U·S·DEPARTMENT OF THE INTERIOR OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT DIRECTIVES SYSTEM	Subject Number: TSR - 1 Transmittal Number: 360 Date: 07/21/87

Subject: Handbook for Calculation of Reclamation Bond Amounts

Approval: **Title:** Acting Director

1. Purpose. This directive incorporates by reference the Bond Calculation Handbook (Handbook) as guidance for the calculation of reclamation bond amounts by the Office of Surface Mining Reclamation and Enforcement (OSMRE).

2. Definitions. None.

3. Policy/Procedures.

a. Policy.

(1) The Handbook shall be used as the guide by all OSMRE personnel when calculating bonds or determining bond amounts under a Federal program, Federal lands program or whenever OSMRE issues a permit for surface coal mining and reclamation operations.

(2) The Handbook may be utilized by OSMRE personnel during oversight of approved State programs as a technical guide when assessing the adequacy of bonds. However, such use is limited to that approved in oversight procedures and guidance. The Handbook must not be used to compel State adherence to the methods of the handbook. In those States with approved alternative bonding systems, the Handbook shall be used for only those bonds calculated on a site-specific basis.

b. Responsibilities.

(1) The Chief, Division of Technical Services is responsible for developing and maintaining the Handbook.

(2) The Chief, Division of Regulatory Programs is responsible for evaluating the use of the Handbook in the assessment of bond adequacy as part of the oversight of approved State programs.

c. Procedures. Revisions/modifications to the Handbook will be made as needed utilizing the directives system process.

4. Reporting Requirements. None.

5. References

a. The Surface Mining Control and Reclamation Act of 1977 (SMCRA), Section 509(a).

b. 30 CFR Part 800.

6. Effect on Other Documents. The Handbook supersedes all other OSMRE guides for determining bond amounts where OSMRE is the regulatory authority.

7. Effective Date. Upon Issuance.

8. Contact. Division of Technical Services, (202) 343-1480.

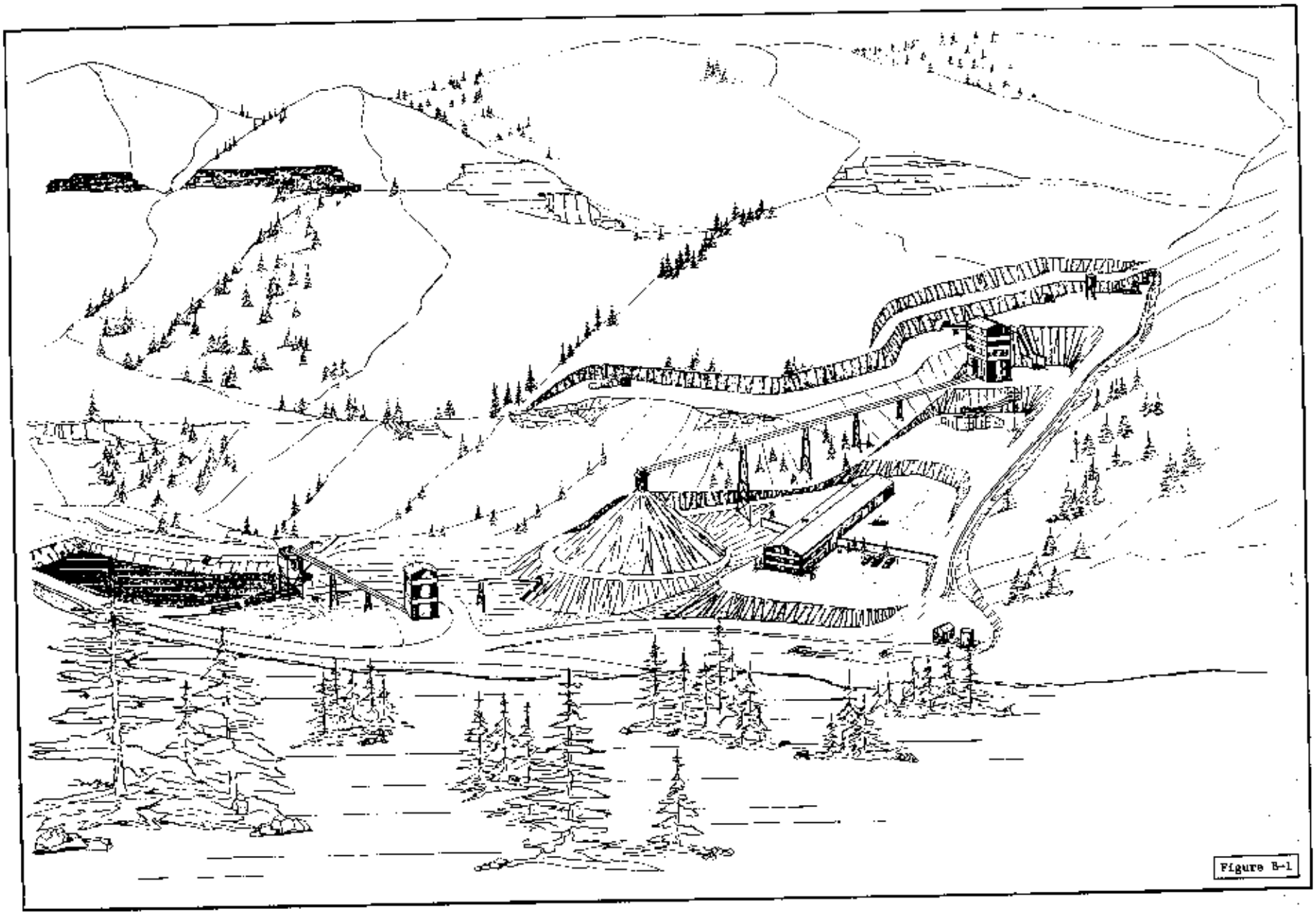


Figure B-1

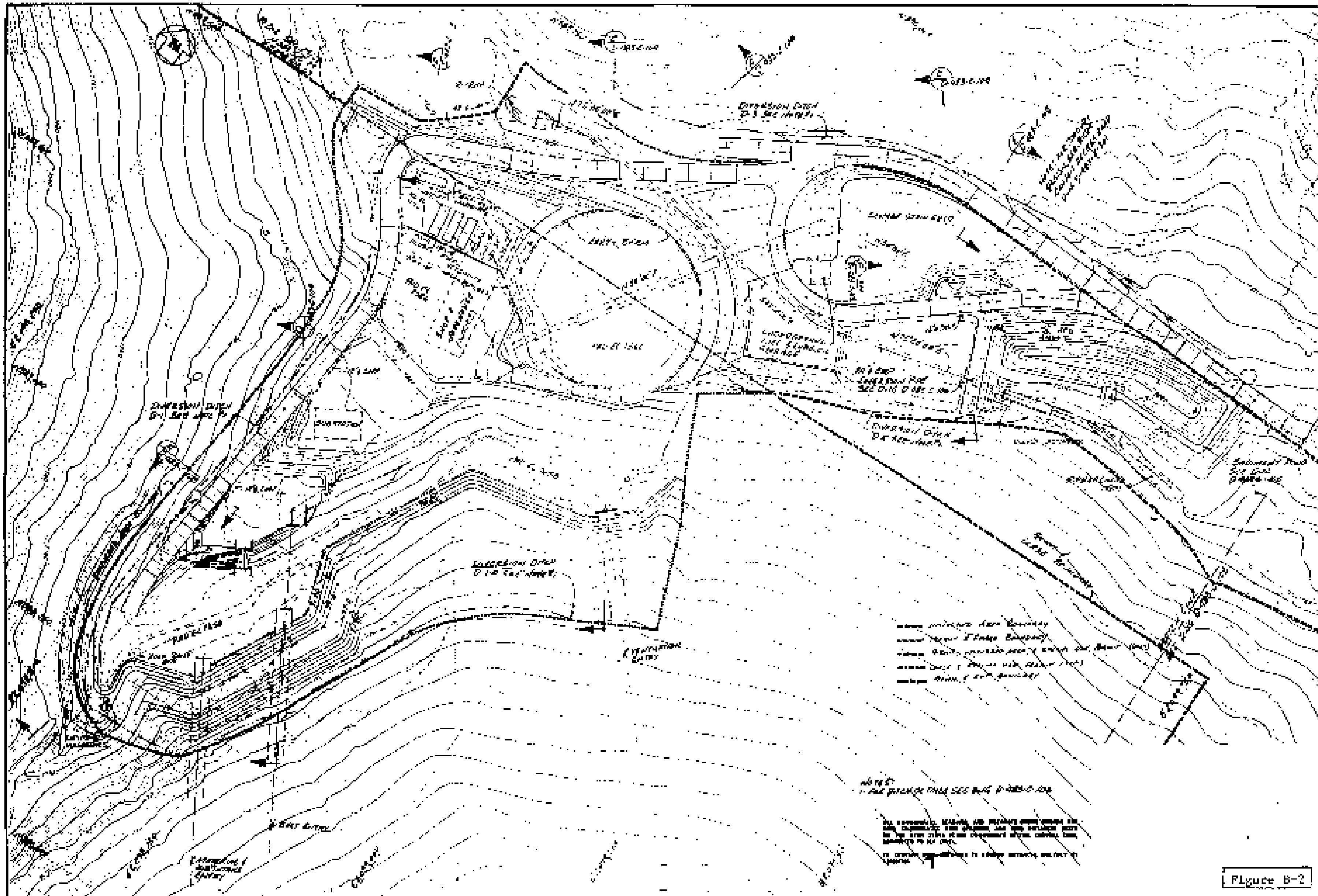


Figure B-2

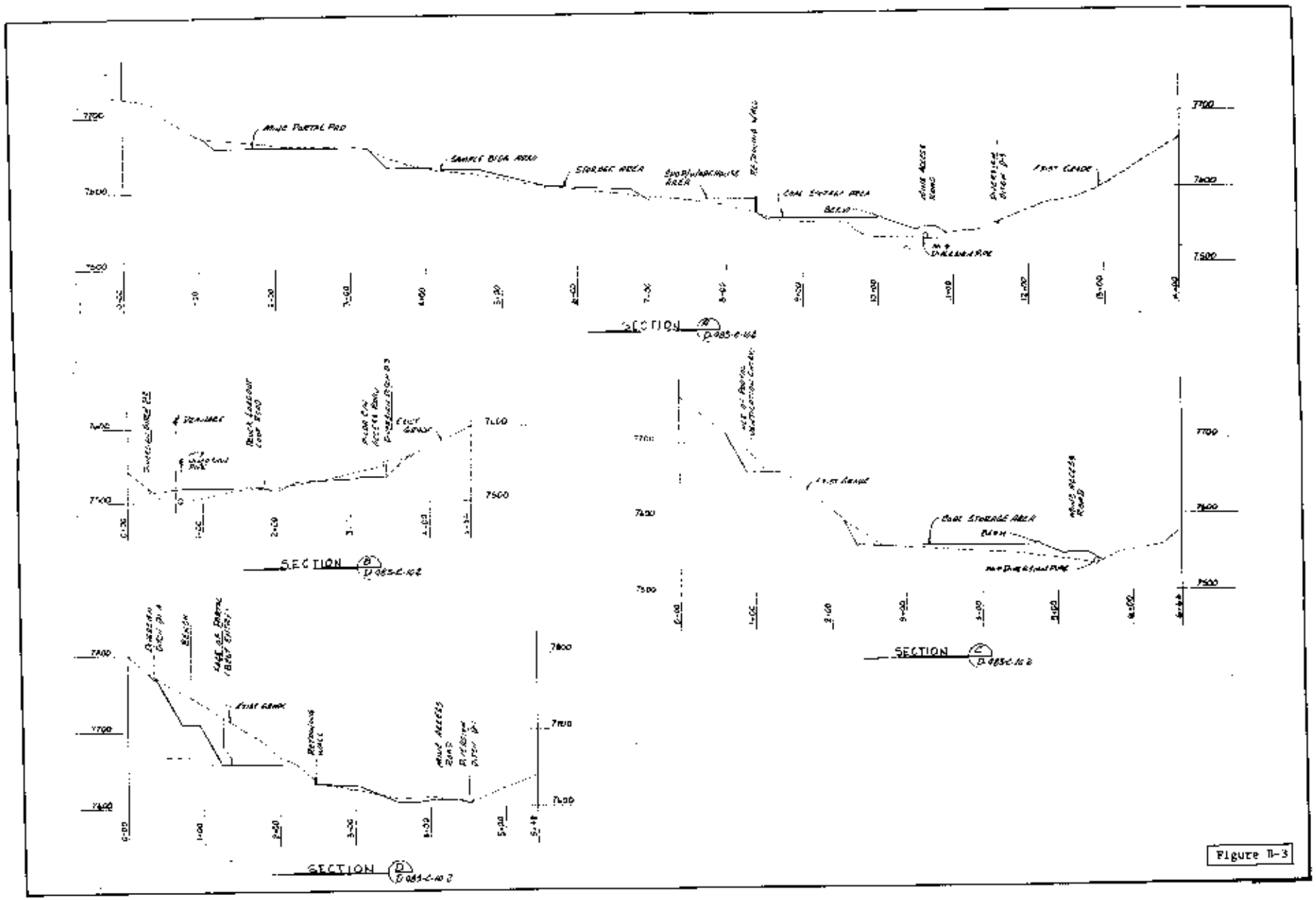


Figure II-3

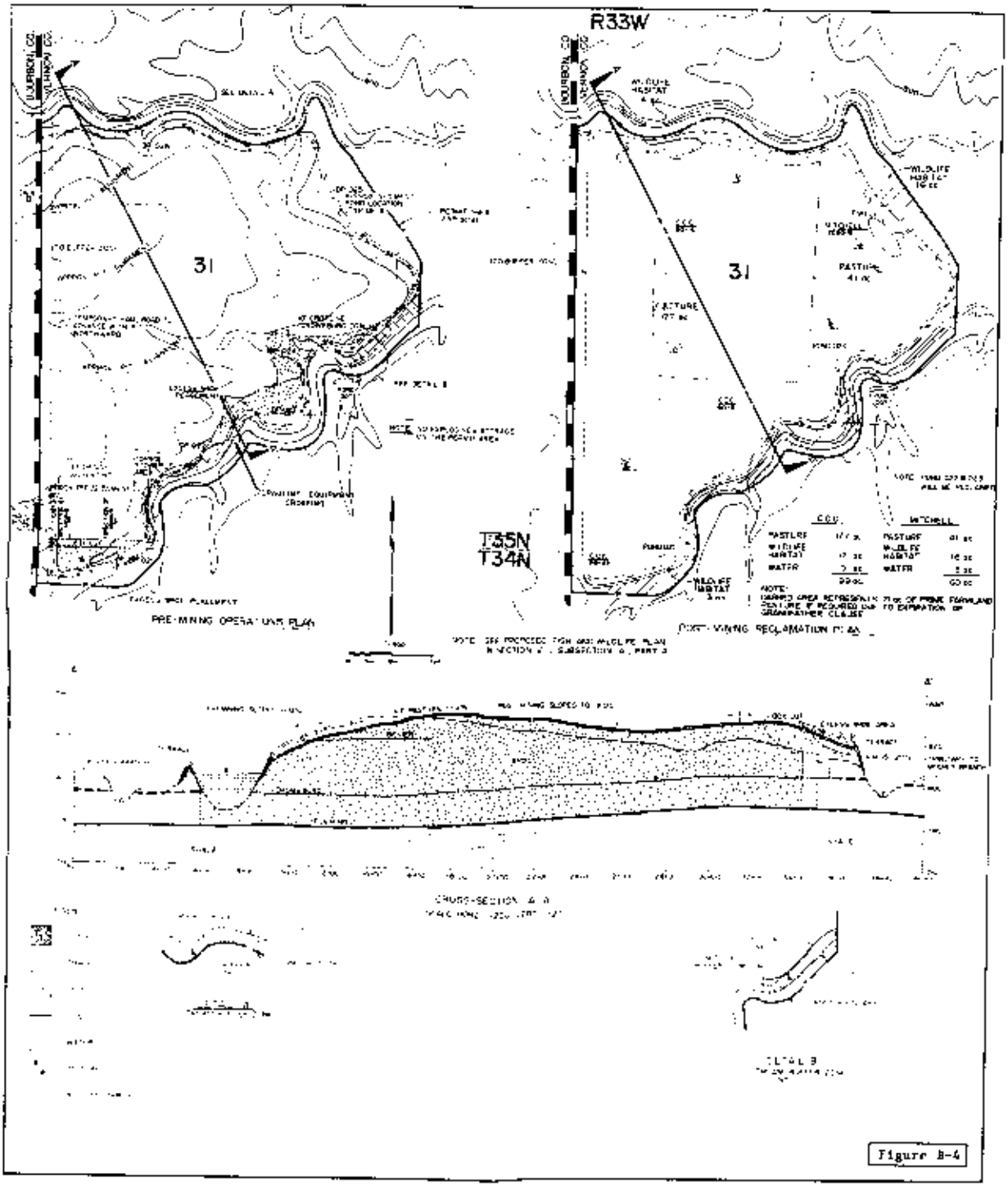

R33W
T35N
T34N
31
PRE-MINING OPERATIONS PLAN
POST-MINING RECLAMATION PLAN
CROSS-SECTION A-A'
DETAIL B

Figure B-4

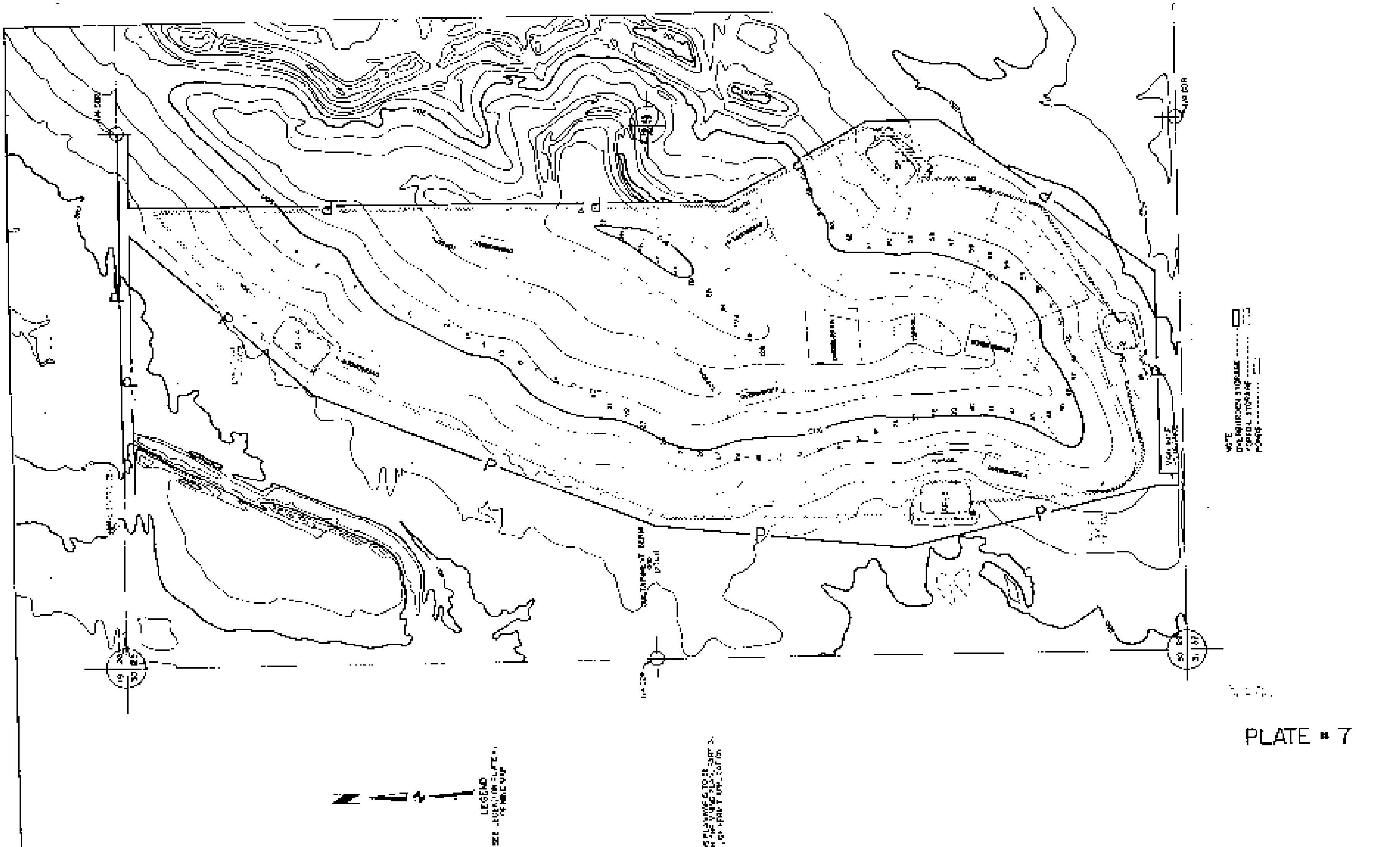
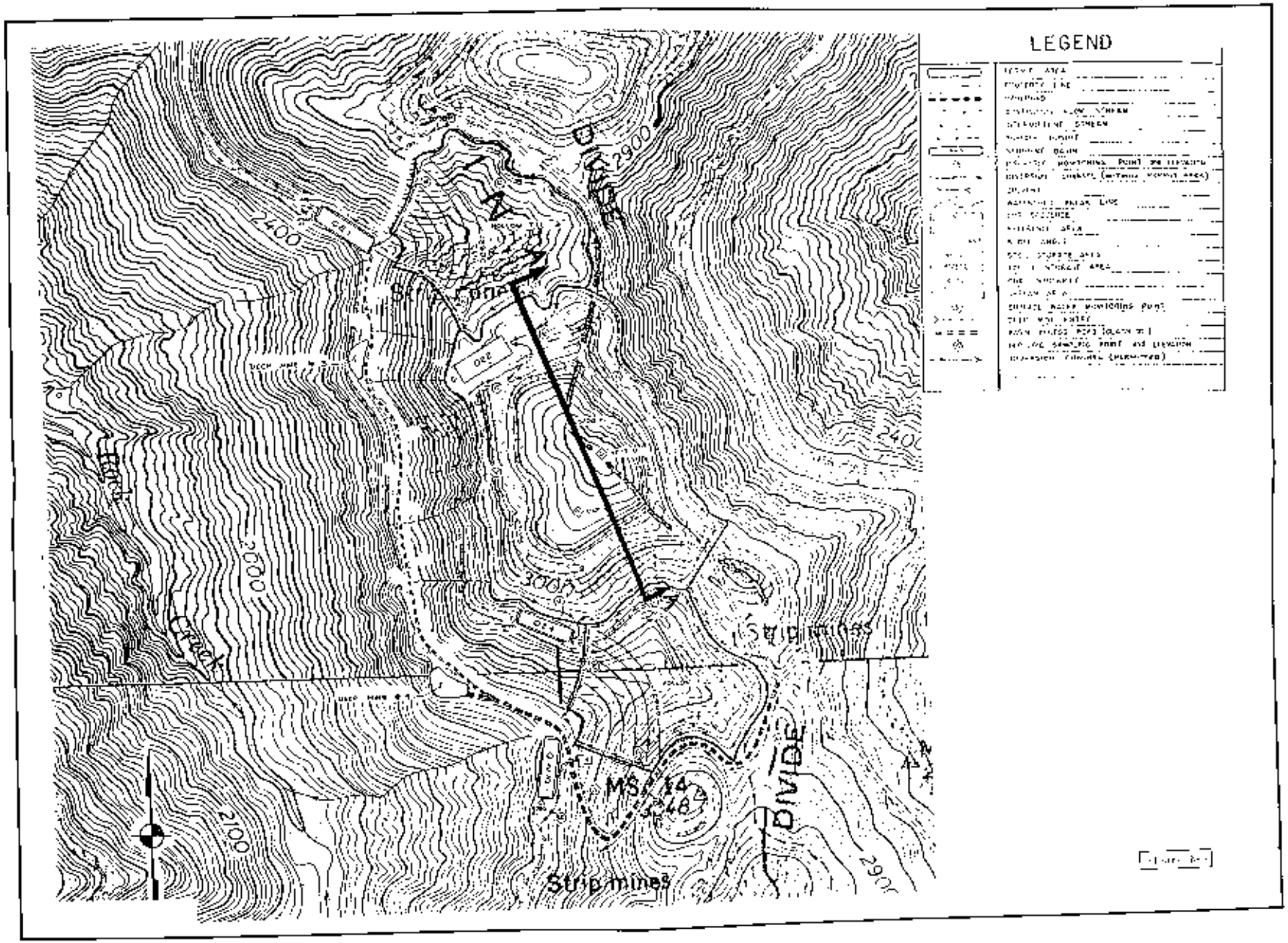
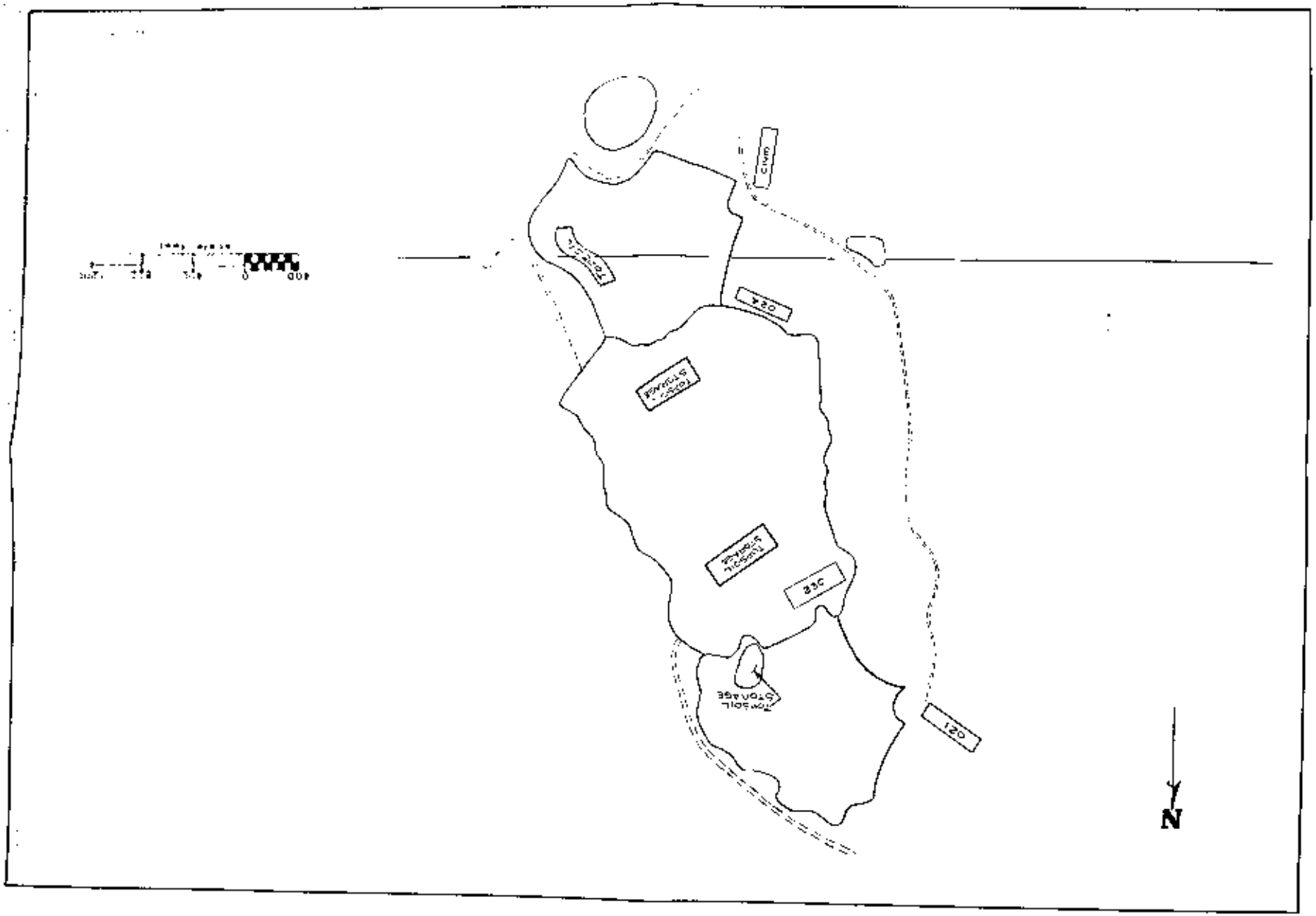
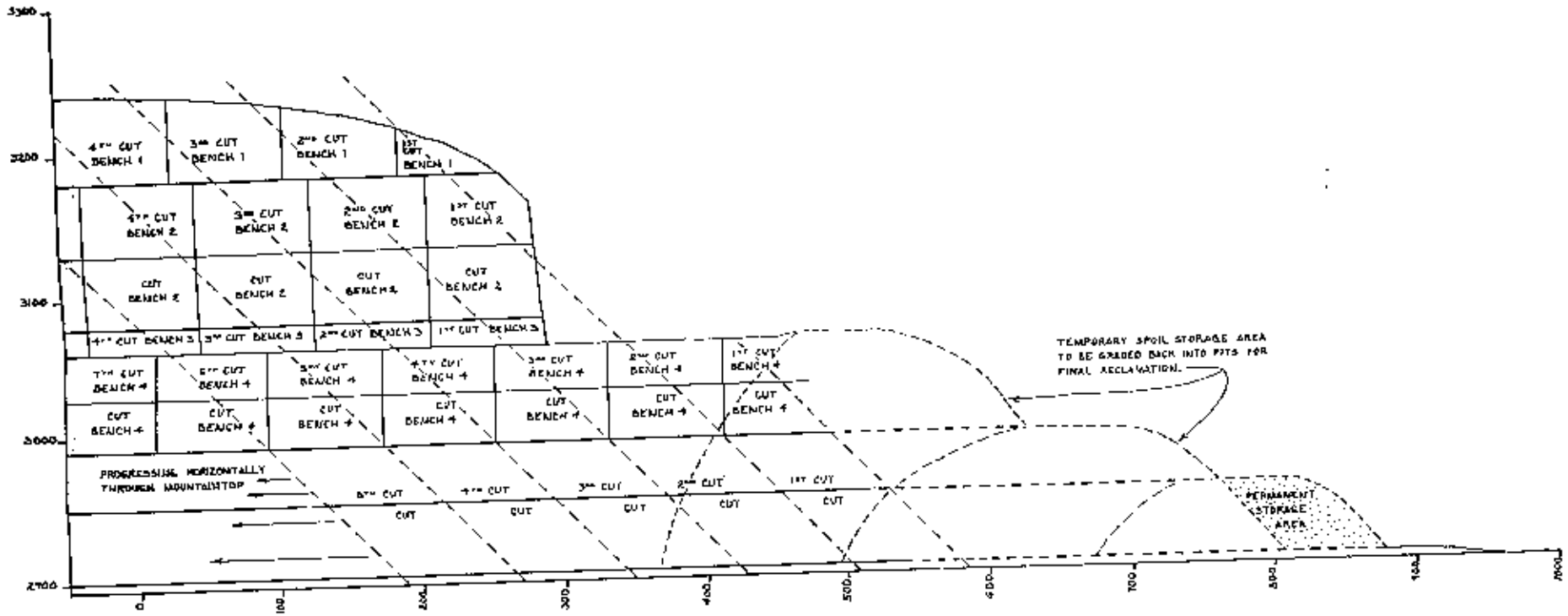


PLATE # 7

Figure B-5

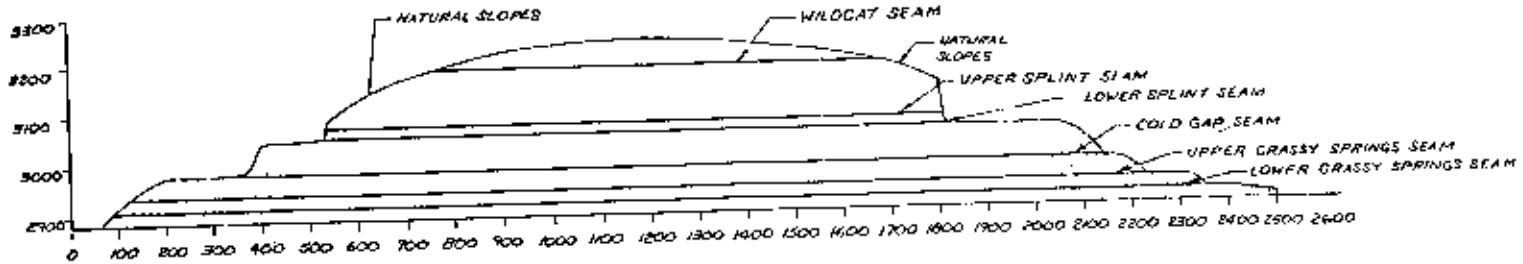

LEGEND
2900
2400
2000
3000
2100
2900
Strip mines
MS 14
DIVIDE


N



LOCATION & SEQUENCE OF CUTS

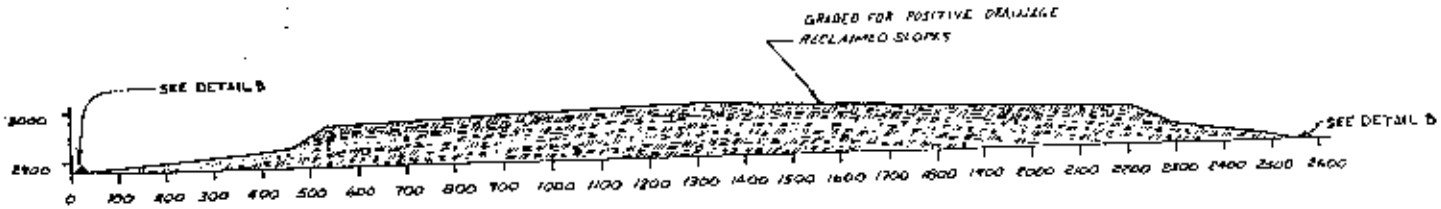
Figure B-8



PRE-MINING AREA SECTION "A-A"

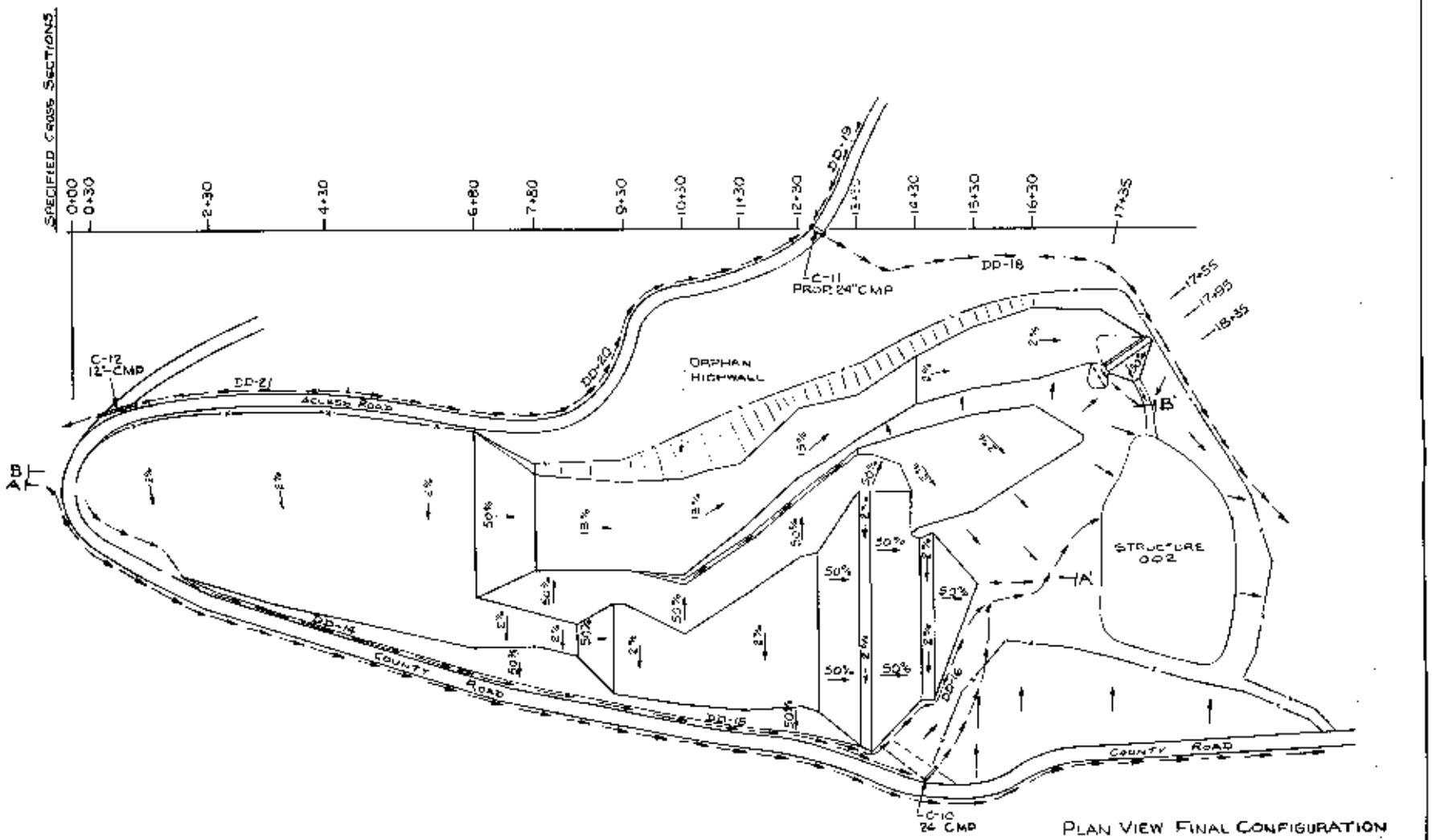
DETAIL A

DETAIL B



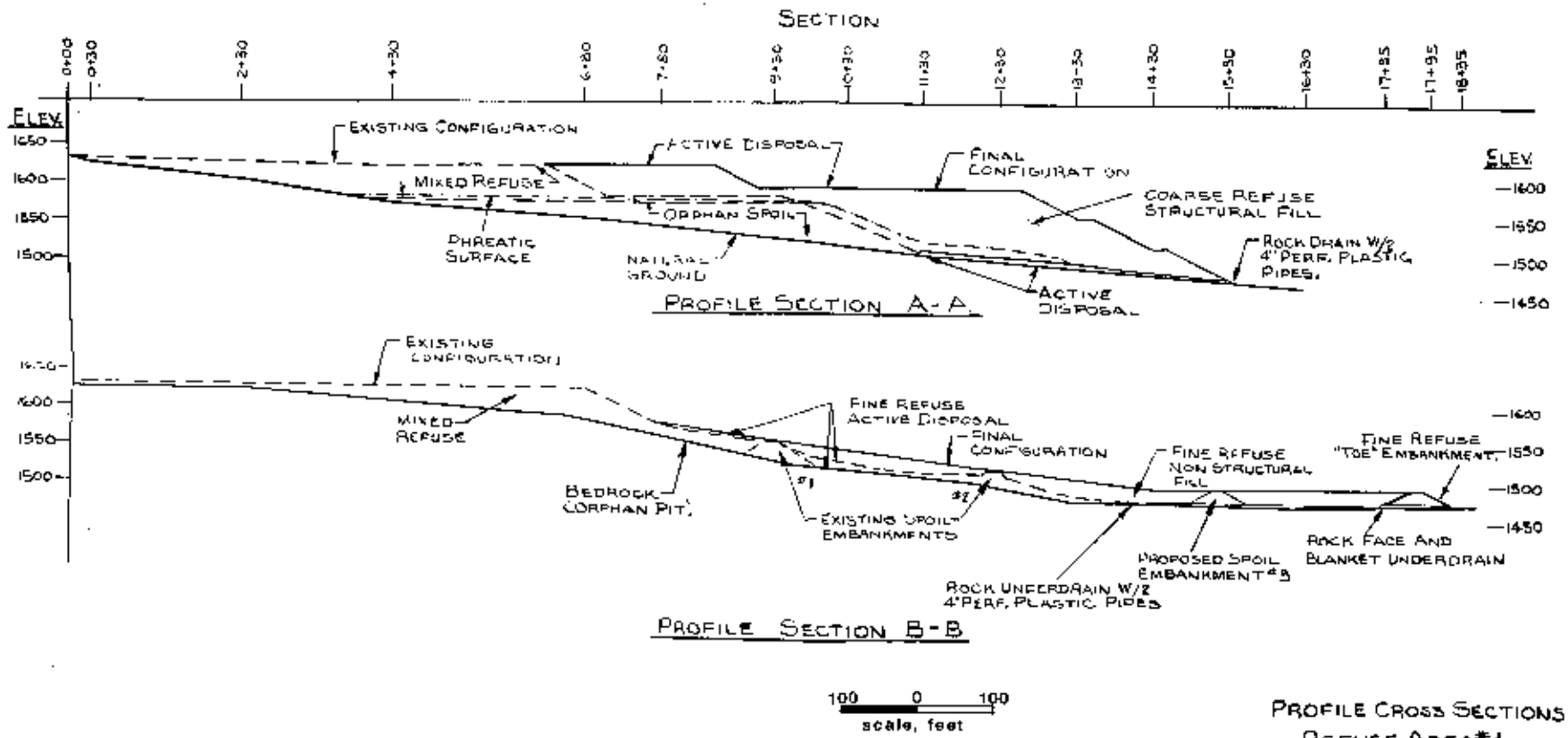
POST MINING AREA SECTION "A-A"

Figure B-9



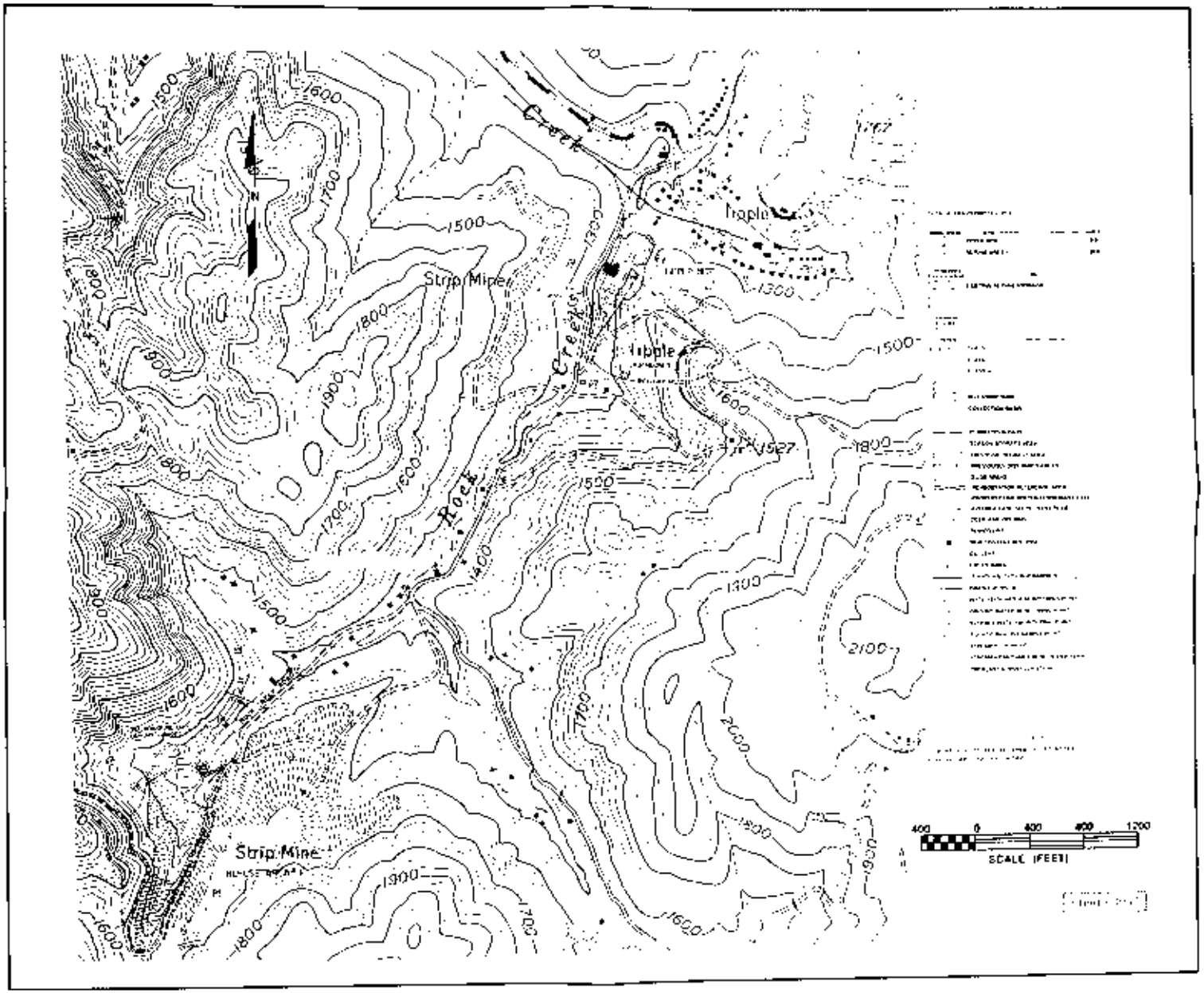
PLAN VIEW FINAL CONFIGURATION
REFUSE AREA #1

Figure 8-10



PROFILE CROSS SECTIONS
REFUSE AREA #1

Figure II-11


Strip Mine
Strip Mine
Creek
Rock
Creeks
Maple
Maple
SCALE (FEET)

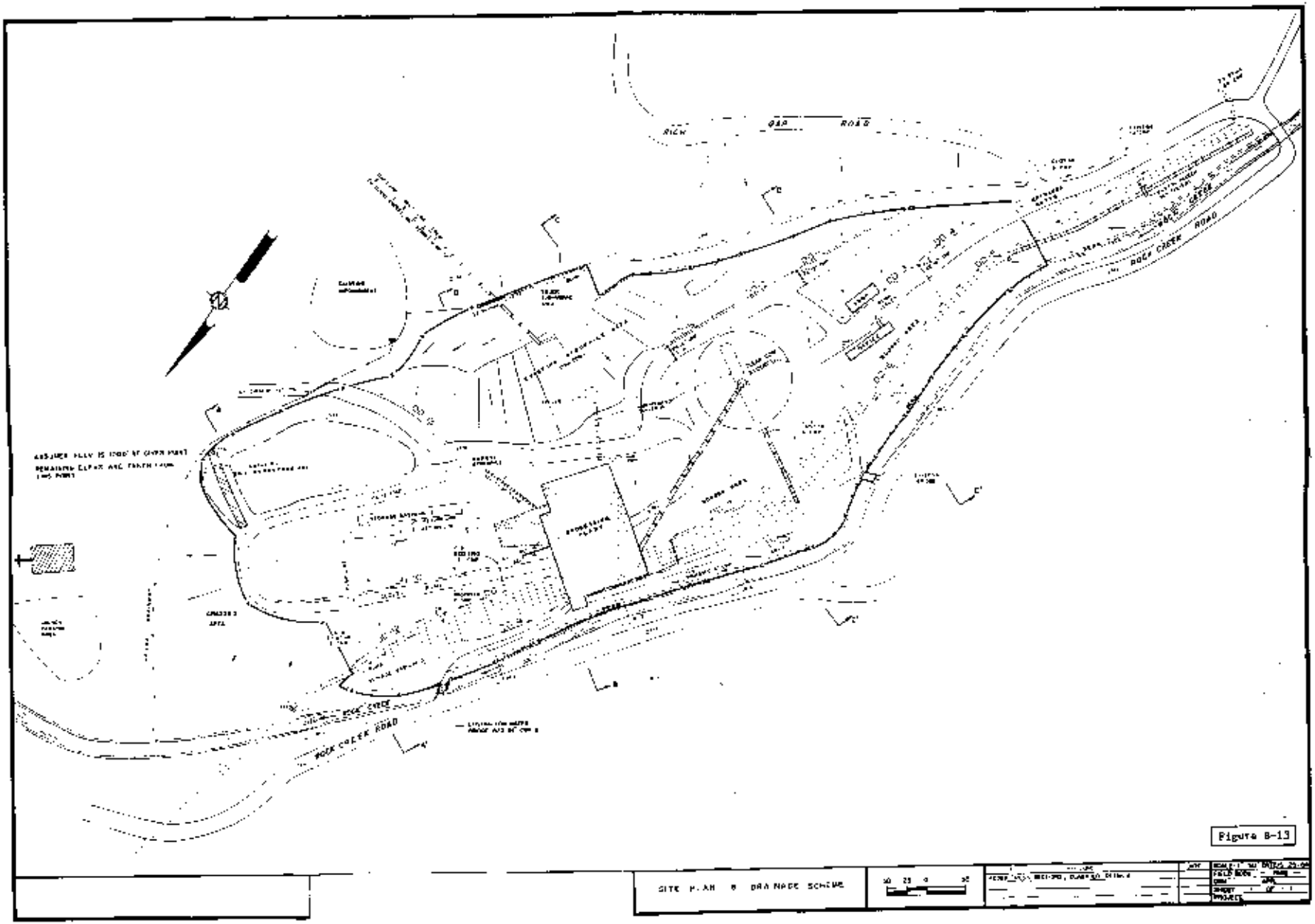


Figure B-13

REVISIONS TO THE HANDBOOK FOR CALCULATION OF RECLAMATION BOND AMOUNTS

United States Department of the Interior
Office of Surface Mining Reclamation and Enforcement
1988

Note: These pages are to replace Pages 3 and 4.

earthmoving costs represent the major portion of the direct cost of reclamation.

DATA SOURCES

There are four major sources of information that will be used by OSMRE to estimate performance bonds. These sources are:

- The mining and reclamation plans provided by the permit applicant;
- Equipment productivity and performance guidebooks;
- Construction cost guidebooks; and
- The Abandoned Mine Lands Reclamation Program, the Tennessee Valley Authority, and the Soil Conservation Service, and other contract data.

The mining and reclamation plan is the chief source of information for calculating reclamation costs. It contains essential information on spoil and topsoil volumes, haul distances, extent of areas disturbed, and structures used during the mining operations.

Another major source of information is the equipment productivity and performance handbooks. These handbooks are essential when estimating backfilling and grading costs. Most manufacturers of heavy equipment publish handbooks containing performance data for their equipment lines. The Caterpillar Performance Handbook is one of the most complete. It includes data on tractors, loaders, scrapers, haulage vehicles, and small hydraulic shovels and excavators, in addition to a variety of other information such as estimating methodologies and heavy equipment cost accounting. Other sources of productivity and performance data are acceptable for cost estimation depending on the documentation provided and the overall reasonableness of the data.

One comprehensive equipment cost reference is the Dataquest Cost Reference Guide for Construction Equipment, which is updated periodically. This reference covers hourly ownership and operating costs for a wide range of heavy equipment. Ownership rates used in this reference are based on factors such as purchase prices, depreciation, equipment ownership-related overhead costs, and average annual use. Hourly operating expenses are based on average fuel, lubrication and wear item costs, and maintenance labor costs; but do not include equipment operator costs. The rates in the Dataquest manual represent the actual cost of buying equipment. This reference is widely used by Government and industry to prepare engineering cost estimates. A problem with use of this reference is that the depreciation period for the equipment is shorter than generally used by coal mining and reclamation companies. To obtain ownership costs using a longer period of equipment depreciation, the methods and tables of Appendix D are recommended.

Equipment operator costs based on regional labor rates will be used. These rates, however, will at least equal the Davis-Bacon wage rates since OSMRE reclamation projects will be performed by Federal contractors.

For estimating construction-related costs, a number of data sources are available including Means' Building Construction Cost Data, Dodge's Guide to Public Works and Heavy Construction Costs, and Engleman's Heavy Construction Cost File. The Means' guide contains an extensive array of line-item costs for building construction. This reference, which is updated annually, is especially useful for estimating material acquisition costs and costs of specific reclamation tasks such as structure removal. Costs obtained from the Means' manual must be taken from the category labeled "Total Bare Costs," which excludes profit and overhead.

Table 1 presents the major information needs and sources for calculating reclamation costs using the estimating method presented in this handbook.

Table 1.--Data Needs and Sources for Estimating Reclamation Costs

Need	Source
Volumes of material to be moved (cross-sections, material handling plans, special handling requirements, and swell factor)	Reclamation Plan
Conditions and characteristics of the minesite (haul distances, grades, etc.)	Reclamation Plan
Disturbed acreage	Reclamation Plan
Description and characteristics of facilities to be removed	Reclamation Plan
Revegetation requirements	Reclamation Plan
Equipment types and productivity for activities such as backfilling and grading	Equipment productivity handbooks and information presented in this document
Equipment ownership and operating costs	Dataquest Cost Reference Guide for Construction Equipment
Labor rates, material, and certain reclamation activity costs such as structure removal	Davis-Bacon wage rates, supplier estimates, standard materials guide-books, and construction cost guides

Note: These revisions are to be added to Chapter 2, as pages 20 through 26.

Phased and Incremental Bonding

The OSMRE regulatory provisions of 30 CFR 800.11(b) and 800.13(a)(2), which allowed for the posting of bonds on a phased or incremental basis, were suspended by OSMRE on February 21, 1985, as a result of a District Court decision. In the Appeals Court decision of January 29, 1988, the authority of OSMRE to promulgate these regulations was upheld. OSMRE reinstated the regulatory provisions on July 11, 1988. Bonds, therefore, can be posted to cover an increment of a permit or a phase as defined in 30 CFR 800.40(c). Calculation of bond for increments and phases should be according to the following procedures.

1. Incremental Bond Calculation

Under incremental bonding, the same steps of the handbook would be used but the steps must be applied to each increment specified in the permit. Some increments may not require the same indirect cost application as other increments. For example, engineering redesign costs may not be appropriate for reclamation of an increment that consists of facilities or topsoil storage. The application of those indirect costs will depend on the nature of the increments.

a) Cumulative bonding

Cumulative bonding is a type of incremental bonding in which there is one bond covering the entire permit area with a schedule of bond amount increases, as the reclamation obligation changes. A cumulative bond is calculated by using the method of the handbook beginning with the first increment, and with a planned schedule of adjustments as new increments are disturbed and new maximum reclamation requirements are encountered. The total bond amount is the addition of the costs for each increment but the approved bond amount would be a schedule of cost changes in the bond as each increment is mined and reclaimed. Application of indirect costs will be the same as for incremental bond calculation.

2. Phased Bond Calculation

A phase is defined as the stage of completed reclamation work eligible for release in accordance with 30 CFR 800.40(c)(1). Phase I includes backfilling, regrading, structure demolition, drainage control and may include topsoil replacement. Phase II includes pond removal, topsoil replacement (unless in Phase I), revegetation, and associated activities.

Phase III would be the reestablishment of vegetation in the event of failure.

Phase bonds can be calculated according to two options, depending upon the choice of the operator.

Option 1: Calculate the total bond for the area by the standard methods of the handbook; Phase I will be 60% of this total bond.
Option 2: Calculate the cost for each activity specified as a Phase I activity in the permit. Indirect costs are added proportionally for each activity.

If an operator wishes to have the entire Phase I bond amount released on schedule, the smaller of these two numbers would be used as the amount of Phase I bond. To illustrate this, the haul back mining example was adapted for calculating phase bonds. The next page shows the costs by phases. In this example, the total bond equals $214,259. Under Option 1, the Phase I bond would be $128,555; under Option 2, the Phase I bond would be $173,925. Phase II bonds will be the remainder of the calculated costs, i.e., $85,704 under Option 1 and $40,334 under Option 2. It is recommended that Phase II and III be covered by one bond.

Project Haulback Example
Date

WORKSHEET NO. 16A-PHASE BONDING
RECLAMATION BOND SUMMARY SHEET

Phase I Direct costs		
1.	Total Facility and Structure Removal Costs:	$ 545
2. Earthmoving Costs:	Backfilling and Grading:	126,594
	Retopsoiling, if Phase I:	-
	Other:	-
	(specify)	-
3. Total Other Phase I Reclamation Activity Costs:		-
4. Subtotal: Phase I Direct Costs: (sum of Items 1 through 3)		127,139
Phase II and III Direct Costs		
5. Earthmoving Costs:	Retopsoiling (if Phase II):	12,029
	Sediment Structure Removal:	-
	Other: **ripping backfill** :	1,756
	(specify) **Final grading, scarificiation**	1,018
6. Revegetation Costs:		14,681
7. Other Phase II Reclamation Activity Costs:		-
8. Subtotal: Phase II Direct Costs: (sum of Items 5 through 7)		29,484
9. Subtotal: Total Direct Costs: (sum of Items 4 & 8)		156,623
Indirect Costs: Phases I, II and III		
10. Mobilization and Demobilization: (at 2 % of Item 9) (1% to 5% of Item 9)		3,132
11. Contingencies: (at 10% of Item 9) (see Table 4)		15,662
12. Engineering Redesign Fee: (at 7.6% of Item 5) (see Graph 1)		11,903
13. Contractor Profit and Overhead: (at 11.6% of Item 9) (see Graph 2)		18,168
14. Reclamation Management Fee: (at 5.6% of Item 9) (see Graph 3)		8,771

15. Total Indirect Cost: 57,636
(sum of Items 10 through 14)

16. GRAND TOTAL BOND AMOUNT: $214,259
(Sum of Items 9 & 15)

OPTION 1

17a. Phase I bond (60% of Item 16) $128,555
17b. Phase II/III bond (40% of Item 16) $ 85,704

18. **OPTION 2**
Phase I Indirect Cost:
Item 4 @ $127,139 X Item 15 @ $57,636= 46,786
Item 9 @ $156,623

19. TOTAL CALCULATED PHASE I BOND AMOUNT: *$ 173,925
(sum of Items 4 & 18) ***Option 2**

20. Phase II Indirect Costs: $ 10,849
(Item 15 minus Item 18)

21. TOTAL CALCULATED PHASE II/III BOND AMOUNT: 40,334
(sum of Items 8 & 20) **Option 2**

22. GRAND TOTAL BOND AMOUNT $214,259
(Sum Items 19 and 21) **Option 2**

23. OPERATOR'S SELECTED PHASE I BOND AMOUNT: _____
(choose between Items 17a and 19)

23. PHASE II/III BOND AMOUNT:
(If operator selected item 19,use item 21 otherwise, use item 17b.) _____

Engineering News Record Cost Index: _____ Date: _____

* At the time of Phase I bond release, only 60% of the total bond, $128,557, can be released. The remaining $45,370 would be held until Phase II release.

PROJECT Haulback
PHASE I
DATE _____

WORKSHEET NO. 13A

SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment Type	Owning and Operating Cost ($/hr) Equipment + Accessories		Labor Cost ($/hr)	Total Hrs Req'd	Total Cost ($)
Cat 988B grader	[(69.80	) +	12.78]	x 297.47	= 24,565
Cat 769 C trucks (3)	[(47.67	) +	15.16]	x 892.41	= 56,070
Cat 140G ** grader	[(27.84	) +	12.63]	x 297.47	= 12,038
Water Truck **	[(64.90	) +	14.91]	x 297.47	= 23,741
Service truck flatbed**	[(19.31	) +	14.91]	x 297.47	= 10,179
_____	[(	) +	]	x	=
_____	[(	) +	]	x	=

Total Cost= $126,594

Accessory Calculations:
*Davis-Bacon wage rates
** Required onsite while earthmoving operations are performed.

PROJECT Haulback
PHASE II
DATE _____

WORKSHEET NO. 13B

SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment Type	Owning and Operating Cost ($/hr) Equipment + Accessories		Labor Cost ($/hr)*		Total Hrs Req'd		Total Cost ($)
Cat 627B NPP scraper	[(62.69	) +	12.78	] x	64.21	=	4,845
Cat D8L ** pushtractor	[(56.58	) +	12.63	] x	32.11	=	2,222
Cat D8L dozer w/ripper	[(66.07	) +	12.63	] x	26.4	=	1,756
Cat 140G **	[(27.84	) +	12.63	] x	57.28	=	2,318
Tanker ** 7000 gal.	[(64.90	) +	14.91	] x	32.11	=	2,562
Service truck flatbed **	[(19.31	) +	14.91	] x	31.11	=	1,098
	[(	) +		] x		=	

Total Cost= $12,029
($14,804-2,774)

Accessory Calculations:
*Davis-Bacon wage rates
** Required onsite while earthmoving operations are performed.
Data Sources:

Use of Explosives for Highwall Elimination

The reduction of highwalls through the use of explosives will require powder factors as low as 0.2 lb/yd for soft shales, to as high as 0.7 lb/yd for massive tight sandstone formations. Refer to the Bureau of Mines, Explosives and Blasting Procedures Manual, IC 8925; the OSMRE Blasting Guidance Manual; Atlas Powder Company's book, Explosives and Rock Blasting; and the 17th edition of the DuPont Blasters Handbook.

The most costly factors in blasting are the drilling costs. The SME Mining Engineer' Handbook gives an average drilling rate of 800 feet per 8 hour shift. The type and hardness of the rock not only affect the powder factor and the drilling rate, but it also affects bit life. Several of the bit manufacturers publish drilling rate tables based on known rock types and drill-down pressures of bit diameter. Bit life may var from 500 feet in hard rock to several thousand feet in soft rock. Drill bit manufacturers or suppliers in the area of the mine can supply bit life and cost information. An example of highwall reduction by blasting is illustrated as part of the Mountain Top Removal example (page B-84).

Note: The folowing sheet replaces Pages A-5 and A-6. Pages A-19 and A-20 are to be added.

Revised 11/88

Project _____

Date _____

WORKSHEET NO. 4
EARTHWORK QUANTITY WORKSHEET

STATION	DIST. ft.	END AREAS (ft.) CUT	FILL	VOLUMES (yds) CUT	FILL	ADJUST VOLUMES* CUT	FILL	MASS
TOTALS								

*Indicate swell factors used

Data Sources:

·vised ~~11/88~~

Project _____
Date _____

WORKSHEET NO. 4
EARTHWORK QUANTITY WORKSHEET

Project _____
Date _____

WORKSHEET NO. 16A-PHASE BONDING
RECLAMATION BOND SUMMARY SHEET

Phase I Direct costs

1. Total Facility and Structure Removal Costs: $_____
2. Earthmoving Costs: Backfilling and Grading: _____
   Retopsoiling, if Phase I _____
   Other (specify) : _____
   _____
3. Total Other Phase I Reclamation Activity Costs: _____
4. Subtotal: Phase I Direct Costs: _____
   (sum of Items 1 through 3)

Phase II and III Direct Costs

5. Earthmoving Costs: Retopsoiling (if Phase II): _____
   Sediment Structure Removal: _____
   Other:_____ : _____
   (specify)_____: _____
6. Revegetation Costs: _____
7. Other Phase II Reclamation Activity Costs: _____
8. Subtotal: Phase II Direct Costs: _____
   (sum of Items 5 through 7)
9. Subtotal: Total Direct Costs: _____
   (sum of Items 4 & 8)

Indirect Costs-Phases I, II and III

10. Mobilization and Demobilization: (at __% of Item 9) (1% to 5% of Item 9) _____
11. Contingencies: (at ___% of Item 9) (see Table 4) _____
12. Engineering Redesign Fee: (at ___% of Item 5) (see Graph 1) _____
13. Contractor Profit and Overhead: (at ____% of Item 9) (see Graph 2) _____
14. Reclamation Management Fee: (at ____% of Item 9) (see Graph 3) _____

15. Total Indirect Cost: _____
(sum of Items 10 through 14)

16. GRAND TOTAL BOND AMOUNT: _____
(Sum of Items 9 & 15)

OPTION 1

17a. Phase I bond (60% of Item 16) _____

17b. Phase II/III bond (40% of Item 16) _____

18. OPTION 2
Phase I Indirect Cost:
Item 4 @ $_____ X Item 15 @ $_____ = _____
Item 9 @ $_____

19. TOTAL CALCULATED PHASE I BOND AMOUNT: _____
(sum of Items 4 & 18) *Option 2

20. Phase II Indirect Costs: _____
(Item 15 minus Item 18)

21. TOTAL CALCULATED PHASE II/III BOND AMOUNT: _____
(sum of Items 8 & 20) Option 2

22. GRAND TOTAL BOND AMOUNT _____
(Sum Items 19 and 21) Option 2

23. Operator's Selected Phase I Bond Amount: _____
(choose between Items 17a and 19)

23. PHASE II/III BOND AMOUNT:
(If operator selected item 19,use item 21 _____
otherwise, use 17b)

Engineering News Record Cost Index:_____ Date:_____

* At the time of Phase I bond release, only 60% of the total bond can be released.

Note: The following pages are to replace Pages B-83 through B-86.

Project Mountain Top

Date May 1986

WORKSHEET NO. 15B

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity:

Haulroad maintenance during reclamation.

Assumptions:

Haulroad - 3.5 ac

Cost Estimate Calculations:

3.5 ac x $600/ac = $2,100

TOTAL = $ 2,100

Other Documentation or Notes:
(Include additional sheets, maps, calculations, etc., as necessary to document estimate.)

Data Sources: AML costs
Application

Revised 11/88

Project Mountain Top

Date _____

WORKSHEET NO. 15C-1

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity: Blasting to reduce highwall

Assumptions:

Powder Factor	=	0.67 lb/yd	
Hole Diameter	=	6.75 inches	
Drill	=	Gardner Denver GO-45C	
Drilling Rate	=	1.6 Ft/min.	SME Handbook 11.4.1
Bit Life	=	8000 ft.	Furnished by applicant
Bit Cost	=	$1200/bit	Furnished by applicant
Explosives	=	$0.1125/lb.	Furnished by applicant
Drill Cost	=	$98.82/hr.	Cost Reference Guide
Blaster rate	=	$11.88/hr.	Dodge Guide
Driller rate	=	$15.68/hr.	Dodge Guide

Data Sources: Dodge, Construction Cost Guide, 1986
Dataquest, Cost Reference Guide for Construction Equipment, 1986
Means, Building Construction Cost Data, 1985
E.I. duPont de Nemours & Co., Blaster's Handbook
SME Mining Engineering Handbook
Atlas Powder Co., Explosives and Rock Blasting

Revised 11/88

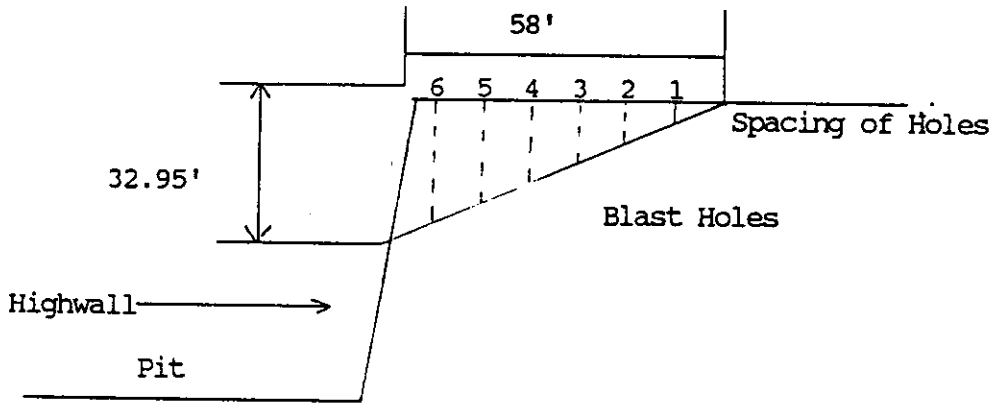
Project Mountain Top

Date _____

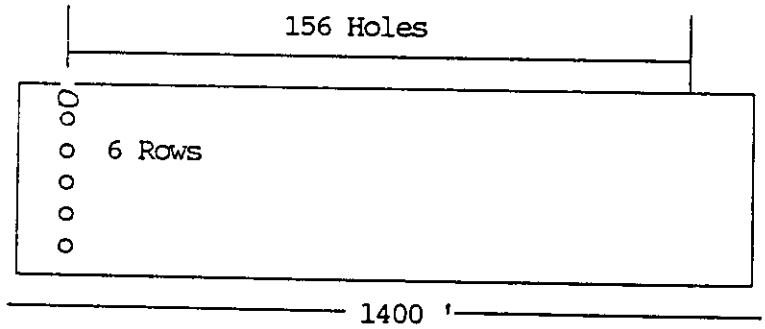
WORKSHEET NO. 15C-2

OTHER RECLAMATION ACTIVITY COSTS

Cost Estimate Calculations:



Drill Hole	1	2	3	4	5	6	Total
Distance to Highwall Face (in feet)	54	45	36	27	18	9	
Drill Hole Depth (feet)	5	10.2	15.3	20.5	25.6	30.7	107
Explosive in Column (lbs.)	10	21	31	42	52	63	219



Total No./Holes = $\frac{1400'}{9'}$ = 156 Holes x 6 Rows = 936 Holes

Total Feet of Drilling Required

107 ft/6 holes x 156 = 16,692 ft.

Avg. Drilling Rate = 1.6 ft./min.

Time = $\frac{16,692 \text{ ft.}}{1.6 \text{ft/min} \times 60 \text{ min/hr.}}$ = 174 hrs.

Total Amount of Explosives

219 lbs./6 holes x 156 =34,164 lbs.

Project Mountain Top

Date _____

WORKSHEET NO. 15C-3

OTHER RECLAMATION ACTIVITY COSTS

Cost Estimate Calculations:

	Ownership Cost	Driller Cost	Blaster Cost
Drilling Cost =	(174 hr. x $98.82/hr)	+ (174 hr. x $15.68/hr.)	+ (174 hr. x $11.88/hr

= $21,990

2 bits @ $1200/bit = $2,400
Explosives: $0.1125/lb. x 34,164 lb. = $3834

TOTAL = $ 28,233

From Worksheets 15A, 15B and 15C GRAND TOTAL = $ 49,151

Revised 11/88

Project Mountain Top

Date May 1988

WORKSHEET NO. 16

RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$	1,500
2.	Total Earthmoving Costs		125,270
3.	Total Revegetation Costs		126,000
4.	Total Other Reclamation Activities Costs		49,151
5.	Subtotal: Total Direct Costs		301,921
6.	Mobilization and Demobilization at 5% of Item 5) (1% to 5% of Item 5)		15,096
7.	Contingencies (at 10 % of Item 5) (see Table 4)		30,192
8.	Engineering Redesign Fee (at 7 % of Item 5) (see Graph 1)		21,134
9.	Contractor Profit and Overhead (at 10 % of Item 5) (see Graph 2)		30,192
10.	Reclamation Management Fee (at 5 % of Item 5) (see Graph 3)		15,096
11.	GRAND TOTAL BOND AMOUNT (Sum of Items 5 through 10)		$413,631

Revised 11/88

Note: The following pages are to be placed after page C-6, as Appendix D.

APPENDIX D

EARTHMOVING EQUIPMENT COSTS

Equipment Cost Adjustments

Although no one particular reference source for equipment costs is specifically required by the OSMRE Handbook for Calculation of Reclamation Bond Amounts, most if not all evaluators use Dataquest Inc.'s Cost Reference Guide for Construction Equipment, the CRG. This guide is based on surveys of actual ownership and operating costs for equipment in the heavy construction industry that was manufactured in the last two years. The analytical methods employed by Dataquest researchers are accepted throughout the construction industry and are based on averages of manufacturer-derived factors that are applied to the current (or most recent) list price. The guide assumes that within a particular machine class the cost factors can be applied equally to all makes and manufacturers of equipment in average condition and under non-severe usage.

Both fixed and variable costs are presented in the CRG which assumes single shift usage during a full work year (2,112 hours per year). Fixed costs (i.e. depreciation and overhead) are accrued whether or not the equipment is being operated. Variable costs (i.e. overhaul, field repair, fuel and lube, and ground engaging components) only accrue when the machine operates. The guide contains a chapter on suggested methods for adjusting the costs for specific job or contractor conditions, multiple shift use, extended use, etc. These methods were applied to adjust the listed CRG costs for: 1) extended use (limited to 60 percent above the CRG average or up to 15 years), 2) slightly reduced annual use of 2040 hours (versus 2112 hours, 2040 = 40 hours per week * 51 weeks per year), and 3) an adjustment for elimination of work site storage and the cost of facilities capitalization as cost factors under overhead expenses. These adjustments should more accurately reflect the nature of bond forfeiture reclamation and current trends in the reclamation contracting industry. The overhead adjustments eliminate duplication with other cost allowances in the handbook's methodology. Recent industry economics and advances in preventive maintenance are bringing about extended equipment use.

Extended use allows reduction in the CRG's hourly cost of Depreciation, but an increase in the Overhaul and Field Repair cost per hour. Annual use adjustments affect the fixed costs. The formulas used to adjust the costs are presented below:

$$\text{Adjusted Cost} = \text{Adjusted Depr. Cost} + \text{Adjusted O'head Cost} + \text{Adjusted O'haul Cost} + \text{Adjusted Op. Cost}$$

where:

$$\text{Depreciation Adjustment} = \text{CRG Depr. Cost (\$/hr)} \times \text{Econ. Life Adjustment Factor} \times \text{Annual Use Adjustment Factor}$$

$$\text{Economic Life Factor} = \frac{\text{CRG Average Life}}{\text{Actual Useful Life}}$$

$$\text{Annual Use Factor} = \frac{\text{CRG Annual Use (2112 hrs)}}{\text{Actual Annual Use*}}$$

$$\text{Overhead Adjustment} = \text{CRG O'head Cost (\$/hr)} \times \text{Storage Item Factor} \times \text{Annual Use Factor}$$

$$\text{Storage Item Factor} = \frac{100 - 64}{100} = 0.36$$

$$\text{Overhaul Adjustment} = \text{CRG O'haul Cost (\$/hr)} \times \text{Econ. Life Factor} \times \text{Extended Life Factor**}$$

$$\text{Operating Cost Adjustment} = \text{Field Repair Cost (\$/hr)} \times \text{Econ. Life Factor} \times \text{Extended Life Factor **}$$

Extended life adjustment factors depend on the number of hours operation is extended beyond the CRG average and whether the equipment is rubber tire- or track-type. Tables D-1 through D-3 list the pertinent extended life adjustment factors that are extracted from the CRG along with the equipment costs adjusted using the above formulas. Additional representative equipment and updated costs will be provided to bond handbook users when available. Users can also adjust the costs for additional CRG-listed equipment as needed using the above formulas and guidance presented in the CRG. It is recommended that extended use is limited to 60 percent of the CRG average using the formula:

$$\text{Actual Hours (Useful Life)} = \text{CRG Average Hours} \times 0.60$$

However, it is further recommended that the useful life be limited to 15 years or 30,600 hours.

* 2040 hours used in Table D-1.
** Listed in the CRG.

Table D-1.--Hourly Equipment Costs-Caterpillar Dozers

CATERPILLAR EQUIPMENT COSTS (June, 1980)

Model#	HP	Cat. Econ.Hrs	CRG Econ.Hrs	Actual Hrs/a Extended Use	Depr.Adjust Factor	Annual Use Adjust.	Extend. Life Hrs	O'haul Factor	Overhead Adjust.	CRG Depr. Cost/hr	CRG O'haul Cost/hr	CRG O'haul (P&L) Cost	Tot. Op. Cost/hr	Adjusted Cost/hr	Model#
D6H-Su/Trip.	165	12,000	12,460	19,936	0.625	1.035	7,476	1.22	0.303	$13.93	$8.56	$8.77	$16.51	$35.01	D6H-Su/Trip.
D6H LGP-S	165	12,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$13.52	$8.70	$8.06	$16.52	$34.02	D6H LGP-S
D7G-S	200	12,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$15.61	$10.15	$9.31	$19.06	$40.00	D7G-S
D7G-Su/Trip.	200	12,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$16.79	$10.84	$10.03	$20.85	$42.59	D7G-Su/Trip.
D7G LGP-S	200	12,000	14,150	22,640	0.625	1.035	8,490	1.22	0.303	$16.30	$11.27	$10.34	$22.25	$43.92	D7G LGP-S
D7H-S	215	12,000	14,150	22,640	0.625	1.035	8,490	1.22	0.303	$16.80	$11.61	$10.67	$22.24	$44.77	D7H-S
D7H-SU	215	10,000	14,150	22,640	0.625	1.035	8,490	1.22	0.303	$16.75	$11.70	$10.59	$22.14	$44.57	D7H-SU
D7H-SUu/Trip.	215	10,000	14,150	22,640	0.625	1.035	8,490	1.22	0.303	$10.59	$12.85	$11.71	$23.69	$48.60	D7H-SUu/Trip.
D7H-U	215	12,000	14,150	22,640	0.625	1.035	8,490	1.22	0.303	$17.15	$11.70	$10.81	$22.45	$45.31	D7H-U
D7H-Su/Trip.	215	12,000	14,150	22,640	0.625	1.035	8,490	1.22	0.303	$18.73	$12.71	$11.79	$23.79	$48.80	D7H-Su/Trip.
D7H-Uu/Trip.	215	12,000	14,150	22,640	0.625	1.035	8,490	1.22	0.303	$18.99	$12.85	$11.93	$24.00	$49.34	D7H-Uu/Trip.
D8L-SU	335	15,000	16,260	26,016	0.625	1.035	9,756	1.22	0.303	$19.53	$15.39	$13.40	$29.31	$56.58	D8L-SU
D8L-U	335	15,000	16,260	26,016	0.625	1.035	9,756	1.22	0.303	$19.34	$15.28	$13.29	$34.01	$60.22	D8L-U
D8L-SUu/Trip.	335	15,000	16,260	26,016	0.625	1.035	9,756	1.22	0.303	$21.98	$17.00	$15.09	$31.62	$62.43	D8L-SUu/Trip.
D8L-Uu/Trip.	335	15,000	16,260	26,016	0.625	1.035	9,756	1.22	0.303	$21.79	$16.89	$14.98	$36.32	$66.07	D8L-Uu/Trip.
D8L-Uu/Trip.	335	15,000	16,260	26,016	0.625	1.035	9,756	1.22	0.303	$22.03	$16.94	$16.22	$36.39	$67.56	D8L-Uu/Trip.
D8N-SU	285	10,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$21.17	$13.70	$12.62	$27.31	$54.53	D8N-SU
D8N-U	285	15,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$21.43	$13.92	$12.76	$27.52	$55.10	D8N-U
D8N-SUu/Trip.	285	15,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$23.01	$14.77	$13.74	$28.06	$58.57	D8N-SUu/Trip.
D8N-SUu/Trip.	285	15,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$23.86	$15.36	$15.55	$29.70	$61.88	D8N-SUu/Trip.
D8N-Uu/Trip.	285	15,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$24.27	$14.99	$13.88	$29.07	$59.78	D8N-Uu/Trip.
D8N-Uu/Trip.	285	15,000	13,305	21,200	0.625	1.035	7,903	1.22	0.303	$28.24	$15.58	$15.69	$29.91	$65.12	D8N-Uu/Trip.
D9N-SU	370	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$20.88	$17.60	$14.97	$34.48	$64.21	D9N-SU
D9N-SUu/Trip.	370	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$23.33	$19.21	$16.66	$36.79	$70.05	D9N-SUu/Trip.
D9N-SUu/Trip.	370	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$23.57	$19.26	$17.90	$36.87	$71.55	D9N-SUu/Trip.
D9N-U	370	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$20.69	$17.66	$14.86	$34.32	$63.86	D9N-U
D9N-Uu/Trip.	370	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$23.14	$19.27	$16.55	$36.63	$69.71	D9N-Uu/Trip.
D9N-Uu/Trip.	370	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$23.38	$19.32	$17.77	$36.71	$71.19	D9N-Uu/Trip.
D9L-S	460	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$25.09	$21.42	$18.02	$42.05	$77.80	D9L-S
D9L-U	460	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$25.69	$21.75	$18.34	$42.52	$79.03	D9L-U
D9L-Uu/Trip.	460	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$29.00	$23.92	$20.61	$45.65	$86.92	D9L-Uu/Trip.
D9L-Uu/Trip.	460	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$29.14	$23.80	$22.09	$45.59	$88.45	D9L-Uu/Trip.
D10-U	700	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$40.62	$34.10	$28.83	$68.65	$125.86	D10-U
D10-Uu/Trip.	700	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$45.12	$36.08	$33.74	$72.65	$138.17	D10-Uu/Trip.
D10-C	700	10,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$37.07	$31.80	$26.71	$65.36	$117.29	D10-C
D10N-SU	520	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$27.71	$23.70	$19.92	$46.89	$86.37	D10N-SU
D10N-SUu/Trip.	520	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$31.02	$25.95	$22.19	$50.02	$94.26	D10N-SUu/Trip
D10N-U	520	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$28.31	$24.02	$20.24	$47.36	$87.56	D10N-U
D10N-Uu/Trip.	520	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$31.62	$26.19	$22.51	$50.49	$95.45	D10N-Uu/Trip.
D10N-Uu/Trip.	520	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$31.76	$26.15	$23.99	$50.43	$96.90	D10N-Uu/Trip.
D11N-U	770	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$48.44	$40.80	$34.50	$77.55	$146.70	D11N-U
D11N-Uu/Trip.	770	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$52.94	$43.66	$39.41	$81.55	$159.00	D11N-Uu/Trip.
D11N-Uu/Trip.	770	15,000	17,530	20,048	0.625	1.035	10,518	1.22	0.303	$53.09	$43.93	$37.60	$81.96	$157.71	D11N-Uu/Trip.

Equip.Life(yrs) 15 Overhead Minutes/ Work Hr = 50
Annual Use(hrs) 2080 Factor= 0.370 Work Hr Factor = 0.833

-S = w/ Straight Blade U= w/U Blade
-SU = w/ Semi-U Blade LGP= Low Ground Pressure

CATERPILLAR EQUIPMENT COSTS (CONTINUED)

Models	HP	Cat. Econ.Hrs	CRG Econ.Hrs	Actual Hrs/o Extended Use	Depr.Adjust Factor	Annual Use Adjust.	Extend. Life hrs	O'haul Factor	Overhead Adjust.	CRG Depr. Cost/hr	CRG O'head Cost/hr	CRG O'haul (P&L) Cost	Tot.Op. Cost/hr	Adjusted Cost/hr	Models
GRADERS															
140G	150	15,000	14,995	23,992	0.625	1.035	8,997	1.10	0.303	$10.07	$7.07	$6.74	$14.38	$27.84	140G
12Gw/rip.	135	15,000	14,995	23,992	0.625	1.035	8,997	1.10	0.303	$9.84	$6.92	$6.60	$13.66	$26.89	12Gw/rip.
14Gw/rip.	180	15,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$12.02	$10.28	$9.29	$19.99	$30.03	14Gw/rip.
16Gw/rip.	250	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$15.26	$14.64	$12.31	$28.51	$52.38	16Gw/rip.
SCRAPERS															
621B C-H	330	15,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$16.77	$12.97	$10.21	$33.80	$54.03	621B C-H
621E C-H	330	15,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$14.46	$14.31	$10.61	$33.52	$53.20	621E C-H
627B N-P-P	225/225	15,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$17.60	$14.64	$11.72	$41.00	$62.69	627B N-P-P
627B P-P	225/225	15,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$18.71	$15.56	$12.46	$42.40	$65.65	627B P-P
627E N-P-P	225/225	15,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$19.65	$16.35	$13.09	$41.88	$66.75	627E N-P-P
627E P-P	225/225	15,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$20.87	$17.31	$13.90	$43.28	$69.87	627E P-P
631D C-H	450	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$19.93	$19.08	$14.74	$49.85	$77.90	631D C-H
631E C-H	450	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$22.76	$22.72	$18.17	$53.35	$87.29	631E C-H
637B N-P-P	450/250	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$24.50	$24.35	$19.56	$66.10	$101.15	637B N-P-P
637B P-P	450/250	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$25.56	$25.41	$20.53	$67.74	$104.64	637B P-P
637E N-P-P	450/250	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$28.76	$28.61	$23.09	$68.87	$111.61	637E N-P-P
637E P-P	450/250	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$29.94	$29.79	$23.14	$70.49	$114.30	637E P-P
651D C-H	550	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$23.72	$23.65	$17.66	$60.37	$93.68	651B C-H
651E C-H	550	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$29.77	$29.70	$22.15	$64.29	$108.01	651E C-H
657D N-P-P	550/400	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$29.25	$29.18	$23.48	$84.04	$125.20	657D N-P-P
657D P-P	550/400	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$31.06	$31.01	$24.90	$86.80	$130.89	657D P-P
657E N-P-P	550/400	15,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$35.99	$35.92	$28.89	$87.21	$140.56	657E N-P-P
657E P-P	550/400	12,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$38.16	$38.11	$30.64	$91.22	$148.01	657E P-P
WHEEL LOADERS															
980C	270	12,000	14,995	23,992	0.625	1.035	8,997	1.10	0.303	$17.72	$13.01	$9.57	$29.14	$50.14	980C
980C-HiLift	270	12,000	14,995	23,992	0.625	1.035	8,997	1.10	0.303	$18.17	$13.40	$9.92	$30.75	$52.30	980C-HiLift
988B	375	12,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$22.56	$19.06	$12.89	$42.27	$69.80	988B
988B-HiLift	375	12,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$23.04	$19.47	$13.27	$42.80	$71.08	988B-HiLift
992C	690	12,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$30.62	$39.11	$26.46	$89.36	$143.06	992C
992C-HiLift	690	12,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$40.57	$40.38	$27.26	$90.92	$147.03	992C-HiLift
TRUCKS															
769C	450	25,000	17,530	28,048	0.625	1.035	10,518	1.10	0.303	$17.20	$12.90	$12.04	$23.71	$47.67	769C
773B	650	25,000	19,220	30,600	0.628	1.035	11,300	1.10	0.303	$22.31	$18.26	$15.62	$31.14	$62.81	773B
777B	870	25,000	19,220	30,600	0.628	1.035	11,300	1.10	0.303	$31.02	$25.38	$20.43	$44.93	$87.42	777B

Equip.Life(yrs) 15 Overhaul Number/ Work Hr = 50 P-P = Push/Pull C-H= Cushion
Annual Use(hrs) 2040 Factor= 0.370 Work Hr Factor = 0.033 N-P-P= Non-Push/Pul Hitch

NON-CATERPILLAR EQUIPMENT COSTS

(June, 1980)

Models	Manufacturer Name	CRG Econ.Life	Useful Life/w Extended Use	Depr.Adjust Factor	Annual Use Adjust.	Extend. Life hrs	O'haul Factor	Overhead Adjust.	CRG Depr. Cost/hr	CRG O'head Cost/hr	CRG O'haul (P&L) Cost	Tot.Op. Cost/hr	Adjusted Cost/hr	Models
HS-23-1 N-P-P	Komatsu	12,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$33.53	$25.81	$20.66	$65.71	$106.66	HS-23-1 N-P-P
HS-23-2 N-P-P	Komatsu	12,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$35.41	$27.27	$21.83	$69.76	$112.96	HS-23-2 N-P-P
HS-23-1 P-P	Komatsu	12,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$34.20	$26.30	$21.12	$66.50	$108.47	HS-23-1 P-P
HS-23-2 P-P	Komatsu	12,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$36.92	$28.41	$22.76	$71.37	$116.64	HS-23-2 P-P
HS-235-1	Komatsu	12,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$23.31	$23.26	$17.25	$50.91	$84.95	HS-235-1
HS-235-2	Komatsu	12,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$24.57	$24.52	$18.10	$52.89	$88.90	HS-235-2
HD325-3/-5	Komatsu	20,000	17,530	20,040	0.625	1.035	10,510	1.10	0.303	$19.01	$14.26	$13.31	$23.20	$50.25	HD325-3/-5
HD465-2/-3	Komatsu	20,000	19,220	30,600	0.620	1.035	11,300	1.10	0.303	$25.08	$20.52	$17.55	$33.94	$69.71	HD465-2/-3
HD475-1	Komatsu	20,000	19,220	30,600	0.620	1.035	11,300	1.10	0.303	$34.05	$27.86	$23.84	$45.32	$94.02	HD475-1
TS-140	Terex	12,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$17.94	$13.70	$11.03	$31.57	$54.04	TS-140
S-24	Terex	12,000	16,260	26,016	0.625	1.035	9,756	1.10	0.303	$20.44	$20.39	$15.13	$52.02	$79.93	S-24
TS-24	Terex	12,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$22.23	$22.18	$17.75	$59.57	$91.48	TS-24
TS-24C	Terex	12,000	21,120	30,600	0.690	1.035	9,400	1.10	0.303	$28.03	$27.98	$22.40	$69.53	$110.72	TS-24C
TJ-07	Terex	20,000	17,530	20,040	0.625	1.035	10,510	1.10	0.303	$14.23	$10.67	$9.96	$19.32	$39.19	33-07
TJ-09	Terex	20,000	19,220	30,600	0.620	1.035	11,300	1.10	0.303	$22.03	$18.02	$15.42	$30.45	$61.77	33-09
TJ-110	Terex	20,000	19,220	30,600	0.620	1.035	11,300	1.10	0.303	$31.61	$25.86	$22.13	$43.51	$88.48	33-110
R-35	Euclid	20,000	17,530	20,040	0.625	1.035	10,510	1.10	0.303	$13.18	$13.18	$12.31	$22.31	$44.27	R-35
R-50	Euclid	20,000	19,220	30,600	0.620	1.035	11,300	1.10	0.303	$22.84	$18.69	$15.99	$28.91	$61.83	R-50
R-85	Euclid	20,000	19,220	30,600	0.620	1.035	11,300	1.10	0.303	$28.81	$23.57	$20.17	$38.08	$79.33	R-85
Pay.350C	Payhauler	20,000	19,220	30,600	0.620	1.035	11,300	1.10	0.303	$21.00	$17.25	$14.76	$26.86	$57.21	Pay.350C

Equipment Life (yrs) = 15 Overhead Minutes/ Work Hr = 50
Annual Use (hrs) = 2040 Factor= 0.370 Work Hr Factor = 0.833

P-P = Push/Pull
N-P-P= Non-Push/Pull

HANDBOOK FOR CALCULATION OF RECLAMATION BOND AMOUNTS

UNITED STATES DEPARTMENT OF THE INTERIOR
OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT
1987

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TABLES

GRAPHS AND FIGURES

(Figures B-1 through B-13 are located at end of document.)

PREFACE

This handbook was prepared by a special bonding committee of the Office of Surface Mining Reclamation and Enforcement (OSMRE). The members of this committee and the OSMRE offices they represent are:

Paul Behum	Eastern Technical Center
Gary Bennethum (Chairman)	Washington Office
David Lane	Tennessee Field Office
Frank Mancino	Washington Office
David Maxwell	Western Technical Center
John Mosesso	Tennessee Field Office
Pete Palone	Eastern Technical Center
Laura Swatek	Western Technical Center
Merline Van Dyke	Western Technical Center

The purpose of this handbook is to provide an accepted and consistent methodology for OSMRE employees to use when calculating the amounts of reclamation bonds for surface coal mining. The handbook uses a standard engineering cost-estimating methodology that provides a detailed estimate of needed bond amounts. The looseleaf format is intended to be updated periodically with the addition of new information or the deletion of dated material. OSMRE employees who use this handbook are encouraged to submit any suggested revisions to any of the members of the bonding committee.

The committee recognizes that certain procedures in the estimating method, such as estimating volumes using cross sections or making initial equipment selections, may not be familiar to the novice. However, in order to make the handbook as simple and straightforward as possible, detailed explanations of these procedures were intentionally omitted. The committee assumed that OSMRE employees involved in bond estimating would have a technical background sufficient to allow use of this handbook with assistance from other OSMRE staff who are experienced in calculating bonds and with the aid of standard engineering texts and equipment productivity books provided by manufacturers.

To completely understand how the methodology presented in this handbook is used, the bond estimator should study the main text as well as the three appendixes. The worksheets in Appendix A, the examples in Appendix B, and the guidance on equipment selection in Appendix C are intended to be an integral part of the handbook.

Finally, the mention of trade names of commercial equipment products in the handbook is for illustrative purposes and does not constitute endorsement or recommendation by the committee or OSMRE.