Table 2-3 Available Substitute Topsoil Material

Location	Drill Hole	Drill Depth (in)	Area (acres)	Volume Available (cu. yd)	Minimum Cut Depth (in)
TS-3	SEDB-1	24	.09	296	13
TS-3	SEDB-2	48	.09	602	13
TS-3	SHP-1	60	1.34	10,797	13
TS-3	SHP-2	60	.81	6,533	13
TS-3 Totals			2.33	18,228	
TS-4	SEDA-1	24	.24	777	2.5
TS-4	SEDA-2	24	.20	641	2.5
TS-4 Totals			.44	1,418	
TS-5	SP-1	18	.69	1,680	18
TS-5	SP-2	24	.36	1,150	24
TS-5	CSP-1	96	.95	~~12,292~~ 12,002	30
TS-5	CSP-2	84	1.32	~~14,903~~ 14,883	27
TS-5	CSP-3	72	.25	~~2,459~~ 2,414	27
TS-5	CSP-4	60	1.67	~~13,477~~ 13,437	27
TS-5	CSP-5	72	3.03	29,325	27
TS-5 Totals			8.28	~~75,286~~ 74,891	
TS-6	PAR-1	84	2.62	29,589	12
TS-7	LHP-1	96	1.73	22,329	12
TS-8	USP-1	120	.87	14,036	12
TS-9	REF-1	36	.26	1,253	18
TS-9	REF-2	36	.71	3,413	18
TS-9	REF-3	36	.23	1,122	18
TS-9 Totals			1.20	5,788	

FILE IN: Expandable 03232006
Refer to Record No. 0017
in C0150025, 2006, Incoming
for additional information

Table 2-7 Reclamation Area Summary					
MARK[1]	DESCRIPTION	Total ac.[1,2,3]	Re-contour acres[1&3]	Pre-1977 acres[2]	New acres
TS-1	Ball Park Topsoil Pile	1.27	0.0	-0-	1.27
TS-2	Lower Haul Road	1.6	0.0	1.6	-0-
TS-3	Sed Pond B & Scale Office Pad	2.60	1.41	1.23	1.37
TS-4	Sed Pond A	0.75	0.75	-0-	0.75
TS-5	Main Pad Area	~~12.32~~ 12.37	9.41	8.89	~~3.43~~ 3.48
TS-6	Portal Access Road	3.25	3.25	0.02	3.23
TS-7	Blind Canyon Seam Portal Area	1.81	1.81	0.51	1.30
TS-8	Upper Storage Pad	0.87	0.83	-0-	0.87
TS-9	Shower House Pad	1.83	1.83	-0-	1.83
TS-10	Tank Seam Access Road	2.91	2.91	-0-	2.91
TS-11	Tank Seam Portal Pad	0.66	0.59	-0-	0.66
TS-12	Wild Horse Ridge Access Road	3.26	0.22	-0-	3.26
TS-13	Conveyor belt Access/Topsoil	1.50	1.14	-0-	1.50
TS-14	Upper Conveyor belt Access Road	.96	0.66	-0-	0.96
TS-15	WHR Blind Canyon Seam Portal Area	1.58	1.58	-0-	1.58
TS-16	WHR TS Lower Portal Access Road	0.89	0.0	-0-	0.89
TS-17	WHR TS Upper Access Road and Pad	2.22	1.74	-0-	2.22
TOTAL		~~40.28~~ 40.33	28.13	12.25	~~28.03~~ 28.08

Notes:

1. See Plates 2-3.
2. See Plates 5-2.
3. The total acres represent acreage which will be reclaimed. Some of the acres will not require re-contouring or regrading during reclamation. The "Re-contour acres" represent the total acres which will require regrading. The "Total acres" shown will be reclaimed in accordance with the reclamation plan.

The proposed substitute topsoil material will be re-tested in the final five years of operations according to Table 5O-1 and will include Total Petroleum Hydrocarbons by EPA Methods 8015 and 418.1. The location of these samples will correlate with the areas generating the most substitute topsoil material as described in Appendix 5-I. Following regrading, soils remaining on the surface as substitute topsoil material will be sampled for pH, EC, and Total Hydrocarbons by EPA method 8015 for diesel fuel and 418.8 for waste oil.

Table 2-8 Substitute Topsoil Summary

	Topsoil Amounts Required			Substitute Topsoil Generated from Cuts (cu. yd.)			
Location	Area (acres)	Depth (in.)	**Volume (cu. yd.)**	Topsoil Stockpile	Sub. Topsoil Generated	Sub. Topsoil Not Regraded	Total Topsoil
TS-3	1.41	12	**2,275**	0	2,080	2,563	**4,643**
TS-4	.75	10	**1,008**	0	1,008	0	**1,008**
TS-5	9.41	12	**15,181**	0	~~21,492~~ 21,097	4,537	**~~26,029~~ 25,634**
TS-6	3.25	12	**5,243**	0	7,111	0	**7,111**
TS-7	1.81	12	**2,920**	0	4,170	0	**4,170**
TS-8	.83	12	**1,339**	0	3,552	0	**3,552**
TS-9	1.83	12	**2,952**	1,200	3,761	0	**4,961**
Total			**36,452**				**~~51,842~~ 51,447**

R645-301-527 Transportation Facilities

There are eleven primary roads in the permit area: Bear Canyon Haul Road, Portal Access Road, Tank Seam Access Road, Shower House Road, road to Sediment Pond A, Tipple Access Road, Shop Road, No. 3 Mine Access Road, No. 4 Mine Access Road, and the No.1 and No.2 Conveyor Access Roads. All roads are shown on Plates 5-2. Road profiles and typical cross sections are shown on Plates 5-4. A description of all roads is included in Appendix 5-F, along with maintenance procedures. Construction of the Tank Seam Access Road is discussed in Appendix 5-G. Construction of the Wild Horse Ridge road is discussed in Appendix 5-J. Construction of the Wild Horse RidgeTank Seam Road is discussed in Appendix 5-K. Construction of the Mohrland Road is discussed in Appendix 5-L. Construction of the No. 4 Mine Access Road is discussed in Appendix 5-K.

The mine area is approached on the Bear Canyon Haul Road. The #1 mine portal is reached on the Portal Access Road. This road has been abandoned and is now used as a ditch. See Chapter 7 for a discussion of ditches. The Tank Seam Portal is reached on the Tank Seam Access Road. The Wild Horse Ridge area is accessed on the No. 3 Mine Access Road. The WHR Tank Seam is accessed on the No. 4 Mine Access Road. Six other primary roads provide access; to the Sediment Pond A, the coal preparation facility (tipple), the shop, the Wild Horse Ridge conveyor belts, and to the Shower House.

The Bear Canyon Haul Road, No. 3 Mine Access Road, and part of the No. 4 Mine Access Road are also used by customers of Sportsman's Hunting to access a hunting cabin, which exists in the right fork of Bear Canyon. This non-mining recreational use of the road occurs primarily from May until November, typically 2-3 times per week. A lease agreement

Primary Haul Road

The Bear Canyon Haul Road is approx 3690 ft long from the gate to the base of the Portal Access Road and Tipple Access Road. See Plates 5-2 and 5-4. As shown on Plates 5-2, this portion of the road is included in the Permit Area. This Primary road is constructed approximately 30 ft wide and widens out to 80 ft in the load-out area. ~~and is~~ It's surfaced with 4 in. minimum of asphalt ~~road base material~~. Approximately 160 ft of the road adjacent to the scalehouse is to be surfaced with 6 in. of pavement. Installation of the black top will involve hauling in a hot mix from a local asphalt plant and laying it on the road. The road is crowned in the middle except in the load-out area where it slopes to the center and has center drains as shown on the cross section, Plate 5-4.

Reclamation of this portion of the Bear Canyon Road will occur at approx the same time as the final removal of the sedimentation ponds and diversions on the mine site. Removal of the asphalt on this road will consist of ~~hauling the material to a landfill approved for solid waste disposal and/or~~ recycling of the material for use at Trail Canyon ~~in cooperation with a local asphalt plant.~~ The road will be narrowed in some areas, but will remain in place for the post-mining land use in accordance with the agreement with Emery County.

Primary Access Roads

The Portal Access Road is approx 3,170 ft long. The road was originally constructed for access to the old Bear Canyon Mine, and has since been abandoned and is being used as a ditch to control undisturbed drainage. For a full description of drainage control see Chapter 7. ~~widened and fitted with proper drainage controls to protect the environment. The road is designed, used and maintained to meet the DOGM requirements, and to control or minimize erosion and siltation, air and water pollution, and damage to public or private property~~.

The road is located along the canyon floor above the stream, and along the stable slope leading to the portals. The overall grade of the road does not exceed l:V:10h (10 pct) and the max grade does not exceed l:V:6.5h (15 pct).

As mentioned earlier, the initial road was constructed under pre-law conditions, using the cut and fill side-cast method. A stability analyses was performed on the road by Dames & Moore in 1981 (Appendix 5-H). Their conclusion was that the Bear Canyon Portal Access Road has a stability factor of safety of a minimum of 1.43, and ranges upward to 2.15.

Shower House Road

This road is 200 ft long and is to be constructed in 1993 to provide access to the shower house area. The road varies from a 0% to 11% grade, with an average grade of 7%. The embankment of the road where it crosses Bear Creek will be constructed at a maximum slope of 1V:1.5H, or 67%. The properties of the material to be used are

SUBSTITUTE TOPSOIL MATERIAL

The substitute topsoil material that will be used is included in the cut volumes. Chapter 2, R645-301-224, describes the source of all substitute topsoil and it's use during reclamation.

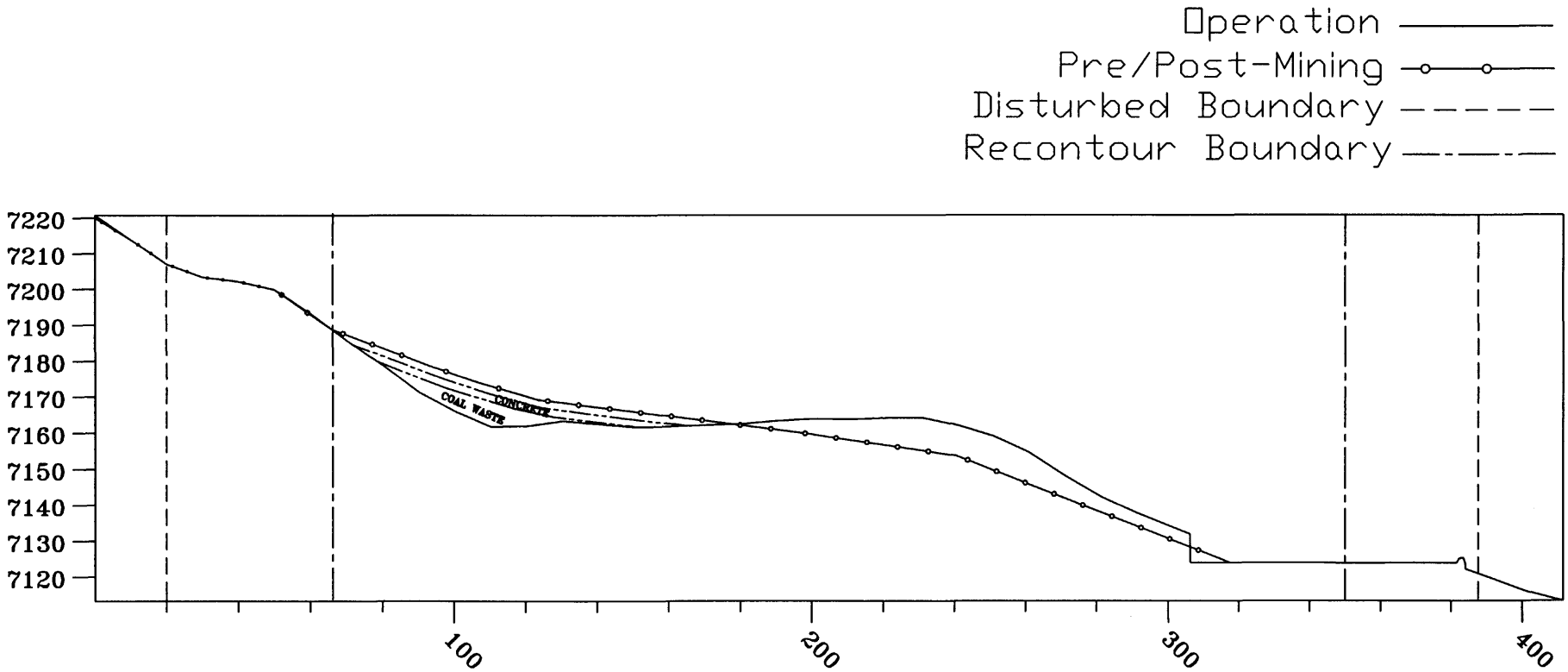
CUT AND FILL VOLUMES

Areas TS-3, TS-4, and TS-9 will balance within themselves and no material will be hauled in or out of the Areas. Fill material generated in Areas TS-5 and TS-6 will be hauled to Areas TS-7 and TS-8 and the four areas will balance together. A total additional volume of 14,948 cu. yd. will be needed in TS-7 and TS-8. During the Wild Horse Ridge construction 1,000 cu. yd. of material was hauled to the area as described on page 5K-7. During the load-out expansion an additional 500 cu. yd. of material was hauled to the area giving a remaining volume of 13,448 cu. yd.

Cut and fill volumes were measured using "Quicksurf" Version 4.0 3-D modeling software package, copyright 1991, Schreiber Instruments, Inc. Volumes are based on the contours on Plates 5-6 and Plates 5-2. Quicksurf was also used to generate the cross-sections which were then used to calculate the amount of substitute topsoil that was generated with each of the cuts.

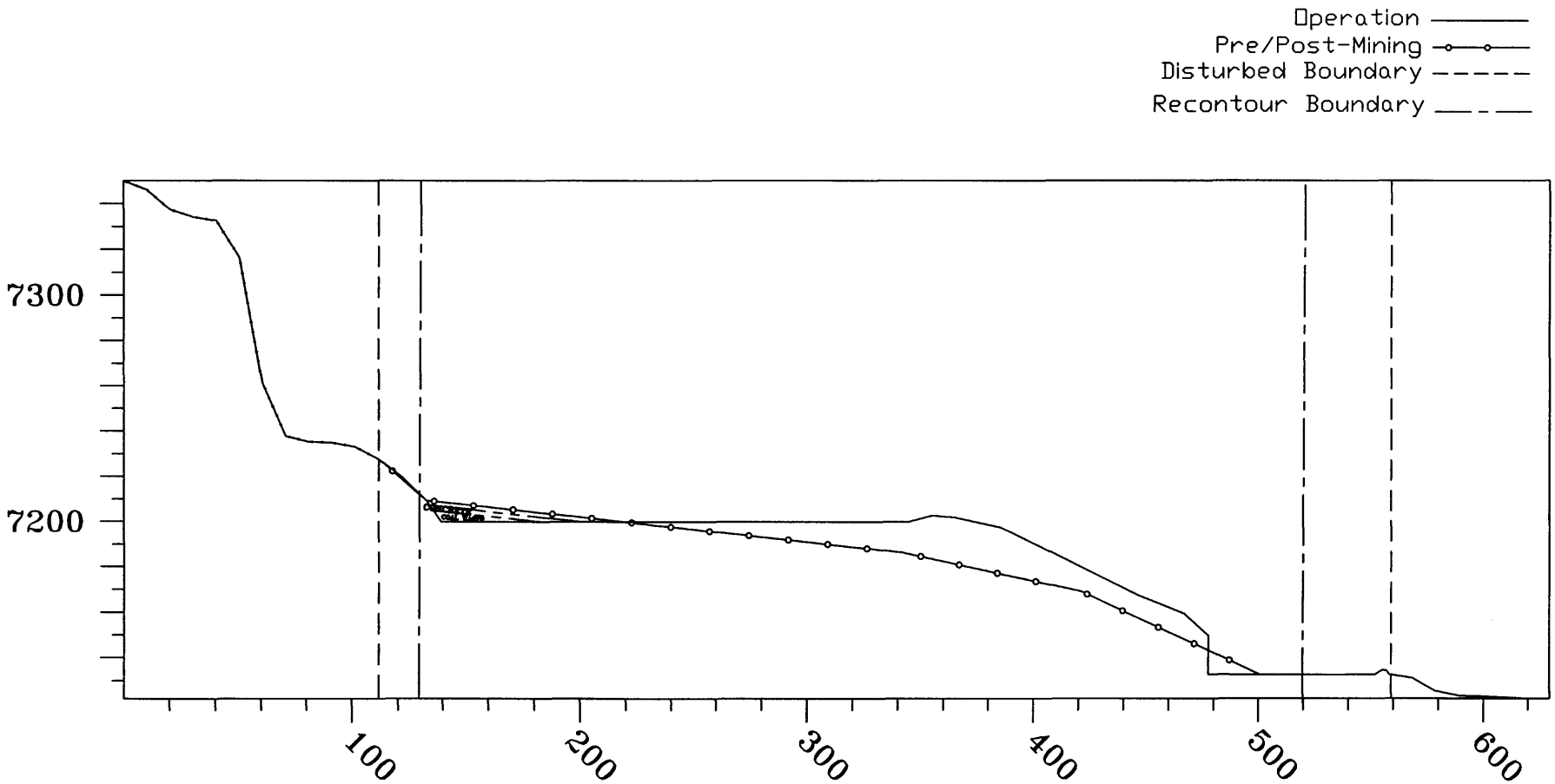
Table 5I-1 shows the summarized cut and fill volumes for each section. The following pages show detailed cut and fill tables as well as cross-sections for each area. Plates 5-6 and 2-3 show the location of the cross-sections for areas TS-3 through TS-9. R645-301-240 describe the topsoil depths and there sources.

TS-5 Section 4+00



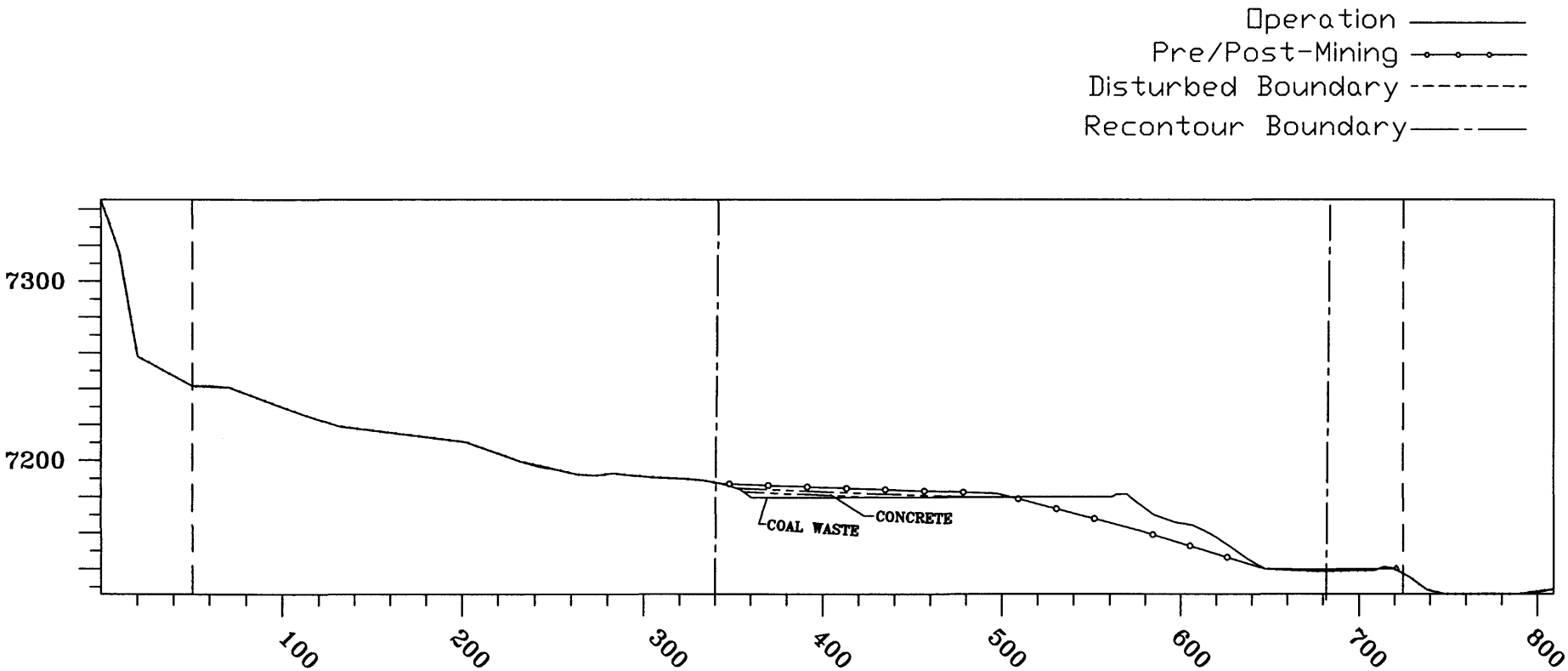
3/22/06

TS-5 Section 5+00



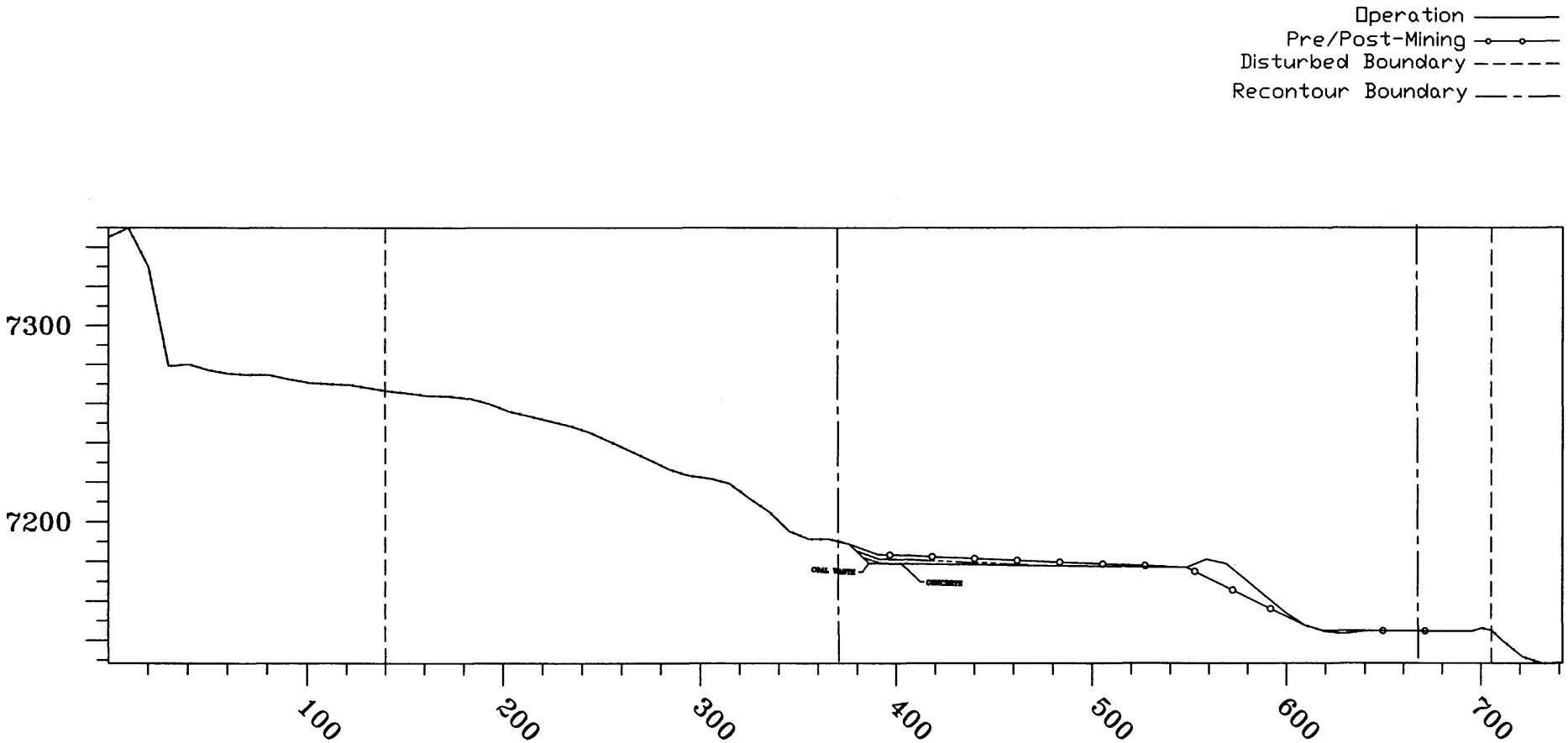
3/22/06

TS-5 Section 6+00



3/22/06

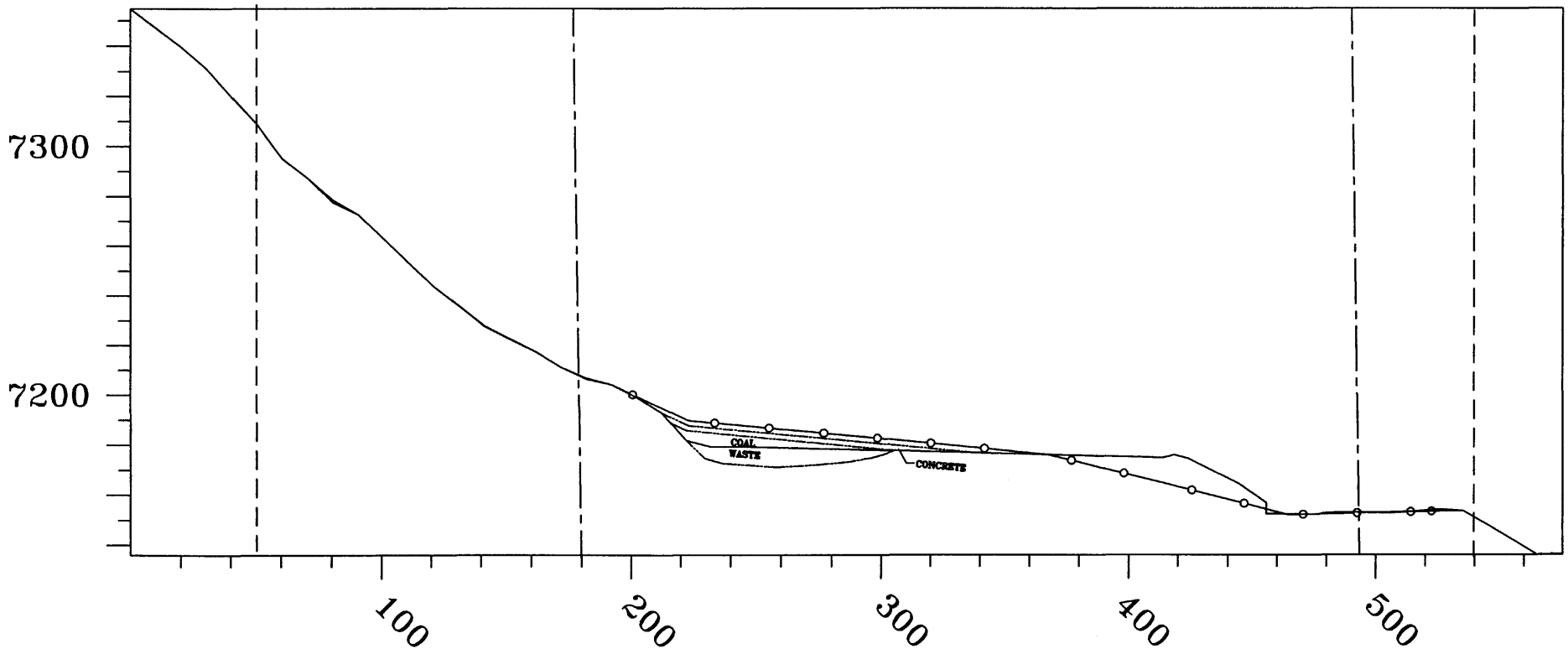
TS-5 Section 7+00



3/22/06

TS-5 Section 8+00

Operation
Pre/Post-Mining
Disturbed Boundary
Recontour Boundary



3/22/06

Table 5I-4 - Area TS-5 Cut & Fill Summary

	Fill (-) Volumes (cu. Yd.)					Cut (+) Volumes (cu. yd.				**Volume Cumulative (cu. yd.)**
Section	Min. required[1]	Soil	Coal Waste / Sediment	Concrete	**Total Fill Volume[2]**	Substitute Topsoil	Other Soil	Coal Waste / Sediment	**Total Cut Volume**	
0+00	0	89	0	0	**89**	304	407	0	**711**	**622**
1+00	0	44	0	0	**44**	1,148	3,311	0	**4,459**	**5,037**
2+00	452	690	0	210	**690**	452	100	0	**552**	**4,899**
3+00	385	596	209	325	**805**	~~359~~ 319	189	0	**~~542~~ 508**	**~~4,642~~ 4,602**
4+00	741	1,182	813	590	**1,995**	~~2,351~~ 2,181	0	412	**~~2,763~~ 2,593**	**~~5410~~ 5,200**
5+00	504	2,316	411	433	**~~2,737~~ 2,727**	~~6,244~~ 6,124	~~3,457~~ 3,352	1,095	**~~10,796~~ 10,571**	**~~13469~~ 13,044**
6+00	1,295	1,322	430	644	**1,752**	~~3,246~~ 3,166	552	1,210	**~~5,008~~ 4,928**	**~~16725~~16,220**
7+00	740	989	137	400	**1,126**	~~359~~ 419	0	1,004	**~~1,363~~ 1,423**	**~~16962~~16,517**
8+00	911	1,326	2,726	763	**4,052**	~~1,937~~ 1,892	892	1,278	**~~4,107~~ 4,062**	**~~17017~~16,527**
9+00	3,481	5,145	2,724	3,548	**7,869**	3,193	1,319	2,105	**6,617**	**~~15765~~15,275**
10+00	452	630	667	440	**1,297**	923	32	775	**1,730**	**~~16198~~15,708**
11+00	415	1,041	0	274	**1,041**	303	0	305	**608**	**~~15765~~15,275**
12+00	430	755	0	293	**755**	429	90	0	**519**	**~~15529~~15,039**
13+00	480	838	67	121	**905**	244	560	0	**804**	**~~15428~~14,938**
Totals		~~16,973~~ 16,963	8,184	8,041	**~~25,157~~ 25,147**	~~21,492~~ 21,097	~~10909~~ 10,804	8,184	**~~40,585~~ 40,085**	

[1] These volumes represent the minimum volume of soil which is required in order to cover the coal waste and concrete material to show that the fill volumes being placed are adequate to cover the coal waste and concrete material.
[2] Fill volumes do not include concrete volumes since concrete disposal on site is provided in separate bond calculations. The volumes are provided here to account for the volumes shown on the cross-sections.

TS-7 Blind Seam Portal Pad

TS-7 will be reclaimed as shown on the following cross-sections in order to match the contours shown on plate 5-6C. 11,582 cu. yd. of material from either TS-5 or TS-6 will be used here for the reclamation. Three highwalls are located in this section and all of them will be completely covered with fill material. The highwall shown on section 3+00 is the belt entry and passes under the road before it enters the coal seam. Table 5I-6 shows a summary of the cut and fill volumes. 500 cu. yd. of material generated during the load-out expansion is being stored here. This is not included in table 5I-6.

Table 5I-6 - Area TS-7 Cut & Fill Summary

	Fill (-) Volumes (cu. yd.)	Cut (+) Volumes (cu. yd.)			**Volume Cumulative (cu. yd.)**
Section	**Total Fill Volume**	Substitute Topsoil	Regular Soil	**Total Cut Volume**	
0+00	**2,881**	1,078	1,274	**2,352**	**-529**
1+00	**2,633**	867	718	**1,585**	**-1,577**
2+00	**1,630**	578	274	**852**	**-2,355**
3+00	**1,356**	248		**248**	**-3,463**
3+50	**1,355**	137		**137**	**-4,681**
4+00	**1,996**	45		**45**	**-6,632**
5+00	**1,703**	685		**685**	**-7,650**
6+00	**696**	67		**67**	**-8,279**
7+00	**989**	420		**420**	**-8,848**
7+50	**443**	0		**0**	**-9,291**
8+00	**2,355**	45	19	**64**	**-11,582**
Totals	**18,037**	4,170	22,207	**6,455**	

Table 7-23 Summary of Storm Runoff Calculations for 10 Year 6 Hour Storm

Watershed	Curve Number CN	Time of Concentration (Hr)	Drainage Area (Acres)	Peak Discharge (CFS)
AU-1	76	~~0.094~~ 0.144	~~6.46~~ 34.72	~~0.83~~ 3.88
~~AU-1A~~	~~83~~	~~0.032~~	~~1.36~~	~~0.51~~
~~AU-1B~~	~~83~~	~~0.026~~	~~1.16~~	~~0.44~~
~~AU-1C~~	~~76~~	~~0.120~~	~~16.40~~	~~1.95~~
~~AU-2~~	~~76~~	~~0.075~~	~~2.23~~	~~0.30~~
~~AU-2A~~	~~76~~	~~0.077~~	~~1.64~~	~~0.22~~
~~AU-2B~~	~~76~~	~~0.081~~	~~3.80~~	~~0.51~~
~~AU-3~~	~~76~~	~~0.078~~	~~3.87~~	~~0.52~~
~~AU-3A~~	~~76~~	~~0.016~~	~~0.30~~	~~0.05~~
AU-4	76	~~0.093~~ 0.119	~~7.97~~ 26.14	~~1.02~~ 3.12
~~AU-4A~~	~~83~~	~~0.029~~	~~0.92~~	~~0.35~~
AU-5	76	~~0.104~~ 0.092	~~20.14~~ 6.12	~~2.51~~ 0.60
AU-6	76	~~0.059~~ 0.062	~~2.73~~ 4.67	~~0.39~~ 0.65
AU-7	76	0.094	13.46	1.72
AU-8	76	0.050	4.95	0.72
AU-9	76	~~0.100~~ 0.117	~~4.77~~ 9.36	~~0.60~~ 1.12
AU-10	76	~~0.137~~ 0.147	~~35.52~~ 30.93	~~4.05~~ 3.43
~~AU-11~~	~~76~~	~~0.045~~	~~0.62~~	~~0.09~~
AU-12	76	0.050	2.33	0.34
AU-13	76	0.022	0.66	0.10
AU-14	76	0.050	2.43	0.35
AU-15	76	0.058	0.91	0.13
AU-16	76	0.152	44.93	4.92
AU-17	76	0.152	30.10	3.29
AU-18	76	0.152	36.55	4.00
AU-19	76	0.144	36.03	4.03

Table 7-23 Summary of Storm Runoff Calculations for 10 Year 6 Hour Storm (cont)

Watershed	Curve Number CN	Time of Concentration (Hr)	Drainage Area (Acres)	Peak Discharge (CFS)
AD-1A	76	~~0.090~~ 0.066	~~3.70~~ 4.21	~~0.48~~ 0.59
AD-1B	76	0.037	2.12	0.32
AD-2A	76	0.040	0.97	0.15
AD-2B	83	0.025	1.08	0.41
AD-2C	83	0.012	0.25	0.10
~~AD-3A~~	~~76~~	~~0.034~~	~~1.49~~	~~0.23~~
~~AD-3B~~	~~76~~	~~0.034~~	~~0.78~~	~~0.12~~
AD-4	83	0.011	0.08	0.03
AD-5	76	0.056	2.13	0.30
AD-6	90	0.220	1.39	0.81
AD-7	90	0.145	2.95	1.83
AD-8 upper	90	0.021	0.70	0.48
AD-8 lower	90	0.247	2.79	1.59
AD-9	90	0.069	0.35	0.23
AD-10 upper	90	0.026	0.30	0.20
AD-10 lower	90	0.078	0.65	0.42
AD-11	95	0.011	0.69	0.65
AD-12 upper	90	0.020	0.22	0.15
AD-12 lower	90	0.076	0.34	0.22
AD-13	91	0.106	1.78	1.23
AD-14	90	0.009	0.08	0.05
AD-15	90	0.069	1.83	1.20
AD-16	90	0.030	0.77	1.24
AD-17	90	0.019	0.24	0.16
AD-18	90	0.170	0.9	0.55
AD-19	90	0.009	0.15	0.10
AD-20	90	0.019	0.47	0.32

[1] Sized for the 100 Yr – 6 hr storm event.

Table 7-24 Summary of Division Ditch Calculations

Ditch	Bottom Width (Ft)	Top Width (Ft)	Depth (Ft)	Type 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-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-9, AD-10 AD-12, AD-14	Soil
D-7D	2	3.5	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	14	0.33	6:1	3 Av.	AD-13	Soil
D-9D	0	2	1	1:1	4 Min 10	AD-15	Soil
D-10D	1	3.33	0.67	1.5:1	7 Min 50	AD-6, AD-3B, (part) AD-2B, AD-2C	D_{50} 4" Bedrock
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	Soil
D-13D Water Shed	0	6	0.5	10:1 2:1	0.5 Av.	AD-6 Partial	Soil
~~D-14D~~*	~~0~~	~~1.33~~	~~0.67~~	~~1.5:1~~	~~0.06 Av.~~	~~AU-4A~~	~~Soil~~
D-15D	0	2.00	1.00	1:1	0.05 Av.	AD-16	Soil
D-16D	0	1.50	1.75	1:1	0.05 Av.	AD-18	Soil
D-17D	0	.96	1	1:1	0.08 Av.	AU-23, AD-20	Soil

Notes: 1. Dimensions given indicate minimum requirements. Actual dimensions may vary. Minimum required cross-sections will be maintained.

2. The use of line drainage ditches is required when flow velocities exceed approximately 5 feet per second. Rip-rap may be installed where not required.

Table 7-24 Summary of Division Ditch Calculations (Cont)

Ditch	Bottom Width (Ft)	Top Width (Ft)	Depth (Ft)	Type Side Slope H:V	Measured Slope %	Contributing Watershed	REQ'D Av. Rip-Rap Size (In.)
D-1U	~~2~~ 0	~~1.33~~ 0.44	~~0.67~~ 0.32	1:1	2 Min 8 Max	AU-5	Soil
D-2U	0	~~1.33~~ 1.07	0.67	1:1	7 Min 10 Max	AU-5, AU-6, ~~AU-11~~	Soil
D-3U	~~1~~ 8	~~2~~ 8.32	~~0.5~~ 0.16	1:1	4 Min 18 Max	AU-5, AU-6, AU-7, AU-8	Soil
D-4U	~~1~~ 8	4 8.28	~~1~~ 0.14	1~~.5~~:1	1 Min 10 Av. 18 Max	AU-5, AU-6, AU-7, AU-8, AU-9, AU-10	Soil Soil D_{50} 6"
D-5U	0	1	0.5	1:1	4 Min 13 Max	AU-15	Soil
D-6U	0	1.33	0.67	1:1	3 Min 16 Max	AU-14	Soil
D-7U	0	1.33	0.67	1:1	1 Min 16 Max	AU-12	Soil
D-8U	2	~~4~~ 3.31	0.67	1:1	2 Min 31 Max	AU-1, ~~AU-1[a], AU-1B, AU-1C, AU-2, AU-2[a], AU-2B~~	Soil D_{50} 6"
D-9U	3	5	1	1:1	1 Min 6 Max	AU-16	Soil D_{50} 4"
D-10U	3	4	0.5	1:1	3 Min 10 Max	AU-17	Soil
D-11U	0	2	1	1:1	3 Min 8 Max	Misc. road damage	Soil
D-12U	0	3	1	1.5:1	3 Min 9 Max	AU-18	Soil D_{50} 4"
D-13U	0	2	1	1:1	2 Min 23 Max	Misc. road damage	Soil
D-14U	4	5.5	0.5	1.5:1	6 Min 66 Max	Sed Pond A Outlet	D_{50} 4" D_{50} 10"
~~D-15U~~	~~0~~	~~2~~	~~0.67~~	~~1.5:1~~	~~5 Min~~ ~~16 Max~~	~~AU-3~~	~~Soil~~
~~D-16U~~	~~0~~	~~2~~	~~0.67~~	~~1.5:1~~	~~10 Av.~~	~~AU-1B~~	~~Soil~~
~~D-17U~~	~~0~~	~~2~~	~~0.67~~	~~1.5:1~~	~~13 Av.~~	~~AU-1[a]~~	~~Bedrock~~
~~D-18U~~	~~0~~	~~2~~	~~0.67~~	~~1.5:1~~	~~5 Min~~	~~AU-1~~	~~Soil~~

Table 7-24 Summary of Division Ditch Calculations (Cont)

Ditch	Bottom Width (Ft)	Top Width (Ft)	Depth (Ft)	Type Side Slope H:V	Measured Slope %	Contributing Watershed	REQ'D Av. Rip-Rap Size (In.)
D-19U	0	2	0.67	1.5:1	6 Av.	AU-2B	Soil
D-20U	0	1.33	0.67	1:1	16 Av.	AU-42	Soil
D-21U	0	2	1.0	1:1	13 Av.	AU-43	D_{50}=3"
D-22U	0	3	1.0	1.5:1	11 Av.	AU-19, AU-25	D_{50}=6"
D-23U	0	1.16	0.58	1:1	19 Av.	AU-36	Soil
D-24U	0	1.16	0.58	1:1	14 Av.	AU-35	Soil
D-25U	0	1	0.5	1:1	16 Av.	AD-17	Soil
D-26U	0	1	0.5	1:1	24 Av.	AU-32	Soil
D-27U	0.50	2	0.5	1.5:1	13 Min, 30 Max	AU-31	Soil
D-28U	0	1	0.5	1:1	14 Av.	AU-33	Soil
D-29U	0	1.33	0.67	1:1	8 Av.	AU-34	Soil
D-30U	0	1.16	0.58	1:1	13 Av.	AU-25	Soil
D-31U	0	3	1.0	1.5:1	12 Av.	AU-20, AU-26	Bedrock
D-32U	0	1	0.5	1:1	17 Av.	AU-30	Soil
D-33U	0	1.16	0.58	1:1	18 Av.	AU-29	Soil
D-34U	1	2.74	0.58	1.5:1	11 Av.	AU-24	Soil
D-35U	0	2.0	1.0	1:1	10 Av.	AU-29	Soil
D-36U	0	1.0	0.5	1:1	8 Av.	AU-27	Soil
D-37U	0	1.4	0.7	1:1	8 Av.	AU-26, AU-21	Soil
D-38U	0	1.33	.0.67	1:1	12 Min, 20 Max	AU-21	D_{50}=3"
D-39U	0	1.0	0.5	1:1	10 Av.	AU-28	Soil
D-40U	0	1.5	0.75	1:1	9 Av.	AU-24A, C-39U	D_{50}=3
D-41U	0	2	1	1:1	15 Av.	AU-22, AU-23A, C-40U	D_{50}=4
D-42U	0	0.5	0.25	1:1	36 Min, 63Max	AU-23A	Soil
D-43U	0	2	2	2:1	20 Min, 45 Max	AU-23	D_{50}=5

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

All calculations for the diversion ditches resulted in a maximum flow velocity of less than the maximum permissible velocity. A flow velocity of less than 5 feet per second was considered non-erosive for those ditch sections with little or no riprap or vegetation. For those ditch sections with an abundance of vegetation or riprap maximum permissible velocities were based on the channel characteristics as presented in Appendix 7-G.

Fifty-three culverts have been or will be installed within the Co-Op Mine area to divert storm runoff from the disturbed and undisturbed drainage areas. These culverts were located in the field and are identified on Plates 7-1.

The adequacy of the culverts to pass the design flow rate was determined. Table 7-25 summarizes the culvert sizing calculations. Because the resulting HW/D (headwater depth divided by the culvert diameter) ratio is less than one for each culvert, these existing culverts will adequately pass the design storm. Culvert calculations are presented in Appendix 7-G.

The slope of each culvert was measured in the field. Calculations were performed to determine the exit velocities at each culvert and the required riprap. A summary of the culvert flow velocity and riprap sizing calculations is presented in Table 7-25. Culvert flow velocity computations are presented in Appendix 7-G.

Where culvert exit velocities were in excess of the maximum permissible velocity, erosion protection measures were designed. These measures are presented in Appendix 7-G.

Table 7-25 Culvert Characteristics

Culvert	Diameter (in.)	Type	Contributing Watersheds	Slope (ft/ft)	Outlet Condition
C-1U	Reclaimed				
C-2U	Reclaimed				
C-3U	Reclaimed				
C-4U	Reclaimed				
C-5U	Reclaimed				
C-6U	Reclaimed				
C-7U	Reclaimed				
C-8U	18	Flexible CMP, RCP	AU-4	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	15	CMP	misc. road drainage	0.06	Soil
C-14U	60	CMP	Bear Creek	0.06	48" rip-rap
C-15U	Reclaimed				
C-16U	Reclaimed				
C-17U	Reclaimed				
C-18U	Reclaimed				
C-19U	Reclaimed				
C-20U	Reclaimed				

WATERSHED CHARACTERISTICS

Disturbed Areas

P = 1.5"

Watershed	CN	Area (Ac.)	Slope y (%)	Hyd length 1 (ft.)	1000 S=-10 CN	$l^{.8}(s+1)^{.7}$ L=1900Y$^{.5}$	T=1.67L Time of Conc (hr)
AD-1A	76	~~3.70~~ 4.21	~~66~~58.2	~~1,300~~ 808	3.16	0.~~050~~ .040	0.~~090~~.066
AD-1B	76	2.12	95.5	520	3.16	0.022	0.037
AD-2A	76	0.97	72	440	3.16	0.020	0.040
AD-2B	83	1.08	59	32 0	2.05	0.015	0.025
AD-2C	83	0.25	64	140	2.05	0.007	0.012
~~AD-3A~~	~~76~~	~~1.49~~	~~70~~	~~400~~	~~3.16~~	~~0.021~~	~~0.034~~
~~AD-3B~~	~~76~~	~~0.78~~	~~71~~	~~400~~	~~3.16~~	~~0.020~~	~~0.034~~
AD-4	83	0.08	49	100	2.05	0.007	0.011
AD-5	76	2.13	73	760	3.16	0.034	0.056
AD-6	90	1.39	1.7	720	1.11	0.131	0.220
AD-7	90	2.95	8.0	1,130	1.11	0.087	0.145
AD-8 upper	90	0.70	70	400	1.11	0.013	0.021
AD-8 lower	90	2.79	1.0	600	1.11	0.148	0.247
AD-9	90	0.35	7.2	420	1.11	0.042	0.069
AD-10 upper	90	0.30	34	320	1.11	0.01 5	0.026
AD-10 lower	90	0 .65	2.0	220	1.11	0.047	0.078
AD-11	95	0.69	20	110	0.53	0.007	0.011
AD-12 upper	90	0.22	64	340	1.11	0.012	0.020
AD-12 lower	90	0.34	8.0	500	1.11	0.045	0.076
AD-13	91	1.78	8.0	800	0.99	0.063	0.106
AD-14	90	0.08	61	120	1.11	0.005	0.009
AD-15	90	1.83	10.5	530	1.11	0.041	0.069
AD-16*	90	0.77	22	303	1.11	0.018	0.030
AD-17*	90	0.24	27	190	1.11	0.011	0.019
AD-18	90	0.9	3.2	771	1.11	0.102	0.170
AD-19*	90	0.15	49.24	109	1.11	0.005	0.009
AD-20*	90	0.47	30.48	204	1.11	0.0113	0.019

*Areas AD-16, AD-17 and AD-19 are ASCA areas treated by alternate sediment controls.

WATERSHED CHARACTERISTICS

Undisturbed Areas
and ASCA Areas Not Reporting To Sediment Pond

Watershed	CN	Area (Ac.)	Slope y (%)	Hyd length l (ft.)	1000 S=-10CN	P = 1.5" $l^{.8}(s+1)^{.7}$ L=1900Y$^{.5}$	T=1.67L Time of Conc (hr)
AU-1	76	~~6.46~~ 34.72	~~57~~67.7	~~1,240~~ 2,333	3.16	~~0.056~~ .086	~~0.094~~ .144
~~AU-1A~~	~~83~~	~~1.36~~	~~65~~	~~460~~	~~2.05~~	~~0.019~~	~~0.032~~
~~AU-1B~~	~~83~~	~~1.16~~	~~59~~	~~330~~	~~2.05~~	~~0.015~~	~~0.026~~
~~AU-1C~~	~~76~~	~~16.40~~	~~72~~	~~1,950~~	~~3.16~~	~~0.072~~	~~0.120~~
~~AU-2~~	~~76~~	~~2.23~~	~~62~~	~~975~~	~~3.16~~	~~0.045~~	~~0.075~~
~~AU-2A~~	~~76~~	~~1.64~~	~~63~~	~~1,025~~	~~3.16~~	~~0.046~~	~~0.077~~
~~AU-2B~~	~~76~~	~~3.80~~	~~63~~	~~1,100~~	~~3.16~~	~~0.049~~	~~0.081~~
~~AU-3~~	~~76~~	~~3.87~~	~~65~~	~~1,060~~	~~3.16~~	~~0.047~~	~~0.078~~
~~AU-3A~~	~~76~~	~~0.30~~	~~64~~	~~140~~	~~3.16~~	~~0.009~~	~~0.016~~
AU-4	76	~~7.97~~ 26.14	~~63~~78.5	~~1,300~~ 2,033	3.16	~~0.056~~ .076	~~0.093~~ .119
~~AU-4A~~	~~83~~	~~0.92~~	~~52~~	~~357~~	~~2.05~~	~~0.018~~	~~0.029~~
AU-5	76	~~20.14~~ 6.12	~~77.3~~53.9	~~1,700~~ 1,159	3.16	~~0.062~~ .055	~~0.104~~ .092
AU-6	76	~~2.73~~ 4.67	~~70.0~~ 53.7	~~780~~ 703	3.16	~~0.035~~ .037	~~0.059~~ .062
AU-7	76	13.46	69.4	1,400	3.16	0.056	0.094
AU-8	76	4.95	85.7	720	3.16	0.030	0.050
AU-9	76	~~4.77~~ 9.36	~~64.8~~49.9	~~1,440~~ 1,502	3.16	~~0.060~~ .070	~~0.100~~ .117
AU-10	76	~~35.52~~ 30.93	~~76.1~~63.1	~~2,380~~ 2,312	3.16	~~0.082~~ .088	~~0.137~~ .147
~~AU-11~~	~~76~~	~~0.62~~	~~73.0~~	~~570~~	~~3.16~~	~~0.027~~	~~0.045~~
AU-12	76	2.33	44.1	480	3.16	0.030	0.050
AU-13	76	0.66	77.5	240	3.16	0.013	0.022
AU-14	76	2.43	66.7	620	3.16	0.030	0.050
AU-15	76	0.91	15.6	300	3.16	0.035	0.058
AU-16	76	44.93	71.0	2,580	3.16	0.091	0.152
AU-17	76	30.10	71.0	2,580	3.16	0.091	0.152
AU-18	76	36.55	71.0	2,580	3.16	0.091	0.152
AU-19	76	36.03	60.5	2,190	3.16	0.086	0.144
AU-20	76	20.55	57.6	1,880	3.16	0.078	0.131
AU-21	76	9.45	48.4	1,360	3.16	0.066	0.110
AU-22	76	12.05	60.3	1,120	3.16	0.051	0.084

Summary of Peak Flows for 10-year, 6-hour storm P=1.5"
(SCS type B distribution)

Watershed	Peak Q (cfs.)	Watershed	Peak Q (cfs)	Watershed	Peak Q (cfs)
AD-1A	~~0.48~~ 0.59	~~AU-1B~~	~~0.44~~	AU-23	0.78
AD-1B	0.32	~~AU-1B~~	~~0.44~~	AU-24	1.66
AD-2A	0.15	~~AU-1C~~	~~1.95~~	AU-25	0.30
AD-2B	0.41	~~AU-2~~	~~0.30~~	AU-26	0.10
AD-2C	0.10	~~AU-2A~~	~~0.22~~	AU-27	0.03
~~AD-3A~~	~~0.23~~	~~AU-2B~~	~~0.50~~	AU-28	0.10
~~AD-3B~~	~~0.12~~	~~AU-3~~	~~0.52~~	AU-29	0.29
AD-4	0.03	~~AU-3A~~	~~0.05~~	AU-29A	0.67
AD-5	0.30	AU-4	~~1.02~~ 3.12	AU-30	0.08
AD-6	0.81	~~AU-4A~~	~~0.35~~	AU-31	0.32
AD-7	1.83	AU-5	~~2.51~~ 0.60	AU-32	0.28
AD-8 upper	0.48	AU-6	~~0.39~~ 0.65	AU-33	0.11
AD-8 lower	1.59	AU-7	1.72	AU-34	0.27
AD-9	0.23	AU-8	0.72	AU-35	0.13
AD-10 upper	0.20	AU-9	~~0.60~~ 1.12	AU-36	0.12
AD-10 lower	0.42	AU-10	~~4.05~~ 3.43	AU-37	13.64
AD-11	0.65	~~AU-11~~	~~0.09~~	AU-38	1.15
AD-12 upper	0.15	AU-12	0.34	AU-39	0.18
AD-12 lower	0.22	AU-13	0.10	AU-40	15.96
AD-13	1.23	AU-14	0.35	AU-41	1.46
AD-14	0.05	AU-15	0.13	AU-42	0.67
AD-15	1.20	AU-16	4.92	AU-43	1.75
AD-16	1.24	AU-17	3.29	BEAR CREEK	108.18
AD-17	0.16	AU-18	4.00	BEAR CREEK[1]	412.70
AD-18	0.55	AU-19	4.03		
AD-19	0.10	AU-20	2.37		
AU-1	~~0.83~~ 3.88	AU-21	1.15		
~~AU-1A~~	~~0.51~~	AU-22	1.59		

[1]Design flow for the 100 year, 6 hour storm event.

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-1A

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76.00
Precip. Depth = 1.50 in	Time of Conc. = ~~0.090~~ 0.066 hrs
Duration = 6.00 hr	Area = ~~1.83~~ 4.21 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = ~~0.48~~ 0.59 cfs (~~0.1285~~ 0.1379 iph)
At T = ~~2.53~~ 2.52 hrs

INPUT SUMMARY FOR W.S.: AD-1B

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = 0.037 hr
Duration = 6.00 hr	Area = 2.12 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.32 cfs (0.1500 iph)
At T = 2.51 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AD-2C

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 83
Precip. Depth = 1.50 in	Time of Conc. = 0.012 hrs
Duration = 6.00 hr	Area = 0.25 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in
Initial Abstraction = 0.4096 in
Peak Flow = 0.10 cfs (0.3820 iph)
At T = 2.50 hrs

~~INPUT SUMMARY FOR W.S.: AD-3A~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.034 hr~~
~~Duration = 6.00 hr~~	~~Area = 1.49 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.23 cfs (0.1511 iph)~~
~~At T = 2.51 hrs~~

PEAK
HYDROGRAPH GENERATION PROGRAM

~~INPUT SUMMARY FOR W.S.: AD-3B~~

~~STORM:~~ ~~WATERSHED:~~

~~Distribution = SCS Type 'B'~~ ~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~ ~~Time of Conc. = 0.034 hrs~~
~~Duration = 6.00 hr~~ ~~Area = 0.78 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.12 cfs (0.1511 iph)~~
~~At T = 2.51 hrs~~

INPUT SUMMARY FOR W.S.: AD-4

STORM: WATERSHED:

Distribution = SCS Type 'B' Curve Number = 83
Precip. Depth = 1.50 in Time of Conc. = 0.011 hr
Duration = 6.00 hr Area = .08 ac

OUTPUT SUMMARY

Runoff depth = 0.3788 in
Initial Abstraction = 0.4096 in
Peak Flow = 0.03 cfs (0.3824 iph)
At T = 2.50 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-1

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = ~~0.094~~ 0.144 hr
Duration = 6.00 hr	Area = ~~6.46~~ 34.72 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = ~~0.83~~ 3.88 cfs (~~0.1270~~ 0.1108 iph)
At T = ~~2.53~~ 2.57 hrs

~~INPUT SUMMARY FOR W.S.: AU-1A~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 83~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.032 hr~~
~~Duration = 6.00 hr~~	~~Area = 1.36 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.3788 in~~
~~Initial Abstraction = 0.4096 in~~
~~Peak Flow = 0.51 cfs (0.3723 iph)~~
~~At T = 2.50 hrs~~

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~~**PEAK**~~

~~HYDROGRAPH GENERATION PROGRAM~~

~~INPUT SUMMARY FOR W.S.: AU-1B~~

~~STORM:~~ ~~WATERSHED:~~

~~Distribution = SCS Type 'B'~~ ~~Curve Number = 83~~

~~Precip. Depth = 1.50 in~~ ~~Time of Conc. = 0.026 hr~~

~~Duration = 6.00 hr~~ ~~Area = 1.16 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.3788 in~~

~~Initial Abstraction = 0.4096 in~~

~~Peak Flow = 0.44 cfs (0.3753 iph)~~

~~At T = 2.50 hrs~~

~~INPUT SUMMARY FOR W.S.: AU-1C~~

~~STORM:~~ ~~WATERSHED:~~

~~Distribution = SCS Type 'B'~~ ~~Curve Number = 76~~

~~Precip. Depth = 1.50 in~~ ~~Time of Conc. = 0.120 hr~~

~~Duration = 6.00 hr~~ ~~Area = 16.40 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~

~~Initial Abstraction = 0.6316 in~~

~~Peak Flow = 1.95 cfs (0.1180 iph)~~

~~At T = 2.54 hrs~~

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~~PEAK~~

~~HYDROGRAPH GENERATION PROGRAM~~

~~INPUT SUMMARY FOR W.S.: AU-2~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.075 hr~~
~~Duration = 6.00 hr~~	~~Area = 2.23 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.30 cfs (0.1345 iph)~~
~~At T = 2.52 hrs~~

~~INPUT SUMMARY FOR W.S.: AU-2A~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.077 hr~~
~~Duration = 6.00 hr~~	~~Area = 1.64 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.22 cfs (0.1332 iph)~~
~~At T = 2.53 hrs~~

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~~**PEAK**~~

~~HYDROGRAPH GENERATION PROGRAM~~

~~INPUT SUMMARY FOR W.S.: AU-2B~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.081 hr~~
~~Duration = 6.00 hr~~	~~Area = 3.80 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.50 cfs (0.1317 iph)~~
~~At T = 2.53 hrs~~

~~INPUT SUMMARY FOR W.S.: AU-3~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.078 hr~~
~~Duration = 6.00 hr~~	~~Area = 3.87 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.52 cfs (0.1327 iph)~~
~~At T = 2.53 hrs~~

PEAK
HYDROGRAPH GENERATION PROGRAM

~~INPUT SUMMARY FOR W.S.: AU-3A~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.016 hr~~
~~Duration = 6.00 hr~~	~~Area = 0.30 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.05 cfs (0.1597 iph)~~
~~At T = 2.50 hrs~~

INPUT SUMMARY FOR W.S.: AU-4

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = ~~0.093~~ 0.119 hr
Duration = 6.00 hr	Area = ~~7.97~~ 26.14 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = ~~1.02~~ 3.12 cfs (~~0.1273~~ 0.1182 iph)
At T = ~~2.53~~ 2.55 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

~~INPUT SUMMARY FOR W.S.: AU-4A~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 83~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.029 hr~~
~~Duration = 6.00 hr~~	~~Area = 0.92 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.3788 in~~
~~Initial Abstraction = 0.4096 in~~
~~Peak Flow = 0.35 cfs (0.3728 iph)~~
~~At T = 2.50 hrs~~

INPUT SUMMARY FOR W.S.: AU-5

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = ~~0.104~~ 0.092 hr
Duration = 6.00 hr	Area = ~~20.14~~ 4.67 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = ~~2.51~~ 0.60 cfs (~~0.1236~~ 0.1277 iph)
At T = ~~2.54~~ 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-6

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = ~~0.059~~ 0.062 hr
Duration = 6.00 hr	Area = ~~2.73~~ 4.67 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = ~~0.39~~ 0.65 cfs (~~0.1404~~ 0.1391 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-7

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = 0.094 hr
Duration = 6.00 hr	Area = 13.46 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 1.72 cfs (0.1270 iph)
At T = 2.53 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-8

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = 0.050 hr
Duration = 6.00 hr	Area = 4.95 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = 0.72 cfs (0.1444 iph)
At T = 2.51 hrs

INPUT SUMMARY FOR W.S.: AU-9

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = ~~0.100~~ 0.117 hr
Duration = 6.00 hr	Area = 4.77 9.36 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = ~~0.60~~ 1.12 cfs (~~0.1248~~ 0.1191 iph)
At T = ~~2.53~~ 2.54 hrs

PEAK
HYDROGRAPH GENERATION PROGRAM

INPUT SUMMARY FOR W.S.: AU-10

STORM:	WATERSHED:
Distribution = SCS Type 'B'	Curve Number = 76
Precip. Depth = 1.50 in	Time of Conc. = ~~0.137~~ 0.147 hr
Duration = 6.00 hr	Area = ~~35.52~~ 30.93 ac

OUTPUT SUMMARY

Runoff depth = 0.1873 in
Initial Abstraction = 0.6316 in
Peak Flow = ~~4.05~~ 3.43 cfs (~~0.1130~~ 0.1099 iph)
At T = ~~2.56~~ 2.57 hrs

~~INPUT SUMMARY FOR W.S.: AU-11~~

~~STORM:~~	~~WATERSHED:~~
~~Distribution = SCS Type 'B'~~	~~Curve Number = 76~~
~~Precip. Depth = 1.50 in~~	~~Time of Conc. = 0.045 hr~~
~~Duration = 6.00 hr~~	~~Area = 0.62 ac~~

~~OUTPUT SUMMARY~~

~~Runoff depth = 0.1873 in~~
~~Initial Abstraction = 0.6316 in~~
~~Peak Flow = 0.09 cfs (0.1464 iph)~~
~~At T = 2.51 hrs~~

CULVERT CHARACTERISTICS

Culvert	Dia (in.)	Type	Contributing Watersheds	Peak Q(cfs)	Slope (ft/ft)	Outlet Condition
C-1U	~~30~~	~~CMP Flexible~~	~~AU-3, AU-4, AU-4A, AU-5~~ Reclaimed	~~4.40~~	~~0.12~~ ~~0.73~~	~~Bedrock~~
~~C-2U~~	~~12~~	~~stl pipe~~	~~AU-11~~ Reclaimed	~~0.09~~	~~0.08~~	~~soil~~
~~C-3U~~	~~12~~	~~CMP~~	~~AU-6, AU-7, AU-11~~ Reclaimed	~~2.20~~	~~0.05~~	~~4" rip-rap~~
~~C-4U~~	~~12~~	~~CMP~~	~~AU-8, AU-9~~ Reclaimed	~~1.32~~	~~0.05~~	~~Soil~~
~~C-5U~~	~~12~~	~~CMP~~	~~AU-8, AU-9, AU-15~~ Reclaimed	~~1.45~~	~~0.05~~	~~Soil~~
~~C-6U~~	~~12~~	~~CMP~~	~~AU-6, AU-7, AU-11 AU-13, AU-14~~ Reclaimed	~~2.65~~	~~0.05~~	~~4" rip-rap~~
~~C-7U~~	~~12~~	~~CMP~~	~~AU-12~~ Reclaimed	~~0.34~~	~~0.05~~	~~6" rip-rap~~
C-8U	18	Flexible CMP, RCP	~~AU-3, AU-3A~~ AU-4, ~~AU-4A, AU-5~~	~~4.45~~ 3.12	0.13	12" rip-rap
C-9U	60	stl pipe	Bear Creek	108.18	0.06	48" rip-rap
C-10U	60	RCP	Bear Creek	108.18	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	Soil
C-14U	60	CMP	Bear Creek	108.18	0.06	48" rip-rap
~~C-15U~~	~~18~~	~~CMP flexible~~	~~AU-1B, AU-2, AU-2A, AU-2B~~ Reclaimed	~~1.46~~	~~0.05~~ ~~0.78~~	~~27" rip-rap~~
~~C-16U~~	~~15~~	~~CMP flexible~~	~~AU-1, AU-1A~~ Reclaimed	~~1.34~~	~~0.05~~ ~~0.80~~	~~Bedrock~~
~~C-17U~~	~~12~~	~~CMP~~	~~AU-1~~ Reclaimed	~~0.83~~	~~0.18~~	~~3" rip-rap~~
~~C-18U~~	~~15~~	~~CMP flexible~~	~~AU-2~~ Reclaimed	~~0.30~~	~~0.05~~ ~~0.75~~	~~10" rip-rap~~
~~C-19U~~	~~15~~	~~CMP flexible~~	~~AU-2A~~ Reclaimed	~~0.22~~	~~0.05~~ ~~0.75~~	~~9" rip-rap~~
~~C-20U~~	~~15~~	~~CMP flexible~~	~~AU-2B~~ Reclaimed	~~0.50~~	~~0.05~~ ~~0.75~~	~~15" rip-rap~~

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~~ Reclaimed	~~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~~ Reclaimed	~~0.23~~	~~0.03~~	~~4" rip-rap~~
C-4D	~~2112~~	CMP	~~AD-3A, AD-5 AD-7,~~ AD-14, ~~C-10D~~	~~2.66~~ 0.30	0.18	9" rip-rap
C-5D	~~18 21~~	CMP	AD-3A, AD-5, AD-7, AD-14, AD-9, C-10D	~~0.23~~ 2.59	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	soil
~~C-11D~~	~~12~~	~~CMP flexible~~	~~AU-4A~~ Reclaimed	~~0.35~~	~~0.05 0.25~~	~~3" rip-rap~~
C-12D	8	CMP	AD-18	0.55	0.05	soil

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	C-8U
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.015	
Slope	0.130000	ft/ft
Diameter	18	in
Discharge	3.12	cfs

Results		
Depth	0.31	ft
Flow Area	0.3	ft²
Wetted Perimeter	1.42	ft
Top Width	1.22	ft
Critical Depth	0.67	ft
Percent Full	20.8	%
Critical Slope	0.006862	ft/ft
Velocity	11.70	ft/s
Velocity Head	2.13	ft
Specific Energy	2.44	ft
Froude Number	4.41	
Maximum Discharge	35.31	cfs
Discharge Full	32.82	cfs
Slope Full	0.001175	ft/ft
Flow Type	Supercritical	

Minimum required riprap conditions = 12" m.d. riprap at outlet

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	C-4D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Slope	0.1800	ft/ft
Diameter	12	in
Discharge	0.30	cfs

Results		
Depth	0.13	ft
Flow Area	0.1	ft²
Wetted Perimeter	0.74	ft
Top Width	0.67	ft
Critical Depth	0.23	ft
Percent Full	13.1	%
Critical Slope	0.019460	ft/ft
Velocity	4.95	ft/s
Velocity Head	0.38	ft
Specific Energy	0.51	ft
Froude Number	2.91	
Maximum Discharge	8.81	cfs
Discharge Full	8.19	cfs
Slope Full	0.000242	ft/ft
Flow Type	Supercritical	

Worksheet
Worksheet for Circular Channel

Project Description	
Worksheet	C-5D
Flow Element	Circular Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.024	
Slope	0.080	ft/ft
Diameter	21	in
Discharge	2.59	cfs

Results		
Depth	0.22	ft
Flow Area	0.2	ft²
Wetted Perimeter	1.27	ft
Top Width	1.16	ft
Critical Depth	0.58	ft
Percent Full	12.6	%
Critical Slope	0.015951	ft/ft
Velocity	14.79	ft/s
Velocity Head	3.4	ft
Specific Energy	3.62	ft
Froude Number	6.71	
Maximum Discharge	82.57	cfs
Discharge Full	76.76	cfs
Slope Full	0.000911	ft/ft
Flow Type	Supercritical	

A velocity arrestor will be placed at the outlet.

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~~ Reclaimed	~~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-14	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-9, AD-10, AD-12 AD-14	3.63	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	~~4.90~~ 5.01	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	0.013
D-9D	4 Min, 10 Max	AD-15	1.20	Soil	0.03
D-10D	7 Min, 50 Max	AD-6, AD-3B, AD-2C	1.03	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
~~D-14D~~	~~0.06 Av.~~	~~AU-4A~~ Reclaimed	~~0.35~~	~~Soil~~	~~0.03~~
D-15D	0.05 Av.	AD-16	1.24	Soil	0.03
D-16D	0.05 Av.	AD-18	0.55	Soil	0.03
D-17D	0.08	AU-23,AD-20	0.99		

DITCH CHARACTERISTICS (cont)

DITCH	CHANNEL SLOPE %	CONTRIBUTING WATERSHED	PEAK Q (cfs)	BANK AND BOTTOM DESC.	MANNING'S $\eta^{(a)}$
D-1U	2 Min, 8 Max	AU-5	~~2.51~~ 0.060	D_{50}.2", D_{max}.4"	0.03
D-2U	7 Min, 10 Max	AU-6, ~~AU-11~~ D-1U	~~0.48~~ 1.25	Rocky Soil	0.03
D-3U	4 Min, 18 Max	D-2U, AU-7, AU-8	~~0.72~~ 3.69	Rocky Soil	0.03
D-4U	1 Min, 10 Av, 18 Max	D-3U, AU-9 ~~AU-10~~	~~4.05~~ 4.81	Rocky Soil	0.03
D-5U	4 Min, 13 Max	AU-15	0.13	Rocky Soil	0.03
D-6U	3 Min, 6 Max	AU-14	0.35	Rocky Soil	0.03
D-7U	1 Min, 16 Max	AU-12	0.34	Rocky Soil	0.03
D-8U	2 Min, 6 Av 31 Max	AU-1, ~~AU-1A, AU-1B AU-1C, AU-2 AU-2A, AU-2B~~	~~4.75~~ 3.88	Soil D_{50}.6"	0.033
D-9U	1 Min, 6 Max	AU-16	4.92	D_{50}.4"	0.03
D-10U	3 Min, 10 Max	AU-17	3.29	D_{50}.4"	0.03
D-11U	3 Min, 8 Max	misc. road drainage	1.0[b]	Soil	0.03
D-12U	3 Min 9 Max	AU-18	4.0	Soil D_{50}.4"	0.03
D-13U	2 Min, 6 Av, 23 Max	misc. road drainage	1.0[b]	Soil	0.03
D-14U	6 Min, 66 Max	Outlet of Sed Pond A	8.9	D_{50}.4" D_{Max}.10"	0.03
D-15U	~~5 Min, 11 Av, 16 Max~~	~~AU-3~~ Reclaimed	~~0.52~~	~~soil~~	~~0.03~~
D-16U	~~10 Av~~	~~AU-1B~~ Reclaimed	~~0.44~~	~~soil~~	~~0.03~~
D-17U	~~13 Av~~	~~AU-1, AU-1A~~ Reclaimed	~~1.34~~	~~bedrock~~	~~0.03~~
D-18U	~~5 Min, 11 Av 17 Max~~	~~AU-1~~ Reclaimed	~~0.83~~	~~soil, bedrock~~	~~0.03~~
D-19U	~~6 Av~~	~~AU-2B~~ Reclaimed	~~0.50~~	~~soil~~	~~0.03~~
D-20U	16 Av	AU-42	0.67	soil	0.03
D-21U	13 Av	AU-43	1.75	D_{50}=3"	0.03
D-22U	11 Av	AU-19, AU-25	4.33	D_{50}=6"	0.03

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	DITCH D-7D
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.020000	ft/ft
Left Side Slope	0.67	V : H
Right Side Slope	0.67	V : H
Bottom Width	2.00	ft
Discharge	5.01	cfs

Results		
Depth	0.51	ft
Flow Area	1.4	ft²
Wetted Perimeter	3.82	ft
Top Width	3.51	ft
Critical Depth	0.51	ft
Critical Slope	0.019943	ft/ft
Velocity	3.58	ft/s
Velocity Head	0.20	ft
Specific Energy	0.71	ft
Froude Number	1.00	
Flow Type	Subcritical	

Use Minimum Depth = 0.75 ft	Minimum Freeboard = ~~0.27~~ 0.24 ft
Velocity < 5 fps	No rip-rap rquired
At steep slope 55%	Use D_{50} = 6"

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	DITCH D-7D (Avg Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.060	ft/ft
Left Side Slope	0.67	V : H
Right Side Slope	0.67	V : H
Bottom Width	2.00	ft
Discharge	5.01	cfs

Results		
Depth	0.37	ft
Flow Area	1.0	ft^2
Wetted Perimeter	3.34	ft
Top Width	3.11	Ft
Critical Depth	0.51	ft
Critical Slope	0.019943	ft/ft
Velocity	5.26	ft/s
Velocity Head	0.43	ft
Specific Energy	0.80	ft
Froude Number	1.68	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	DITCH D-7D (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.550	ft/ft
Left Side Slope	0.67	V : H
Right Side Slope	0.67	V : H
Bottom Width	2.00	ft
Discharge	5.01	cfs

Results		
Depth	0.20	ft
Flow Area	0.5	ft²
Wetted Perimeter	2.71	ft
Top Width	2.59	ft
Critical Depth	0.51	ft
Critical Slope	0.019943	ft/ft
Velocity	11.12	ft/s
Velocity Head	1.92	ft
Specific Energy	2.12	ft
Froude Number	4.70	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-1U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.020	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	0	ft
Discharge	0.60	cfs

Results		
Depth	0.22	ft
Flow Area	0.05	ft²
Wetted Perimeter	0.62	ft
Top Width	0.44	ft
Critical Depth	0.19	ft
Critical Slope	0.045935	ft/ft
Velocity	1.27	ft/s
Velocity Head	0.02	ft
Specific Energy	0.24	ft
Froude Number	0.68	
Flow Type	Subcritical	

Use Minimum Depth = ~~.67~~ 0.32 ft Velocity < 5 fps	Minimum Freeboard = ~~0.31~~ 0.10 ft No riprap required

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-1U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.080	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	0	ft
Discharge	0.06	cfs

Results		
Depth	0.17	ft
Flow Area	0.03	ft²
Wetted Perimeter	0.47	ft
Top Width	0.34	ft
Critical Depth	0.19	ft
Critical Slope	0.045934	ft/ft
Velocity	2.13	ft/s
Velocity Head	0.07	ft
Specific Energy	0.24	ft
Froude Number	1.30	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-2U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.070	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	0.00	ft
Discharge	1.25	cfs

Results		
Depth	0.54	ft
Flow Area	0.3	ft²
Wetted Perimeter	1.52	ft
Top Width	1.07	ft
Critical Depth	0.63	ft
Critical Slope	0.030641	ft/ft
Velocity	4.33	ft/s
Velocity Head	0.29	ft
Specific Energy	0.83	ft
Froude Number	1.47	
Flow Type	Supercritical	

Use Minimum Depth = 0.67 ft Velocity < 5 fps	Minimum Freeboard = 0.29 ft No riprap required

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-2U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.100	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	0.00	ft
Discharge	1.25	cfs

Results		
Depth	0.50	ft
Flow Area	0.3	ft^2
Wetted Perimeter	1.42	ft
Top Width	1.01	ft
Critical Depth	0.63	ft
Critical Slope	0.030641	ft/ft
Velocity	4.95	ft/s
Velocity Head	0.38	ft
Specific Energy	0.88	ft
Froude Number	1.74	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-3U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.040	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	8.00	ft
Discharge	3.69	cfs

Results		
Depth	0.16	ft
Flow Area	1.3	ft²
Wetted Perimeter	8.45	ft
Top Width	8.32	ft
Critical Depth	0.19	ft
Critical Slope	0.023708	ft/ft
Velocity	2.84	ft/s
Velocity Head	0.13	ft
Specific Energy	0.28	ft
Froude Number	1.27	
Flow Type	Supercritical	

Use Minimum Depth = 0.5 ft Velocity < 5 fps	Minimum Freeboard = ~~0.29~~ 0.34 ft No riprap required

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-3U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.180	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	8.00	ft
Discharge	3.69	cfs

Results		
Depth	0.10	ft
Flow Area	0.8	ft^2
Wetted Perimeter	8.29	ft
Top Width	8.20	ft
Critical Depth	0.19	ft
Critical Slope	0.023708	ft/ft
Velocity	4.50	ft/s
Velocity Head	0.31	ft
Specific Energy	0.42	ft
Froude Number	2.51	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-4U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.100	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	8.00	ft
Discharge	4.81	cfs

Results		
Depth	0.14	ft
Flow Area	1.2	ft²
Wetted Perimeter	8.40	ft
Top Width	8.28	ft
Critical Depth	0.22	ft
Critical Slope	0.022492	ft/ft
Velocity	4.17	ft/s
Velocity Head	0.27	ft
Specific Energy	0.41	ft
Froude Number	1.97	
Flow Type	Supercritical	

Use Minimum Depth = 0.5 ft Velocity < 5 fps	Minimum Freeboard = 0.36 ft No riprap required

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-4U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.030	
Slope	0.180	ft/ft
Left Side Slope	1.00	V : H
Right Side Slope	1.00	V : H
Bottom Width	8.00	ft
Discharge	4.81	cfs

Results		
Depth	0.12	ft
Flow Area	1.0	ft²
Wetted Perimeter	8.34	ft
Top Width	8.24	ft
Critical Depth	0.22	ft
Critical Slope	0.022493	ft/ft
Velocity	4.99	ft/s
Velocity Head	0.39	ft
Specific Energy	0.51	ft
Froude Number	2.57	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-8U
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.033	
Slope	0.020	ft/ft
Left Side Slope	0.67	V : H
Right Side Slope	0.67	V : H
Bottom Width	2.00	ft
Discharge	3.88	cfs

Results		
Depth	0.44	ft
Flow Area	2.2	ft²
Wetted Perimeter	3.58	ft
Top Width	3.31	ft
Critical Depth	0.44	ft
Critical Slope	0.020626	ft/ft
Velocity	3.32	ft/s
Velocity Head	0.17	ft
Specific Energy	0.61	ft
Froude Number	0.99	
Flow Type	Subcritical	

Use Minimum Depth = 0.67 ft Velocity < 5 fps At steep slope 31%	Minimum Freeboard = ~~0.15~~ 0.23 ft No riprap required typically Use D_{50} = 6"

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-8U (Avg Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.033	
Slope	0.060	ft/ft
Left Side Slope	0.67	V : H
Right Side Slope	0.67	V : H
Bottom Width	2.00	ft
Discharge	3.88	cfs

Results		
Depth	0.32	ft
Flow Area	0.8	ft²
Wetted Perimeter	3.18	ft
Top Width	2.46	ft
Critical Depth	0.44	ft
Critical Slope	0.020626	ft/ft
Velocity	4.85	ft/s
Velocity Head	0.37	ft
Specific Energy	0.69	ft
Froude Number	1.65	
Flow Type	Supercritical	

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	D-8U (Max Slope)
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Channel Depth

Input Data		
Mannings Coefficient	0.033	
Slope	0.310	ft/ft
Left Side Slope	0.67	V : H
Right Side Slope	0.67	V : H
Bottom Width	2.00	ft
Discharge	3.88	cfs

Results		
Depth	0.20	ft
Flow Area	0.5	ft^2
Wetted Perimeter	2.72	ft
Top Width	2.60	ft
Critical Depth	0.44	ft
Critical Slope	0.020626	ft/ft
Velocity	8.44	ft/s
Velocity Head	1.11	ft
Specific Energy	1.31	ft
Froude Number	3.53	
Flow Type	Supercritical	

980 Loader Cycle Time

(From Cat Performance Handbook)			0.55 min
a.	3/4 inch to 6 inch		0.00 min
b.	Pile (10 ft or less)	+	0.01 min
c.	3/4 inch to 6 inch	-	0.04 min
			0.52 min

(60 min/hr)/(0.52 min/cycle) = 115.4 cycles/hr
Efficiency 50 min/hr - (115.4 cycles/hr)(6 cu yd/cycle)(50 min/60 min) = 577 cu yd/hr (96 cycles/hr)

Summary of Reclamation Cost Estimate

Direct Costs		
a.	Seal Portals and Backfill	$ 112,500
b.	Removal of Structures	$ ~~210,403~~ 216,280
c.	Soil Placement and Ripping	$ 178,617
d.	Channel Restoration	$ 403,728
e.	Revegetation	$ 462,968
f.	Monitor Well Plugging	$ 5,000
Total Direct Costs:		$ ~~1,373,216~~ 1,379,093
Indirect Costs		
g.	Maintenance and Monitoring (10%)	$ ~~137,322~~ 137,904
h.	Contingency (5%)	$ ~~68,661~~ 68,955
i.	Engineering Redesign (2.5%)	$ ~~34,330~~ 34,477
j.	Mobilization and Demobilization (5%)	$ ~~68,661~~ 68,955
k.	Contract Management Fee (2.5%)	$ ~~34,330~~ 34,477
Total Indirect Costs:		$ ~~343,304~~ 344,773
Total Reclamation Cost (2001 dollars)		**$ ~~1,716,520~~ 1,723,866**

Escalated Values	Escalation Factor
2002 - 1,770,075	3.12% (est)
2003 - 1,825,302	3.12% (est)
2004 - 1,882,251	3.12% (est)
2005 - 1,940,978	3.12% (est)

The total bond currently posted, rounded to the nearest $1,000, is **$1,825,000**.

~~Scalehouse Area~~ Pavement

02220-875-1750 (Pavement Removal 3")
Area = ~~800~~ 1,450 square yards (1,200 at Bath-House, 250 at load-out)
Cost = ($ 3.85 /sq yd) (~~800~~ 1,450 sq yd) = $ ~~3,080~~ 5,583
Time = (~~800~~ 1,450 sq yd) / (420 sq yd/day) = ~~1.90~~ 3.45 days

~~Disposal at landfill~~ Asphalt will be relayed at Trail Canyon
Volume = (~~67~~ 121 CY) (2 tons/yd) (1.3 swell factor) = ~~174~~ 315 Tons
16 ton truck; distance to haul approx. ~~40~~ 4 miles round trip = 3 8 trips/day
Time = (~~67~~ 121 cu yd)/(~~48~~ 128 cu yd/day) = ~~1.4~~ 0.95 days
~~Dump Fee = (174 Tons) ($7.00/ton) = $1,218~~

01590-200- 5300 Dump Truck Cost = ($ 823.88/day) (~~1.4~~ 1.0 days) = $ ~~1,154~~ 824

Cost Subtotal	$ ~~5,452~~ 6,407
Time Subtotal	~~3.3~~ 4.5 days

Shower House

02220-100-0100 (Framed Portion, includes disposal)
Volume = (92 ft) (50 ft) (8 ft) = 36,800 cu ft
Cost = ($ 0.24 /cu ft) (36,800 cu ft) = $ 8,832
Dump Fee = ((36,800 cu ft) / 27) (0.3 rubble volume) (1.35 tons/cy) ($7.00/ton) = $3,864
Time = (36,800 cu ft) / (20,100 cu ft/day) = 1.83 days

02220-100-0080 (Masonry Portion, includes disposal)
Volume = (92 ft) (50 ft) (8 ft) = 36,800 cu ft
Boot wash Volume = (12 ft) (5.5 ft) (8 ft) = 528 cu ft
Cost = ($ 0.24 /cu ft) (37,328 cu ft) = $ 8,959
Dump Fee = ((37,328 cu ft) / 27) (0.3 rubble volume) (1.35 tons/cy) ($7.00/ton) = $3,919
Time = (37,328 cu ft) / (20,100 cu ft/day) = 1.86 days

Concrete Demolition
Foundation Volume = (0.67 ft) (2 ft) (284 ft) = (380.6 cu ft) / 27 = 14.1 cu yds
Footing Volume = (0.67 ft) (2 ft) (319 ft) = (427.5 cu ft) / 27 = 15.8 cu yds
Floor Volume = (92 ft) (50 ft) (0.33 ft) = (1518 cu ft) / (27) = 56.2 cu yds
Boot wash Floor Volume =(12 ft) (5.5 ft)(0.33 ft) = (21.8) / 27 = 0.81 cu yds
Total Volume = 86.9 cu yds
Cost = (86.9 CY) ($12.78/CY) = $1,111
Time = (638 s.f.) / (180 s.f./day) + (319 L.F.) / (300 L.F./day) + (4,666 s.f.) / (500 s.f./day) = 13.94 days

02220-875-5550 (Concrete Disposal on Site) 002315-400-1300 (3 CY loader) 02320-200-0320 (16 ton truck)
Volume = (86.9 CY) (1.3 swell factor) = 113.0
Cost = (113 CY) ($10.69/CY) = $1,208
Time = (113 cu. yds) / (232 cu. yds/day) = 0.49 days

Cost Subtotal	$ 27,893
Time Subtotal	18.12 days

~~Hilfiker~~ Pre-Fab Retaining Wall

01590-600-2500 (Crane - 25 Ton), (Flatbed Truck - 16 Ton)

Assume each piece takes 10 min. average to disassemble and load with crane.
Number of pieces = 95 pieces
Time = 95 (.17 hr) = 16 hrs
Crane + operator = (16 hrs) ($133.72 /hr) = $2,140
Truck + operator = (16 hrs) ($102.99 /hr) (2) = $1,648
CLAB = (16 hrs) ($35.75 /hr) (2) = $1,144
Time = 2 days

The pre-fabricated wall has a resell value of $14,000 (2006 dollars)

~~02220-100-0012 (Steel Building, includes disposal)~~

~~Volume = (1,584 sq ft) (0.02 ft) = 32 cu ft~~
~~Cost = (32 cu ft) ($0.22/cu ft) = $7~~
~~Dump Fee = (32 / 27 cu yd) (0.3 Demolished volume) (1.35 Ton/cu yd) ($7.00/Ton) = $3~~
~~Time = (32) / (21,500 cu ft/day) = .01 days~~

Cost Subtotal	~~$10~~ 4,932
Time Subtotal	~~.01~~ 2 days

Coal Processing/Crusher Facility (Tipple)

Primary Structure = 27 ft x 40 ft Approx. (25% is 25 ft high, 50% is 17 ft high, and 25% is 8 ft high.)
Secondary Structure = 20 ft x 30 ft x 51 ft high

02220-100-0012 (Steel Building, includes disposal)

$Volume_1$ = (27 ft) (40 ft) [(25%) (25 ft) + (50%) (17 ft) + (25%) (8 ft)] = 18,090 c.f.
$Volume_2$= (20 ft) (30 ft) (51 ft) = 30,600 c.f.
Cost = ($ 0.22 /cu ft) (48,690 cu ft) = $ 10,712
Dump Fee = (48,690 / 27 cu yd) (0.3 Demolished volume) (1.35 Ton/cu yd) ($7.00/Ton) = $5,113
Time = (48,690 cu ft) / (21,500 cu ft/day) = 2.26 days

02220-100-0100 (Control House, Mixture type, includes disposal)

Volume = (12 ft)(20 ft)(10ft) = 2,400 cu ft
Cost = ($ 0.24 /cu ft) (2,400 cu ft) = $ 576
Dump Fee = (2400 / 27 cu yd) (0.3 Demolished volume) (1.35 Ton/cu yd) ($7.00/Ton) = $252
Time = (2,400 cu ft) / (20,100 cu ft/day) = 0.12 days

Concrete Demolition

Primary Structure Footings = (2 ft x 2 ft x 1.5 ft x 11) / 27 = 2.4 cu yd
Secondary Structure Footings = (3 ft x 3 ft x 2 ft x 4) / 27 = 2.6 cu yd
Primary Structure Floor = (27 ft x 40 ft x (3.5"/12)) / 27 = 11.7 cu yd
Secondary Structure Floor = (20 ft x 30 ft x (3.5"/12)) / 27 = 6.5 cu yd
Total Volume = 2.4 + 2.6 + 11.7 + 6.5 = 23.2 cu yd
Cost = (23.2 cu yd) ($12.78/cu yd) = $297
Time = (38 L.F.) / (300 L.F./day) + (1,680 s.f.) / (400 s.f./day) = 4.33 days

02220-875-5550 (Concrete Disposal on Site) 002315-400-1300 (3 CY loader) 02320-200-0320 (16 ton truck)

Total Volume = (23.2 cu yd) (1.3 swell factor) = 30.2 cu yd
Cost =($10.69 /cu. yd.) (30.2 cu yds) = $323
Time = (30.2 cu yds) / (232 cu yds/day) = 0.13 days

Cost Subtotal	$ 17,273
Time Subtotal	6.81 days