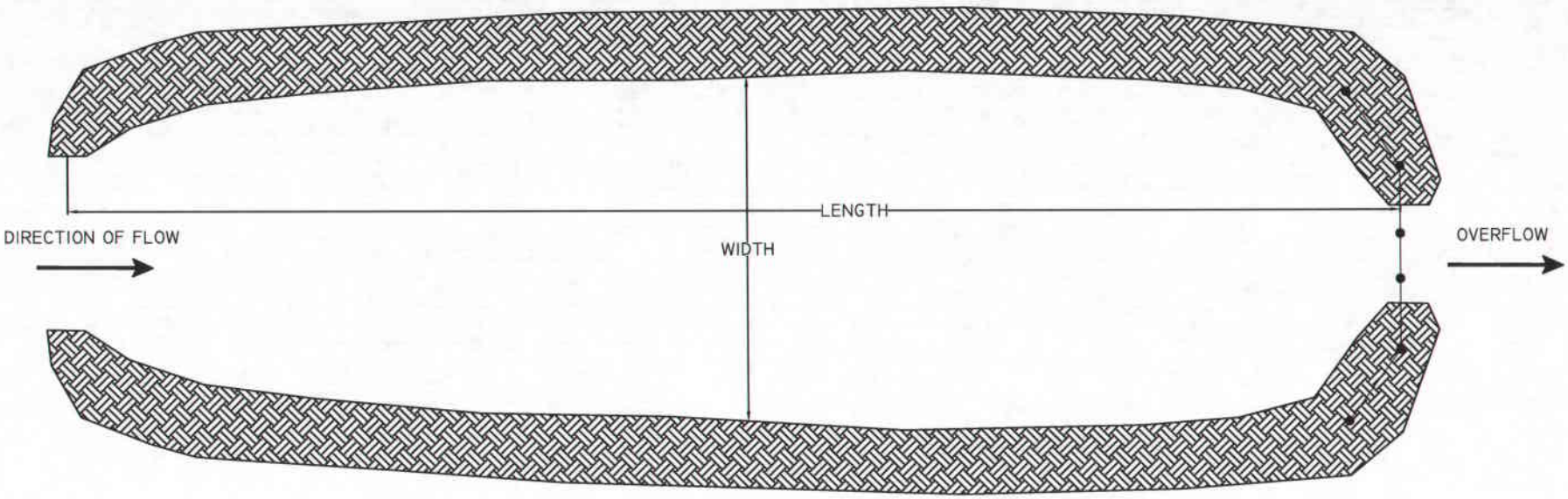
ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

STRAW BALES SWPPP BMP'S TYPICAL DRAWING

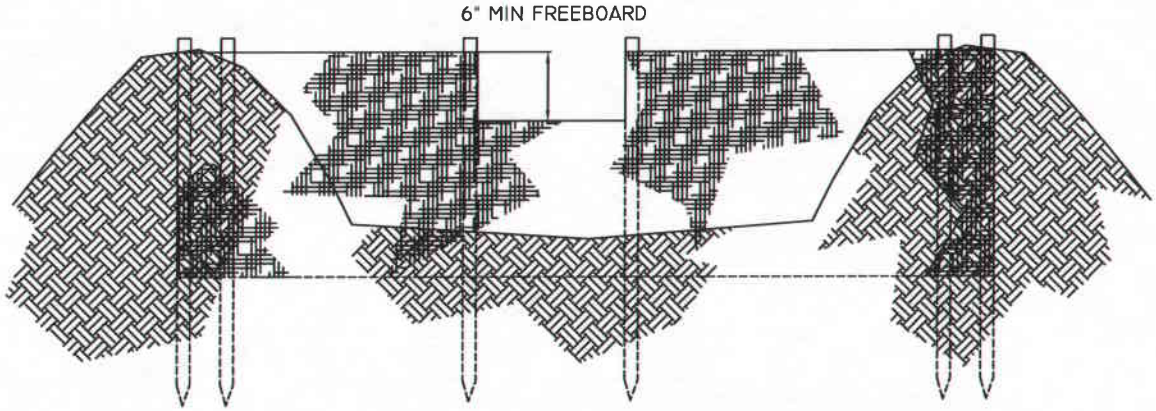
DRAWN BY:	DENNIS OAKLEY	SC120	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1 of 1	REV.

NOTES:

INSURE TIGHTLY ABUTED ENDS TO ELIMINATE LEAKAGE
KEY BALES INTO GROUND TO PREVENT FLOW UNDER BALES
COMPACT EARTH MATERIAL AROUND BASE OF BALES
USE TWO STAKES PER BALE TO SECURE IN PLACE



PLAN VIEW



ELEVATION VIEW

TABLE I

SINGLE CHAMBER SEDIMENT CONTAINMENT SYSTEM

PRECIP (IN) / AREA (AC)	0.6 L (M)	0.6 W (M)	1.2 L (M)	1.2 W (M)	1.8 L (M)	1.8 W (M)	2.4 L (M)	2.4 W (M)
0.5	3	1	6	1	9	2	11	2
1.0	4	1	9	2	13	3	16	3
1.5	5	1	11	2	16	3	20	4
2.0	6	1	13	3	18	4	23	5

PREDOMINATELY LOAMY/SILT SOILS (0.05MM AND LARGER DIAMETER PARTICLES

MODIFIED FROM "DESIGNING FOR EFFECTIVE SEDIMENT AND EROSION CONTROL ON CONSTRUCTION SITES" BY JERALD S. FIFIELD, PH.D. C.P.E.S.C.

NOTES:

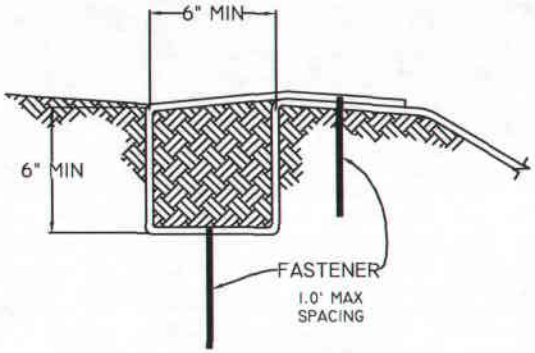
CONTRIBUTING AREA CAN BE NO LARGER THAN 2.0 ACRES
CAN USE STRAW BALES OR ROCK CHECK DAM IN PLACE OF SILT FENCE
LENGTHS AND WIDTHS VARY DEPENDING ON DRAINAGE AREA
REFER TO TABLE I FOR SIZING
DEPTH OF TRAP SHOULD AVERAGE 30 INCHES

CAD FILE NAME/DISK#: SC130

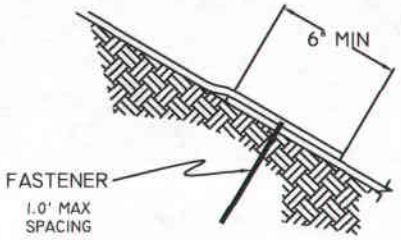
ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

SEDIMENT TRAP
SWPPP BMP'S
TYPICAL DRAWING

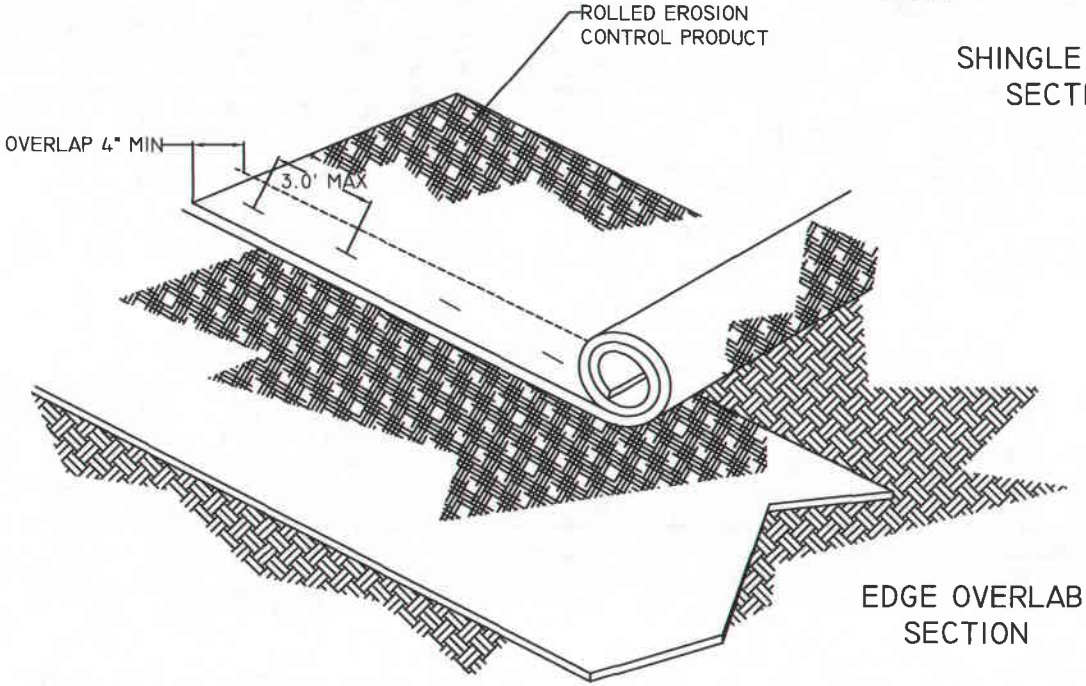
DRAWN BY:	DENNIS OAKLEY	SC130	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1	REV.



ANCHORING TRENCH
SECTION



SHINGLE SPLICE
SECTION



EDGE OVERLAB
SECTION

NOTES:

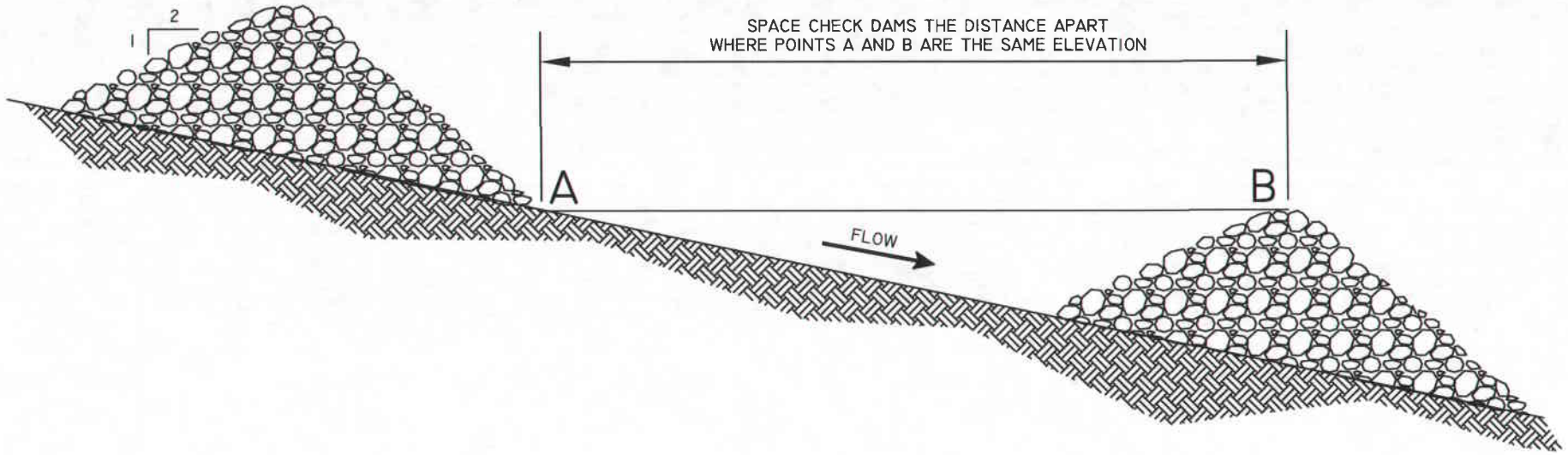
MORE THAN MINIMUM FASTENERS MAY BE REQUIRED DUE TO CONDITIONS SUCH AS SOIL TYPE, SURFACE UNIFORMITY, AND SLOPE STEEPNESS
USE STAPLES RECOMMENDED BY RECP MANUFACTURER
COMPACT SOIL IN ANCHORING TRENCH
FASTENER SPACING AT TOE SHOULD NOT EXCEED 1.0 FEET MAXIMUM

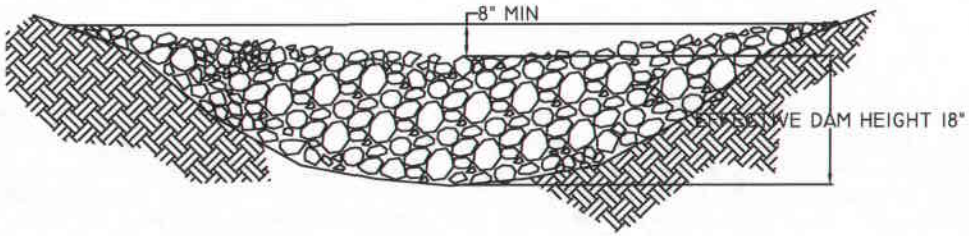
CAD FILE NAME/DISK#: SC140

ENERGY WEST
MINING COMPANY
A SUBSIDIARY OF PACIFICORP

RECP
SWPPP BMP'S
TYPICAL DRAWING

DRAWN BY:	DENNIS OAKLEY	SC140	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1	REV. ---





NOTES:

USE 2"-3" ROCK OR LARGER DEPENDING ON SLOPE

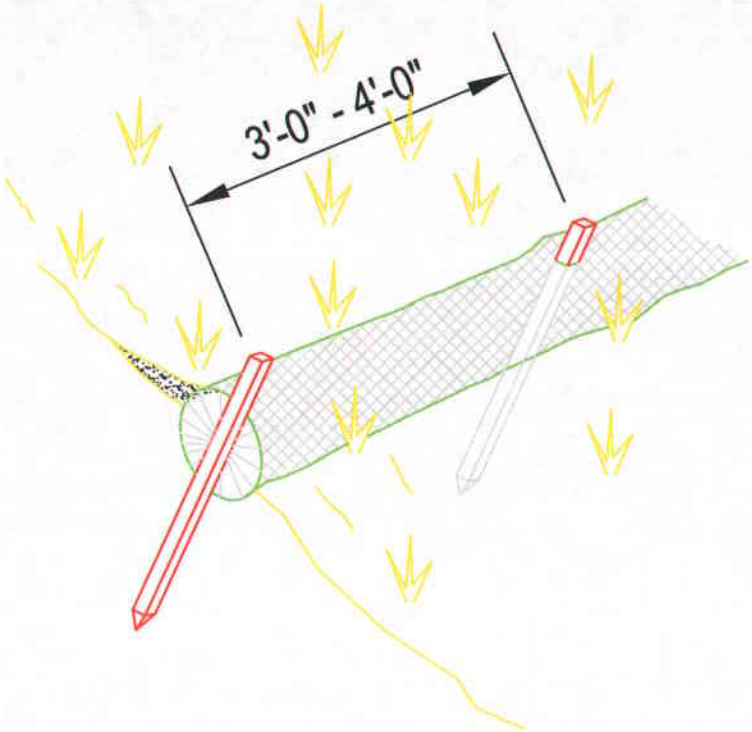
MAINTAIN REGULARLY AND AFTER STORM EVENTS

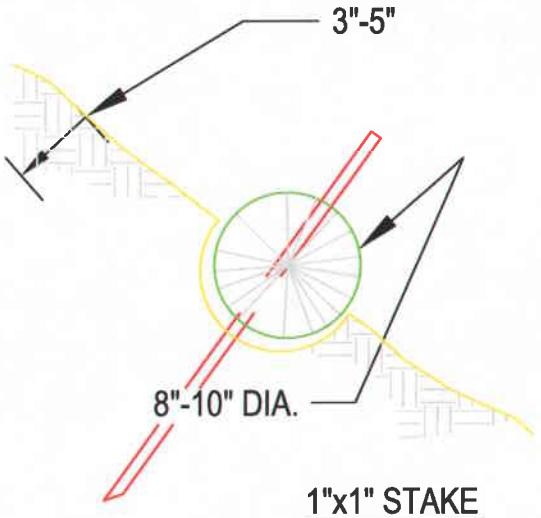
CAD FILE NAME/DISK#: SC150

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

CHECK DAMS SWPPP BMP'S TYPICAL DRAWING

DRAWN BY:	DENNIS OAKLEY	SC150	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1	REV. ---





1"x1" STAKE

NOTES:

INSTALLATION TO BE COMPLETED IN ACCORDANCE WITH MANUFACTURE'S SPECS.
STRAW ROLL INSTALL REQIRES THE PLACEMENT AND SECURE STAKING OF THE ROLL IN A TRENCH, 3"-5" DEEP, DUG ON CONTOUR.
RUNOFF MUST NOT BE ALLOWED TO RUN UNDER OR AROUND ROLL.
ABUT ADJACENT ROLLS TIGHTLY.

CAD FILE NAME/DISK#: SC160

ENERGY WEST MINING COMPANY
A SUBSIDIARY OF PACIFICORP

WATTLE
SWPPP BMP'S
TYPICAL DRAWING

DRAWN BY:	DENNIS OAKLEY	SC160	
SCALE:	NOT TO SCALE	DRAWING #:	
DATE:	3/7/2007	SHEET 1	REV. ___

Appendix 5

Soil Loss Calculations (RUSLE) – Operational

RUSLE2 Profile Erosion Calculation Record

Info:

File: profiles\Rilda Facility - UA-6

Inputs:
Location: Emery County\UT_Emery_R_12
Soil: UA-8
Horiz. overland flow path length: 780 ft
Avg. slope steepness: 72 %

Management	*Vegetation*	*Yield units*	*Yield (# of units)*
Strip/Barrier Managements\UA-8 Cool season grass; not harvested	UA-8 Range Southern desert shrub	pounds	640

Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: 1 gradient terrace 0.75% grade at bottom of RUSLE slope
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial

Outputs:
Soil loss erod. portion: 7.7 t/ac/yr
Detachment on slope: 7.7 t/ac/yr
Soil loss for cons. plan: 7.7 t/ac/yr
Sediment delivery: 3.5 t/ac/yr

Crit. slope length:
Surf. cover after planting: 0 %

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
1/1/0	UA-8 Graze, continuous	UA-8 Range Southern desert shrub	0
1/1/0	UA-8 Graze, continuous	UA-8 Range Southern desert shrub	0

RUSLE2 Profile Erosion Calculation Record

Info:

File: profiles\Rilda Facility - UA-8

Inputs:
Location: Emery County\UT_Emery_R_12
Soil: silty clay loam (low-mod OM,v. slow perm)
Horiz. overland flow path length: 170 ft
Avg. slope steepness: 54 %

Management	*Vegetation*	*Yield units*	*Yield (# of units)*
Strip/Barrier Managements\UA-8 Cool season grass; not harvested	UA-8 Range Southern desert shrub	pounds	644

Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial

Outputs:
Soil loss erod. portion: 13 t/ac/yr
Detachment on slope: 13 t/ac/yr
Soil loss for cons. plan: 13 t/ac/yr
Sediment delivery: 13 t/ac/yr

Crit. slope length: 51.0 ft
Surf. cover after planting: 0 %

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
1/1/0	UA-8 Graze, continuous	UA-8 Range Southern desert shrub	0

RUSLE2 Profile Erosion Calculation Record

Info:

File: profiles\Rilda Facility - UA-9a

Inputs:
Location: Emery County\UT_Emery_R_12
Soil: silty clay loam (low-mod OM,v. slow perm)
Horiz. overland flow path length: 347 ft
Avg. slope steepness: 56 %

Management	*Vegetation*	*Yield units*	*Yield (# of units)*
Strip/Barrier Managements\UA-8 Cool season grass; not harvested	UA-8 Range Southern desert shrub	pounds	640

Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial

Outputs:
Soil loss erod. portion: 14 t/ac/yr
Detachment on slope: 14 t/ac/yr
Soil loss for cons. plan: 6.8 t/ac/yr
Sediment delivery: 6.8 t/ac/yr

Crit. slope length:
Surf. cover after planting: 0 %

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
1/1/0	UA-8 Graze, continuous	UA-8 Range Southern desert shrub	0

RUSLE2 Profile Erosion Calculation Record

Info:

File: profiles\Rilda Facility - DA-3

Inputs:
Location: Emery County\UT_Emery_R_12
Soil: silty clay loam (low-mod OM,v. slow perm)
Horiz. overland flow path length: 296 ft
Avg. slope steepness: 14 %

Management	*Vegetation*	*Yield units*	*Yield (# of units)*

Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial

Outputs:
Soil loss erod. portion: 0.24 t/ac/yr
Detachment on slope: 0.24 t/ac/yr
Soil loss for cons. plan: 0.24 t/ac/yr
Sediment delivery: 0.24 t/ac/yr

Crit. slope length:
Surf. cover after planting: 0 %

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
1/1/0	Add mulch		99

RUSLE2 Profile Erosion Calculation Record

Info:

File: profiles\Rilda Facility - Basin DA-4

Inputs:
Location: Emery County\UT_Emery_R_12
Soil: silty clay loam (low-mod OM,v. slow perm)
Horiz. overland flow path length: 60.0 ft
Avg. slope steepness: 40 %

Management	*Vegetation*	*Yield units*	*Yield (# of units)*

Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial

Outputs:
Soil loss erod. portion: 2.2 t/ac/yr
Detachment on slope: 2.2 t/ac/yr
Soil loss for cons. plan: 2.2 t/ac/yr
Sediment delivery: 2.2 t/ac/yr

Crit. slope length:
Surf. cover after planting: 0 %

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
1/1/0	Add mulch		50

RUSLE2 Profile Erosion Calculation Record

Info:

File: profiles\Rilda Facility - Pond DA-5

Inputs:
Location: Emery County\UT_Emery_R_12
Soil: silty clay loam (low-mod OM,v. slow perm)
Horiz. overland flow path length: 171 ft
Avg. slope steepness: 44 %

Management	*Vegetation*	*Yield units*	*Yield (# of units)*

Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: (none)
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial

Outputs:
Soil loss erod. portion: 3.7 t/ac/yr
Detachment on slope: 3.7 t/ac/yr
Soil loss for cons. plan: 3.7 t/ac/yr
Sediment delivery: 3.7 t/ac/yr

Crit. slope length:
Surf. cover after planting: 0 %

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
1/1/0	Add mulch		50

Appendix 6

Channel Design – Reclamation

Reclaim Channel: RC-1
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\rilda re.fm2
Worksheet	RC-1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.320000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft
Discharge	2.55	cfs

Results		
Depth	0.24	ft
Flow Area	0.35	ft²
Wetted Perimeter	2.06	ft
Top Width	1.94	ft
Critical Depth	0.44	ft
Critical Slope	0.029413	ft/ft
Velocity	7.34	ft/s
Velocity Head	0.84	ft
Specific Energy	1.07	ft
Froude Number	3.06	
Flow is supercritical.		

Reclaim Channel: RC-2
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\rilda re.fm2
Worksheet	RC-2
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.135000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft
Discharge	0.92	cfs

Results		
Depth	0.17	ft
Flow Area	0.23	ft^2
Wetted Perimeter	1.77	ft
Top Width	1.68	ft
Critical Depth	0.25	ft
Critical Slope	0.033673	ft/ft
Velocity	4.01	ft/s
Velocity Head	0.25	ft
Specific Energy	0.42	ft
Froude Number	1.91	
Flow is supercritical.		

Reclaim Channel: RC-3
Worksheet for Trapezoidal Channel

Project Description	
Project File	c:\haestad\fmw\rilda re.fm2
Worksheet	RC-3
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.035	
Channel Slope	0.179000	ft/ft
Left Side Slope	2.000000	H : V
Right Side Slope	2.000000	H : V
Bottom Width	1.00	ft
Discharge	2.13	cfs

Results		
Depth	0.25	ft
Flow Area	0.38	ft^2
Wetted Perimeter	2.12	ft
Top Width	2.00	ft
Critical Depth	0.40	ft
Critical Slope	0.030104	ft/ft
Velocity	5.67	ft/s
Velocity Head	0.50	ft
Specific Energy	0.75	ft
Froude Number	2.31	
Flow is supercritical.		

Appendix 7

Soil Loss Calculations (RUSLE) - Reclamation

RUSLE2 Profile Erosion Calculation Record

Info:

File: profiles\Rilda Facility - Reclaim

Inputs:
Location: Emery County\UT_Emery_R_12
Soil: silty clay loam (low-mod OM,v. slow perm)
Horiz. overland flow path length: 120 ft
Avg. slope steepness: 29 %

Management	*Vegetation*	*Yield units*	*Yield (# of units)*
Rilda-Reclaim 1yr	Rilda - Grass, cool season, fall seeded -	ton	1.00

Contouring: a. rows up-and-down hill
Strips/barriers: (none)
Diversion/terrace, sediment basin: Rilda 6% grade channel at bottom of slope
Subsurface drainage: (none)
Adjust res. burial level: Normal res. burial

Outputs:
Soil loss erod. portion: 5.9 t/ac/yr
Detachment on slope: 5.9 t/ac/yr
Soil loss for cons. plan: 5.9 t/ac/yr
Sediment delivery: 5.9 t/ac/yr

Crit. slope length:
Surf. cover after planting: 0 %

Date	*Operation*	*Vegetation*	*Surf. res. cov. after op, %*
5/1/0	Bulldozer, filling/leveling		0
5/1/0	Chisel, st. pt. 15 in deep		0
6/1/0	Planting, broadcast seeder	Rilda - Grass, cool season, fall seeded -	0
6/15/0	Add mulch		70

PacifiCorp

Energy West Mining Company

Deer Creek Mine

C/015/0018

Amendment Update the Deer Creek Mining and Reclamation Plan, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

Seven (7) Redline/Strikeout Copies – Volume 11, Appendix Volume B, Hydrology Tab, Appendix B

Maps Section – Replace Maps 700-1, 700-2, 700-3, 700-4.

Deer Creek Coal Mine
Rilda Canyon
Portal Facilities

Hydrology
Maps Section

Permit No. C/015/018
December 2004
Amended June 2010 2010

Volume 11
Appendix Volume
Appendix B

R645-301-700

HYDROLOGY

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PacifiCorp

Energy West Mining Company

Deer Creek Mine

C/015/0018

Amendment Update the Deer Creek Mining and Reclamation Plan, Volume 11, North Rilda Canyon Portal Facilities, PacifiCorp, Deer Creek Mine, C/015/0018, Emery County, Utah.

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Maps Section – Remove Maps 700-5 and 700-6.