Form DOGM - E (Last Revised 6/93)

File Folder # 3

PERMIT CHANGE TRACKING FORM

DATE RECEIVED	8/20/93	PERMIT NUMBER	ACT/015/025
Title of Proposal:	D4aD & D-13D	PERMIT CHANGE #	93K
Description:	NOV N93-35-5-1 and N93-35-6-1	PERMITTEE	Co-Op Mining Co.
		MINE NAME	Bear Canyon Mine

	DATE DUE	DATE DONE	RESULT	
☐ 15 DAY INITIAL RESPONSE TO PERMIT CHANGE APPLICATION			☐ ACCEPTED	☐ REJECTED
☐ Notice of Review Status of proposed permit change sent to the Permittee.			Permit Change Classification	
☐ Request additional review copies prior to Division/Other Agency review.			☐ Significant Permit Revision	
☐ Notice of Approval of Publication. (If change is a Significant Revision.)			☐ Permit Amendment	
☐ Notice of request to modify proposed permit change prior to approval.			☐ Incidental Boundary Change	

REVIEW TRACKING	INITIAL REVIEW		MODIFIED REVIEW		FINAL REVIEW AND FINDINGS	
DOGM REVIEWER	DUE	DONE	DUE	DONE	DUE	DONE
☐ Administrative ____						
☐ Biology ____						
☐ Engineering JK						
☐ Geology ____						
☐ Soils ____						
☐ Hydrology TM HK						
☐ Bonding ____						
☐ AVS Check ____						
COORDINATED REVIEWS	**DUE**	**DONE**	**DUE**	**DONE**	**DUE**	**DONE**
☐ OSMRE						
☐ US Forest Service						
☐ Bureau of Land Management						
☐ US Fish and Wildlife Service						
☐ US National Parks Service						
☐ UT Environmental Quality						
☐ UT Water Resources						
☐ UT Water Rights						
☐ UT Wildlife Resources						
☐ UT State History						
☐ Other						

☐ Public Notice/Comment/Hearing Complete (If the permit change is a Significant Revision)		☐ Permit Change Approval Form signed and approved effective as of this date. ☐ Permit Change Denied.	
☐ Copies of permit change marked and ready for MRP.		☐ Notice of ☐ Approval ☐ Denial to Permittee.	
☐ Special Conditions/Stipulations written for approval.		☐ Copy of Approved Permit Change to File.	
☐ TA and CHIA modified as required.		☐ Copy of Approved Permit Change to Permittee.	
☐ Permit Change Approval Form ready for approval.		☐ Copies to Other Agencies and Price Field Office.	

Form DOGM - E (Last Revised 6/93)

File Folder # 3

PERMIT CHANGE TRACKING FORM

DATE RECEIVED	8/20/93	PERMIT NUMBER	ACT/015/028
Title of Proposal:	D4aD & D-13D	PERMIT CHANGE #	93K
Description:	NOV N93-35-5-1 and N93-35-6-1	PERMITTEE	Co-Op Mining Co.
		MINE NAME	Bear Canyon Mine

	DATE DUE	DATE DONE	RESULT	
☐ 15 DAY INITIAL RESPONSE TO PERMIT CHANGE APPLICATION			☐ ACCEPTED	☐ REJECTED
☐ Notice of Review Status of proposed permit change sent to the Permittee.			Permit Change Classification	
☐ Request additional review copies prior to Division/Other Agency review.			☐ Significant Permit Revision	
☐ Notice of Approval of Publication. (If change is a Significant Revision.)			☐ Permit Amendment	
☐ Notice of request to modify proposed permit change prior to approval.			☐ Incidental Boundary Change	

REVIEW TRACKING	INITIAL REVIEW		MODIFIED REVIEW		FINAL REVIEW AND FINDINGS	
DOGM REVIEWER	DUE	DONE	DUE	DONE	DUE	DONE
☐ Administrative ____						
☐ Biology ____						
☐ Engineering JK						
☐ Geology ____						
☐ Soils ____						
☐ Hydrology TM HK						
☐ Bonding ____						
☐ AVS Check ____						
COORDINATED REVIEWS	**DUE**	**DONE**	**DUE**	**DONE**	**DUE**	**DONE**
☐ OSMRE						
☐ US Forest Service						
☐ Bureau of Land Management						
☐ US Fish and Wildlife Service						
☐ US National Parks Service						
☐ UT Environmental Quality						
☐ UT Water Resources						
☐ UT Water Rights						
☐ UT Wildlife Resources						
☐ UT State History						
☐ Other						

☐ Public Notice/Comment/Hearing Complete (If the permit change is a Significant Revision)		☐ Permit Change Approval Form signed and approved effective as of this date. ☐ Permit Change Denied.	
☐ Copies of permit change marked and ready for MRP.		☐ Notice of ☐ Approval ☐ Denial to Permittee.	
☐ Special Conditions/Stipulations written for approval.		☐ Copy of Approved Permit Change to File.	
☐ TA and CHIA modified as required.		☐ Copy of Approved Permit Change to Permittee.	
☐ Permit Change Approval Form ready for approval.		☐ Copies to Other Agencies and Price Field Office.	

PERMIT AMENDMENT APPROVAL

Title: D-4AD AND D-13D DESIGN	PERMIT NUMBER: ACT/015/025
Description: NOV N93-35-5-1 AND N93-35-6-1	PERMIT CHANGE #: 93K
	MINE: BEAR CANYON MINE
	PERMITTEE: CO-OP MINING

	WRITTEN FINDINGS FOR PERMIT APPLICATION APPROVAL	YES, NO or N/A
1.	The application is complete and accurate and the applicant has complied with all the requirements of the State Program.	
2.	The proposed permit area is not within an area under study or administrative proceedings under a petition, filed pursuant to R645-103-400 or 30 CFR 769, to have an area designated as unsuitable for coal mining and reclamation operations, unless:	
	A. The applicant has demonstrated that before January 4, 1977, substantial legal and financial commitments were made in relation to the operation covered by the permit application, or	
	B. The applicant has demonstrated that the proposed permit area is not within an area designated as unsuitable for mining pursuant to R645-103-300 and R645-103-400 or 30 CFR 769 or subject to the prohibitions or limitations of R645-103-230.	
3.	For coal mining and reclamation operations where the private mineral estate to be mined has been severed from the private surface estate, the applicant has submitted to the Division the documentation required under R645-301-114.200.	
4.	The Division has made an assessment of the probable cumulative impacts of all anticipated coal mining and reclamation operations on the hydrologic balance in the cumulative impact area and has determined that the proposed operation has been designed to prevent material damage to the hydrologic balance outside the permit area.	
5.	The operation would not affect the continued existence of endangered or threatened species or result in destruction or adverse modification of their critical habitats, as determined under the Endangered Species Act of 1973 (16 U.S.C. 1531 et.seq.).	
6.	The Division has taken into account the effect of the proposed permitting action on properties listed on and eligible for listing on the National Register of Historic Places. This finding may be supported in part by inclusion of appropriate permit conditions or changes in the operation plan protecting historic resources, or a documented decision that the Division has determined that no additional protection measures are necessary.	
7.	The Applicant has demonstrated that reclamation as required by the State Program can be accomplished according to information given in the permit application.	
8.	The Applicant has demonstrated that any existing structure will comply with the applicable performance standards of R645-301 and R645-302.	
9.	The Applicant has paid all reclamation fees from previous and existing coal mining and reclamation operations as required by 30 CFR Part 870.	
10.	The Applicant has satisfied the applicable requirements of R645-302.	
11.	The Applicant has, if applicable, satisfied the requirements for approval of a long-term, intensive agricultural postmining land use, in accordance with the requirements of R645-301-353.400.	

	SPECIAL CONDITIONS OR STIPULATIONS TO THE PERMIT AMENDMENT APPROVAL	YES	NO
1.	Are there any variances associated with this permit amendment approval? If yes, attach.		
2.	Are there any special conditions associated with this permit amendment approval? If yes, attach.		
3.	Are there any stipulations associated with this permit amendment approval? If yes, attach.		

The Division hereby grants approval for Permit Amendment to the Existing Permit by incorporation of the proposed changes described herein and effective the date signed below. All other terms and conditions of the Existing Permit shall be maintained and in effect except as superseded by this Permit Amendment.

Signed _____ _____

Director, Division of Oil, Gas and Mining **EFFECTIVE DATE**

PERMIT CHANGE CHRONOLOGY

Title of Proposal: D-4AD AND D-13D	PERMIT NUMBER: ACT/015/025
Description: NOV N93-35-5-1 AND N93-35-6-1	PERMIT CHANGE #: 93K
	PERMITTEE: CO-OP MINING COMPANY
	MINE NAME: BEAR CANYON MINE

DATE		DOCUMENT ALL ACTIVITIES ASSOCIATED WITH THIS PERMIT CHANGE
	☐Sent ☒Recv'd.	Initial Application for Permit Change Received from Permittee
	☐Sent ☐Recv'd.	
	☐Sent ☐Recv'd.	
	☐Sent ☐Recv'd.	
	☐Sent ☐Recv'd.	
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	☐Sent ☐Recv'd.	

☐ ADDITIONAL SHEETS

Form DOGM - 9.1 (Last Revised 6/93)

File Folder # 3

APPLICATION FOR PERMIT CHANGE

Title of Change: D-4aD and D-13D design

Permit Number: ACT/015/025

Mine: Bear Canyon

Permittee: Co-Op Mining Co

Description, include reason for change and timing required to implement:

Abatement of NOV # 93-35-5-1 + 93-35-6-1

☐ Yes	☒ No	1. Change in the size of the Permit Area? _____ acres ☐ increase ☐ decrease.
☐ Yes	☒ No	2. Change in the size of the Disturbed Area? _____ acres ☐ increase ☐ decrease.
☐ Yes	☒ No	3. Will permit change include operations outside the Cumulative Hydrologic Impact Area?
☐ Yes	☒ No	4. Will permit change include operations in hydrologic basins other than currently approved?
☐ Yes	☒ No	5. Does permit change result from cancellation, reduction or increase of insurance or reclamation bond?
☐ Yes	☒ No	6. Does permit change require or include public notice publication?
☒ Yes	☐ No	7. Permit change as a result of a Violation? Violation # 93-35-5-1, 93-35-6-1
☐ Yes	☒ No	8. Permit change as a result of a Division Order? D.O.#
☐ Yes	☒ No	9. Permit change as a result of other laws or regulations? Explain:
☐ Yes	☒ No	10. Does permit change require or include ownership, control, right-of-entry, or compliance information?
☐ Yes	☒ No	11. Does the permit change affect the surface landowner or change the post mining land use?
☐ Yes	☒ No	12. Does permit change require or include collection and reporting of any baseline information?
☐ Yes	☒ No	13. Could the permit change have any effect on wildlife or vegetation outside the current disturbed area?
☐ Yes	☒ No	14. Does permit change require or include soil removal, storage or placement?
☐ Yes	☒ No	15. Does permit change require or include vegetation monitoring, removal or revegetation activities?
☐ Yes	☒ No	16. Does permit change require or include construction, modification, or removal of surface facilities?
☒ Yes	☐ No	17. Does permit change require or include water monitoring, sediment or drainage control measures?
☒ Yes	☐ No	18. Does permit change require or include certified designs, maps, or calculations?
☐ Yes	☒ No	19. Does permit change require or include underground design or mine sequence and timing?
☐ Yes	☒ No	20. Does permit change require or include subsidence control or monitoring?
☐ Yes	☒ No	21. Have reclamation costs for bonding been provided or revised for any change in the reclamation plan?
☐ Yes	☒ No	22. Is permit change within 100 feet of a public road or perennial stream or 500 feet of an occupied dwelling?
☐ Yes	☒ No	23. Is this permit change coal exploration activity ☐ inside ☐ outside of the permit area?

☒ **Attach 3 complete copies of proposed permit change as it would be incorporated into the Mining and Reclamation Plan.**

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.

Charles Reynolds 8-18-93
Signed - Name - Position - Date Compliance Coordinator

Subscribed and sworn to before me this 18th day of August, 19 93

Leanne Stone
Notary Public

My Commission Expires: _____, 19__

Attest: STATE OF _____
COUNTY OF _____

Notary Public
LEANNE STONE
P.O. Box 300
Huntington, Utah 84528
My Commission Expires
June 18, 1997
State of Utah

Received by Oil, Gas & Mining

8/20/93

ASSIGNED PERMIT CHANGE NUMBER

Application for Permit Change
Detailed Schedule of Changes to the Permit

Title of Change: D-4aD and D-13D design

Permit Number: ACT/015/025

Mine: Bear Canyon

Permittee: Co-Op Mining Co.

Provide a detailed listing of all changes to the mining and reclamation plan which will be required as a result of this proposed permit change. Individually list all maps and drawings which are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise the exiting mining and reclamation plan. Include page, section and drawing numbers as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
☐ ADD	☒ REPLACE	☐ REMOVE	7-87, 7-89; Tables Updated
☐ ADD	☒ REPLACE	☐ REMOVE	76-24A, 76-24B; Culvert designs Updated
☐ ADD	☒ REPLACE	☐ REMOVE	76-45A; C-7D abandoned
☐ ADD	☒ REPLACE	☐ REMOVE	76-46; Ditch designs Updated
☒ ADD	☐ REPLACE	☐ REMOVE	76-57A; Ditch D-4aD Calculations (93-35-6-1)
☒ ADD	☐ REPLACE	☐ REMOVE	76-108; Ditch D-13D Calculations (93-35-5-1)
☐ ADD	☒ REPLACE	☐ REMOVE	Plate 7-1C; Ditches Added to Hydrology map
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
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☐ ADD	☐ REPLACE	☐ REMOVE	

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

Construction of D-4aD is dependent upon approval of "Coal Storage Pad Interim Reclamation" (93D), because the slope which the ditch will be constructed will be reclaimed and recontoured prior to construction of ditch D-4aD

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DRAFT

Table 7.2-10 Summary of Diversion Ditch Calculations

DITCH	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	DEPTH (FT)	TYP SIDE SLOPE H:V	MEASURED SLOPE %	CONTRIBUTING WATERSHED	REQ'D AV. RIP-RAP SIZE (IN.)
D-1D	0	1.33	0.67	1:1	2 Min 11 Max	AD-3A	Soil
D-2D	0	1.33	0.67	1:1	6 Min 20 Max	AD-3A, AD-5	Bedrock
D-3D	0	2	1	1:1	2 Min 6 Av. 18 Max	AD-3A, AD-5 AD-7	Soil Soil Grouted
D-4D	0	2	1	1:1	2 Min 6 Av. 17 Max	~~AD-8,~~ AD-14	Soil Soil D_{50} 6"
D-5D	0	1.33	0.67	1:1	4 Min 10 Max	AD-9	Soil
D-6D	0	3	1.5	1:1	2 Min 4 Max	AD-3A,AD-5,AD-7, ~~AD-8,~~AD-9,AD-10, AD-12,AD-14	Soil
D-7D	2	3.5	~~0.5~~ 0.75	1.5:1	2 Min 6 Av. 55 Max	AD-1A,AD-1B,AD-2A,AD-2B,AD-2C, AD-3B,AD-4,AD-6, AD-8	Soil Soil D_{50} 6"
D-8D	0	2	1	1:1	2 Min 7 Max	AD-13	Soil
D-8D Water Bar	0	2.67	0.67	2:1	3 Av.	AD-13	Soil
D-9D	0	2	1	1:1	4 Min 10 Max	AD-15	Soil
D-10D	1	3.33	0.67	1.5:1	7 Min 50 Max	AD-6,AD-3B,(part) AD-2B, AD-2C	D_{50} 4" Bedrock
D-10aD	0	2	1	1:1	7 Av.	AD-6,AD-3B,(part) AD-2B, AD-2C	Soil
D-11D	0	1	0.5	1:1	41 Min Near Vert	TIPPLE WASH HOSE	Grouted Rip-rap
D-12D	0	1	0.5	1:1	81 Av.	TIPPLE WASH HOSE	Grouted
D-13D Water Bar	0	6	0.5	10:1 2:1	0.5 Av.	AD-6 Partial	Soil

Notes:

1. Dimensions given indicate minimum requirements. Actual dimensions may vary. Minimum required cross section will be maintained.
2. The use of riprap to line drainage ditches is required when flow velocities exceed approximately 5 feet per second. Rip-rap may be installed where not required.

Table 7.2-11 Culvert Charateristics

Culvert	Dia in.	Type	Contributing Watersheds	Slope ft/ft	Outlet Condition
C-1U	30 15	CMP & flexible	AU-3, AU-4, AU-5	0.73	Bedrock
C-2U	12	stl pipe	AU-11	0.08	Soil
C-3U	12	CMP	AU-6, AU-7, AU-11	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	0.05	4" rip-rap
C-5U	12	CMP	AU-8, AU-9, AU-15	0.05	4" rip-rap
C-6U	12	CMP	AU-6, AU-7, AU-11, AU-13, AU-14	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.05	6" rip-rap
C-8U	18	CMP to RCP	AU-2, AU-3 AU-4, AU-5	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek	0.06	48" rip-rap
C-11U	18	CMP	AU-16	0.10	6" rip-rap
C-12U	24	CMP	AU-17	0.04	6" rip-rap
C-13U & C-13aU	16	CMP	misc. road drainage	0.06	3" rip-rap
C-14U	60	CMP	Bear Creek	0.06	48" rip-rap
C-1D	15	CMP, flexible	AD-6, AD-3B	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 ~~AD-7, AD-8~~	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.08	soil
C-6D	12	CMP	AD-10	0.48	9" rip-rap
C-7D	18	CMP	Abandoned in Place		
C-8D	18	CMP	AD-3A, AD-5 AD-7	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.03	3" rip-rap

DRAFT

Shower House Drainage Control and Stream Protection

Due to the narrow nature of Bear Canyon, disturbance for the shower house structure and parking lot will encroach upon the 100 ft buffer zone of Bear Creek. Co-Op requests authorization from the division for operation within this zone. Bear Creek will be protected from disturbed runoff or sediment loading with berms placed along the lower edge of the disturbed area. Ditch D-9D (Plate 7-1B) will convey all disturbed runoff from the area to sediment pond "C", preventing disturbed runoff from entering Bear Creek. Stream Buffer Zone signs will be placed at the edge of the disturbed area as shown on Plate 2-4C in accordance with section 3.5.3.1.

Access to the area will require the crossing of Bear Creek. A 60" culvert (C-14U) will be installed according to the stream alteration permit shown in Appendix 7-O. The only other impact to Bear Creek will be the riprapping of the outlet to sediment pond "C", also included in Appendix 7-O. Temporary sediment control structures will be placed in Bear Creek during the installation of C-14U to trap sediment resulting from the culvert installation. Reclamation of C-14U will be performed in accordance with section 7.3.3.

Area AD-8 Drainage, 1993

In 1993, the inlet to culvert C-7D failed, resulting in NOV 93-35-6-1. In order to eliminate the maintenance problems with culvert C-7D, the south end of drainage area AD-8, the coal storage pad, will be regraded to allow the drainage to flow into ditch D-7D below the water tank shown on Plate 2-4C. At this point, the storage pad is level with D-7D, allowing drainage to easily flow into the ditch. The berm around the coal storage pad will prevent drainage over the edge of the pad and direct the flow toward ditch D-7D. The point at which the storage pad intersects D-7D is outside of the angle of repose of the coal pile, and the ditch will not be plugged by coal spillage. A catch basin exists just below this point which will trap any coal fines which may be washed into the drainage, protecting ditch D-7D below this point.

7.2.7.4 Additional Sediment Control

In order to reduce potential impacts from sediment, silt fences shall be installed as shown in Figure 7.2-15. Silt fence locations are noted on Plates 7-1.

DRAFT

CULVERT CHARACTERISTICS (con't)

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1D	15	CMP, flexible	AD-6, AD-3B	0.93	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	1.47	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.23	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7~~, AD-8~~	4.43	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.23	0.08	soil
C-6D	12	CMP	AD-10	0.62	0.48	9" rip-rap
C-7D	18	CMP	Abandoned In Place			
C-8D	18	CMP	AD-3A, AD-5 AD-7	2.36	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	2.36	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.25	0.03	3" rip-rap

DRAFT

Circular Channel Analysis & Design
Solved with Manning's Equation

Open Channel - Uniform flow

Worksheet Name: CULVERT ADEQUACY

Comment: CULVERT C-4D

Solve For Actual Depth

Given Input Data:

Diameter.....	1.75 ft
Slope.....	0.1800 ft/ft
Manning's n.....	0.024
Discharge.....	2.36 cfs

Computed Results:

Depth.....	0.30 ft
Velocity.....	8.52 fps
Flow Area.....	0.28 sf
Critical Depth....	0.56 ft
Critical Slope....	0.0159 ft/ft
Percent Full.....	17.25 %
Full Capacity.....	36.41 cfs
QMAX @.94D.....	39.17 cfs
Froude Number.....	3.28 (flow is Supercritical)

Open Channel Flow Module, Version 3.3 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

DRAFT

Culvert C-7D

Abandoned In Place

DRAFT

B.C. 7G-45A 10/05/93

DITCH CHARACTERISTICS

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q(cfs)	BANK AND BOTTOM DESC.	MANNING'S $\eta^{(a)}$
D-1D	2 Min, 11 Max	AD-3A	0.23	Rocky Soil	0.03
D-2D	6 Min, 20 Max	AD-3A, AD-5	0.53	Rocky Soil, Bedrock	0.03
D-3D	2 Min, 6 Av, 14 Max	AD-3A, AD-5, AD-7	2.36	Soil, grouted half round culvert	0.03
D-4D	2 Min, 7 Av, 17 Max	~~AD-8,~~ AD-14	~~2.12~~ 0.05	Soil	0.03
D-5D	4 Min, 10 Max	AD-9	0.23	Soil	0.03
D-6D	2 Min, 4 Max	AD-3A, AD-5, AD-7, ~~AD-8,~~ AD-9, AD-10, AD-12, AD-14	~~5.68~~ 3.61	Rocky Soil	0.03
D-7D	2 Min, 6 Av, 55 Max	AD-1A, AD-1B, AD-2A, AD-2B, AD-2C, AD-3B, AD-4, AD-6, AD-8	~~2.39~~ 4.46	Soil, D_{50}=3"	0.03, 0.033
D-8D	2 Min, 7 Max	AD-13	1.23	Soil	0.03
D-8D Water Bar	3 Av.	AD-13	1.23	Soil	0.03
D-9D	4 Min, 10 Max	AD-15	1.25	Soil	0.03
D-10D	7 Min, 50 Max	AD-6, AD-3B, AD-2C	0.93	D_{50}=4"	0.033
D-10aD	7 Av.	AD-6, AD-3B, AD-2C(part)	0.93	D_{50}=4"	0.033
D-11D	41 Min, Near Vertical Max	TIPPLE WASH HOSE	0.25	Grouted rip-rap	0.035
D-12D	81 Av.	TIPPLE WASH HOSE	0.25	Grouted	0.03
D-13D Water Bar	0.5 Av.	AD-6 Partial	0.23	Soil	0.03

DRAFT

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-4D

Comment: MIN SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	0.05 cfs

Computed Results:

Depth.....	0.20 ft
Velocity.....	1.21 fps
Flow Area.....	0.04 sf
Flow Top Width...	0.41 ft
Wetted Perimeter.	0.57 ft
Critical Depth...	0.17 ft
Critical Slope...	0.0471 ft/ft
Froude Number....	0.67 (flow is Subcritical)

Use Minimum Depth = 1 ft	=>	Min Freeboard = ~~0.17~~ 0.80ft
Velocity < 5 fps	=>	No rip-rap required typ
At steep slope 17%	=>	Use D_{50}= 6"

Open Channel Flow Module, Version 3.3 (c) 1991
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DRAFT

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-4D

Comment: AV. SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0700 ft/ft
Discharge.....	0.05 cfs

Computed Results:

Depth.....	0.16 ft
Velocity.....	1.94 fps
Flow Area.....	0.03 sf
Flow Top Width...	0.32 ft
Wetted Perimeter.	0.45 ft
Critical Depth...	0.17 ft
Critical Slope...	0.0471 ft/ft
Froude Number....	1.20 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-4D

Comment: MAX SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.1700 ft/ft
Discharge.....	0.05 cfs

Computed Results:

Depth.....	0.14 ft
Velocity.....	2.70 fps
Flow Area.....	0.02 sf
Flow Top Width...	0.27 ft
Wetted Perimeter.	0.38 ft
Critical Depth...	0.17 ft
Critical Slope...	0.0471 ft/ft
Froude Number....	1.83 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-6D

Comment: MIN SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	3.61 cfs

Computed Results:

Depth.....	1.01 ft
Velocity.....	3.53 fps
Flow Area.....	1.02 sf
Flow Top Width...	2.02 ft
Wetted Perimeter.	2.86 ft
Critical Depth...	0.96 ft
Critical Slope...	0.0266 ft/ft
Froude Number....	0.87 (flow is Subcritical)

Use Minimum Depth = 1.5 ft => Min Freeboard = 0.345 ft
Velocity ≈ 5 fps => No rip-rap required

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-6D

Comment: MAX SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0400 ft/ft
Discharge.....	3.61 cfs

Computed Results:

Depth.....	0.89 ft
Velocity.....	4.58 fps
Flow Area.....	0.79 sf
Flow Top Width...	1.78 ft
Wetted Perimeter.	2.51 ft
Critical Depth...	0.96 ft
Critical Slope...	0.0266 ft/ft
Froude Number....	1.21 (flow is Supercritical)

Open Channel Flow Module, Version 3.3 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Ditch D-7D

Comment: MIN SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0200 ft/ft
Discharge.....	4.46 cfs

Computed Results:

Depth.....	0.48 ft
Velocity.....	3.46 fps
Flow Area.....	1.29 sf
Flow Top Width...	3.43 ft
Wetted Perimeter.	3.71 ft
Critical Depth...	0.47 ft
Critical Slope...	0.0203 ft/ft
Froude Number....	0.99 (flow is Subcritical)

Use Minimum Depth = 0.75 ft	=>	Min Freeboard = 0.~~15~~27 ft
Velocity < 5 fps	=>	No rip-rap required typ
At steep slope 55%	=>	Use D_{50}= 6"

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Ditch D-7D

Comment: AV. SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0600 ft/ft
Discharge.....	1.46 cfs

Computed Results:

Depth.....	0.35 ft
Velocity.....	5.07 fps
Flow Area.....	0.88 sf
Flow Top Width...	3.05 ft
Wetted Perimeter.	3.26 ft
Critical Depth...	0.47 ft
Critical Slope...	0.0203 ft/ft
Froude Number....	1.66 (flow is Supercritical)

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: Ditch D-7D

Comment: MAX SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	2.00 ft
Left Side Slope..	1.50:1 (H:V)
Right Side Slope.	1.50:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.5500 ft/ft
Discharge.....	4.46 cfs

Computed Results:

Depth.....	0.18 ft
Velocity.....	10.68 fps
Flow Area.....	0.42 sf
Flow Top Width...	2.55 ft
Wetted Perimeter.	2.66 ft
Critical Depth...	0.47 ft
Critical Slope...	0.0203 ft/ft
Froude Number....	1.65 (flow is Supercritical)

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DRAFT

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-13D

Comment: WATER BAR

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	0.23 cfs

Computed Results:

Depth.....	0.22 ft
Velocity.....	0.79 fps
Flow Area.....	0.29 sf
Flow Top Width...	2.64 ft
Wetted Perimeter.	2.70 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0317 ft/ft
Froude Number....	0.42 (flow is Subcritical)

Use Minimum Depth = 6 inches	=>	Min Freeboard = 0.34 ft
Velocity < 5 fps	=>	No rip-rap required

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Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340
801-359-3940 (Fax)
801-538-5319 (TDD)

November 18, 1993

Mr. Robert Hagen, Director
Office of Surface Mining
Reclamation and Enforcement
505 Marquette N.W., Suite 1200
Albuquerque, New Mexico 87102

Re: Abatement Plans for N93-35-5-1 and N93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025-93K, Folder #2, Emery County, Utah

Dear Mr. Hagen:

Enclosed please find the finalized copies of the permit changes for the above-noted violations.

Sincerely,

Pamela Grubaugh-Littig
Permit Supervisor

pgl
Enclosure
cc/enc: Bill Malencik, PFO

September 22, 1993

Please finalize

TO: Pamela Grubaugh-Littig, Permit Supervisor

FROM: Thomas Munson, Senior Reclamation Hydrologist

RE: D-4aD and D-13D Design, Nov#93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025, File Folder # 2 and 5, Emery County, Utah

Synopsis

The Division received abatement plans to NOV #93-35-5-1 and N93-35-6-1 on August 20,1993. This memo discusses the changes made to the drainage plan to abate the ~~NOV~~ violations

Analysis

The operator has provided the necessary supporting data to describe designed swale necessary to abate N93-35-5-1.

In regards to N93-35-6-1 it is important to mention that the operator has tried in the past to use concrete pilings and infiltration galleries to control the flows in this area. They have both been successful in an limited sense. The current proposal to use an open ditch hopefully will prevent past failures due to clogging. There is no mention of headwalls associated with ditch D-4aD. It is also appropriate that the operator show how runoff will be controlled at the inlet and outlet of this ditch. There also is a question how the operator will prevent coal from blocking the inlet to the ditch.

Recommendation

Approve the plans and calculations regarding the swale and N93-35-5-1.

In regards to N93-35-6-1 provide the necessary information to delineate the inlet and outlet to ditch D-4aD and how coal will be prevented from blocking this inlet and also how excessive erosion and/or deposition of coal material will be controlled at the outlet.

CO-OP MINING COMPANY

P.O. Box 1245
Huntington, Utah 84528

(801) 381-5238
Coal Sales (801) 381-5777

Tom — For your further review by 10/19. Do you have the files?

tober 5, 1993

Pamela Grubaugh-Littig
Permit Supervisor
Utah Division of Oil, G
3 Triad Center, Suite 3
Salt Lake City, Utah 84

DIVISION OF
OIL, GAS & MINING

Ms. Grubaugh-Littig,

Re: D-13D and AD-8 drainage, NOV93-35-5-1, NOV93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025-93K, Emery County, Utah

Enclosed are three copies of a revised proposal for abatement of the above referenced violations. This submittal is being made in response to the deficiency letter dated September 23, 1993 for proposal 93K.

After review of the previous design of D-4aD, it was concluded that protection of the inlet would be difficult and a high maintenance issue. An alternative was selected to regrade the South end of the pad to allow the drainage to drain into D-7D, which passes the storage pad on the West side, and is level with the pad at the South end. We feel this design will prevent future problems with the drainage from the coal storage pad.

Also enclosed is a revised "Detailed Schedule of Changes to the Permit". Please replace the previous submittal with these pages and plates. Pages and Plates have been marked DRAFT to distinguish them frompreviously approved pages and plates. Upon approval, finalized copies will be sent to the Division. If you have any questions, please call Charles Reynolds at (801) 381-2450.

Thank You,

Wendell Owen

Wendell Owen,
Resident Agent

WJO/sr

CO-OP MINING COMPANY

P.O. Box 1245
Huntington, Utah 84528

(801) 381-5238
Coal Sales (801) 381-5777

October 5, 1993

Pamela Grubaugh-Littig
Permit Supervisor
Utah Division of Oil, Gas & Mining
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

RECEIVED
OCT 08 1993
DIVISION OF
OIL, GAS & MINING

Ms. Grubaugh-Littig,

Re: D-13D and AD-8 drainage, NOV93-35-5-1, NOV93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025-93K, Emery County, Utah

Enclosed are three copies of a revised proposal for abatement of the above referenced violations. This submittal is being made in response to the deficiency letter dated September 23, 1993 for proposal 93K.

After review of the previous design of D-4aD, it was concluded that protection of the inlet would be difficult and a high maintenance issue. An alternative was selected to regrade the South end of the pad to allow the drainage to drain into D-7D, which passes the storage pad on the West side, and is level with the pad at the South end. We feel this design will prevent future problems with the drainage from the coal storage pad.

Also enclosed is a revised "Detailed Schedule of Changes to the Permit". Please replace the previous submittal with these pages and plates. Pages and Plates have been marked DRAFT to distinguish them frompreviously approved pages and plates. Upon approval, finalized copies will be sent to the Division. If you have any questions, please call Charles Reynolds at (801) 381-2450.

Thank You,

Wendell Owen

Wendell Owen,
Resident Agent

WJO/sr

Form DOGM - C2 (Last Revised 6/93)

File Folder # 3

Application for Permit Change
Detailed Schedule of Changes to the Permit

Title of Change: AD8 + D-13D design (93K)

Permit Number: ACT 015 1025

Mine: Bear Canyon

Permittee: Co-Op Mining Co.

Provide a detailed listing of all changes to the mining and reclamation plan which will be required as a result of this proposed permit change. Individually list all maps and drawings which are to be added, replaced, or removed from the plan. Include changes of the table of contents, section of the plan, pages, or other information as needed to specifically locate, identify and revise the exiting mining and reclamation plan. Include page, section and drawing numbers as part of the description.

			DESCRIPTION OF MAP, TEXT, OR MATERIALS TO BE CHANGED
☐ ADD	☒ REPLACE	☐ REMOVE	2-4C, 7-1C, 8-5C; AD8 regraded to drain to D-7D
☐ ADD	☒ REPLACE	☐ REMOVE	7-iv; Figure 7.2-16 deleted
☐ ADD	☒ REPLACE	☐ REMOVE	7-87, 7-89; Tables updated for AD-8 + D-13D
☐ ADD	☒ REPLACE	☐ REMOVE	~~76-24A~~, 76-24B; C-7D abandoned, C-4D updated
☐ ADD	☒ REPLACE	☐ REMOVE	76-42; AD-8 drainage deleted from designs
☐ ADD	☒ REPLACE	☐ REMOVE	76-45A; C-7D abandoned
☐ ADD	☒ REPLACE	☐ REMOVE	76-46; AD-8 + D-13D designs updated
☐ ADD	☒ REPLACE	☐ REMOVE	76-55, 56, 57, 60, 61; AD8 drainage deleted from design
☐ ADD	☒ REPLACE	☐ REMOVE	76-62, 63, 64; AD-8 drainage added to design
☒ ADD	☐ REPLACE	☐ REMOVE	76-108; D-13D Calculations (93-35-5-1)
☐ ADD	☒ REPLACE	☐ REMOVE	7-104, 106; description of AD-8 drainage (93-35-6-1)
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
☐ ADD	☐ REPLACE	☐ REMOVE	
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☐ ADD	☐ REPLACE	☐ REMOVE	

RECEIVED
OCT 08 1993
DIVISION OF
OIL, GAS & MINING

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

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340
801-359-3940 (Fax)
801-538-5319 (TDD)

October 22, 1993

TO: Pamela Grubaugh-Littig, Permit Supervisor

FROM: Thomas Munson, Senior Reclamation Hydrologist

RE: D-13 D and AD-8 drainage, NOV93-35-5-1, NOV 93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025-93K, Emery County, Utah

Synopsis

On October 8, 1993 the Division received three copies of a revised proposal for abatement of the above referenced violations. Included in this submittal was revised plans for the drainage from the lower coal storage pad which will be reviewed in this memo.

Analysis

The proposed amendment discussed taking all the Coal Pad drainage and putting it into Ditch D-7D. It is the best alternative to preventing erosion and deposition of coal fines at the previous proposed location of D-4aD. The plans have been changed for inclusion into the PAP.

Recommendation

This amendment regarding Ditch D-7D be approved and inserted into the PAP.

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340
801-359-3940 (Fax)
801-538-5319 (TDD)

October 28, 1993

Mr. Wendell Owen
Co-Op Mining Company
P.O. Box 1245
Huntington, Utah 84528

Re: Abatement Plans for Violations #N93-35-5-1 and N93-35-6-1, Bear Canyon Mine, Co-Op Mining Company, ACT/015/025-93K, Folders #3 and #5, Emery County, Utah

Dear Mr. Owen:

The abatement plan that was resubmitted for October 8, 1993 for violation #N93-35-6-1 is approved. The abatement plan for violation #N93-35-5-1 was previously approved on October 8, 1993. Implementation within 15 days is required.

Please submit the finalized information relative to both of the approved plans by November 15, 1993.

Sincerely,

Pamela Grubaugh-Littig
Permit Supervisor

cc: Susan White

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor
Ted Stewart
Executive Director
James W. Carter
Division Director

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340
801-359-3940 (Fax)
801-538-5319 (TDD)

October 8, 1993

Mr. Wendell Owen
Co-Op Mining Company
P.O. Box 1245
Huntington, Utah 84528

Re: Abatement Plan, Violation #N93-35-5-1, Co-Op Mining Company, Bear Canyon Mine, ACT/0-15/025-93K, Folder #5, Emery County, Utah

Dear Mr. Owen:

Information submitted August 20, 1993 provided the necessary supporting data to describe the swale necessary to abate the above-noted violation. The plans and calculation for C-1D are approved.

Information relative to ditches D-41D and D-13D must be resubmitted, see letter dated September 23, 1993.

Sincerely,

Pamela Grubaugh-Littig
Permit Supervisor

pgl
Enclosure
cc/enc: Susan White

State of Utah
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF OIL, GAS AND MINING

Michael O. Leavitt
Governor

Ted Stewart
Executive Director

James W. Carter
Division Director

355 West North Temple
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203
801-538-5340
801-359-3940 (Fax)
801-538-5319 (TDD)

September 23, 1993

Mr. Wendell Owen
Co-Op Mining Company
P.O. Box 1245
Huntington, Utah 84528

Re: D-4aD and D-13D Design, NOVs #N93-35-5-1 and N93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025-93K, Folder #2, Emery County, Utah

Dear Mr. Owen:

The Division has reviewed the abatement plans for violations #N93-35-5-1 and N93-35-6-1. The proposal to use an open ditch will hopefully prevent failures due to clogging. However, there is no mention of headwall associated with ditch D-4aD. Therefore, please provide the necessary information to delineate the inlet and outlet to ditch D-4aD and describe how coal will be prevented from blocking this inlet and also how excessive erosion and/or deposition of coal material will be controlled at the outlet. Please submit this information by October 7, 1993.

If you have any questions, please call me or Tom Munson.

Sincerely,

Pamela Grubaugh-Littig
Permit Supervisor

cc: Susan White

September 22, 1993

TO: Pamela Grubaugh-Littig, Permit Supervisor

FROM: Thomas Munson, Senior Reclamation Hydrologist

(C-1D N93-35-5+1)

RE: D-4aD and D-13D Design, Nov#93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025, File Folder # 2 and 5, Emery County, Utah

Synopsis

and N93-35-6-1

The Division received abatement plans to NOV #93-35-5-1 on August 20,1993. This memo discusses the changes made to the drainage plan to abate the NOV.

N93-35-5-1??

Analysis

~~N93-5~~

The operator has provided the necessary supporting data to describe the ditches and designed swale necessary to abate the violation. It important to mention that the operator has tried in the past to use concrete pilings and infiltration galleries to control the flows in this area. They have both been successful in an limited sense. The current proposal to use an open ditch hopefully will prevent past failures due to clogging. There is no mention of headwalls associated with ditch D-4aD It is appropriate that the operator show how runoff will be controlled at the inlet and outlet of this ditch. There also is a question how the operator will prevent coal from blocking the inlet to the ditch.

Recommendation

Provide the necessary information to delineate the inlet and outlet to ditch D-4aD and how coal will be prevented from blocking this inlet and also how excessive erosion and/or deposition of coal material will be controlled at the outlet.

93-35-5-1 can be terminated for the plan portion.

CO-OP MINING COMPANY

P.O. Box 1245
Huntington, Utah 84528

(801) 381-5238
Coal Sales (801) 381-5777

AUG 20 1993

DIVISION OF
OIL, GAS & MINING

August 18, 1993

Pamela Grubaugh-Littig
Permit Supervisor
Utah Division of Oil, Gas & Mining
3 Triad Center, Suite 350
Salt Lake City, Utah 84180-1203

93K
#2 C#5

Ms. Grubaugh-Littig,

Re: D-4aD and D-13D Design, Nov#93-35-5-1, Nov#93-35-6-1, Co-Op Mining Company, Bear Canyon Mine, ACT/015/025, Emery County, Utah

Enclosed is a proposal being submitted for abatement of violations N93-35-5-1 and N93-35-6-1, issued by Susan White as a result of her inspection on August 10, 1993. The proposal includes plans for the design of the water bar directing runoff flow to culvert C-1D (N93-35-5-1), and the redesign of the drainage from area AD-8, the Coal Storage Pad (N93-35-6-1). Upon approval, the plans will be implemented according to the required time schedule specified in the violation abatement requirements.

Implementation of D-4aD (N93-35-6-1) is also dependent upon approval of the Coal Storage Pad Interim Reclamation proposal (93D). Completion of the review of this proposal was anticipated by the Division to be August 20, 1993.

Pages and plates have been marked DRAFT to distinguish them from previously approved pages and plates. If you have any questions, please call Charles Reynolds at (801) 381-2450.

Thank You,

Wendell Owen

Wendell Owen,
Resident Agent

WJO/cr
Enclosure(s)

Table 7.2-10 Summary of Diversion Ditch Calculations

DITCH	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	DEPTH (FT)	TYP SIDE SLOPE H:V	MEASURED SLOPE %	CONTRIBUTING WATERSHED	REQ'D AV. RIP-RAP SIZE (IN.)
D-1D	0	1.33	0.67	1:1	2 Min 11 Max	AD-3A	Soil
D-2D	0	1.33	0.67	1:1	6 Min 20 Max	AD-3A, AD-5	Bedrock
D-3D	0	2	1	1:1	2 Min 6 Av. 18 Max	AD-3A, AD-5 AD-7	Soil Soil Grouted
D-4D	0	2	1	1:1	2 Min 6 Av. 17 Max	AD-8, AD-14	Soil Soil D_{50} 6"
D-4aD	0	2	1	1:1	83 Av.	AD-8	Grouted
D-5D	0	1.33	0.67	1:1	4 Min 10 Max	AD-9	Soil
D-6D	0	3	1.5	1:1	2 Min 4 Max	AD-3A,AD-5,AD-7, AD-8,AD-9,AD-10, AD-12,AD-14	Soil
D-7D	2	3.5	0.5	1.5:1	2 Min 6 Av. 55 Max	AD-1A,AD-1B,AD- 2A,AD-2B,AD-2C, AD-3B,AD-4,AD-6	Soil Soil D_{50} 6"
D-8D	0	2	1	1:1	2 Min 7 Max	AD-13	Soil
D-8D Water Bar	0	2.67	0.67	2:1	3 Av.	AD-13	Soil
D-9D	0	2	1	1:1	4 Min 10 Max	AD-15	Soil
D-10D	1	3.33	0.67	1.5:1	7 Min 50 Max	AD-6,AD-3B,(part) AD-2B, AD-2C	D_{50} 4" Bedrock
D-10aD	0	2	1	1:1	7 Av.	AD-6,AD-3B,(part) AD-2B, AD-2C	Soil
D-11D	0	1	0.5	1:1	41 Min Near Vert	TIPPLE WASH HOSE	Grouted Rip-rap
D-12D	0	1	0.5	1:1	81 Av.	TIPPLE WASH HOSE	Grouted
D-13D Water Bar	0	6	0.5	10:1 2:1	0.5 Av.	AD-6 Partial	Soil

Notes:

1. Dimensions given indicate minimum requirements. Actual dimensions may vary. Minimum required cross section will be maintained.
2. The use of riprap to line drainage ditches is required when flow velocities exceed approximately 5 feet per second. Rip-rap may be installed where

Table 7.2-11 Culvert Charateristics

Culvert	Dia in.	Type	Contributing Watersheds	Slope ft/ft	Outlet Condition
C-1U	30 15	CMP & flexible	AU-3, AU-4, AU-5	0.73	Bedrock
C-2U	12	CMP	AU-11	0.08	Soil
C-3U	12	CMP	AU-6, AU-7, AU-11	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	0.05	4" rip-rap
C-5U	12	CMP	AU-8, AU-9, AU-15	0.05	4" rip-rap
C-6U	12	CMP	AU-6, AU-7, AU-11, AU-13, AU-14	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.05	6" rip-rap
C-8U	18	CMP to RCP	AU-2, AU-3 AU-4, AU-5	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek	0.06	48" rip-rap
C-11U	18	CMP	AU-16	0.10	6" rip-rap
C-12U	24	CMP	AU-17	0.04	6" rip-rap
C-13U & C-13aU	16	CMP	misc. road drainage	0.06	3" rip-rap
C-14U	60	CMP	Bear Creek	0.06	48" rip-rap
C-1D	15	CMP, flexible	AD-6, AD-3B	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7, AD-8	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.08	soil
C-6D	12	CMP	AD-10	0.48	9" rip-rap
C-7D	18	CMP	Abandoned In Place		
C-8D	18	CMP	AD-3A, AD-5 AD-7	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.03	3" rip-rap

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CULVERT CHARACTERISTICS

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1U	15	CMP flexible	AU-3, AU-4, AU-4A, AU-5	3.97	0.12 0.73	Bedrock
C-2U	12	CMP	AU-11	0.09	0.08	Soil
C-3U	12	CMP	AU-6, AU-7, AU-11	2.20	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	1.32	0.05	4" rip-rap
C-5U	12	CMP	AU-8, AU-9, AU-15	1.45	0.05	4" rip-rap
C-6U	12	CMP	AU-6, AU-7, AU-11, AU-13, AU-14	2.65	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.34	0.05	6" rip-rap
C-8U	18	Flexible CMP, RCP	AU-2, AU-3 AU-4, AU-5	4.00	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek[b]	108.53	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek[b]	108.53	0.06	48" rip-rap
C-11U	18	CMP	AU-16	4.92	0.10	6" rip-rap
C-12U	24	CMP	AU-17	3.29	0.04	6" rip-rap
C-13U C-13aU	15	CMP	misc. road drainage	1.00	0.06	3" rip-rap
C-14U	60	CMP	Bear Creek	108.53	0.06	48" rip-rap

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CULVERT CHARACTERISTICS (con't)

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1D	15	CMP, flexible	AD-6, AD-3B	0.93	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	1.47	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.23	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7, AD-8	4.43	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.23	0.08	soil
C-6D	12	CMP	AD-10	0.62	0.48	9" rip-rap
C-7D	18	CMP	Abandoned In Place			
C-8D	18	CMP	AD-3A, AD-5 AD-7	2.36	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	2.36	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.25	0.03	3" rip-rap

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Culvert C-7D

Abandoned In Place

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DITCH CHARACTERISTICS

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q(cfs)	BANK AND BOTTOM DESC.	MANNING'S $\eta^{(a)}$
D-1D	2 Min, 11 Max	AD-3A	0.23	Rocky Soil	0.03
D-2D	6 Min, 20 Max	AD-3A, AD-5	0.53	Rocky Soil, Bedrock	0.03
D-3D	2 Min, 6 Av, 14 Max	AD-3A, AD-5, AD-7	2.36	Soil, grouted half round culvert	0.03
D-4D	2 Min, 7 Av, 17 Max	AD-8, AD-14	2.12	Soil	0.03
D-4aD	83 Av.	AD-8	0.23	Grouted	0.036
D-5D	4 Min, 10 Max	AD-9	0.23	Soil	0.03
D-6D	2 Min, 4 Max	AD-3A, AD-5, AD-7, AD-8, AD-9, AD-10, AD-12, AD-14	5.68	Rocky Soil	0.03
D-7D	2 Min, 6 Av, 55 Max	AD-1A, AD-1B, AD-2A, AD-2B, AD-2C, AD-3B, AD-4, AD-6	2.39	Soil, D_{50}≈3"	0.03, 0.033
D-8D	2 Min, 7 Max	AD-13	1.23	Soil	0.03
D-8D Water Bar	3 Av.	AD-13	1.23	Soil	0.03
D-9D	4 Min, 10 Max	AD-15	1.25	Soil	0.03
D-10D	7 Min, 50 Max	AD-6, AD-3B, AD-2C	0.93	D_{50}≈4"	0.033
D-10aD	7 Av.	AD-6, AD-3B, AD-2C(part)	0.93	D_{50}≈4"	0.033
D-11D	41 Min, Near Vertical Max	TIPPLE WASH HOSE	0.25	Grouted rip-rap	0.035
D-12D	81 Av.	TIPPLE WASH HOSE	0.25	Grouted	0.03
D-13D Water Bar	0.5 Av.	AD-6 Partial	0.23	Soil	0.03

DRAFT

Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-4aD

Comment: MIN AND MAX SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.8330 ft/ft
Discharge.....	2.07 cfs

Computed Results:

Depth.....	0.43 ft
Velocity.....	11.08 fps
Flow Area.....	0.19 sf
Flow Top Width...	0.86 ft
Wetted Perimeter.	1.22 ft
Critical Depth...	0.77 ft
Critical Slope...	0.0390 ft/ft
Froude Number....	4.20 (flow is Supercritical)

Use Minimum Depth = 12 inches	=>	Min Freeboard = 0.23 ft
Velocity = 11 fps	=>	Use concrete grout

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-13D

Comment: WATER BAR

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	0.23 cfs

Computed Results:

Depth.....	0.22 ft
Velocity.....	0.79 fps
Flow Area.....	0.29 sf
Flow Top Width...	2.64 ft
Wetted Perimeter.	2.70 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0317 ft/ft
Froude Number....	0.42 (flow is Subcritical)

Use Minimum Depth = 6 inches	=>	Min Freeboard = 0.34 ft
Velocity < 5 fps	=>	No rip-rap required

Open Channel Flow Module, Version 3.3 (c) 1991
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Table 7.2-10 Summary of Diversion Ditch Calculations

DITCH	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	DEPTH (FT)	TYP SIDE SLOPE H:V	MEASURED SLOPE %	CONTRIBUTING WATERSHED	REQ'D AV. RIP-RAP SIZE (IN.)
D-1D	0	1.33	0.67	1:1	2 Min 11 Max	AD-3A	Soil
D-2D	0	1.33	0.67	1:1	6 Min 20 Max	AD-3A, AD-5	Bedrock
D-3D	0	2	1	1:1	2 Min 6 Av. 18 Max	AD-3A, AD-5 AD-7	Soil Soil Grouted
D-4D	0	2	1	1:1	2 Min 6 Av. 17 Max	AD-8, AD-14	Soil Soil D_{50} 6"
D-4aD	0	2	1	1:1	83 Av.	AD-8	Grouted
D-5D	0	1.33	0.67	1:1	4 Min 10 Max	AD-9	Soil
D-6D	0	3	1.5	1:1	2 Min 4 Max	AD-3A,AD-5,AD-7, AD-8,AD-9,AD-10, AD-12,AD-14	Soil
D-7D	2	3.5	0.5	1.5:1	2 Min 6 Av. 55 Max	AD-1A,AD-1B,AD- 2A,AD-2B,AD-2C, AD-3B,AD-4,AD-6	Soil Soil D_{50} 6"
D-8D	0	2	1	1:1	2 Min 7 Max	AD-13	Soil
D-8D Water Bar	0	2.67	0.67	2:1	3 Av.	AD-13	Soil
D-9D	0	2	1	1:1	4 Min 10 Max	AD-15	Soil
D-10D	1	3.33	0.67	1.5:1	7 Min 50 Max	AD-6,AD-3B,(part) AD-2B, AD-2C	D_{50}4" Bedrock
D-10aD	0	2	1	1:1	7 Av.	AD-6,AD-3B,(part) AD-2B, AD-2C	Soil
D-11D	0	1	0.5	1:1	41 Min Near Vert	TIPPLE WASH HOSE	Grouted Rip-rap
D-12D	0	1	0.5	1:1	81 Av.	TIPPLE WASH HOSE	Grouted
D-13D Water Bar	0	6	0.5	10:1 2:1	0.5 Av.	AD-6 Partial	Soil

Notes:

1. Dimensions given indicate minimum requirements. Actual dimensions may vary. Minimum required cross section will be maintained.
2. The use of riprap to line drainage ditches is required when flow velocities exceed approximately 5 feet per second. Rip-rap may be installed where

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Table 7.2-11 Culvert Charateristics

Culvert	Dia in.	Type	Contributing Watersheds	Slope ft/ft	Outlet Condition
C-1U	30 15	CMP & flexible	AU-3, AU-4, AU-5	0.73	Bedrock
C-2U	12	CMP	AU-11	0.08	Soil
C-3U	12	CMP	AU-6, AU-7, AU-11	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	0.05	4" rip-rap
C-5U	12	CMP	AU-8, AU-9, AU-15	0.05	4" rip-rap
C-6U	12	CMP	AU-6, AU-7, AU-11, AU-13, AU-14	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.05	6" rip-rap
C-8U	18	CMP to RCP	AU-2, AU-3 AU-4, AU-5	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek	0.06	48" rip-rap
C-11U	18	CMP	AU-16	0.10	6" rip-rap
C-12U	24	CMP	AU-17	0.04	6" rip-rap
C-13U & C-13aU	16	CMP	misc. road drainage	0.06	3" rip-rap
C-14U	60	CMP	Bear Creek	0.06	48" rip-rap
C-1D	15	CMP, flexible	AD-6, AD-3B	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7, AD-8	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.08	soil
C-6D	12	CMP	AD-10	0.48	9" rip-rap
C-7D	18	CMP	Abandoned in Place		
C-8D	18	CMP	AD-3A, AD-5 AD-7	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.03	3" rip-rap

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CULVERT CHARACTERISTICS

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1U	15	CMP flexible	AU-3, AU-4, AU-4A, AU-5	3.97	0.12 0.73	Bedrock
C-2U	12	CMP	AU-11	0.09	0.08	Soil
C-3U	12	CMP	AU-6, AU-7, AU-11	2.20	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	1.32	0.05	4" rip-rap
C-5U	12	CMP	AU-8, AU-9, AU-15	1.45	0.05	4" rip-rap
C-6U	12	CMP	AU-6, AU-7, AU-11, AU-13, AU-14	2.65	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.34	0.05	6" rip-rap
C-8U	18	Flexible CMP, RCP	AU-2, AU-3 AU-4, AU-5	4.00	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek[b]	108.53	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek[b]	108.53	0.06	48" rip-rap
C-11U	18	CMP	AU-16	4.92	0.10	6" rip-rap
C-12U	24	CMP	AU-17	3.29	0.04	6" rip-rap
C-13U C-13aU	15	CMP	misc. road drainage	1.00	0.06	3" rip-rap
C-14U	60	CMP	Bear Creek	108.53	0.06	48" rip-rap

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CULVERT CHARACTERISTICS (con't)

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1D	15	CMP, flexible	AD-6, AD-3B	0.93	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	1.47	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.23	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7, AD-8	4.43	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.23	0.08	soil
C-6D	12	CMP	AD-10	0.62	0.48	9" rip-rap
C-7D	18	CMP	Abandoned in Place			
C-8D	18	CMP	AD-3A, AD-5 AD-7	2.36	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	2.36	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.25	0.03	3" rip-rap

Culvert C-7D

Abandoned In Place

DITCH CHARACTERISTICS

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q(cfs)	BANK AND BOTTOM DESC.	MANNING'S η (a)
D-1D	2 Min, 11 Max	AD-3A	0.23	Rocky Soil	0.03
D-2D	6 Min, 20 Max	AD-3A, AD-5	0.53	Rocky Soil, Bedrock	0.03
D-3D	2 Min, 6 Av, 14 Max	AD-3A, AD-5, AD-7	2.36	Soil, grouted half round culvert	0.03
D-4D	2 Min, 7 Av, 17 Max	AD-8, AD-14	2.12	Soil	0.03
D-4aD	83 Av.	AD-8	0.23	Grouted	0.035
D-5D	4 Min, 10 Max	AD-9	0.23	Soil	0.03
D-6D	2 Min, 4 Max	AD-3A, AD-5, AD-7, AD-8, AD-9, AD-10, AD-12, AD-14	5.68	Rocky Soil	0.03
D-7D	2 Min, 6 Av, 55 Max	AD-1A, AD-1B, AD-2A, AD-2B, AD-2C, AD-3B, AD-4, AD-6	2.39	Soil, D_{50}≈3"	0.03, 0.033
D-8D	2 Min, 7 Max	AD-13	1.23	Soil	0.03
D-8D Water Bar	3 Av.	AD-13	1.23	Soil	0.03
D-9D	4 Min, 10 Max	AD-15	1.25	Soil	0.03
D-10D	7 Min, 50 Max	AD-6, AD-3B, AD-2C	0.93	D_{50}≈4"	0.033
D-10aD	7 Av.	AD-6, AD-3B, AD-2C(part)	0.93	D_{50}≈4"	0.033
D-11D	41 Min, Near Vertical Max	TIPPLE WASH HOSE	0.25	Grouted rip-rap	0.035
D-12D	81 Av.	TIPPLE WASH HOSE	0.25	Grouted	0.03
D-13D Water Bar	0.5 Av.	AD-6 Parial	0.23	Soil	0.03

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-4aD

Comment: MIN AND MAX SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.8330 ft/ft
Discharge.....	2.07 cfs

Computed Results:

Depth.....	0.43 ft
Velocity.....	11.08 fps
Flow Area.....	0.19 sf
Flow Top Width...	0.86 ft
Wetted Perimeter.	1.22 ft
Critical Depth...	0.77 ft
Critical Slope...	0.0390 ft/ft
Froude Number....	4.20 (flow is Supercritical)

Use Minimum Depth = 12 inches	=>	Min Freeboard = 0.23 ft
Velocity = 11 fps	=>	Use concrete grout

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-13D

Comment: WATER BAR

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	10.00:1 (H:V)
Right Side Slope.	2.00:1 (H:V)
Manning's n.....	0.030
Channel Slope....	0.0050 ft/ft
Discharge.....	0.23 cfs

Computed Results:

Depth.....	0.22 ft
Velocity.....	0.79 fps
Flow Area.....	0.29 sf
Flow Top Width...	2.64 ft
Wetted Perimeter.	2.70 ft
Critical Depth...	0.16 ft
Critical Slope...	0.0317 ft/ft
Froude Number....	0.42 (flow is Subcritical)

Use Minimum Depth = 6 inches	=>	Min Freeboard = 0.34 ft
Velocity < 5 fps	=>	No rip-rap required

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Table 7.2-10 Summary of Diversion Ditch Calculations

DITCH	BOTTOM WIDTH (FT)	TOP WIDTH (FT)	DEPTH (FT)	TYP SIDE SLOPE H:V	MEASURED SLOPE %	CONTRIBUTING WATERSHED	REQ'D AV. RIP-RAP SIZE (IN.)
D-1D	0	1.33	0.67	1:1	2 Min 11 Max	AD-3A	Soil
D-2D	0	1.33	0.67	1:1	6 Min 20 Max	AD-3A, AD-5	Bedrock
D-3D	0	2	1	1:1	2 Min 6 Av. 18 Max	AD-3A, AD-5 AD-7	Soil Soil Grouted
D-4D	0	2	1	1:1	2 Min 6 Av. 17 Max	AD-8, AD-14	Soil Soil D_{50} 6"
D-4aD	0	2	1	1:1	63 Av.	AD-8	Grouted
D-5D	0	1.33	0.67	1:1	4 Min 10 Max	AD-9	Soil
D-6D	0	3	1.5	1:1	2 Min 4 Max	AD-3A,AD-5,AD-7, AD-8,AD-9,AD-10, AD-12,AD-14	Soil
D-7D	2	3.5	0.5	1.5:1	2 Min 6 Av. 55 Max	AD-1A,AD-1B,AD- 2A,AD-2B,AD-2C, AD-3B,AD-4,AD-6	Soil Soil D_{50} 6"
D-8D	0	2	1	1:1	2 Min 7 Max	AD-13	Soil
D-8D Water Bar	0	2.67	0.67	2:1	3 Av.	AD-13	Soil
D-9D	0	2	1	1:1	4 Min 10 Max	AD-15	Soil
D-10D	1	3.33	0.67	1.5:1	7 Min 50 Max	AD-6,AD-3B,(part) AD-2B, AD-2C	D_{50}4" Bedrock
D-10aD	0	2	1	1:1	7 Av.	AD-6,AD-3B,(part) AD-2B, AD-2C	Soil
D-11D	0	1	0.5	1:1	41 Min Near Vert	TIPPLE WASH HOSE	Grouted Rip-rap
D-12D	0	1	0.5	1:1	81 Av.	TIPPLE WASH HOSE	Grouted
D-13D Water Bar	0	6	0.5	10:1 2:1	0.5 Av.	AD-6 Partial	Soil

Notes:

1. Dimensions given indicate minimum requirements. Actual dimensions may vary. Minimum required cross section will be maintained.
2. The use of riprap to line drainage ditches is required when flow velocities exceed approximately 5 feet per second. Rip-rap may be installed where

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Table 7.2-11 Culvert Charateristics

Culvert	Dia in.	Type	Contributing Watersheds	Slope ft/ft	Outlet Condition
C-1U	30 15	CMP & flexible	AU-3, AU-4, AU-5	0.73	Bedrock
C-2U	12	CMP	AU-11	0.08	Soil
C-3U	12	CMP	AU-6, AU-7, AU-11	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	0.05	4" rip-rap
C-5U	12	CMP	AU-8, AU-9, AU-15	0.05	4" rip-rap
C-6U	12	CMP	AU-6, AU-7, AU-11, AU-13, AU-14	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.05	6" rip-rap
C-8U	18	CMP to RCP	AU-2, AU-3 AU-4, AU-5	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek	0.06	48" rip-rap
C-11U	18	CMP	AU-16	0.10	6" rip-rap
C-12U	24	CMP	AU-17	0.04	6" rip-rap
C-13U & C-13aU	16	CMP	misc. road drainage	0.06	3" rip-rap
C-14U	60	CMP	Bear Creek	0.06	48" rip-rap
C-1D	15	CMP, flexible	AD-6, AD-3B	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7, AD-8	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.08	soil
C-6D	12	CMP	AD-10	0.48	9" rip-rap
C-7D	18	CMP	Abandoned In Place		
C-8D	18	CMP	AD-3A, AD-5 AD-7	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.03	3" rip-rap

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CULVERT CHARACTERISTICS

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1U	15	CMP flexible	AU-3, AU-4, AU-4A, AU-5	3.97	0.12 0.73	Bedrock
C-2U	12	CMP	AU-11	0.09	0.08	Soil
C-3U	12	CMP	AU-6, AU-7, AU-11	2.20	0.05	4" rip-rap
C-4U	12	CMP	AU-8, AU-9	1.32	0.05	4" rip-rap
C-5U	12	CMP	AU-8, AU-9, AU-15	1.45	0.05	4" rip-rap
C-6U	12	CMP	AU-6, AU-7, AU-11, AU-13, AU-14	2.65	0.05	4" rip-rap
C-7U	12	CMP	AU-12	0.34	0.05	6" rip-rap
C-8U	18	Flexible CMP, RCP	AU-2, AU-3 AU-4, AU-5	4.00	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek[b]	108.53	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek[b]	108.53	0.06	48" rip-rap
C-11U	18	CMP	AU-16	4.92	0.10	6" rip-rap
C-12U	24	CMP	AU-17	3.29	0.04	6" rip-rap
C-13U C-13aU	15	CMP	misc. road drainage	1.00	0.06	3" rip-rap
C-14U	60	CMP	Bear Creek	108.53	0.06	48" rip-rap

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CULVERT CHARACTERISTICS (con't)

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1D	15	CMP, flexible	AD-6, AD-3B	0.93	1.00	24" rip-rap
C-2D	15	CMP, RCP, flexible	AD-2B, AD-2C, AD-3B, AD-4, AD-6	1.47	0.40	10" rip-rap
C-3D	20	stl pipe	AD-3A	0.23	0.03	4" rip-rap
C-4D	21	CMP	AD-3A, AD-5 AD-7, AD-8	4.43	0.18	9" rip-rap
C-5D	18	CMP	AD-9	0.23	0.08	soil
C-6D	12	CMP	AD-10	0.62	0.48	9" rip-rap
C-7D	18	CMP	Abandoned In Place			
C-8D	18	CMP	AD-3A, AD-5 AD-7	2.36	0.05	3" rip-rap
C-9D	18	CMP	See C-8D	2.36	0.05	3" rip-rap
C-10D	18	CMP	TIPPLE WASH HOSE	0.25	0.03	3" rip-rap

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Culvert C-7D

Abandoned In Place

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B.C. 7G-45A 8/16/93

DITCH CHARACTERISTICS

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q(cfs)	BANK AND BOTTOM DESC.	MANNING'S $\eta^{(a)}$
D-1D	2 Min, 11 Max	AD-3A	0.23	Rocky Soil	0.03
D-2D	6 Min, 20 Max	AD-3A, AD-5	0.53	Rocky Soil, Bedrock	0.03
D-3D	2 Min, 6 Av, 14 Max	AD-3A, AD-5, AD-7	2.36	Soil, grouted half round culvert	0.03
D-4D	2 Min, 7 Av, 17 Max	AD-8, AD-14	2.12	Soil	0.03
D-4aD	83 Av.	AD-8	0.23	Grouted	0.035
D-5D	4 Min, 10 Max	AD-9	0.23	Soil	0.03
D-6D	2 Min, 4 Max	AD-3A, AD-5, AD-7, AD-8, AD-9, AD-10, AD-12, AD-14	5.68	Rocky Soil	0.03
D-7D	2 Min, 6 Av, 55 Max	AD-1A, AD-1B, AD-2A, AD-2B, AD-2C, AD-3B, AD-4, AD-6	2.39	Soil, $D_{50}\approx 3"$	0.03, 0.033
D-8D	2 Min, 7 Max	AD-13	1.23	Soil	0.03
D-8D Water Bar	3 Av.	AD-13	1.23	Soil	0.03
D-9D	4 Min, 10 Max	AD-15	1.25	Soil	0.03
D-10D	7 Min, 50 Max	AD-6, AD-3B, AD-2C	0.93	$D_{50}\approx 4"$	0.033
D-10aD	7 Av.	AD-6, AD-3B, AD-2C(part)	0.93	$D_{50}\approx 4"$	0.033
D-11D	41 Min, Near Vertical Max	TIPPLE WASH HOSE	0.25	Grouted rip-rap	0.035
D-12D	81 Av.	TIPPLE WASH HOSE	0.25	Grouted	0.03
D-13D Water Bar	0.5 Av.	AD-6 Parial	0.23	Soil	0.03

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Trapezoidal Channel Analysis & Design
Open Channel - Uniform flow

Worksheet Name: DITCH D-4aD

Comment: MIN AND MAX SLOPE

Solve For Depth

Given Input Data:

Bottom Width.....	0.00 ft
Left Side Slope..	1.00:1 (H:V)
Right Side Slope.	1.00:1 (H:V)
Manning's n.....	0.035
Channel Slope....	0.8330 ft/ft
Discharge.....	2.07 cfs

Computed Results:

Depth.....	0.43 ft
Velocity.....	11.08 fps
Flow Area.....	0.19 sf
Flow Top Width...	0.86 ft
Wetted Perimeter.	1.22 ft
Critical Depth...	0.77 ft
Critical Slope...	0.0390 ft/ft
Froude Number....	4.20 (flow is Supercritical)

Use Minimum Depth = 12 inches	=>	Min Freeboard = 0.23 ft
Velocity = 11 fps	=>	Use concrete grout

Open Channel Flow Module, Version 3.3 (c) 1991
Haestad Methods, Inc. * 37 Brookside Rd * Waterbury, Ct 06708

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