Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 1
DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

The reclamation and operation plans outline the following mining sequence for this dragline operation. (See Figure B-4 at end of worksheets.) Mining begins at the southern end of the property in non-prime farmland soils and progresses northward. The 6 inches of existing topsoil and the opening box-cut material will be stockpiled separately near the southern end of the permit boundary and outside the 120' buffer zone of the adjacent creek that runs along the south and east sides of the permit boundary. In addition, the operations plan identifies 71 acres of prime farmland for which 48 inches of prime farmland soils must be salvaged. The mine is located in Crawford County, Kansas. 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 non-vegetated land.**

From inspection, the worst case was determined as occurring about midway through the mining operation when one of the longest pits is through prime farmland, four spoil ridges exist behind the open pit, and no revegetation has been initiated (see sketch on following page). 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 post 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 h : 1 v slope and the spoil ridge side will maintain a slope of 1-1/2 h:1v (see sketch). It is assumed that four spoil ridges exist behind the open pit, which must be rough graded before rough backfilling and grading of the pit can begin. 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 and subsoil and the non-prime land areas will receive 6 inches of topsoil. These areas will be final graded once the topsoil is placed.

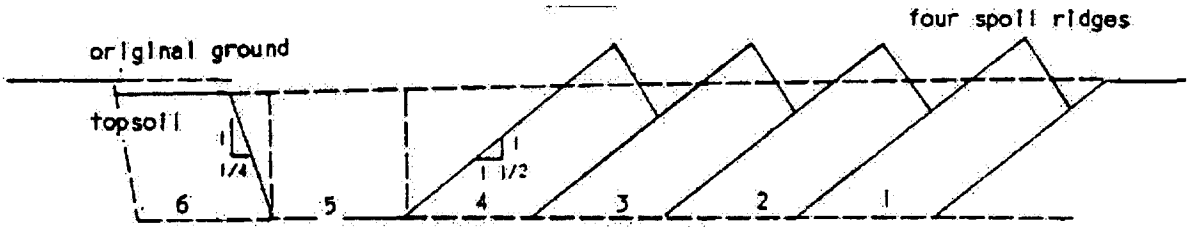
4. **Revegetation**

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

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 1 (continued)
DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

Sketch of Operations



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

NOTE: *WORKSHEETS 2, 6, 8, 9, 10, 11A, 15, 17* and *18* are not applicable to this example.

Data Sources: Operation and reclamation plans in the approved permit.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 3
MATERIAL HANDLING PLAN SUMMARY

Earthmoving Activity	Volume (LCY)	Origin	Destination	Haul Distance (ft)	Grade * (%)	Equipment To Be Used
1. Backfilling and Grading	568,836	Box cut	Excess Spoil Area	1,900 ave	4	637E scraper with D9R push tractor**
2. Rough Grading	132,922	Spoil Ridges	Spoil Ridge Area	100 ave	3	D9R-SU dozer
3. Topsoil (non-prime)	15,972	Stockpile	Disturbed Area	1,000 ave	4	637E scraper with D9R push tractor**
4. Subsoil (prime)	116,886	Stockpile	Disturbed Area	1,000 ave	4	637E scraper with D9R push tractor**
5. Topsoil (prime)	16,698	Stockpile	Disturbed Area	1,000 ave	4	637E scraper with DR9 push tractor**
6. Ripping	131,003	Disturbed Area	Disturbed Area		0	D7R-SU dozer with 3-shank ripper
7. Scarification	40.5 ac	Disturbed Area	Disturbed Area		0	14H grader
8. Final Grading	40.5 ac	Disturbed Area	Disturbed Area		0	14H grader

* Record grade resistance (% grade) here.
** Scraper and dozer work concurrently

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 4A
EARTHWORK QUANTITY

Cross-Section/ Station	Distance Between Stations (ft)	End Area (ft^2)	Volume (yd^3)*	Adjust-ment Factor * (%)	Adjusted Volume (LCY)
east end of pit		4,580			
	2,916		494,640	15	568,836
west end of pit		4,580			
TOTALS			494,640		568,836

* Select adjustment factor based on the state of the material to be moved.

Data Source(s): Mine plan.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 4B
EARTHWORK QUANTITY

Pit Backfill Volume

End Area of Pit

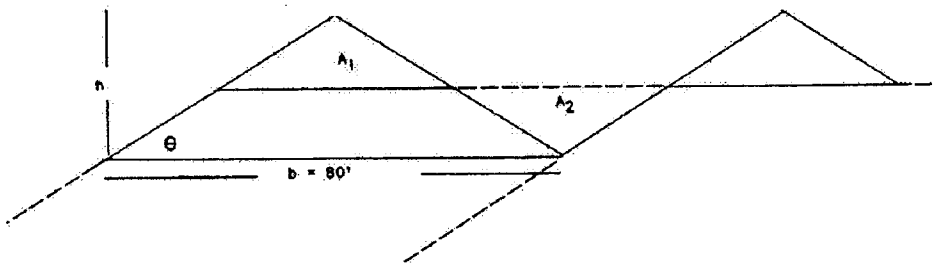
1.	0.5 x 10' x 40' =	200 ft²
2.	80' x 40' =	3,200 ft²
3.	0.5 x 40' x 59' =	1,180 ft²
	=	4,580 ft²

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 (tar θ)(b)²
θ = 34° (given 1-1/2:1 slope)
b = 80'
A_1 = 269.8 ft² (area is per lineal foot of pit length)

Therefore:

Ridge 4:	269.8 ft²/ linear foot x 3,150 feet long ÷ 27 ft³/CY =	31,477
Ridge 3:	269.8 ft²/ linear foot x 3,267 feet long ÷ 27 ft³/CY =	32,646
Ridge 2:	269.8 ft²/ linear foot x 3,384 feet long ÷ 27 ft³/CY =	33,815
Ridge 1:	269.8 ft²/ linear foot x 3,501 feet long ÷ 27 ft³/CY =	34,984
		132,922 CCY



Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 4B (continued)
EARTHWORK QUANTITY

Volume of Material to be Ripped

40.6 acres x 43,560 ft^2/acre x 2 ft deep ÷ 27 ft^3/CY = 131,003 BCY

Topsoil Volume

Non-prime Farmland

19.8 acres to receive 6 inches of topsoil

$$19.8 \text{ acres} \times \frac{43560 \text{ ft}^2}{\text{acre}} \times 0.5 \text{ ft} \div \frac{27 \text{ ft}^3}{1 \text{ CY}} = 15{,}972 \text{ CY}$$

Prime Farmland

20.7 acres to receive 48" of topsoil and subsoil

Topsoil:

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

Subsoil:

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

Data Source(s): Mine plan.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 5A
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:
Spoil ridge reduction.

Characterization of Dozer Used (type, size, etc.):
D9R dozer with "Semi-U or SU" Blade.

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):
Origin: in spoil ridge peak Destination: valley between spoil ridges
100 ft. push at a + 3% effective grade; material is a mixture of earth and blasted limestone and shale rock.

Productivity Calculations:

Operating Adjustment Factor = .75 (operator factor) x .80 (material factor) x .83 (efficiency factor) x .95 (grade factor)

x .932 (weight correction factor*) x 1.0 (production method/blade factor) x 1.0 (visibility factor) x 1.0 (elevation factor) = .441

Net Hourly Production = 1,250 (normal hourly production) LCY/hr x .441 (operating adjustment factor) = 551.3 LCY/hr

Hours Required = 132,922 (volume to be moved) LCY ÷ 551.3 (net hourly production) LCY/hr = 241 hr

* Weight Correction Factor = 2,300 / (2,700 + 2,600 + 2,100) + 3 = 2,300 / 2,466.7 = 0.932
(From Caterpillar Performance Handbook: Bulldozer production factors)

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 5B
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:
Push tractor to assist loading scrapers.

Characterization of Dozer Used (type, size, etc.):
D9R dozer with a "SU" Blade.

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):
Scrapers loaded with back-track loading method.

Productivity Calculations:

Operating Adjustment Factor = _____ (operator factor) x _____ (material factor) x _____ (efficiency factor) x _____ (grade factor)

x _____ (weight correction factor) x _____ (production method/blade factor) x _____ (visibility factor) x _____ (elevation factor) = _____

Net Hourly Production = _____ (normal hourly production) LCY/hr x _____ (operating adjustment factor) = _____ LCY/hr

Hours Required = _____ (volume to be moved) LCY + _____ (net hourly production) LCY/hr = **636*** hr

*** See *Worksheet 13*. Dozer assists scrapers for total project time of 636 hours.**

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 7
PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:
This unit will be used for ripping the 40.6 (approx. 1,330' x 1,330') acre site prior to topsoil and subsoil placement.

Characterization of Dozer and Ripper Use:
D7R w/ SU blade (Direct Steer) and 3-shank adjustable parallelogram ripper; ripper has a 39 inch (3.25-foot) pocket spacing.

Description of Ripping (ripping depth, cut spacing, cut length, and material to be ripped):
Material to be ripped: Sandstone and Shale Ripping depth = 2 feet
Ripping effective width = 3.25 feet X 3 = 9.75 feet

Productivity Calculation:

Cycle Time = (1,330 ft (cut length) + 88 ft/min (speed)) + .25 min (fixed turn time *) = 15.36 min/pass

Passes/Hour = 60 min/hr + 15.36 min/pass (cycle time) x .83 (efficiency factor) = 3.24 passes/hr

Volume Cut/Pass = (2.0 ft (tool penetration) x 9.75 ft (cut spacing) x 1,330 ft (cut length)) + 27 ft^3/yd^3

= 960.6 BCY/pass

Hourly Production = 960.6 BCY/pass x 3.24 passes/hr = 3,112.3 BCY/hr

Hours Required = 131,003 BCY (bank volume to be ripped **) + 3,112.3 BCY/hr (hourly production) = 42.1 hr

* Fixed turn time depends upon dozer used. 0.25 min/turn is normal.

** Remember to use the swell factor to convert from bank cubic yards to loose cubic yards when applying these data to *Worksheet 5*. Calculate separate dozer hauling of ripped material for each lift on that worksheet.

*** The D7R bulldozer is to be for miscellaneous tasks during the life of the project = 636 hours. (*See Worksheet No 13*)

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 11B-1
PRODUCTIVITY OF DOZER PUSH-LOADED SCRAPER USE

Earthmoving Activity:
Backfill and grade final pit area.

Characterization of Scraper Used (type, capacity, etc.):
Cat 637E Non-push pull 21CY (struck) + 31 CY (heaped) = (21CY + 31CY)/2 = 26 CY avg capacity.

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):
1,900' haul @ 4% effective grade; 1,900' return @ 0% effective grade.

List Pusher Tractor(s) Used:
D9R dozer will assist the scraper in loading.

Describe Push Tractor Loading Method (see figure following *Worksheet 11B-3*):
Back-track loading method with a single push tractor.

Scraper Productivity Calculations:

Cycle Time = .6 (load time) min + 1.1 (loaded trip time) min + .6 (maneuver and spread time) min + .75 (return trip time) min = 3.05 min

Hourly Production = 26 (capacity *) LCY x 60 min/hr ÷ 3.05 (cycle time) min x .75 (efficiency factor) = 383.6 LCY/hr

Hours Required = 568,836 (volume to be handled) LCY ÷ 383.6 (hourly production) LCY/hr = 1,483 hr

* Use the average of the struck and heaped capacities.

Push Tractor Productivity Calculations:

Pusher Cycle Time = .6 (scraper load time) min x 1.5 (pusher factor) = .90 min

Scrapers/Pusher = 3.05 (scraper cycle time) min ÷ .90 (pusher cycle time) min = 3.39 (use 3) scrapers

Pusher Hours Required = 1483 (scraper hours) hr ÷ 3 (scrapers per pusher) = 495 (round up) hr

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 11B-2
PRODUCTIVITY OF DOZER PUSH-LOADED SCRAPER USE

Earthmoving Activity:
Replacing 42" (3.5') of prime farmland, subsoils over 20.7 acres.

Characterization of Scraper Used (type, capacity, etc.):
Cat 637E Non-push pull 21CY (struck) + 31 CY (heaped) = (21CY + 31CY)/2 = 26 CY avg capacity.

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):
1,000' haul at 4% effective grade; 1,000' return at 0% effective grade.

List Pusher Tractor(s) Used:
D9R dozer will assist the scraper in loading.

Describe Push Tractor Loading Method (see figure on next page):
Back-track loading method with a single push tractor.

Scraper Productivity Calculations:

Cycle Time = .6 (load time) min + .6 (loaded trip time) min + .6 (maneuver and spread time) min + .4 (return trip time) min = 2.2 min

Hourly Production = 26 (capacity *) LCY x 60 min/hr ÷ 2.2 (cycle time) min x .75 (efficiency factor) = 531.8 LCY/hr

Hours Required = 116,886 (volume to be handled) LCY ÷ 531.8 (hourly production) LCY/hr = 220 hr

* Use the average of the struck and heaped capacities.

Push Tractor Productivity Calculations:

Pusher Cycle Time = .6 (scraper load time) min x 1.5 (pusher factor) = .9 min

Scrapers/Pusher = 2.2 (scraper cycle time) min ÷ .9 (pusher cycle time) min = 2.44 (use 2) scrapers

Pusher Hours Required = 220 (scraper hours) hr ÷ 2 (scrapers per pusher) = 110 (round up) hr

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 11B-3
PRODUCTIVITY OF DOZER PUSH-LOADED SCRAPER USE

Earthmoving Activity:
Replacing 6" (0.5') of topsoil over 40.5 acres (19.8 acres on non-prime and 20.7 of prime farmland).

Characterization of Scraper Used (type, capacity, etc.):
Cat 637E Non-push pull 21CY (struck) + 31 CY (heaped) = (21CY + 31CY)/2 = 26 CY avg capacity.

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):
1,000' haul at 4% effective grade; 1,000' return at 0% effective grade.

List Pusher Tractor(s) Used:
D9R dozer will assist the scraper in loading.

Describe Push Tractor Loading Method (see figure on next page):
Back-track loading method with a single push tractor.

Scraper Productivity Calculations:

Cycle Time = .6 (load time) min + .6 (loaded trip time) min + .6 (maneuver and spread time) min + .4 (return trip time) min = 2.2 min

Hourly Production = 26 (capacity *) LCY x 60 min/hr + 2.2 (cycle time) min x .75 (efficiency factor) = 531.8 LCY/hr

Hours Required = 32,670 (volume to be handled) LCY + 531.8 (hourly production) LCY/hr = 61 hr

* Use the average of the struck and heaped capacities.

Push Tractor Productivity Calculations:

Pusher Cycle Time = .6 (scraper load time) min x 1.5 (pusher factor) = .9 min

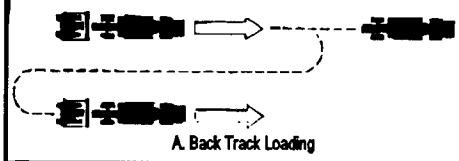
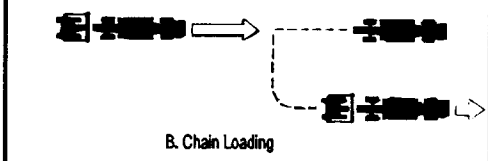
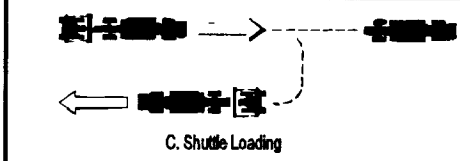
Scrapers/Pusher = 2.2 (scraper cycle time) min + .9 (pusher cycle time) min = 2.44 (use 2) scrapers

Pusher Hours Required = 61 (scraper hours) hr + 2 (scrapers per pusher) = 31 (round up) hr

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 11B (continued)
PRODUCTIVITY OF DOZER PUSH-LOADED SCRAPER USE

PUSHER FACTORS	Single Push	Tandem Push
 A. Back Track Loading	1.5	2.0
 B. Chain Loading	1.3	1.5
 C. Shuttle Loading	1.3	1.5

Modified from Terex,1981

Data Source(s): Illustration from "Production and Cost Estimating of Material Movement and Earthmoving Equipment," TEREX AMERICAS, Tulsa, OK 74107, (918) 445-5802. See disclaimer in Appendix A, *Worksheet 11B.*

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 12
PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE

Earthmoving Activity:
The motorgrader will be used for maintaining haul roads, for 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 D7R bulldozer/ripper will be used for the life of the reclamation contract.

Characterization of Grader Used (type, size capacity, etc.):
Caterpillar 14H, 215 horsepower, equipped with EROPS and scarifier.

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

Productivity Calculations:

Grading

Hourly Production = _____ (average speed) mi/hr x _____ (effective blade width) ft x 5,280 ft/mi x 1 ac/43,560 ft²

x _____ (efficiency factor) = _____ ac/hr

Hours Required = _____ (area to be graded) ac ÷ _____ (hourly production) ac/hr = _____ hr

Scarification

Hourly Production = _____ (average speed) mi/hr x _____ (scarifier width) ft x 5,280 ft/mi x 1 ac/43,560 ft²

x _____ (efficiency factor) = _____ ac/hr

Hours Required = _____ (area to be scarified) ac ÷ _____ (hourly production) ac/hr = _____ hr

Total Hours Required

Total Hours = _____ (grading hours required) + _____ (scarification hours required) = 636* hr

*** Motorgrader is to be used for the life of the reclamation contract (see Worksheet 13) = 636 hours, including grading operations.**

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 13
SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment *	Ownership & Operation Cost ($/hr)	Labor Cost ($/hr)	Total Hours Required **	Total Cost *** ($)
637E Scraper	173.84	8.05	(3 x 495)	270,107
637E Scraper	173.84	8.05	(2 X 110)	40,016
637E Scraper	173.84	8.05	(2 X 31)	11,277
D7R-SU Dozer	74.85	8.78	636*	53,189
D9R-SU Dozer	111.20	8.78	241	28,915
14H Grader	58.02	8.78	636*	42,485
6,000 Water Tanker	69.96	7.52	636*	49,277
D9R-SU Push Tractor	111.20	8.78	636*	76,307
			Grand Total	571,573

* Add support equipment such as water wagons and graders to match total project time as appropriate. Sum of dozer hours assisting scrapers is 636 (see *Worksheets 11B-1, -2, -3*).

** Account for multiple units in truck and/or scraper teams.

*** To compute Total Cost: Add Ownership & Operation Cost and Labor Cost columns then multiply by Total Hours Required column.

Data Source(s): PRIMEDIA Information, Inc., Cost Reference Guide for Construction Equipment (3Q99); Department of Labor, Davis-Bacon Wage Rates (General Decision KS990063, 10/08/99).

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 14
REVEGETATION COSTS

Name and Description of Area To Be Revegetated:
The area consists of prime and non-prime farmlands. Both areas will be vegetated in the same manner. Alfalfa will be used as a cover crop.

Description of Revegetation Activities:
The following costs are indicated in the mining plan and confirmed by the local Natural Resource Conservation Service (formerly SCS) Office:
Seed @ $150/Ac + Mulch @ $250/Ac + Fertilizer @ $40/Ac = TOTAL Revegetation Cost $440/Ac

Cost Calculation for Individual Revegetation Activities:

Initial Seeding

40.5 ac (area to be seeded) x ($ _____ /ac (seedbed preparation) + $ 440 /ac (seeding, fertilizing & mulching)) = $ 17,820

Planting Trees and Shrubs

_____ ac (area to be planted) x ($ _____ /ac (planting) + $ _____ /ac (herbicide treatment)) = $ _____

Reseeding

40.5 ac (area to be seeded & unreleased disturbed areas) x .30 (failure rate*) x ($ _____ /ac (seedbed preparation) + $ 440 /ac (seeding, fertilizing & mulching)) = $ 5,346

Replanting Trees and Shrubs

_____ ac (area to be planted & unreleased disturbed areas) x _____ (failure rate*) x ($ _____ /ac (planting) + $ _____ /ac (herbicide treatment)) = $ _____

Other Necessary Revegetation Activities

(Examples of other activities that may be necessary include soil sampling, irrigation, and rill and gully repair. Describe each activity and provide a cost estimate with documentation. Use additional worksheets if necessary.)

Other Costs: $_____

TOTAL REVEGETATION COST = $ 23,166

*** Scarifying is done by motorgrader (*Worksheet 12*). Historical revegetative failure rate is 30%. There are no unreleased areas.**

Data Source(s): Mine plan; local NRCS.

Project: Area Mining/Dragline Example
Date: 01/05/00
Prepared by: K. G. Bond

WORKSHEET 16
RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$ 0	
2.	Total Earthmoving Costs	$ 571,573	
3.	Total Revegetation Costs	$ 23,166	
4.	Total Other Reclamation Activities Costs	$ 0	
5.	Total Direct Costs (sum of Lines 1 through 4)	$ 594,739	
6.	*Inflated Total Direct Costs* (Line 5 x inflation factor *)		$ 672,055
7.	Mobilization/Demobilization (5 % of Line 6) (1% to 10% of Line 6)	$ 33,603	
8.	Contingencies (5 % of Line 6) (3% to 5% of Line 6)	$ 33,603	
9.	Engineering Redesign Fee (4.25 % of Line 6) (2.5% to 6% of Line 6)	$ 28,562	
10.	Contractor Profit/ Overhead (24 % of Line 6) (see Graph 1)	$ 161,293	
11.	Project Management Fee (4.7 % of Line 6) (see Graph 2)	$ 31,587	
12.	*Total Indirect Costs* (sum of Lines 7 through 11)		$ 288,648
13.	GRAND TOTAL BOND AMOUNT (sum of Lines 6 and 12)		$ 960,703 (round to $ 961,000)

---

* Inflation factor = ENR Construction Cost Index (CCI) for current mo/yr / ENR CCI for mo/yr 5 years prior to current mo/yr = 6127 / 5439 = 1.13

Identify current month/year used in formula above: 12/99
Identify prior month/year used in formula above: 12/94

ENR = *Engineering News Record*, McGraw-Hill Construction Information Group, New York, NY; http://www.enr.com.

Formula assumes permit term or time until next bond adequacy evaluation is 5 years. Adjust timeframe as necessary.

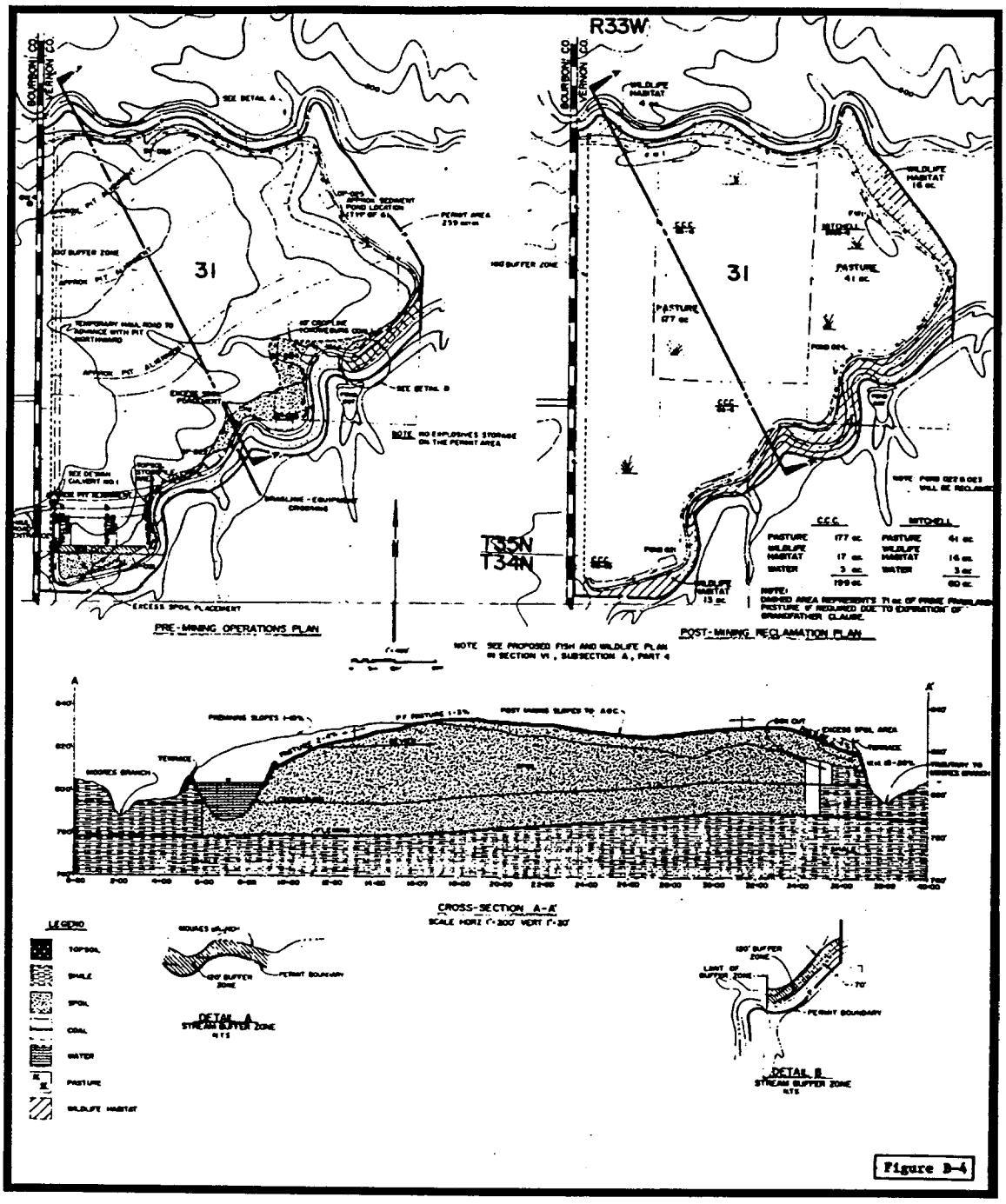

R33W
T35N
T34N
31
PRE-MINING OPERATIONS PLAN
POST-MINING RECLAMATION PLAN
CROSS-SECTION A-A'
DETAIL A
STREAM BUFFER ZONE
DETAIL B
STREAM BUFFER ZONE
LEGEND
TOPSOIL
SHALE
SPOIL
COAL
WATER
PASTURE
WILDLIFE HABITAT

Figure B-4

BOND AMOUNT COMPUTATION

Applicant: Haulback Example

Permit Number: Example No. 3 **Permitted Acreage:** 160

Bonding Scheme (permit area, incremental, cumulative): permit area

If Incremental:

Increment Number: _____

Increment Acreage: _____

If Cumulative:

Acres previously authorized for disturbance: _____

New acres proposed for disturbance: _____

Type of Operation: Contour-type surface (truck and loader)

Location: USA

Prepared by: K. J. Bond

Date: December 2, 1999

Total Bond Amount: $ 387,000

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 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 worksheets). 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. The mine is located in Navajo County, AZ.

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 require 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 1/4h:1v slope and the spoil side is assumed to have a 2h:1v slope based on field observation (see *Worksheet 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.

WORKSHEET 1 (continued)
DESCRIPTION OF THE WORST-CASE RECLAMATION SCENARIO

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.

In addition, pits #17 through #22 will need to be ripped prior to topsoil placement. (See *Worksheet 7.*) There will also need to be final grading and scarifying of the topsoil prior to revegetation. (See *Worksheet 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.

Revegetation costs will include the cost for reseeding 5.6 acres of previously disturbed land which has been reclaimed, had an initial seeding applied, but which has not yet been released from liability.

NOTE: *Worksheets 6, 10, 11A, 15, 17* and *18* are not applicable to this example.

Data Source(s): Mine plan.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 2
STRUCTURE DEMOLITION AND DISPOSAL COSTS

Structures to be demolished:

Item	Construction Material	Volume (cubic feet)	Unit Cost Basis ($)	Demolition Cost ($)
None*				
			Subtotal	

Other items to be demolished (paved roads, conveyors, utility poles, rail spurs, etc.):

***Remove office trailer, 50' x 10'; same price as installation fee = $545.**

Subtotal = $ 545**

Debris Handling and Disposal Costs:

****Demolition includes disposal with up to 20 miles haul.**

TOTAL DEMOLITION AND DISPOSAL = $ 545

Data Source(s): Means *Site Work and Landscape Cost Data*, 1998; Mine plan.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 3
MATERIAL HANDLING PLAN SUMMARY

Earthmoving Activity	Volume (LCY)	Origin	Destination	Haul Distance (ft)	Grade * (%)	Equipment To Be Used
1. Fill Open Pit	60,315	West Overburden Stockpile	Pit #22	1,600 200	3 10	988F loader with 769D trucks
2. Fill Open Pit	60,315	East Overburden Stockpile	Pit #22	800 200	3 10	988F loader with 769D trucks
3. Fill Open Pit	22,037	Haul Road Area	Pit #22	1,800 200	3 10	988F loader with 769D trucks
4. Office Area	672	Coal Pad/Area	Pit #22	3,200 200	3 10	988F loader with 769D trucks
5. Rough Grading	30,326	Disturbed Area	Disturbed Area	100	3	D8R-SU dozer
6. Ripping of Backfill, Haul Road, and Office Areas	70,758	Disturbed Area	Disturbed Area		0	D8R-SU dozer with 3-shank ripper
7. Final Grading of Backfill, Haul Road, and Office Areas	16.2 acres	Disturbed Area	Disturbed Area		0	140H grader
8. Scarification and Final Grading	26.1 acres	Disturbed Area	Disturbed Area		0	140H grader
9. Replace Topsoil in Pits #17-22 Area	14,626	Topsoil Stockpiles	East and West Disturbed Areas	750	4	627F scraper with D8R push tractor
10. Replace Topsoil over Office and Haul Road	7,149	West Topsoil Stockpile	Disturbed Area	2,100	4	627F scraper with D8R push tractor

* Record grade resistance (% grade) here.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 4A
EARTHWORK QUANTITY

Cross-Section/ Station	Distance Between Stations (ft)	End Area (ft^2)	Volume (yd^3)	Adjust-ment Factor * (%)	Adjusted Volume (LCY)
east end of pit		4,031.4			
	800		119,449	1.2	143,339
west end of pit		4,031.4			
TOTALS			119,449		143,339

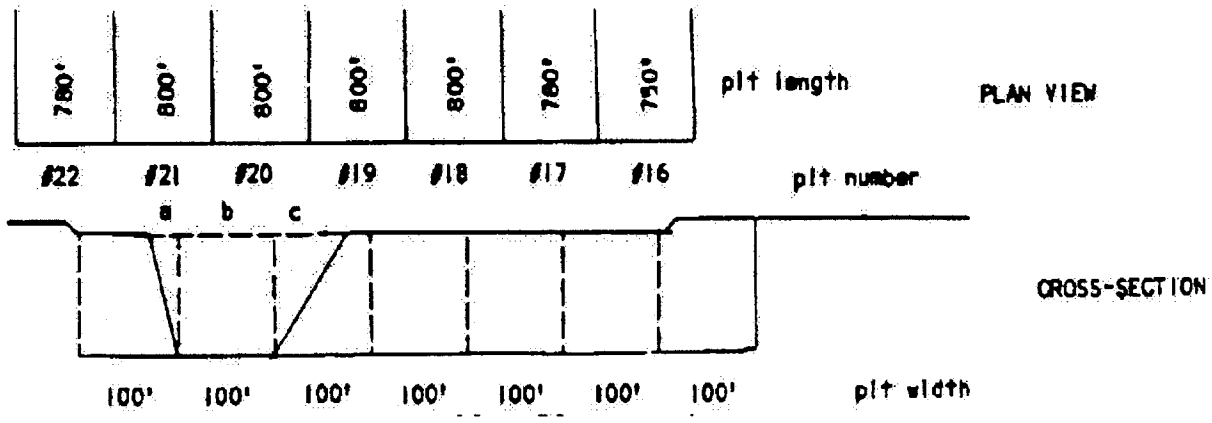
* Select adjustment factor based on the state of the material to be moved.

Data Source: Mine plan.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 4B
EARTHWORK QUANTITY

Earthmoving Volume Area Calculations



Backfilling of Pits #21 and 22 - 50%

Area a: 0.5 x 30' x 7.5' = 112.5 ft²
Area b: 30' x 100' = 3,000 ft²
Area c: 0.5 x 30' x 60' = 900 ft²
= 4,012.5 ft²

Backfill Volume Needed (Calculations on *Worksheet 4A*) = 143,339 LCY

Haul Road Haul Material

Total haul road volume = 22,037 LCY
The volume and haul distance (from centroid to centroid) for the northern half of the haul road = 12,622 BCY @ 2200'; for the southern half = 9,415 BCY @ 1700'. The total average haul distance = 2000'.

Spoil Ridge Volume = Pit Backfill Volume - Haul Road Volume
= 143,339 - 22,037 = 121,302 LCY

A dozer is needed to spread and rough grade this backfill material. Assume that 25% of the material is graded (3% average grade) = 121,302 x .25 = 30,326

Office Area, and Coal Pad Area Cleanup

Office / Coal Pad Area: 0.5 acres x 43,560 sf/acre x .83' thick ÷ 27 cf/cy = 670 BCY

The total average haul distance = 3,400'.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 4B (continued)
EARTHWORK QUANTITY

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 = 14,626 BCY

Haul Road: 7,000' long x 30' wide
x .83' thick ÷ 27 cf/cy = 6,477 BCY

Office & Coal Pad Area: 0.5 acres x 43,560 sf/acre
x .83' thick ÷ 27 cf/cy = 670 BCY
Total 21,773 BCY

Topsoil Volume

Topsoil Haul Distance:

Assume that total topsoil volume is evenly distributed between the two stockpiles. Therefore,

West Topsoil Stockpile (TSW) = 10,888 cy
East Topsoil Stockpile (TSE) = 10,888 cy

The 7,149 BCY of topsoil required for the haul road, office/coal pad area will come from TSW. The remaining 3,739 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'.

Final Grading/Scarification Area - Pits #11 through #22, Haul Road, Office Area, and Coal Pad

A SEDCAD 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

Data Source: Mine plan.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 5A
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:
Spoil Rough Grading for Pits 17-22.

Characterization of Dozer Used (type, size, etc.):
D8R dozer with "Semi-U or SU" Blade.

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):
100 ft. push at a +3% effective grade; material is a mixture of earth and blasted sandstone and shale rock.

Productivity Calculations:

Operating Adjustment Factor = .75 (operator factor) x .80 (material factor) x .83 (efficiency factor) x .95 (grade factor) x

.94* (weight correction factor) x 1.0 (production method/blade factor) x 1.0 (visibility factor) x 1.0 (elevation factor) = .444

Net Hourly Production = 870 (normal hourly production) LCY/hr x .444 (operating adjustment factor) = 386.3 LCY/hr

Hours Required = 30,326 (volume to be moved) LCY ÷ 386.3 (net hourly production) LCY/hr = 78.5 hr**

* 2300 / (2,700+2,550+2,100) / 3 = 2,300 / 2,450 = 0.94

** **Use 301 Total Hours.** Assume D8R-SU is available as support equipment during project life; see ***Worksheet 13.***

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 5B
PRODUCTIVITY AND HOURS REQUIRED FOR DOZER USE

Earthmoving Activity:
Pusher tractor to assist loading scrapers.

Characterization of Dozer Used (type, size, etc.):
D8R dozer with a "SU" Blade.

Description of Dozer Use (origin, destination, grade, haul distance, material, etc.):
Scrapers loaded with Back-track Loading Method.

Productivity Calculations:

Operating Adjustment Factor = _____ (operator factor) x _____ (material factor) x _____ (efficiency factor) x _____ (grade factor) x

_____ (weight correction factor) x _____ (production method/blade factor) x _____ (visibility factor) x _____ (elevation factor) = _____

Net Hourly Production = _____ (normal hourly production) LCY/hr x _____ (operating adjustment factor) = _____ LCY/hr

Hours Required = _____ (volume to be moved) LCY ÷ _____ (net hourly production) LCY/hr = **301*** hr

***Use 301 total hours** for D8R-SU; see *Worksheet 13.*

Data Source(s): **Caterpillar Performance Handbook**, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 7A
PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:
This unit will be used for ripping Pits #16 through #22 prior to topsoil placement.

Characterization of Dozer and Ripper Use:
D8R w/ SU blade and 3-shank adjustable parallelogram ripper; ripper has a 43 inch (3.58-foot) pocket spacing.

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

Ripping depth = 2.6 feet ; Cut length = 793'
Ripping effective width = 43"/12"per foot x 3 = 10.75 feet
Volume = 6 pits x 100' wide x 2.6' deep x 793' long ÷ 27 cy/cf = 45,818 cy

Productivity Calculation*:

Cycle time = (793 ft (cut length) ÷ 88 ft/min ([speed]) + 0.25 min (fixed turn time**) = 9.3 min/pass

Passes/hour = 60 min/hr ÷ 9.3 min/pass (cycle time) x .83 (efficiency factor) = 5.35 passes/hr

Volume cut per pass = (2.6 ft (tool penetration) x 10.75 ft (cut spacing) x 793 ft (cut length)) ÷ 27 ft^3/yd^3 = 820.9 BCY/pass

Hourly Production = 820.9 BCY/pass x 5.35 passes/hr = 4,391.8 BCY/hr

Hours Required = 45,818 BCY (bank volume to be ripped) ÷ 4,391.8 BCY/hr (hourly production***) = 10 hrs***

* Remember to use the swell factor to convert from bank cubic yards to loose cubic yards when applying these data to *Worksheet 5*. Calculate separate dozer hauling of ripped material for each lift on *Worksheet 5*.

** Fixed turn time is dependent on dozer used. Normally 0.25 min. per turn is used.

*** Use 301 hours (support equipment, see *Worksheet 13*)

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 7B
PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:
Rip the 30.1' wide haul road prior to topsoil placement.

Characterization of Dozer and Ripper Use:
D8R w/ SU blade and 3-shank adjustable parallelogram ripper; ripper has a 43 inch (3.58-foot) pocket spacing.

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

Ripping depth = 2.6' Length = 7,000'
Ripping effective width = 43"/12"per foot X 3 = 10.75'
Volume = 7,000' x 30' wide x 2.6' deep ÷ 27 cy/cf = 20,222 cy

Productivity Calculation*:

Cycle time = (7,000 ft ÷ 88 ft/min) + 0.25 min = 79.8 min/pass
(cut length; [speed]; fixed turn time**)

Passes/hour = 60 min/hr ÷ 79.8 min/pass x .83 = .62 passes/hr
(cycle time; efficiency factor)

Volume cut per pass = (2.6 ft x 10.75 ft x 7,000 ft) ÷ 27 ft³/yd³ = 7,246 BCY/pass
(tool Penetration; cut spacing; cut length)

Hourly Production = 7,246 BCY/pass x .62 passes/hr = 4,492.7 BCY/hr

Hours Required = 20,222 BCY ÷ 4,492.7 BCY/hr = 4.5 hrs****
(bank volume to be to be ripped; hourly production***)

* Remember to use the swell factor to convert from bank cubic yards to loose cubic yards when applying these data to *Worksheet 5*. Calculate separate dozer hauling of ripped material for each lift on *Worksheet 5*.

** Fixed turn time is dependent on dozer used. Normally 0.25 min. per turn is used.

*** This D8R-SU bulldozer is to be for rough grading of the backfill area (see *Worksheets 5A, 7A* and *7B*).

**** Use 301 total hours, see *Worksheet 7A*; support equipment, see *Worksheet 13*.

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 7C
PRODUCTIVITY AND HOURS REQUIRED FOR RIPPER-EQUIPPED DOZER USE

Ripping Activity:
Rip the office/coal pad area prior to topsoil placement.

Characterization of Dozer and Ripper Use:
D8R w/ SU blade and 3-shank adjustable parallelogram ripper; ripper has a 43 inch (3.58-foot) pocket spacing.

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

Ripping depth = 2.6'
Ripping effective width = 43"/12"per foot X 3 = 10.75'
Volume = 21,780 sf x 2.6' deep ÷ 27 cy/cf = 2,097 cy

Length = 148'
Area = 21,780 sf (0.5 ac.)

Productivity Calculation*:

Cycle time = (148 (cut length) ft ÷ 88 ft/min [speed]) + 0.25 (fixed turn time**) min = 1.93 min/pass

Passes/hour = 60 min/hr ÷ 1.93 (cycle time) min/pass x .83 (efficiency factor) = 25.80 passes/hr

Volume cut per pass = (2.6 (tool penetration) ft x 10.75 (cut spacing) ft x 148 (cut length) ft) ÷ 27 ft^3/yd^3 = 153.2 BCY/pass

Hourly Production = 153.2 BCY/pass x 25.80 passes/hr = 3,952.6 BCY/hr

Hours Required = 2,097 (bank volume to be ripped) BCY/ yd^3 ÷ 3,952.6 (hourly production) BCY/hr = .53 hrs***

* Remember to use the swell factor to convert from bank cubic yards to loose cubic yards when applying these data to *Worksheet 5.* Calculate separate dozer hauling of ripped material for each lift on *Worksheet 5.*

** Fixed turn time is dependent on dozer used. Normally 0.25 min. per turn is used.

*** Use 301 total hours, see *Worksheet 7A*; support equipment, see *Worksheet 13.*

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 8A
PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:
Load haul truck with spoil from overburden stockpile, west (OSW).

Characterization of Loader Use (type, size, etc.):
988F, Spade-edge 8 cy rock bucket, 11.5' dump height clearance.

Description of Loader Use (origin, destination, grade, haul distance, etc.):
Loading 35 ton trucks from stockpile with minimum haul.

Productivity Calculations:

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

Net Bucket Capacity = 8 (heaped bucket capacity) LCY x .8 (bucket fill factor*) = 6.4 LCY

Hourly Production = 6.4 (net bucket capacity) LCY ÷ .575 (cycle time) min x .75 (efficiency factor) x 60 min/hr = 501 LCY/hr

Hours Required = 60,315 (volume to be moved) LCY ÷ 501 (hourly production) LCY/hr = 120 hr

*See loader section of equipment manual.

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 8B
PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:
Load haul truck with spoil from overburden stockpile, west (OSE).

Characterization of Loader Use (type, size, etc.):
988F, Spade-edge 8 cy rock bucket, 11.5' dump height clearance.

Description of Loader Use (origin, destination, grade, haul distance, etc.):
Loading 35 ton trucks from stockpile with minimum haul.

Productivity Calculations:

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

Net Bucket Capacity = 8 (heaped bucket capacity) LCY x .8 (bucket fill factor*) = 6.4 LCY

Hourly Production = 6.4 (net bucket capacity) LCY ÷ .575 (cycle time) min x .75 (efficiency factor) x 60 min/hr = 501 LCY/h.

Hours Required = 60,315 (volume to be moved) LCY ÷ 501 (hourly production) LCY/hr = 120 hr

*See loader section of equipment manual.

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 8C
PRODUCTIVITY AND HOURS REQUIRED FOR LOADER USE

Earthmoving Activity:
Excavate and load road base material.

Characterization of Loader Use (type, size, etc.):
988F, 8 cy spade-edge rock bucket.

Description of Loader Use (origin, destination, grade, haul distance, etc.):
Approximately 50' haul at a 4% effective grade.

Productivity Calculations:

Cycle time = .15 (haul time (loaded)) + .135 (return time (empty)) + .575 (basic cycle time) = .86 min

Net Bucket Capacity = 8 (heaped bucket capacity) LCY x .9 (bucket fill factor*) = 7.2 LCY.

Hourly Production = 7.2 (net bucket capacity) LCY ÷ .86 (cycle time) min x .75 (efficiency factor) x 60 min/hr = 376.7 LCY/hr

Hours Required = 22,037 (volume to be moved) LCY ÷ 376.7 (hourly production) LCY/hr = 59 hr

*See loader section of equipment manual.

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 8D
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 Use (type, size, etc.):
988F with 8 cy spade-edge rock bucket, 11.5' dump height

Description of Loader Use (origin, destination, grade, haul distance, etc.):
Approximately 50' haul and loading of 35 ton trucks.

Productivity Calculations:

Cycle time = 0.15 (haul time (loaded)) + 0.135 (return time (empty)) + 0 .575 (basic cycle time) = 0 .86 min

Net Bucket Capacity = 8.0 (heaped bucket capacity) LCY x 0.9 (bucket fill factor*) = 7.2 LCY

Hourly Production = 7.2 (net bucket capacity) LCY ÷ 0.86 (cycle time) min x 0 .75 (efficiency factor) x 60 min/hr = 376.7 LCY/hr

Hours Required = 670 (volume to be moved) LCY ÷ 376.7 (hourly production) LCY/hr = 2.0 hr

*See loader section of equipment manual.

NOTE: Total hours for 988F = 120 + 120 + 59 + 2 = 301 hours.

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 9A
PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

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

Characterization of Truck Use (type, size, etc.):
Caterpillar 769D, (21.6 + 31.7) ÷ 2 = 27cy average capacity (ave of struck and heaped).

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

Haul distance and grade from OSW to open pit.
Haul: 1600' @ 3% effective grade plus 200' @ 10% effective grade;
Return: 1600' @ 3% effective grade plus 200' @ (-)7% effective grade

Productivity Calculations:

No. Loader Passes/Truck = 27 (truck capacity *) LCY ÷ 6.4 (loader bucket net capacity) LCY = 4.22 (round down to nearest whole number) passes

Net Truck Capacity = 6.4 (loader bucket net capacity) LCY x 4 (no. loader passes/truck) = 25.6 LCY

Loading Time/Truck = .575 (loader cycle time (from *Worksheet 8* or *10*)) min x 4 (no. loader passes/truck) = 2.3 min

Truck Cycle Time = .6 + .1 (haul time) + .45 + .1** (return time) + 2.3 (loading time) + 2.0 (dump and maneuver time) = 5.55 min

No. of Trucks Required = 5.55 (truck cycle time) min ÷ 2.3 (loading time) min = 2.41 trucks

Production Rate = 27 (truck capacity*) LCY x 3 (no. of trucks) ÷ 5.55 (truck cycle time) min = 14.59 LCY/min

Hourly Production = 14.59 (production rate) LCY/min x 60 min/hr x .75 (efficiency factor) = 656.6 LCY/hr

Hours Required = 60,315 (volume to be moved) LCY ÷ 656.6 (hourly production) LCY/hr = 91.9 hr

NOTE: Use 3 trucks for 120 hours each to match loader, see Worksheet 8A.

* Normally the average of the struck and heaped capacities.

** 200' ÷ (25 MPH x 88FPM/1 MPH) = 0.09 min (use 0.1).

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 9B
PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

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

Characterization of Truck Use (type, size, etc.)
Caterpillar 769D, (21.6 + 31.7) ÷ 2 = 27cy average capacity (ave of struck and heaped).

Description of Truck Use (origin, destination, grade, haul distance, capacity, etc.):
Haul distance and grade from OSE to open pit.
Haul: 800' @ 3% effective grade plus 200' @ 10% grade
Return: 800' @ 3% effective grade plus 200' @ (-)7% grade

Productivity Calculations:

No. Loader Passes/Truck = 27 (truck capacity *) LCY ÷ 6.4 (loader bucket net capacity) LCY = 4.22 (round down to nearest whole number) passes

Net Truck Capacity = 6.4 (loader bucket net capacity) LCY x 4 (no. loader passes/truck) = 25.6 LCY

Loading Time/Truck = .575 (loader cycle time (from *Worksheet 8* or *10*)) min x 4 (no. loader passes/truck) = 2.3 min

Truck Cycle Time = .4 + .2 (haul time) + .3 + .1** (return time) + 2.3 (loading time) + 2.0 (dump and maneuver time) = 5.3 min

No. of Trucks Required = 5.3 (truck cycle time) min ÷ 2.3 (loading time) min = 2.3 trucks.

Production Rate = 27 (truck capacity**) LCY x 3 (no. of trucks) ÷ 5.3 (truck cycle time) min = 15.3 LCY/min

Hourly Production = 15.3 (production rate) LCY/min x 60 min/hr x .75 (efficiency factor) = 688.5 LCY/hr

Hours Required = 60,315 (volume to be moved) LCY ÷ 688.5 (hourly production) LCY/hr = 87.6 hr

NOTE: Use 3 trucks for 120 hours each to match loader, see Worksheet 8B.

* Normally the average of the struck and heaped capacities.

** 200' ÷ (25 MPH x 88FPM/1 MPH) = 0.09 min (use 0.1).

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 9C
PRODUCTIVITY AND HOURS REQUIRED FOR TRUCK USE

Earthmoving Activity:
Haul spoil base material to open pit.

Characterization of Truck Use (type, size, etc.)
Caterpillar 769D, (21.6 + 31.7) ÷ 2 = 27 cy average capacity (ave of struck and heaped).

Description of Truck Use (origin, destination, grade, haul distance, capacity, etc.):
1800' @ 3% effective grade and 200' haul @ 10% effective grade
1800' @ 3% effective grade and 200' haul @ (-)7% effective grade

Productivity Calculations:

No. Loader Passes/Truck = 27 (truck capacity *) LCY ÷ 6.4 (loader bucket net capacity) LCY = 4.22 (round down to nearest whole number) passes

Net Truck Capacity = 6.4 (loader bucket net capacity) LCY x 4 (no. loader passes/truck) = 25.6 LCY

Loading Time/Truck = .575 (loader cycle time (from *Worksheet 8* or *10*)) min x 4 (no. loader passes/truck) = 2.3 min

Truck Cycle Time = .8 + .2 (haul time) + 0.3 + .1** (return time) + 2.3 (loading time) + 2.0 (dump and maneuver time) = 5.70 min

No. of Trucks Required = 5.70 (truck cycle time) min ÷ 2.3 (loading time) min = 2.5 trucks.

Production Rate = 27 (truck capacity*) LCY x 2 (no. of trucks) ÷ 5.7 (truck cycle time) min = 9.47 LCY/min

Hourly Production = 9.47 (production rate) LCY/min x 60 min/hr x .75 (efficiency factor) = 426.3 LCY/hr

Hours Required = 22,037 (volume to be moved) LCY ÷ 426.3 (hourly production) LCY/hr = 51.7 hr

NOTE: Use 2 trucks for 59 hours each to match loader, see Worksheet 8C.

* Normally the average of the struck and heaped capacities.

** 200' + (25 MPH x 88FPM/1 MPH) = 0.09 min (use 0.1).

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 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 Use (type, size, etc.)
Caterpillar 769C, (21.6 + 31.7) ÷ 2 = 27 cy average capacity (ave of the struck and heaped).

Description of Truck Use (origin, destination, grade, haul distance, capacity, etc.):
Haul: 3200' at 3% effective grade and 200' @ 10% effective grade.
Return: 3200' at 3% effective grade and 200' @ (-)7% effective grade.

Productivity Calculations:

No. Loader Passes/Truck = 27 (truck capacity *) LCY ÷ 6.4 (loader bucket net capacity) LCY = 4.22 (round down to nearest whole number) passes

Net Truck Capacity = 6.4 (loader bucket net capacity) LCY x 4 (no. loader passes/truck) = 25.6 LCY

Loading Time/Truck = .575 (loader cycle time (from *Worksheet 8* or *10*)) min x 4 (no. loader passes/truck) = 2.3 min

Truck Cycle Time = 1.35 + .2 (haul time) + .9 + .1** (return time) + 2.3 (loading time) + 2.0 (dump and maneuver time) = 6.85 min

No. of Trucks Required = 6.85 (truck cycle time) min ÷ 2.3 (loading time) min = 2.98 trucks

Production Rate = 27 (truck capacity*) LCY x 3 (no. of trucks) ÷ 6.85 (truck cycle time) min = 11.82 LCY/min

Hourly Production = 11.82 (production rate) LCY/min x 60 min/hr x .75 (efficiency factor) = 532.1 LCY/hr

Hours Required = 670 (volume to be moved) LCY ÷ 532.1 (hourly production) LCY/hr = 1.26 hr

NOTE: Use 3 trucks for 2 hours each to match loader, see Worksheet 8D.

* Normally the average of the struck and heaped capacities.

** 200' + (25 MPH x 88FPM/1 MPH) = 0.09 min (use 0.1).

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 11B-1
PRODUCTIVITY OF DOZER PUSH-LOADED SCRAPER USE

Earthmoving Activity:
Replacing topsoil over Pits #17 - #22.

Characterization of Scraper Used (type, capacity, etc.):
Cat 627F Non-push pull 14cy (struck) + 20 cy (heaped) = (14 cy + 20 cy)/2 = 17 cy ave capacity.

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):
750' haul @ 4% effective grade; 750' return @ 4% effective grade.

List Pusher Tractor(s) Used:
D8N dozer will assist the scraper in loading.

Describe Push Tractor Loading Method (see figure):
Back-track loading method with a single push tractor.

Scraper Productivity Calculations:

Cycle Time = .5 (load time (push-pull is per pair)) + .5 (loaded trip time) + .6 (maneuver and spread time) + .5 (return trip time) = 2.1 min (push-pull is per pair)

Hourly Production = 17 (capacity*) LCY x 60 min/hr ÷ 2.1 (cycle time) min x .75 (efficiency factor) = 364.29 LCY/hr

Hours Required = 14,626 (volume to be handled) LCY ÷ 364.29 (net hourly production) LCY/hr = 40 hr

* The average of the struck and heaped capacities; use total for two scrapers for push-pull.

Push Tractor Productivity Calculations:

Pusher Cycle Time = .5 (scraper load time) min x 1.5 (pusher factor) = .75 min

Scrapers per Pusher = 2.1 (scraper cycle time) min ÷ .75 (pusher cycle time) min = 2.8 (round down) min

Pusher Hours Required = 40 (scraper hours) hrs ÷ 2 (scrapers per pusher) = 20 (round up) hr

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 11B-2
PRODUCTIVITY OF DOZER PUSH-LOADED SCRAPER USE

Earthmoving Activity:
Replacing topsoil over office area and haul road.

Characterization of Scraper Used (type, capacity, etc.):
Cat 627F Non-push pull 14cy (struck) + 20 cy (heaped) = (14 cy + 20 cy)/2 = 17 cy avg capacity.

Description of Scraper Use (origin, destination, grade, haul distance, capacity, etc.):
2,100' haul @ 4% effective grade; 2,100' return @ 4% effective grade.

List Pusher Tractor(s) Used:
D8N dozer will assist the scraper in loading.

Describe Push Tractor Loading Method (see figure on next page):
Back-track loading method with 1 push tractor.

Scraper Productivity Calculations:

Cycle Time = .5 (load time (push-pull is per pair)) + 1.1 (loaded trip time) + .6 (maneuver and spread time) + .8 (return trip time) = 3.0 min (push-pull is per pair)

Hourly Production = 17 (capacity*) LCY x 60 min/hr ÷ 3.0 (cycle time) min x .75 (efficiency factor) = 255 LCY/hr

Hours Required = 7,149 (volume to be handled) LCY ÷ 255 (net hourly production) LCY/hr = 28.04 hr

* The average of the heaped and struck capacities; use total for two scrapers for push-pull.

Push Tractor Productivity Calculations:

Pusher Cycle Time = .5 (scraper load time) min x 1.5 (pusher factor) = .75 min

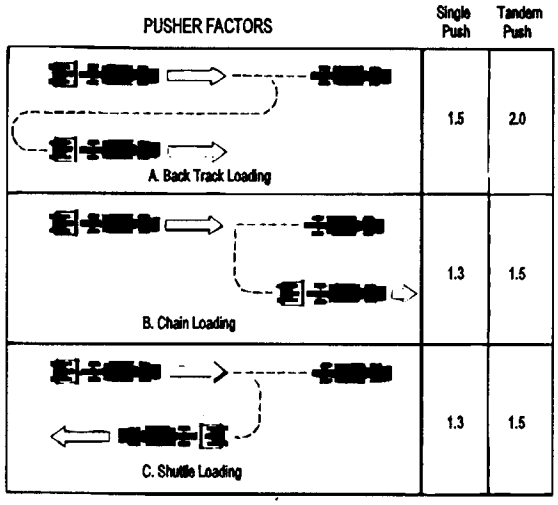
Scrapers per Pusher = 3.0 (scraper cycle time) min ÷ .75 (pusher cycle time) min = 4.0 (round down) min

Pusher Hours Required = 28.04 (scraper hours) hrs ÷ 2 (scrapers per pusher (match *Worksheet 11-B-1*)) = 14.0 (round up) hr

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 11B (continued)
PRODUCTIVITY OF DOZER PUSH-LOADED SCRAPER USE



Modified from Terex,1981

Data Source(s): Illustration from "Production and Cost Estimating of Material Movement and Earthmoving Equipment," TEREX AMERICAS, Tulsa, OK 74107, (918) 445-5802. See disclaimer in Appendix A, *Worksheet 11B*.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 12A
PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE

Earthmoving Activity:
Final grade ripped area prior to placing topsoil.

Characterization of Grader Used (type, size capacity, etc.):
Caterpillar 140H; 215 horsepower, equipped with EROPS, scarifier/ripper.

Description of Grader Route (push distance, % grade, effective blade width, operating speed, etc.):
Pit area (#17- #22) = 10.9 acres; Haul road area = 10.9 acres; Coal pad/office area = 0.5 acres
TOTAL: 16.2 acres

Productivity Calculations:

Grading

Hourly Production = 2.8 (average speed) mi/hr x 9 (effective blade width) ft x 5,280 ft/mi x 1 ac/43,560 ft² x .75 (efficiency factor) = 2.29 ac/hr

Hours Required = 16.2 (area to be graded) ac ÷ 2.29 (hourly production) ac/hr = 7 hr

Scarification - N/A

Hourly Production = _____ (average speed) mi/hr x _____ (scarifier width) ft x 5,280 ft/mi x 1 ac/43,560 ft² x _____ (efficiency factor) = _____ ac/hr

Hours Required = _____ (area to be scarified) ac ÷ _____ (hourly production) ac/hr = _____ hr

Total Hours = 301*

***Total support equipment hours is 301 (see *Worksheet 13*).**

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 12B
PRODUCTIVITY AND HOURS REQUIRED FOR MOTORGRADER USE

Earthmoving Activity:
Scarify all disturbance prior to re-seeding.

Characterization of Grader Used (type, size capacity, etc.):
Caterpillar 140H; 215 horsepower, equipped with EROPS, scarifier/ripper.

Description of Grader Route (push distance, % grade, effective blade width, operating speed, etc.):
Pit area (#11- #22) = 20.8 acres; Haul road area = 4.8 acres; Coal pad/office area = 0.5 acres
TOTAL: 26.1 acres

Productivity Calculations:

Grading - N/A

Hourly Production = _____ mi/hr (average speed) x _____ ft (effective blade width) x 5,280 ft/mi x 1 ac/43,560 ft² x _____ (efficiency factor) = _____ ac/hr

Hours Required = _____ ac (area to be graded) ÷ _____ ac/hr (hourly production) = _____ hr

Scarification

Hourly Production = 2.8 mi/hr (average speed) x 7.67 ft (scarifier width) x 5,280 ft/mi x 1 ac/43,560 ft² x .75 (efficiency factor) = 1.95 ac/hr

Hours Required = 26.1 ac (area to be scarified) ÷ 1.95 ac/hr (hourly production) = 13.36 hr

Total Hours = 301*.

* Motorgrader is assumed to be onsite support equipment during total project (see *Worksheet 13*).

Data Source(s): Caterpillar Performance Handbook, Edition 29.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 13
SUMMARY CALCULATION OF EARTHMOVING COSTS

Equipment *	Ownership & Operation Cost ($/hr)	Labor Cost ($/hr)	Total Hours Required	Total Cost *** ($)
627F Scraper	113.47	22.39	34**	4,619
627F Scraper	113.47	22.39	34**	4,619
D8R-SU Push Tractor	84.13	22.39	34**	3,622
988F Loader	100.40	23.47	301*	37,285
D8R-SU Dozer with 3 shank ripper	95.28	22.39	301*	35,419
140 H Grader	37.04	22.39	301*	17,888
6,000 gal. Water Tank	69.96	17.80	301*	26,416
769D Truck	86.09	19.89	360****	38,153
769D Truck	86.09	19.89	360****	38,153
769D Truck	86.09	19.89	118****	12,506
769D Truck	86.09	19.89	6****	636
			Grand Total	$219,316

* Include all necessary attachments and accessories for each item of equipment. Also, add support equipment such as water wagons and graders to match total project time as appropriate. Total Project Time = total truck and loader time = 120 + 120 + 59 + 2 = 301 hours; therefore support equipment time will equal 301 hours.

** Account for multiple units in truck and/or scraper teams.

*** To compute Total Cost: Add Ownership & Operation Cost and Labor Cost columns then multiply by Total Hours Required column.

**** See Worksheets 9A, B, C and D.

Data Source(s): D8R-SU hourly rate estimate quoted by PRIMEDIA (PRIMEDIA Information, Inc., Cost Reference Guide for Construction Equipment.) Labor cost for last five items from AZ 990017 (08/06/99); assume wages for highway use truck drivers, Navajo County.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 14
REVEGETATION COSTS

Name and Description of Area to be Revegetated:
Pits #11 - #22 = 20.8 acres; Haul road = 4.8 acres; Coal pad/office area = 0.5 acres; TOTAL = 26.1 acres

Description of Revegetation Activities:
No special revegetation activities required. Seedbed preparation has already taken place. The local NRCS office provided an average revegetation cost of $450/acre.

Cost Calculation for Individual Revegetation Activities:

Initial Seeding

26.1 ac x ($ _____ /ac + $ 450 /ac) = $ 11,745
(area to be seeded; seedbed preparation; seeding, fertilizing & mulching)

Planting Trees and Shrubs

_____ ac x ($ _____ /ac + $ _____ /ac) = $ 0
(area to be planted; planting; herbicide treatment)

Reseeding

31.7 ac x .25 x ($ _____ /ac + $ 450 /ac) = $ 3,566
(area to be seeded & unreleased disturbed areas; failure rate*; seedbed preparation; seeding, fertilizing & mulching)

Replanting Trees and Shrubs

_____ ac x _____ x ($ _____ /ac + $ _____ /ac) = $ 0
(area to be planted & unreleased disturbed areas; failure rate*; planting; herbicide treatment)

Other Revegetation Activity for this Area:
(Examples of other activities that may be necessary include soil sampling, irrigation, and rill and gully repair. Describe each activity and provide a cost estimate with documentation. Use additional worksheets if necessary.)

Other Costs: $ _____

TOTAL REVEGETATION COST FOR THIS AREA = $ 15,311

*** The 25% failure rate is applied to all initial seeding disturbance (26.1 acres) plus reclaimed but unreleased areas within the permit boundary (5.6 acres).**

Data Source(s): Mine plan and local NRSC.

Project: Haul Back Example
Date: 12/2/99
Prepared by: K.J. Bond

WORKSHEET 16
RECLAMATION BOND SUMMARY SHEET

1.	Total Facility and Structure Removal Costs	$ 545	
2.	Total Earthmoving Costs	$ 219,317	
3.	Total Revegetation Costs	$ 15,311	
4.	Total Other Reclamation Activities Costs	$ 0	
5.	Total Direct Costs (sum of Lines 1 through 4)	$ 235,173	
6.	*Inflated Total Direct Costs* (Line 5 x inflation factor *)		$ 265,745
7.	Mobilization/Demobilization (5 % of Line 6) (1% to 10% of Line 6)	$ 13,287	
8.	Contingencies (4 % of Line 6) (3% to 5% of Line 6)	$ 10,630	
9.	Engineering Redesign Fee (4.25% of Line 6) (2.5% to 6% of Line 6)	$ 11,294	
10.	Contractor Profit/ Overhead (27 % of Line 6) (see Graph 1)	$ 71,751	
11.	Project Management Fee (5.25 % of Line 6) (see Graph 2)	$ 13,952	
12.	*Total Indirect Costs* (sum of Lines 7 through 11)		$ 120,914
13.	GRAND TOTAL BOND AMOUNT (sum of Lines 6 and 12)		$ 386,659 (round to $387,000)

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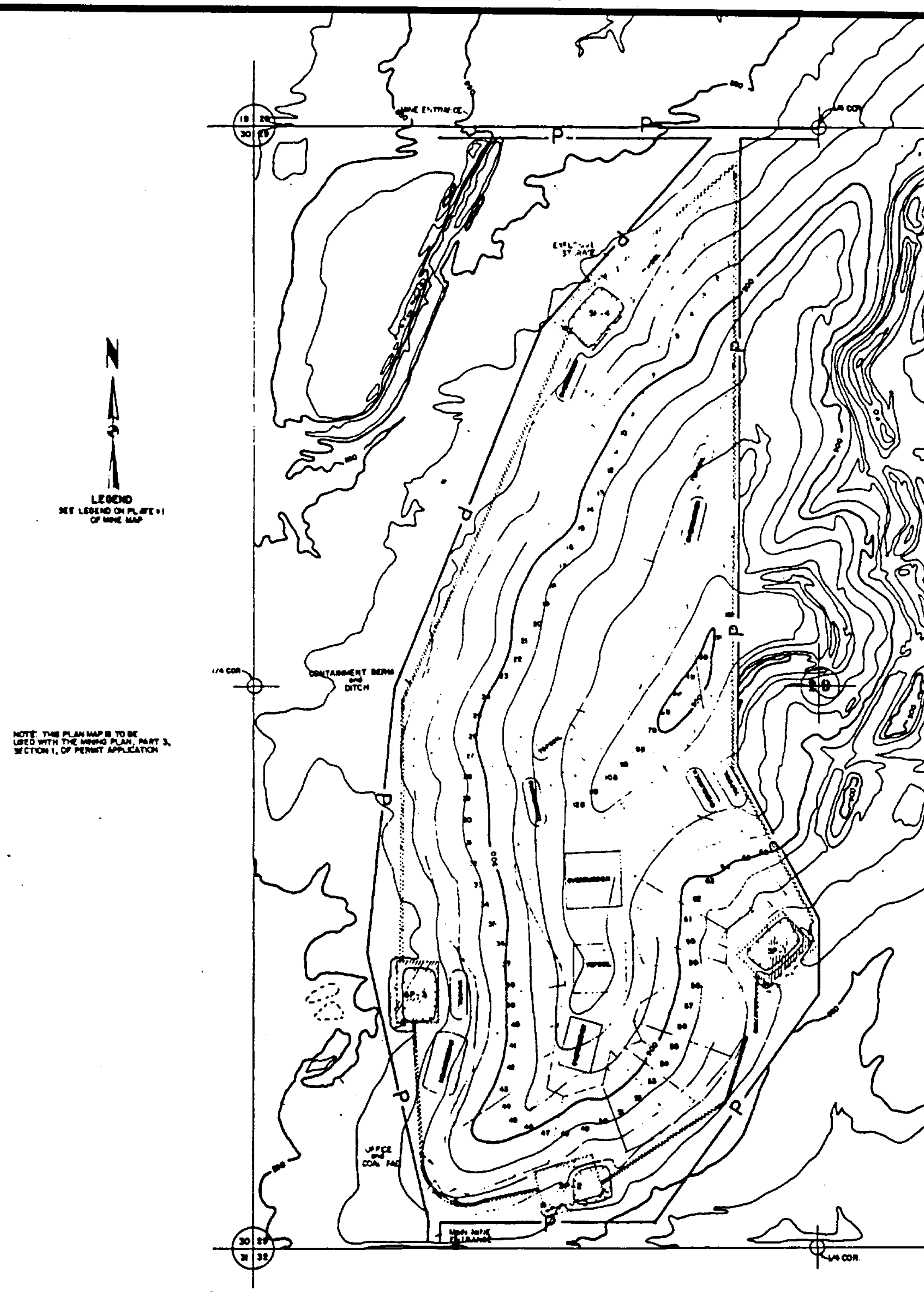
* Inflation factor = $\frac{\text{ENR Construction Cost Index (CCI) for current mo/yr}}{\text{ENR CCI for mo/yr 5 years prior to current mo/yr}} = \frac{6127}{5439} = 1.13$

Identify current month/year used in formula above: 12/99
Identify prior month/year used in formula above: 12/94

ENR = *Engineering News Record*, McGraw-Hill Construction Information Group, New York, NY; http://www.enr.com.

Formula assumes permit term or time until next bond adequacy evaluation is 5 years. Adjust timeframe as necessary.



NOTE:
OVERBURDEN STORAGE
TOPSOIL STORAGE
PONDS

PLATE # 7

Figure B-5

BOND AMOUNT COMPUTATION

Applicant: Mountain Top Removal Example

Permit Number: Example No. 4 **Permitted Acreage:** 175

Bonding Scheme (permit area, incremental, cumulative): Permit Area

If Incremental:

Increment Number: _____

Increment Acreage: _____

If Cumulative:

Acres previously authorized for disturbance: _____

New acres proposed for disturbance: _____

Type of Operation: Mountain Top Removal

Location: USA

Prepared by: R. R. Bond

Date: December 2, 1999

Total Bond Amount: $ 653,000