Project Underground Example

Date May 1986

WORKSHEET NO. 11A

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

1) Backfill and grade benches and 2) backfill sediment pond.
NOTE: Since these two tasks have similar grade and haul distances, the yardages can be added together and hours required determined. Total yardage = 41,110 cy + 25,814 cy (from worksheet No. 3). Site located 8000 feet above sea level.

Characterization of Scraper Used (type, capacity, etc.):

Cat 627B $\frac{14 \text{ cy (struck)} + 20 \text{ cy (heaped)}}{2}$ = 17 cy avg. capacity

A D8L dozer will assist the scraper in loading.

Description of Scraper Route (haul distance, % grade, etc.):

500' haul @ 10% effective grade
500' haul @ -4% effective grade

Cycle time = .6 (load time) min + .6 (loaded trip time) min + .6 (maneuver and spread time) min + .32 (return trip time) min = 2.12 min

Cycles/Hour = $\frac{50 \text{ min/hr}}{\text{work hour factor}}$ ÷ 2.12 min/cycle = 23.58 cycles/hr

Hourly Production = 17 (Adjusted load) yd^3 × 23.58 cycles/hr = 400.94 yd^3/hr

Hours Required = 66,924 (yd^3 volume to be handled) ÷ 400.94 (yd^3/hr net hourly production) = 166.95 hrs

Pusher cycle time = 140% load time + .25 min = 1.09 min

Number of scrapers that can be handled by one pusher = $\frac{2.12 \text{ min (scraper cycle time)}}{1.09 \text{ min (pusher cycle time)}}$ = 1.95 (use 2)

Therefore, two scrapers are required for 83.5 hours and one D8L dozer is required for 83.5 hours.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Underground Example

Date May 1986

WORKSHEET NO. 11B

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Haul and spread topsoil; 19,360 cy
Each scraper will be assisted in loading by one Cat D8L push dozer.
The site is at 8000 feet above sea level.

Characterization of Scraper Used (type, capacity, etc.):

Cat 627B, average capacity = 17 cy

Description of Scraper Route (haul distance, % grade, etc.):

1100' haul @ 10% effective grade
1100 return @ -4% effective grade

Cycle time = .6 (load time) min + 1.3 (loaded trip time) min + .6 (maneuver and spread time) min + .69 (return trip time) min = 3.19 min

Cycles/Hour = 50 min/hr (work hour factor) ÷ 3.19 min/cycle = 15.67 cycles/hr

Hourly Production = 17 (Adjusted load) yd^3 x 15.67 cycles/hr = 266.46 yd^3/hr

Hours Required = 19,360 (volume to be handled) yd^3 ÷ 266.46 (net hourly production) yd^3/hr = 72.7 hrs

Pusher cycle time = 1.09 min (from worksheet 11A)

Number of scrapers that can be handled by one pusher = 3.19 min (scraper cycle time) / 1.09 min (pusher cycle time) = 2.92 (use 2)

Therefore, 2 scrapers are required for 36.4 hours and 1 push dozer is required for 36.4 hours.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Underground Example

Date May 1986

WORKSHEET NO. 12

PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE--GRADING

Earthmoving Activity:

The motorgrader will be used for maintaining haul roads, final grading prior to topsoil placement, final grading of topsoil prior to seeding, clean-up, and maintenance work around the site. The motorgrader, along with the D7G bulldozer/ripper will be used for the life of the reclamation contract (131 hours). This unit will be working at 8000 feet, msl.

Characterization of Grader Used (type, size capacity, etc.):

Caterpillar 140G, 150 horsepower, equipped with rops and scarifier

Description of Grader Route (push distance, % grade, blade effective length, operating speed, etc.)

Effective blade width = 8 feet
operating speed = 2.4 mph

Productivity Calculations:

Contour Grading:

Hourly Production = _____ (speed) mi/hr x _____ (eff. blade width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Scarification:

Hourly Production = _____ (work speed) mi/hr x _____ (scarifier width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Hours Required = _____ ac ÷ _____ ac/hr = 119.8 hrs*

*Motorgrader to be used for the life of the reclamation contract (see Worksheet No. 13)

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Underground Example

Date May 1986

WORKSHEET NO. 13

SUMMARY CALCULATION OF EARTHMOVING COSTS

	Equipment Type	Owning and Operating Cost ($/hr) Equipment + Accessories		Labor Cost* ($/hr)		Total Hrs Req'd		Total Cost ($)
1)	Scrapers 627B (2)	[(91.73 + 0.89)	+	12.78]	x	119.8 x 2 = 239.7	=	25,264
2)	D8L push tractor	[(76.66 + 1.68 + 1.98 - 8.51)	+	12.63]	x	119.8	=	10,116
3)	Bulldozer D9L (3)	[(102.98 + 2.07 + 14.26 - 12.57)	+	12.63]	x	91.2 x 2 = 182.4	=	21,773
4)	Bulldozer D7G**	[(52.12 - 3.91 + 3.92 + 3.33)	+	12.63]	x	119.8	=	8,157
5)	Motorgrader 140G**	[(35.61 + 2.71 + 1.48)	+	12.63]	x	119.8	=	6,281
6)	Service/water truck**	[(20.99)	+	14.91]	x	119.8	=	4,301
7)	Fuel truck**	[(20.99)	+	14.91]	x	119.8	=	4,301
		[( )	+	]	x		=	
		[( )	+	]	x		=	
		[( )	+	]	x		=	
		[( )	+	]	x		=	
		[( )	+	]	x		=	

Total Cost = $80,193

Accessory Calculations:

1) Scraper equipped w/rops (roll over protection system)
2) Dozer equipped w/push cushion, controls, & w/out a blade
3) Dozer equipped with a "U" blade (subtract "S" blade & add "U" blade) and controls
4) Dozer equipped with an "A" blade (subtract "S" blade & add "A" blade) and controls
5) Motorgrader equipped with scarifier and controls

*Davis-Bacon wage rates

**These units are required to be on site for the life of the reclamation contract. This is assumed to be hours required to perform the earthwork tasks which is approximately 120 hours.

Date Sources: Dataquest, Cost Reference Guide for Construction Equipment

Project Underground Example

Date May 1986

WORKSHEET NO. 14

REVEGETATION COSTS

Name and Description of Area to be Revegetated:

Total disturbed area = 20 Acres

Description of Revegetation Activities:

The local SCS office provided a cost of $425 per acre for seeding, fertilizing, and mulching. Assuming 50 percent failure, total cost equals $637.5/acre.

Reseeding:

20 acres x ($ * per acre + $ 637.5 per acre) = $ 12,750

(# of acres to be reseeded) ($/acre for seedbed preparation) ($/acre for seeding, fertilizing, and mulching) (costs for reseeding)

Planting Trees and Shrubs:

_____ acres x $_____ per acre = $_____

(# of acres for planting) ($/acre for planting trees and shrubs) (costs for planting)

Other Revegetation Activity for this Area (e.g., Soil Sampling):

(Describe and provide cost estimate with documentation; use additional sheets if necessary.)

TOTAL REVEGETATION COST FOR THIS AREA = $ 12,750

*To be accomplished by motor grader, see Worksheet No. 12.

Data Sources: Mine plan and the local SCS

Project Underground Example

Date May 1986

WORKSHEET NO. 15

OTHER RECLAMATION ACTIVITY COSTS

Descriptions of Reclamation Activity:

Sealing three mine entries: ventilation, manway, and material. The sealing will be as follows: 1) each entryway will be pneumatically filled for 50 feet and 2) a masonry wall will be installed @ the entrance.

Assumptions:

	Backfill	Masonry Wall
1. Ventilation	1,964 ft^3	39 ft^2
2. Manway	12,272	245
3. Materials	2,827	57
	17,063 ft^3	341 ft^2

Cost Estimate Calculations:

Pneumatically filled materials	17,063 ft^3 x $1.11	= $18,940
Masonry walls	341 ft^2 x $4.36	= $ 1,487

TOTAL = $ 20,427.00

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

Data Sources: Local AML contract figures

Project Underground Example

Date May 1986

WORKSHEET NO. 16

RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$ 306,363
2.	Total Earthmoving Costs	80,193
3.	Total Revegetation Costs	12,750
4.	Total Other Reclamation Activities Costs	20,427
5.	Subtotal: Total Direct Costs	419,733
6.	Mobilization and Demobilization at 5 % of Item 5) (1% to 5% of Item 5)	20,987
7.	Contingencies (at 10 % of Item 5) (see Table 4)	41,973
8.	Engineering Redesign Fee (at 6.8 % of Item 5) (see Graph 1)	28,542
9.	Contractor Profit and Overhead (at 10.2 % of Item 5) (see Graph 2)	42,813
10.	Reclamation Management Fee (at 5 % of Item 5) (see Graph 3)	20,987
11.	GRAND TOTAL BOND AMOUNT (Sum of Items 5 through 10)	$575,035

Engineering News Record Cost Index: 4,228.95 Date: 4/26/86

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT
BOND AMOUNT COMPUTATION

Applicant Dragline Example

Permit Number Example No. 2

Date May 1986

Number of Acres 115.1

Type of Operation Dragline Mining Operations

Location U.S.A.

Prepared by M.V. Bond

Project Dragline Example

Date May 1986

WORKSHEET NO. 1

DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

The mine plan outlines the following mining sequence for this dragline operation. (See Figure B-4 at end of document.) Mining begins at the southern end of the property in nonprime farmland soils and progresses northward. The 6 inches of existing topsoils and the opening box-cut material will be stockpiled separately near the southern end of the permit boundary and along the creek that runs along the south and east sides of the permit boundary. In addition, the mine plan identifies 71 acres of prime farmland in which 48 inches of prime farmland soils must be salvaged. The worst-case situation will occur when there is:

1. The greatest disturbance of prime farmland,
2. The largest pit, and
3. The greatest exposure of nonvegetated land.

From inspection, the worst case was determined as occurring about midway through the mining operation when one of the longest pits through prime farmlands is open, four spoil ridges exist behind the open pit, and no revegetation is initiated (see sketch). Assuming this worst-case situation, the following reclamation tasks should be completed.

1. Structure Demolition

   There are no facilities. One haul road and five ponds are to remain as part of the approved permit mining land use.

2. Earthmoving Activities

   One pit will be open at the time of forfeiture that will need to be backfilled and rough graded. The accompanying cross-section indicates about a 40-foot depth for the open pit. The mine plan indicates that the highwall will maintain a 1/4:1 slope and the spoil ridge side will maintain a slope of 1-1/2:1 (see sketch). It is assumed that four spoil ridges exist behind the open pit before rough backfilling and grading is required to begin. Therefore, these spoil ridges will also need rough grading. Once rough grading is accomplished, the whole area will be ripped prior to final grading and topsoil placement.

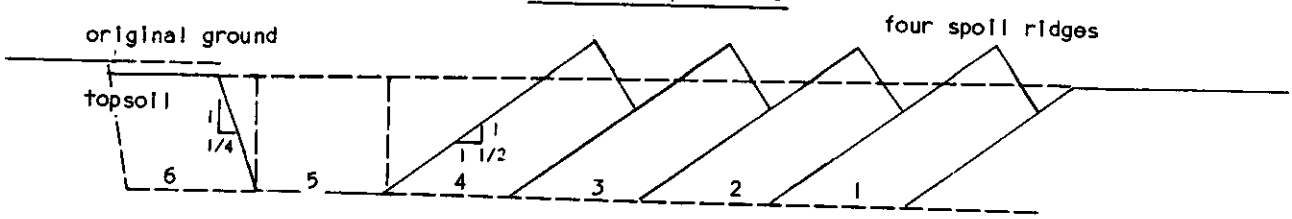
3. Topsoil Replacement

   It is assumed that the next pit to be mined has had all topsoil stripped. All areas behind the open pit from the start of mining need topsoil replaced plus revegetation. The prime farmland areas will receive 48 inches of topsoil (A and B Horizons) and the nonprimeland areas will receive 6 inches of topsoil (A Horizon only). These areas will be final graded once the topsoil is placed.

4. Revegetation

   The revegetation worst case would be if mining started in the fall of the year, as scheduled, with no revegetation occurring since mining began. Therefore, the entire disturbed area of 40.5 acres will need seedbed preparation, fertilization, seeding, and mulching.

Sketch of Operations



pit width	80'	80'	80'	80'	80'
pit length	2916'	3150'	3267'	3384'	3501'
pit depth	40'	40'	40'	40'	40'

Data Sources:

Project Dragline Example

Date May 1986

WORKSHEET NO. 3

MATERIAL HANDLING PLAN SUMMARY SHEET

Listing of All Earthmoving Activities:

Description	Volume	Origin	Destination	Haul Distance	Grade	Equipment to be Used
1) Backfilling and grading	568,836 yd^3	box cut	stockpiles	1,900'	4%	637D scraper D9L push tractor
2) Rough grading	132,923	spoil ridges	in place	100'	3%	D9L dozer
3) Final grading	40.5 acres	in place	in place	--	v*	D7G dozer
4) Ripping	131,030 yd^3	in place	in place	--	v*	D7G dozer
5) Topsoil (nonprime)	15,972 yd^3	stockpile	disturbed area	1,000'	3%	637D scraper D9L push tractor
6) Topsoil Prime "B"	116,886 yd^3	stockpile	disturbed area	1,000'	3%	637D scraper D9L push tractor
7) Topsoil Prime "A"	16,698 yd^3	stockpile	disturbed area	1,000'	3%	637D scraper D9L push tractor
8) Scarifying	40.5 acres	in place	in place	--	v*	140G motorgrader
9)						
10)						

* Varies to actual conditions and direction of field work

Project Dragline Example

Date May 1986

WORKSHEET NO. 4

Pit Backfill Volume

End Area of Pit

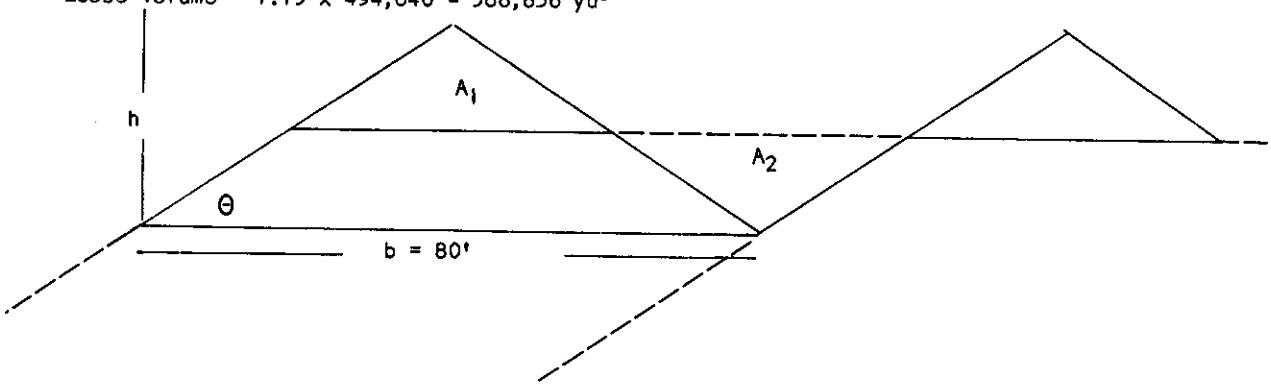
1. 0.5 x 10' x 40' = 200 ft^2
2. 80' x 40' = 3,200 ft^2
3. 0.5 x 40' x 59' = 1,180 ft^2

= 4,580 ft^2

Pit Volume = 4580 ft^2 x 2916 ft ÷ 27 ft^3/yd^3 = 494,640 yd^3

In order to account for material shrinkage due to compaction, assume a 15 percent volume loss due to compaction. Therefore, the loose volume required to backfill the pit is:

Loose Volume = 1.15 x 494,640 = 568,836 yd^3



Spoil Ridge Volume

A_1 = A_2
A_1 = 1/4 total pile
A_1 = 1/4(1/2)(b)(h)
h = 1/2 (tan Θ) (b)
A_1 = 1/16 (tan Θ)$(b)^2$
Θ = 34° (given 1-1/2:1 slope)
b = 80'
A_1 = 269.8 ft^2
= 269.8 ft^2/lineal foot

Therefore:

Ridge 4: 269.8 ft^2/lineal foot x 3150 feet long x 1 cy = 31,477
Ridge 3: 269.8 ft^2/lineal foot x 3267 feet long x 1 cy = 32,646
Ridge 2: 269.8 ft^2/lineal foot x 3384 feet long x 1 cy = 33,815
Ridge 1: 269.8 ft^2/lineal foot x 3501 feet long x 1 cy = 34,985

132,923 cy

WORKSHEET NO. 4 (continued)

Topsoil Volume

Nonprime Farmland

19.8 acres to receive 6 inches of topsoil

$$19.8 \text{ acres} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times 0.5 \text{ ft} \div \frac{27 \text{ ft}^3}{\text{yd}^3} = 15{,}972 \text{ yd}^3$$

Prime Farmland

20.7 acres to receive 48" of A and B Horizon soils

"A" Horizon

$$20.7 \text{ acres} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times 0.5 \text{ ft} \times \frac{1 \text{ yd}^3}{27 \text{ ft}^3} = 16{,}698 \text{ yd}^3$$

"B" Horizon

$$20.7 \text{ acres} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times 3.5 \text{ ft} \times \frac{1 \text{ yd}^3}{27 \text{ ft}^3} = 116{,}886 \text{ yd}^3$$

Project Dragline Example

Date May 1986

WORKSHEET NO. 5A

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Spoil Ridge Reduction

Characterization of Dozer Used (type, size, etc.):

Caterpillar, D9L with "U" Blade, ideal production = 1450 LCY/hour

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

100 foot push @ 3% effective grade, volume = 132,923 yd^3

Productivity Calculations:

Operating Adjustment Factor = 0.75 (operator factor) × 0.80 (material factor) × 0.84 (work hour factor) × 0.95 (grade factor) × 0.91* (weight correction factor) × 1.1 (production method/blade factor)

× 0.90 (visibility) × 1 (elevation) × 1 (direct drive transmission) = 0.431

Net Hourly Production = 1450 (normal hourly production) yd^3/hr × 0.431 (operating adjustment factor) = 624.95 yd^3/hr

Hours Required = 132.923 yd^3 (volume to be moved) ÷ 624.95 yd^3/hr (net hourly production) = 212.7 hrs (use 213 hours)

* $\frac{2412}{2650} = 0.91$

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Dragline Example

Date May 1986

WORKSHEET NO. 5B

PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:

Push tractor to be used to assist scrapers with loading backfill and topsoil material.

Characterization of Dozer Used (type, size, etc.):

Caterpillar D9L tractor with push pad

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):

Productivity Calculations:

Operating Adjustment Factor = _____ (operator factor) × _____ (material factor) × _____ (work hour factor) × _____ (grade factor) × _____ (weight correction factor) × _____ (production method/blade factor) ×

_____ (visibility) × _____ (elevation) × _____ (direct drive transmission) = _____

Net Hourly Production = _____ (normal hourly production) yd^3/hr × _____ (operating adjustment factor) = _____ yd^3/hr

Hours Required = _____ (volume to be moved) yd^3 ÷ _____ (net hourly production) yd^3/hr = 782 hrs*

*See Worksheet No. 11A, 11B, and 11C

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Dragline Example

Date May 1986

WORKSHEET NO. 7

PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:

The 40.5 acre (1330' x 1330') site to be ripped prior to placing/replacing the topsoils.

Characterization of Dozer and Ripper Used:

Caterpillar D7G bulldozer with rippers

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

Depth = 2'
Width = 7'

Productivity Calculations:

Cycle time = (1330 ft (cut length) / 88 fpm (speed)) + 0.30 (turn time) = 15.4 min/pass

Passes/hour = 45 (work hour factor) min/hr ÷ 15.4 (cycle time) min/pass = 2.9 passes/hr

Volume cut per pass = 2 (tool penetration) ft x 7 (cut spacing) ft x 1330 (cut length) ft) / 27 ft^3/yd^3 = 689.6 bank yd^3/pass

Ripping Production = 689.6 bank yd^3/pass x 2.9 passes/hr = 1999.8 bank yd^3/hr

Hours Required = 131,030* (volume to be ripped) bank yd^3 ÷ 1999.8 (hourly production) bank yd^3/hr = 65.5** hrs

Calculate separate dozer hauling of ripped material in each lift on Worksheet No. 5, using material factor to account for swell.

*1330' x 1330' x 2' 27 ft^3/yd^3 = 131,030 yd^3

**The bulldozer is assumed to be needed for the life of the reclamation contract in order to perform miscellaneous activities in addition to this ripping task. See Worksheet No. 13 for determination of the reclamation contract.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Dragline Example

Date May 1986

WORKSHEET NO. 11A

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Backfill the final pit

Characterization of Scraper Used (type, capacity, etc.):

Caterpillar 637D scraper plus D9L push tractor

Capacity = $\frac{31\ yd^3\ (heaped) + 21\ yd^3\ (struck)}{2} = 26\ yd^3$

Description of Scraper Route (haul distance, % grade, etc.):

1900 LF @ 4% grade

Cycle time = 0.5 min (load time) + 1.05 min (loaded trip time) + 0.6 min (maneuver and spread time) + 0.85 min (return trip time) = 3.00 min

Cycles/Hour = 50 min/hr (work hour factor) ÷ 3.00 min/cycle = 16.7 cycles/hr

Hourly Production = 26 yd^3 (Adjusted load) × 16.7 cycles/hr = 434.2 yd^3/hr

Hours Required = 568,836 yd^3 (volume to be handled) ÷ 434.2 yd^3/hr (net hourly production) = 1310 hrs

Pusher cycle time = 140% of load time + 0.25 min = .95

Number of scrapers that can be handled by one pusher = $\frac{3.00\ (scraper\ cycle\ time)}{.95\ (pusher\ cycle\ time)} = 3.16\ (3)$

However, only two scrapers are required for topsoil activities (see Worksheet Nos. 11B and 11C); therefore, assume that one push tractor will handle two scrapers and any wait time for the push tractor will be used to clean up load site.

Two scrapers needed for 655 hours and one push tractor needed for 655 hours.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Dragline Example

Date May 1986

WORKSHEET NO. 11B

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Replacing 42 inches of prime farmland, B Horizon, over 20.7 acres

$$20.7 \text{ acres} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times \frac{42}{} \text{ in} \times \frac{\text{ft}}{12 \text{ in}} \div \frac{27 \text{ ft}^3}{\text{yd}^3} = 116{,}886 \text{ yd}^3$$

Characterization of Scraper Used (type, capacity, etc.):

Caterpillar 637D scraper plus D9L push tractor

$$\text{Capacity} = \frac{31 + 21}{2} = 26 \text{ yd}^3$$

Description of Scraper Route (haul distance, % grade, etc.):

1000 LF @ 3% effective grade

$$\text{Cycle time} = \underset{\text{load time}}{0.50} \text{ min} + \underset{\text{loaded trip time}}{0.60} \text{ min} + \underset{\text{maneuver and spread time}}{0.60} \text{ min} + \underset{\text{return trip time}}{0.50} \text{ min} = \underline{2.20} \text{ min}$$

$$\text{Cycles/Hour} = \underset{\text{work hour factor}}{50 \text{ min/hr}} \div \underline{2.20} \text{ min/cycle} = \underline{22.7} \text{ cycles/hr}$$

$$\text{Hourly Production} = \underset{\text{Adjusted load}}{26} \text{ yd}^3 \times \underline{22.7} \text{ cycles/hr} = \underline{590.2} \text{ yd}^3\text{/hr}$$

$$\text{Hours Required} = \underset{\text{volume to be handled}}{116{,}886} \text{ yd}^3 \div \underset{\text{net hourly production}}{590.2} \text{ yd}^3\text{/hr} = \underline{198} \text{ hrs}$$

Pusher cycle time = 140% of load time + 0.25 min = .95 min

$$\text{Number of scrapers that can be handled by one pusher} = \frac{2.20 \text{ (scraper cycle time)}}{.95 \text{ (pusher cycle time)}} = 2.3 \text{ (use 2)}$$

Therefore, two scrapers are required for 99 hours and one push tractor is required for 99 hours.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Dragline Example

Date May 1986

WORKSHEET NO. 11C

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Replacing 6 inches of topsoil over 40.5 acres (19.8 acres nonprime farmland and 20.7 acres of prime farmlands)

$$40.5 \text{ acres} \times \frac{43{,}560 \text{ ft}^2}{\text{acre}} \times 0.5\text{" thick} \div \frac{27 \text{ ft}^3}{\text{yd}^3} = 32{,}670 \text{ yd}^3$$

Characterization of Scraper Used (type, capacity, etc.):

Caterpillar 637D scraper plus D9L push tractor

$$\text{Capacity} = \frac{31 + 21}{2} = 26 \text{ yd}^3$$

Description of Scraper Route (haul distance, % grade, etc.):

100 LF @ 3% effective grade

$$\text{Cycle time} = \underset{\text{load time}}{0.5 \text{ min}} + \underset{\text{loaded trip time}}{0.60 \text{ min}} + \underset{\text{maneuver and spread time}}{0.6 \text{ min}} + \underset{\text{return trip time}}{0.50 \text{ min}} = 2.20 \text{ min}$$

$$\text{Cycles/Hour} = \frac{50 \text{ min/hr}}{\text{work hour factor}} \div 2.20 \text{ min/cycle} = 22.7 \text{ cycles/hr}$$

$$\text{Hourly Production} = \underset{\text{Adjusted load}}{26} \text{ yd}^3 \times 22.7 \text{ cycles/hr} = 590.2 \text{ yd}^3/\text{hr}$$

$$\text{Hours Required} = \underset{\text{volume to be handled}}{32{,}670 \text{ yd}^3} \div \underset{\text{net hourly production}}{590.2 \text{ yd}^3/\text{hr}} = \underset{\text{use 55 hours}}{55.4 \text{ hrs}}$$

Pusher cycle time = 140% of load time + 0.25 min = .95 min

$$\text{Number of scrapers that can be handled by one pusher} = \frac{2.20 \text{ (scraper cycle time)}}{.95 \text{ (pusher cycle time)}} = 2.3 \text{ (use 2)}$$

Therefore, two scrapers are required for 27.7 hours and one push tractor is required for 27.7 hours.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Dragline Example

Date May 1986

WORKSHEET NO. 12

PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE--GRADING

Earthmoving Activity:

The motorgrader will be used to maintain the haul roads, for scarifying the site before revegetation, and for other site maintenance duties not specifically identified.

Characterization of Grader Used (type, size capacity, etc.):

Caterpillar 140G w/scarifier

Description of Grader Route (push distance, % grade, blade effective length, operating speed, etc.)

Blade and scarifier width = 8 feet
Working speed = 2.4 mph

Productivity Calculations

Contour Grading:

Hourly Production = _____ (speed) mi/hr x _____ (eff. blade width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Scarification:

Hourly Production = _____ (work speed) mi/hr x _____ (scarifier width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

_____ (work hour factor) = _____ ac/hr

Hours Required = _____ ac ÷ _____ ac/hr = 782 hrs*

*Motorgrader assumed to be required for the life of the reclamation contract to perform above activities. See Worksheet No. 13 for determination of reclamation contract term.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Dragline Example

Date May 1986

WORKSHEET NO. 13

SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment Type	Owning and Operating Costs ($/hr) Equipment + Accessories		Labor Cost ($/hr)		Total Hrs* Req'd		Total Cost ($)
1) D9L, "U" Blade	[(102.98 + 13.05 - 12.57 + 3.01)	+	12.63	] x	212.7	=	25,333
2) D9L, push	[(102.98 + 2.07 + 3.01)	+	12.63	] x	782	=	94,380
3) 637D scrapers(2)	[(138.83 + 1.14)	+	12.78	] x	782 x 2 = 1564	=	238,901
4) D7G, ripper**	[(52.12 + 2.70 + 0.98 + 2.08)	+	12.63	] x	782	=	55,139
5) 140G** motorgrader	[(35.61 + 2.74 + 1.16 + 1.65)	+	12.63	] x	782	=	42,064
6) fuel truck**	[(20.99)	+	14.91	] x	782	=	28,074
7) service/water truck**	[(20.99)	+	14.91	] x	782	=	28,074
	[( )	+		] x		=	
	[( )	+		] x		=	
	[( )	+		] x		=	
	[( )	+		] x		=	
	[( )	+		] x		=	

Total Cost = 511,965

Equipment and Accessory Identification:

1) D9L with "U" blade, rops (roll over protection system)
2) D9L with push pad, rops
3) D7G with ripper, rops, control
4) 637D with rops
5) 140G with scarifier, control, rops

*Davis-Bacon wage rates
**These pieces of equipment are required to be onsite for the life of the reclamation contract. The life of the reclamation contract is assumed to be the hours required to fill the open pit and to replace the topsoils, which was determined to be 782 hours.

Data Sources: Dataquest, Cost Reference Guide for Construction Equipment

Project Dragline Example

Date May 1986

WORKSHEET NO. 14

REVEGETATION COSTS

Name and Description of Area to be Revegetated:

The area consists of prime and nonprime farmlands. Both areas will be vegetated in the same manner. Alfalfa will be used as cover crop.

Description of Revegetation Activities:

The mine plan indicated, and the local SCS office confirmed, the following costs:

Seed = $150/Ac
Fertilizer = $ 40/Ac
Mulch = $250/Ac
TOTAL = $440/Ac

Reseeding:

Assume 50% reseeding required, new total = 660

40.5 acres (# of acres to be reseeded) x ($ * ($/acre for seedbed preparation) per acre + $ 660 ($/acre for seeding, fertilizing, and mulching) per acre) = $ 26,730 (costs for reseeding)

Planting Trees and Shrubs:

_____ acres (# of acres for planting) x $ _____ ($/acre for planting trees and shrubs) per acre = $ _____ (costs for planting)

Other Revegetation Activity for this Area (e.g., Soil Sampling):

(Describe and provide cost estimate with documentation; use additional sheets if necessary.)

TOTAL REVEGETATION COST FOR THIS AREA = $ 26,730

*To be accomplished by the motorgrader, see Worksheet No. 12.

Data Sources: State SCS suggesting 440/acre w/50% reseeding

Project Dragline Example

Date May 1986

WORKSHEET NO. 16

RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$ ____
2.	Total Earthmoving Costs	511,965
3.	Total Revegetation Costs	26,730
4.	Total Other Reclamation Activities Costs	----
5.	Subtotal: Total Direct Costs	538,695
6.	Mobilization and Demobilization at 5 % of Item 5) (1% to 5% of Item 5)	26,935
7.	Contingencies (at 7 % of Item 5) (see Table 4)	37,709
8.	Engineering Redesign Fee (at 6.5% of Item 5) (see Graph 1)	35,015
9.	Contractor Profit and Overhead (at 9.8% of Item 5) (see Graph 2)	52,792
10.	Reclamation Management Fee (at 4.8% of Item 5) (see Graph 3)	25,857
11.	GRAND TOTAL BOND AMOUNT (Sum of Items 5 through 10)	$717,003

Engineering News Record Cost Index: 4228.95 Date: 4/26/86

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT
BOND AMOUNT COMPUTATION

Applicant Haul Back Example

Permit Number Example No. 3

Date May 1986

Number of Acres 160

Type of Operation Haul Back

Location U.S.A.

Prepared by L.S. Bond

Project Haul Back

Date May 1986

WORKSHEET NO. 1

DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

The mining sequence for this haul back operation begins with Pit #1 and progresses through Pit #66 (see Figure B-5 at end of document). The topsoil from the box cut and the box-cut material will be stored separately in the four stockpiles located near Pits #4, #10, and #13. From inspection, the worst-case reclamation scenario will occur while Pit #21 is being mined due to the pit size and distance from these stockpiles. At this time, all additional stockpiles would not exist.

1. Structure Demolition

The mine plan indicates that the office is located at the southern end of the permit area. This facility is mobile therefore it would not be demolished. The office and coal pad area combined take up about 0.5 acres. There are no other structures located on the permit area.

2. Earthmoving Activities

The worst-case reclamation scenario assumes that Pit #21 is completely mined. However, the haul back mining sequence, once in full operation, is conducted such that spoil is hauled immediately behind the active coal mining face and placed within the previous mined-out area. Therefore, it is assumed that 50 percent of Pit #21 and 50 percent of Pit #22 requires backfilling. The total volume contained in both stockpiles, plus 20 percent swell, and the volume of the haul-road surfacing is considered to be sufficient to fill the remaining open pit.

The main haul road is located along the western edge of the permit area, runs for 7000 feet and is 30 feet wide. The mine plan states that the haul road will be constructed out of crushed rock obtained from the initial box cut. The crushed rock will be 34 inches thick for the entire haul road length. This material will be removed and disposed of in the open pit by using the same equipment as used to move the spoil from the stockpiles to the open pit.

The mine plan indicates about a 30-foot overburden depth. The highwall is assumed to have a 1/4:1 slope and the spoil side is assumed to have a 2:1 slope based on field observation (see Worksheet No. 4). Because the mining operation uses scrapers, backfilling and rough grading is already accomplished. Therefore, Pits #17 through #22 require final grading prior to topsoil replacement.

Reclamation of the coal pad/office area will require that contaminated material be removed to a depth of 10 inches. This material will be disposed of in the open pit.

All existing ponds and the containment berm will be left as part of the approved postmining land use.

3. Topsoil Replacement

The mine plan indicates that 10 inches of topsoil will be salvaged. The topsoil from Pit #22 is assumed to have been removed and placed over Pit #16. The stockpiled topsoil will be used to cover Pits #17 through #22, the haul road, and the office/coal pad area. The topsoiled areas will then be final graded. The topsoil stockpile located on the west side of Pit #5 will be referred to as TSW on the worksheets and the topsoil stockpile located on the east side of Pit #10 will be referred to as TSE on the worksheets.

Data Sources: Mine plan

In addition, pits #17 through #22 will need to be ripped prior to topsoil placement. (See Worksheet No. 7, item #7). There will also need to be final grading and scarifying of the topsoil prior to revegetation. (See Worksheet No. 3, item #9).

4. Revegetation

The worst-case reclamation situation is assumed to occur during the first year of mining at the end of the winter period when approximately 6 months of winter weather would have inhibited the establishment of permanent revegetation. Therefore, Pits #11 through #22, the haul road, and the office and coal pad area would need seedbed preparation, fertilization, seeding, and mulching. No prime farmlands are identified in the mine plan.

Project Haul Back

Date May 1986

WORKSHEET NO. 2

STRUCTURE DEMOLITION AND DISPOSAL COST SUMMARY

Listing of Buildings to be Demolished:

Item	Type of Construction Material	Volume (cubic feet)	Unit Cost Basis	Demolition Cost
1) None*				
2)				
3)				
4)				
5)				

Total Cost = $

Other Items to be Demolished:

*Remove office trailer, 50'x10'; same as installation fee $545.00

Debris Handling and Disposal Costs:

TOTAL DEMOLITION AND DISPOSAL COST = $ 545.00

Data Sources: Means, Building Construction Cost Data, 1986

Project Haul Back

Date May 1986

WORKSHEET NO. 3

MATERIAL HANDLING PLAN SUMMARY SHEET

Listing of All Earthmoving Activities:

	Description	Volume	Origin	Destination	Haul Distance	Grade	Equipment to be Used
1)	Fill open pit	60,289 cy	Overburden Stockpile West	Pit #22	1600' 200'	3% 10%	Cat 988B loader Cat 769C haul truck
2)	Fill open pit	60,289 cy	Overburden Stockpile East	Pit #22	800' 200'	3% 10%	Cat 988B loader Cat 769C haul truck
3)	Fill open pit	22,088 cy	Haul road	Pit #22	1800' 200'	3% 10%	Cat 988B loader Cat 769C haul truck
4)	Office area cleanup	672 cy	Coal pad/ Office area	Pit #22	3200' 200'	3% 10%	Cat 988B loader Cat 769C haul truck
5)	Rip backfill, haul road, office area	70,758 cy	---	---	---	---	Cat D8L dozer with multishank ripper
6)	Final grade backfill, haul road, office area	---	---	---	---	---	Cat 140G motorgrader
7)	Replace topsoil over Pits #17-#22	14,679 cy	TSW TSE	Pits #17-#22	750'	3%	Cat 627B scraper Cat D8L push tractor
8)	Replace topsoil over office area & haul road	7,151 cy	TSW	Office area & haul road	2100'	3%	Cat 627B scraper Cat D8L push tractor
9)	Final grade and scarify topsoil	---	---	---	---	---	Cat 140G motorgrader w/ scarifier
10)							

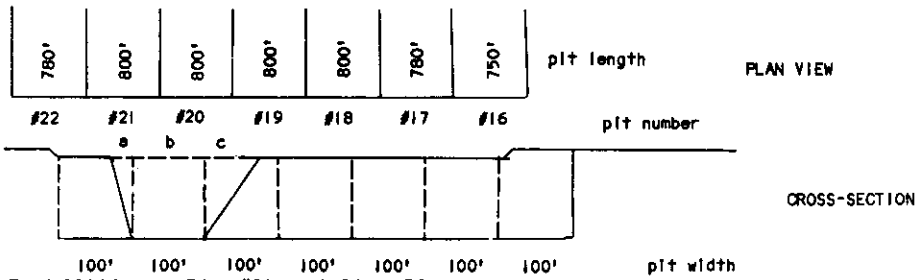
Project Haul Back

Date May 1986

WORKSHEET NO. 4

EARTHWORK QUANTITY WORKSHEET

Earthmoving Volume and Area Calculations



Backfilling - Pit #21 and 22 - 50 percent

Area a: 0.5 x 30' x 7.5' = 112.5 sf
Area b: 30' x 100' = 3000.0 sf
Area c: 0.5 x 30' x 60' = 900.0 sf

4012.5 sf

Volume for open pit: 800'(length) x 4012.5sf x 1.2(swell) ÷ 27 cf/cy = 142,666.66 cy
Volume of haul road material: 7000' x 30' x 2.84' ÷ 27 ft^3/yd^3 = 22,088.88 cy
Volume of overburden stockpiles: Pit Volume - Road Volume = 120,577.78 cy

Haul Road Haul Distance:

Total haul road volume = 22,088 cy
The volume and haul distance (from centroid to centroid) for the northern half of the haul road = 12,622 cy @ 2200'; for the southern half = 9,466 cy @ 1700'. The total average haul distance = 2000'.

Topsoil Replacement - Pits #17 through #22, Haul Road, Office Area, and Coal Pad

Pits #17 through #22: 6 pits x 100' wide x 793' long
x .83' thick ÷ 27 cf/cy = 14,679.31 cy

Haul Road: 7000' long x 30' wide
x .83' thick ÷ 27 cf/cy = 6,478.89 cy

Office & Coal 0.5 acres x 43560 sf/acre
Pad Area: 0.5 acres x 43560 sf/acre
x .83' thick ÷ 27 cf/cy = 672.55 cy

Topsoil Haul Distance:

Assume that total topsoil volume is evenly distributed between the two stockpiles. Therefore,
TSW = 10,915 cy
TSE = 10,915 cy

The 7,151 cy of topsoil required for the haul road, office/coal pad area will come from TSW. The remaining topsoil in TSW and the topsoil in TSE will be placed over Pits #17-#22. The total average haul distance for TSW is 2100'. The total average haul distance for remaining TSW and TSE is 750'.

WORKSHEET NO. 4 (continued)

Revegetation - Pits #11 through #22, Haul Road, Office Area, and Coal Pad

A planimeter was used to determine the area of Pits #11 through #22.

Pits #11 - #22	=	20.8 acres
Haul Road	=	4.8 acres
Office & Coal Pad Area	=	0.5 acres
		26.1 acres

Project Haul Back

Date May 1986

WORKSHEET NO. 7A

PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:

Rip backfill prior to placing topsoil.

Characterization of Dozer and Ripper Used:

Caterpillar D8L, No. 8 multishank

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

Ripping depth = 2.7'
Cut width = 6.25'
Cut length = 793'
Volume = 6 pits x 100' wide x 793' long x 2.7' deep ÷ 27 ft ^{3}/ yd^3 = 47,580 yd^3

Productivity Calculations:

Cycle time = (793 (cut length) ft / 88 fpm (speed)) + .3 (turn time) = 9.3 min/pass

Passes/hour = 50 (work hour factor) min/hr ÷ 9.3 (cycle time) min/pass = 5.38 passes/hr

Volume cut per pass = (2.7 (tool penetration) ft x 6.25 (cut spacing) ft x 793 (cut length) ft) / 27 ft^3/yd^3 = 495.6 bank yd^3/pass

Ripping Production = 495.6 bank yd^3/pass x 5.38 passes/hr = 2666.5 bank yd^3/hr

Hours Required = 47,580 (volume to be ripped) bank yd^3 ÷ 2,666.5 (hourly production) bank yd^3/hr = 17.85 hrs

Calculate separate dozer hauling of ripped material in each lift on Worksheet No. 5, using material factor to account for swell.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 7B

PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:

Rip haul road

Characterization of Dozer and Ripper Used:

Caterpillar D8L, No. 8 multishank

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

Depth = 2.7'
Width = 6.25'
Length = 7000'
Volume = 7000' long x 30' wide x 2.7' deep ÷ 27 cf/cy = 21,000 cy

Productivity Calculations:

Cycle time = (7000 (cut length) ft / 88 fpm (speed)) + .3 (turn time) = 79.8 min/pass

Passes/hour = 50 (work hour factor) min/hr ÷ 79.3 (cycle time) min/pass = .63 passes/hr

Volume cut per pass = 2.7 (tool penetration) ft x 6.25 (cut spacing) ft x 7000 (cut length) ft / 27 ft^3/yd^3 = 4,375 bank yd^3/pass

Ripping Production = 4,375 bank yd^3/pass x .63 passes/hr = 2756.25 bank yd^3/hr

Hours Required = 21,000 (volume to be ripped) bank yd^3 ÷ 2756.25 (hourly production) bank yd^3/hr = 7.62 hrs

Calculate separate dozer hauling of ripped material in each lift on Worksheet No. 5, using material factor to account for swell.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 7C

PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:

Rip office/coal pad area

Characterization of Dozer and Ripper Used:

Caterpillar D8L, No. 8 multishank

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):

Ripping depth = 2.7'
Cut width = 6.25'
Area = 21,780 sf
Volume = .5Ac x $\frac{43560 ft^2}{Ac}$ x 2.7' deep ÷ 27cf/cy = 2178 cy

Productivity Calculations:

Cycle time = (148 ft (cut length) / 88 fpm (speed)) + .3 (turn time) = 1.98 min/pass

Passes/hour = 50 min/hr (work hour factor) ÷ 1.98 min/pass (cycle time) = 25.23 passes/hr

Volume cut per pass = 2.7 ft (tool penetration) x 6.25 ft (cut spacing) x 148 ft (cut length) / 27 ft^3/yd^3 = 92.5 bank yd^3/pass

Ripping Production = 92.5 bank yd^3/pass x 25.25 passes/hr = 2333.7 bank yd^3/hr

Hours Required = 2178 bank yd^3 (volume to be ripped) ÷ 2,333.7 bank yd^3/hr (hourly production) = .93 hrs

Calculate separate dozer hauling of ripped material in each lift on Worksheet No. 5, using material factor to account for swell.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 8A

PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:

1. Load haul truck with spoil from overburden stockpile, west (OSW)
2. Load haul truck with spoil from overburden stockpile, east (OSE)

Characterization of Loader Used (type, size, etc.):

Caterpillar 988B, 7 cy bucket

Description of Loader Use (origin, destination, grade, haul distance, etc.):

N/A

Productivity Calculations:

Cycle time = 0 (haul time (loaded)) + 0 (return time (empty)) + .575 (basic cycle time) = .575 min

Net Bucket Capacity = 7 (heaped bucket capacity) yd^3 x .8 (bucket fill factor) = 5.6 yd^3

Net Hourly Production = 5.6 (net bucket capacity) yd^3 ÷ .575 (cycle time) min x 50 min/hr (work hour factor) = 486.96 yd^3/hr

Hours Required = 1. 60,289 / 2. 60,289 (volume to be moved) yd^3 ÷ 486.96 (net hourly production) yd^3/hr = 123.81 hrs

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 8B

PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:

Excavate and load road base material.

Characterization of Loader Used (type, size, etc.):

Caterpillar 988B, 7 cy bucket

Description of Loader Use (origin, destination, grade, haul distance, etc.):

Approximately 30' total haul @ 3% effective grade

Productivity Calculations:

Cycle time = .06 (haul time (loaded)) + .055 (return time (empty)) + .575 (basic cycle time) = .69 min

Net Bucket Capacity = 7 (heaped bucket capacity) yd^3 x .9 (bucket fill factor) = 6.3 yd^3

Net Hourly Production = 6.3 (net bucket capacity) yd^3 ÷ .69 (cycle time) min x 50 min/hr (work hour factor) = 456.5 yd^3/hr

Hours Required = 22,088 (volume to be moved) yd^3 ÷ 456.5 (net hourly production) yd^3/hr = 48.38 hrs

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 8C

PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:

Office and coal pad area waste cleanup: Remove 10 inches of contaminated material and place in final pit.

Characterization of Loader Used (type, size, etc.):

Caterpillar 988B, w/ 7 cy bucket

Description of Loader Use (origin, destination, grade, haul distance, etc.):

Approximate 30' total haul @ 3% effective grade

Productivity Calculations:

Cycle time = .06 (haul time (loaded)) + .055 (return time (empty)) + .575 (basic cycle time) = .69 min

Net Bucket Capacity = 7 (heaped bucket capacity) yd^3 x .9 (bucket fill factor) = 6.3 yd^3

Net Hourly Production = 6.3 (net bucket -capacity) yd^3 ÷ .69 (cycle time) min x 50 min/hr (work hour factor) = 456.5 yd^3/hr

Hours Required = 672 (volume to be moved) yd^3 ÷ 456.5 (net hourly production) yd^3/hr = 1.47 hrs

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 9A

PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:

Haul spoil from Overburden Stockpile West (OSW) to open pit.

Characterization of Truck Used (type, size, etc.):

Caterpillar 769C, 26.8 cy capacity (average of struck and heaped)

Description of Truck Use (origin, destination, grade, haul distance, truck capacity, etc.):

Haul distance and grade from OSW to open pit.

1600' @ 3% effective grade plus 200' @ 10% effective grade

Productivity Calculations:

Cycle time = $\frac{.7 + .42}{\text{haul time}} + \frac{.65 + .51}{\text{return time}} + \frac{2.75}{\text{total loading time}} = \frac{2.0}{\text{dump and maneuver time}} = 7.03$ min

Number of Trucks Required = $\frac{7.03}{\text{truck cycle time}} \div \frac{2.75}{\text{total loading time}} = 2.56$ (3)*

Production Rate = $\frac{26.8}{\text{truck capacity}}$ yd^3 x $\frac{3}{\text{\# of trucks}} \div \frac{7.03}{\text{cycle time}}$ min = 11.44 yd^3/min

Hourly Production = $\frac{11.44}{\text{production rate}}$ yd^3/min x $\frac{50 \text{ min/hr}}{\text{work hour factor}}$ = 571.83 yd^3/hr

Hours Required = $\frac{60,289}{\text{volume to be moved}}$ yd^3 $\div$ $\frac{571.83}{\text{hourly production}}$ yd^3/hr = 105.4* hrs

*Need 3 trucks for 123.81 hours each = 371.43 hours
(match loader hours from Worksheet No. 8A)

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 9B

PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:

Haul spoil from Overburden Stockpile East (OSE) to open pit.

Characterization of Truck Used (type, size, etc.):

Caterpillar 769C, 26.8 cy capacity (average of heaped and struck)

Description of Truck Use (origin, destination, grade, haul distance, truck capacity, etc.):

Haul distance and grade from OSE to open pit.

800' @ 3% effective grade plus 200' @ 10% grade

Productivity Calculations:

Cycle time = $\underset{\text{haul time}}{.56 + .2} + \underset{\text{return time}}{.45 + .25} + \underset{\text{total loading time}}{2.75} = \underset{\substack{\text{dump and} \\ \text{maneuver} \\ \text{time}}}{2.0} = 6.21$ min

Number of Trucks Required = $\underset{\text{truck cycle time}}{6.21} \div \underset{\text{total loading time}}{2.75} = 2.26$ (3)*

Production Rate = $\underset{\text{truck capacity}}{26.8}$ yd^3 x $\underset{\text{\# of trucks}}{3} \div \underset{\text{cycle time}}{6.21}$ min = 12.95 yd^3/min

Hourly Production = $\underset{\text{production rate}}{12.95}$ yd^3/min x $\underset{\substack{\text{work hour} \\ \text{factor}}}{50 \text{ min/hr}}$ = 647.34 yd^3/hr

Hours Required = $\underset{\text{volume to be moved}}{60,289}$ yd^3 $\div$ $\underset{\text{hourly production}}{647.34}$ yd^3/hr = 93.1* hrs

*Need 3 trucks for 123.81 hours each = 371.43 hours
(match loader hours from Worksheet No. 8A)

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 9C

PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:

Haul spoil base material to open pit.

Characterization of Truck Used (type, size, etc.):

Caterpillar 769C, 26.8 cy capacity

Description of Truck Use (origin, destination, grade, haul distance, truck capacity, etc.):

1800' @ 3% effective grade and 200' haul @ 10% effective grade

Productivity Calculations:

Cycle time = $\frac{.95 + .42}{\text{haul time}} + \frac{.7 + .51}{\text{return time}} + \frac{2.94}{\text{total loading time}} = \frac{2.0}{\text{dump and maneuver time}} = 7.52$ min

Number of Trucks Required = $\frac{7.52}{\text{truck cycle time}} \div \frac{2.94}{\text{total loading time}} = 2.56$ (3)*

Production Rate = $\frac{26.8}{\text{truck capacity}}$ yd^3 x $\frac{3}{\text{\# of trucks}} \div \frac{7.52}{\text{cycle time}}$ min = 10.69 yd^3/min

Hourly Production = $\frac{10.69}{\text{production rate}}$ yd^3/min x $\frac{50 \text{ min/hr}}{\text{work hour factor}}$ = 534.57 yd^3/hr

Hours Required = $\frac{22,088}{\text{volume to be moved}}$ yd^3 $\div$ $\frac{534.57}{\text{hourly production}}$ yd^3/hr = 41.32* hrs

*Need 3 trucks for 43.38 hours each = 145.15 total hours
(match loader hours from Worksheet No. 8B)

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 9D

PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:

Haul office area/coal pad waste material to open pit for burial.

Characterization of Truck Used (type, size, etc.):

Caterpillar 769C, 26.8 cy bucket capacity

Description of Truck Use (origin, destination, grade, haul distance, truck capacity, etc.):

Haul distance is 3200' at 3% effective grade and 200' @ 10% effective grade.

Productivity Calculations:

Cycle time = $\frac{1.55 + .2}{\text{haul time}} + \frac{1.1 + .25}{\text{return time}} + \frac{2.94}{\text{total loading time}} = \frac{2.0}{\text{dump and maneuver time}} = 8.04$ min

Number of Trucks Required = $\frac{8.04}{\text{truck cycle time}} \div \frac{2.94}{\text{total loading time}} = 2.73$ (3)*

Production Rate = $\frac{26.8}{\text{truck capacity}}$ yd^3 x $\frac{3}{\text{\# of trucks}} \div \frac{8.04}{\text{cycle time}}$ min = 10 yd^3/min

Hourly Production = $\frac{10}{\text{production rate}}$ yd^3/min x $\frac{50 \text{ min/hr}}{\text{work hour factor}}$ = 500 yd^3/hr

Hours Required = $\frac{672}{\text{volume to be moved}}$ yd^3 $\div$ $\frac{500}{\text{hourly production}}$ yd^3/hr = 1.34* hrs

*Need 3 trucks for 1.47 hours each = 4.41 hours
(match loader hours from Worksheet No. 8C)

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 11A

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Replace topsoil over Pits #17 - #22.

Characterization of Scraper Used (type, capacity, etc.):

Cat 627B scraper with one D8L dozer for pushing, 17cy average capacity (avg. between heaped and struck)

Description of Scraper Route (haul distance, % grade, etc.):

Average haul distance = 750' @ 3% effective grade

Cycle time = .6 (load time) min + .5 (loaded trip time) min + .6 (maneuver and spread time) min + .46 (return trip time) min = 2.16 min

Cycles/Hour = 50 min/hr (work hour factor) ÷ 2.16 min/cycle = 23.15 cycles/hr

Hourly Production = 17 (Adjusted load) yd^3 x 23.15 cycles/hr = 393.55 yd^3/hr

Hours Required = 14,679 (volume to be handled) yd^3 ÷ 393.55 (net hourly production) yd^3/hr = 37.30 hrs

Pusher cycle time = 140 percent of load time + 0.25 min. = 1.09 min.

Number of scrapers which can be handled by one push tractor = 2.61 min (scraper cycle time) / 1.09 min (pusher cycle time) = 2.39 (2)

Therefore two scrapers needed for 18.65 hours., and one push tractor for 18.65 hours.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 11B

PRODUCTIVITY FOR SCRAPER USE

Earthmoving Activity:

Replace topsoil over office area and haul road.

Characterization of Scraper Used (type, capacity, etc.):

Cat 627B scraper with one D8L dozer for pushing, 17 cy capacity (avg. between struck and heaped)

Description of Scraper Route (haul distance, % grade, etc.):

Average haul distance = 2100' @ 3% effective grade

Cycle time = .6 (load time) min + 1.1 (loaded trip time) min + .6 (maneuver and spread time) min + .9 (return trip time) min = 3.2 min

Cycles/Hour = 50 min/hr (work hour factor) ÷ 3.2 min/cycle = 15.63 cycles/hr

Hourly Production = 17 (Adjusted load) yd^3 x 15.63 cycles/hr = 265.71 yd^3/hr

Hours Required = 7,151 (yd^3 volume to be handled) ÷ 265.71 (yd^3/hr net hourly production) = 26.91 hrs

Pusher cycle time = 140% of load time + 0.25 min. = 1.09 min.

Number of scrapers which can be handled by one push tractor = 3.2 min (scraper cycle time) / 1.09 min (pusher cycle time) = 2.93 (2)

Therefore two scrapers needed for 13.46 hours and one push tractor for 13.46 hours.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 12A

PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE--GRADING

Earthmoving Activity:

Final grade ripped area prior to placing topsoil.

Characterization of Grader Used (type, size capacity, etc.):

Caterpillar 140G motorgrader

Description of Grader Route (push distance, percent grade, blade effective length, operating speed, etc.)

Pit area (#17-#22)	=	10.9
Haul road area	=	4.8
Coal pad/office area	=	0.5
TOTAL AREA		16.2 Ac

Productivity Calculations:

Contour Grading:

$$\text{Hourly Production} = \frac{2.4 \text{ mi/hr (speed)}}{} \times \frac{8 \text{ ft (eff. blade width)}}{} \times 5280 \text{ ft/mi} \times 1 \text{ ac}/43{,}560 \text{ ft}^2 \times \frac{.83 \text{ (work hour factor)}}{} = 1.93 \text{ ac/hr}$$

Scarification:

$$\text{Hourly Production} = \frac{\text{\_\_\_\_ mi/hr (work speed)}}{} \times \frac{\text{\_\_\_\_ ft (scarifier width)}}{} \times 5280 \text{ ft/mi} \times 1 \text{ ac}/43{,}560 \text{ ft}^2 \times \frac{\text{\_\_\_\_ (work hour factor)}}{} = \text{\_\_\_\_ ac/hr}$$

Hours Required = 16.2 ac ÷ 1.93 ac/hr = 8.39 hrs*

*Note that a motorgrader is assumed to be onsite while all of the earthmoving tasks are being conducted. Therefore, this task is assumed to be performed during that time frame along with other miscellaneous tasks required of the motorgrader.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 12B

PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE - GRADING

Earthmoving Activity:

Scarify and final grade topsoil area prior to revegetation.

Characterization of Grader Used (type, size capacity, etc.):

Caterpillar 140G motorgrader

Description of Grader Route (push distance, % grade, blade effective length, operating speed, etc.)

Pit area (#17-#22)	=	10.9
Haul road area	=	4.8
Coal pad/office area	=	0.5
TOTAL AREA		16.2 Ac

Productivity Calculations:

Contour Grading:

Hourly Production = 2.4 (speed) mi/hr x 8 (eff. blade width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

.83 (work hour factor) = 1.93 ac/hr

Scarification:

Hourly Production = 2.4 (work speed) mi/hr x 8 (scarifier width) ft x 5280 ft/mi x 1 ac/43,560 ft^2 x

.83 (work hour factor) = 1.93 ac/hr

Hours Required = 16.2 ac ÷ 1.93 ac/hr = 8.39* hrs**

*Total hours required = 8.39 hours for grading + 8.39 hours for scarification = 16.78 hours

**Note that a motorgrader is assumed to be onsite while all earthmoving tasks are being conducted. Therefore, these tasks are assumed to be performed during that time frame along with other miscellaneous tasks required of the motorgrader.

Data Sources: Caterpillar Performance Handbook, Edition 16

Project Haul Back

Date May 1986

WORKSHEET NO. 13

SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment Type	Owning and Operating Costs ($/hr) Equipment + Accessories			Labor Cost ($/hr)		Total Hrs* Req'd	Total Cost ($)
1) Cat 988B loader	[(	99.42	) +	12.78	]	x 297.47	= 33,376.13
2) Cat 769C haul trucks (3)	[(	68.46	) +	15.16	]	x 892.41 (297.47 x 3)	= 74,623.32
3) Cat D8L dozer	[(	76.66 + 7.95	) +	12.63	]	x 26.4	= 2,567.14
4) Cat 627B scrapers (2)	[(	88.34	) +	12.78	]	x 64.21 (32.11 x 2)	= 6,492.92
5) Cat D8L push tractor	[(	76.66	) +	12.63	]	x 32.11	= 2,867.10
6) ** Cat 140G motorgrader	[(	35.61 + 2.74	) +	12.63	]	x 329.58	= 16,801.99
7) ** Water truck 7000 gallon	[(	64.90	) +	14.91	]	x 329.58	= 26,303.78
8) ** Service truck flatbed	[(	19.31	) +	14.91	]	x 329.58	= 11,278.23
	[(		) +		]	x	=
	[(		) +		]	x	=
	[(		) +		]	x	=
	[(		) +		]	x	=

Total Cost = 174,310.61

Equipment and Accessory Identification:

3) Bulldozer equipped with multishank ripper
4) & 7) Motorgrader equipped with scarifier

*Davis-Bacon Wage rates
**A motorgrader, water truck, and service truck are required to be onsite while all earthmoving tasks are performed. This was determined to be 297.47 hours for backfilling and 32.11 hours for topsoil placement.

Data Sources: Dataquest, Cost Reference Guide for Construction Equipment

Project Haul Back

Date May 1986

WORKSHEET NO. 14

REVEGETATION COSTS

Name and Description of Area to be Revegetated:

Pits #11-#22 = 20.8 Ac, Haul road = 4.8 Ac, Coal pad/office area = .5 Ac TOTAL = 26.1 Ac

Description of Revegetation Activities:

No special revegetation activities required. Seedbed preparation has already taken place. The local SCS office provided an average revegetation cost of $450/Ac. It is assumed that 25 percent of the area will require additional vegetation due to seed failure.

Reseeding:

26.1 (# of acres to be reseeded) acres x ($ * ($/acre for seedbed preparation) per acre + $ 450.00 + 112.50 ($/acre for seeding, fertilizing, and mulching) per acre) = $14,681.25 (costs for reseeding)

Planting Trees and Shrubs:

_____ (# of acres for planting) acres x $_____ ($/acre for planting trees and shrubs) per acre = $_____ (costs for planting)

Other Revegetation Activity for this Area (e.g., Soil Sampling):

(Describe and provide cost estimate with documentation; use additional sheets if necessary.)

*Note that seedbed preparation cost has already been accounted for on Worksheet No. 13.

TOTAL REVEGETATION COST FOR THIS AREA = $ 14,681.25

Data Sources: The approved mine plan and local SCS office

Project Haul Back

Date May 1986

WORKSHEET NO. 16

RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$ 545
2.	Total Earthmoving Costs	174,310
3.	Total Revegetation Costs	14,681
4.	Total Other Reclamation Activities Costs	
5.	Subtotal: Total Direct Costs	189,536
6.	Mobilization and Demobilization at 2 % of Item 5) (1% to 5% of Item 5)	3,790
7.	Contingencies (at 10 % of Item 5) (see Table 4)	18,954
8.	Engineering Redesign Fee (at 7.4% of Item 5) (see Graph 1)	14,026
9.	Contractor Profit and Overhead (at 11.4% of Item 5) (see Graph 2)	21,607
10.	Reclamation Management Fee (at 5.5% of Item 5) (see Graph 3)	10,424
11.	GRAND TOTAL BOND AMOUNT (Sum of Items 5 through 10)	$258,337

Engineering News Record Cost Index: $4,228.95 Date: 4/24/86

OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT
BOND AMOUNT COMPUTATION

Applicant Mountain Top Removal Example

Permit Number Example No. 4

Date May 1986

Number of Acres 175

Type of Operation Mountain Top Removal

Location USA

Prepared by R.R. Bond

Project Mountain Top

Date May 1986

WORKSHEET NO. 1A

DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

This is a 175-acre mountain-top-removal site from which six seams of coal will be removed (see Figures B-6 through B-9 at end of document). The spoil will be stored both in temporary and permanent storage. Spoil material is composed of 90% sandstone and 10% shale. The permanent storage will be in two durable rock valley fills. The temporary spoil storage will be adjacent to the working face of the highwall. The spoil above the 2,975-foot elevation will be stored in the valley fills while the spoil below elevation 2,975 will be temporarily stored, as shown on attached drawings, and graded over the disturbed mine area for positive drainage.

The worst-case reclamation scenario occurs when the mining of the lower seams (A & B) just begins. At this point, approximately 1,400 feet of highwall is exposed above the B through E seams. It is assumed that all work activities on both hollowfills are current except for spreading topsoil and revegetation. Hollowfills are approximately one-half their designed capacity at this point.

The following sections discuss the reclamation plan for the worst-case scenario.

1. Structure Removal

   No buildings are planned for the site; however, three 40-foot storage trailers will need to be removed.

2. Earthmoving Activities

   The first step of the earthmoving activities is backfilling of the open highwall. Approximately 1,400 feet of highwall length is exposed at the D-seam level. This highwall will be eliminated by shooting a portion of it to an acceptable grade and pushing the shot material and the stored spoil to reclaim the highwall. Spoil is stored adjacent to the base of the exposed highwall. Prior to topsoil redistribution, the spoil storage areas adjacent to the highwall must be graded to final contours.

   For the road areas, the main road will be permanent. The access road to the ponds will be removed when the ponds are removed.

   Ponds are to be removed by grading the pond berms to original drainage contours.

Data Sources: Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 1B

DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

3. Revegetation & Topsoil Redistribution

Topsoil will be redistributed by loaders and trucks and will be graded by dozers. It is assumed that 140 acres will require topsoil distribution. This includes the mined area and hollowfills. A 6-inch depth amounts to 112,933 cubic yards of topsoil requiring replacement. It is assumed that the topsoil will need to be hauled 650 feet up a 5 percent grade to the mined area and 600 feet down a 5 percent grade to the hollowfills. Assume that the trucks will spread 50 percent of the topsoil in dumping and the remaining 50 percent is spread by dozers.

The areas that require revegetation and topsoil redistribution are listed below.

Area	Revegetation	Topsoil Redistribution
Mining	58.2 Ac	58.2 Ac
Hollowfill A	37.8 Ac	37.8 Ac
Hollowfill B	35.6 Ac	35.6 Ac
Basins	4.6 Ac	4.6 Ac
Basin Access Road	1.3 Ac	1.3 Ac
Explosive Area	2.5 Ac	2.5 Ac
	140 Ac	140 Ac

It is assumed that all areas will be revegetated using the same type of seed mix recommended in the mining plan and no tree planting will be conducted.

4. Other Reclamation Activities

a. Ponds will need to be maintained and pumped prior to removal.

b. The haulroad is permanent and will need to be maintained until reclamation is complete.

c. Drilling and blasting the highwall to an acceptable grade is required.

Data Sources: Application

Project Mountain Top

Date May 1986

WORKSHEET NO. 2

STRUCTURE DEMOLITION AND DISPOSAL COST SUMMARY

Listing of Buildings to be Demolished:

Item	Type of Construction Material	Volume (cubic feet)	Unit Cost Basis	Demolition Cost
1) None				
2)				
3)				
4)				
5)				

Total Cost = $ 0

Other Items to be Demolished:

Remove 40-foot storage trailers - 3 ea. x $500.00 ea. = $1,500.

Debris Handling and Disposal Costs:

TOTAL DEMOLITION AND DISPOSAL COST = $ 1,500

Data Sources: Application