Earthwork and Water Management Cost Estimate Summary Report

Continental Mine

Prepared for

Freeport-McMoRan Inc.
Chino Mines Company
99 Santa Rita Mine Road
Vanadium, New Mexico 88043

Prepared by

Telesto Solutions, Inc.
3801 Automation Way, Suite 201
Fort Collins, CO 80525

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Report Authors and Contributors

Telesto Solutions, Inc.

_____
Fred Charles, P.E. – Author

_____
Walt Niccoli, P.E. – Report Review

Contributors:

Peggy Carter

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1.0 INTRODUCTION

The New Mexico Environmental Department, Groundwater Bureau (NMED) and the New Mexico Energy, Minerals and Natural Resources Department, Mining and Minerals Division (MMD) regulations require that financial assurance (FA) be posted for facilities that have to be reclaimed at closure (New Mexico Administrative Code NMAC 20.6.7.29 and NMAC 19.10.12, respectively). This summary report and accompanying appendices describe the base assumptions and approach used to determine the Continental Mine FA earthwork and water management reclamation cost estimates (RCEs) for Freeport-McMoRan Chino Mines Company (Chino). Operations and maintenance (O&M) costs are also included in this RCE.

The earthwork and water management RCEs for the Continental Mine were originally presented as part of the 2014 Continental Mine Closure/Closeout Plan (CCP) (Telesto Solutions, Inc., 2014). A subsequent submittal in May 2018 (Telesto Solutions, Inc., 2018) updated the costs presented in the 2014 CCP.

The cost estimate is based on the configuration of facilities as described in the end-of-year (EOY) 2023 mine plan (formerly submitted as the EOY 2019 mine plan) and it assumes reclamation would begin at any time should a default occur between now and 2023. The original 2014 CCP (Telesto Solutions, Inc., 2014) mine planning dates have not been retained in this document and, thus, there is a four-year difference with the submitted 2014 CCP. This update brings all costs and schedules (current dollars and schedule, respectively) in line with a 2018 start of mining date.

This current submittal provides an update to the Continental Mine RCE by incorporating 2019 unit costs and labor rates, along with changes to indirect rates and other costing resolutions under the Agreement with the FA Work Group (see Appendix D). The FA

Work Group involved representatives of Freeport-McMoRan New Mexico Operations (FNMO), MMD, NMED, and Gila Resources Information Project (GRIP).

This summary RCE report consists of the following sections:

- **Section 1.0** provides an introduction for this update to the Continental Mine earthwork RCE and water management RCE.
- **Section 2.0** provides an overview of the appendices in which details of this cost estimate are presented.
- **Section 3.0** summarizes the updated cost estimates for earthwork and water management.
- **Section 4.0** lists the references cited in this report.

2.0 COST ESTIMATING OVERVIEW

Details supporting the updated cost estimate are presented in a series of appendices which are identified and briefly described in this section.

2.1 Facility Characteristics

Appendix A describes the facilities associated with Chino's Continental Mine that would be reclaimed according to the approved CCP. Appendix A briefly provides a summary of each facility's current condition, the planned reclamation, and the facility's estimated reclamation cost in current dollars. Table 1 summarizes the planned reclamation activities as described in Appendix A.

Table 1 Summary of Reclamation Activities

	Rough Grading	Dozer Assist Cover Load	Load Cover	Haul Cover	Rip Rough Grade	Place Cover & Grade	Revegetate	Excavate for Downdrains	Excavate Bench Channels	Rip Liner	Load & Haul Riprap	Place Riprap Bench Channels	Place ACB Downdrains	Fence, Berms	O&M
Tailings Ponds															
Main Tailings Impoundment	X	X	X	X	X	X	X	X	X		X	X	X		X
Magnetite Tailings Impoundment	X	X	X	X	X	X	X	X					X		X
Stockpiles															
South Waste Rock Disposal Facility	X	X	X	X	X	X	X	X	X		X	X	X		X
Low Grade Waste Rock Facility	X	X	X	X	X	X	X								X
No. 3 Shaft Stockpile	X	X	X	X	X	X	X								X
Mines															
Continental Pit														X	X
Hanover Mountain Deposit		X	X	X		X	X							X	X
Surface Impoundments															
Grape Gulch Pond #3 (HDPE lined; reclaimed year 12)		X	X	X		X	X			X					X
Blackman's Seep (HDPE Lined; reclaimed year 5)	The Pond is closed as part of tailings reclamation														
Upper Creek Containment Pond 1 (HDPE Lined; Reclaimed year 12)		X	X	X		X	X			X					X
Magnetite Seepage Pond (HDPE Lined) (Reclaimed year 12)		X	X	X		X	X			X					X
SWRF Dam 1 (Reclaimed year 12)		X	X	X		X	X								X
SWRF Dam 2 (Reclaimed year 12)		X	X	X		X	X								X
SWRF Dam 3 (Reclaimed year 12)		X	X	X		X	X								X
Decant Pond #4 (HDPE lined; reclaimed year 12)		X	X	X		X	X			X					X
North Tailings Decant Pond (Reclaimed year 12)		X	X	X		X	X			X					X
East WRF Containment (Proposed; Reclaimed Year 12)		X	X	X		X	X			X					X
Historic Sites															
Pearson-Barnes Mine Area		X	X	X	X	X	X								X
Disturbed Area Adjacent and North of the SWRDF		X	X	X	X	X	X								X
Other															
Unplanned Future Disturbance Areas	X	X	X	X		X	X								X
Exploration Roads, Remaining Internal Hal Roads	X	X	X	X		X	X								X
North Overburden Stockpile Borrow Area							X								X
Demolition		X	X	X	X	X	X								X
Cobre Haul Road	X						X								X

2.2 Earthwork Costs

Appendix B provides the information utilized to develop the earthwork cost estimate. Overall, the cost estimating process follows the typical, standard approach used in the engineering and construction industries. The earthwork cost estimate is an iterative process based on the required loading and hauling operations and haul distance. Telesto utilizes the unit costs associated with equipment in the fleet to calculate the total reclamation cost utilizing the spreadsheets. Figure 1 summarizes the costing steps used for one piece of equipment in developing the fleet.

2.3 Water Management Costs

Appendix C provides the components utilized to develop the water management costs associated with reclamation. The water management cost estimation process begins by quantifying the facilities and physical nature (e.g., pumping distances, hydraulic heads, flow rates, facility age, and power consumption) of the water management system at EOY 2023. From the quantifications, unit rates are applied as shown in the cost estimating spreadsheet.

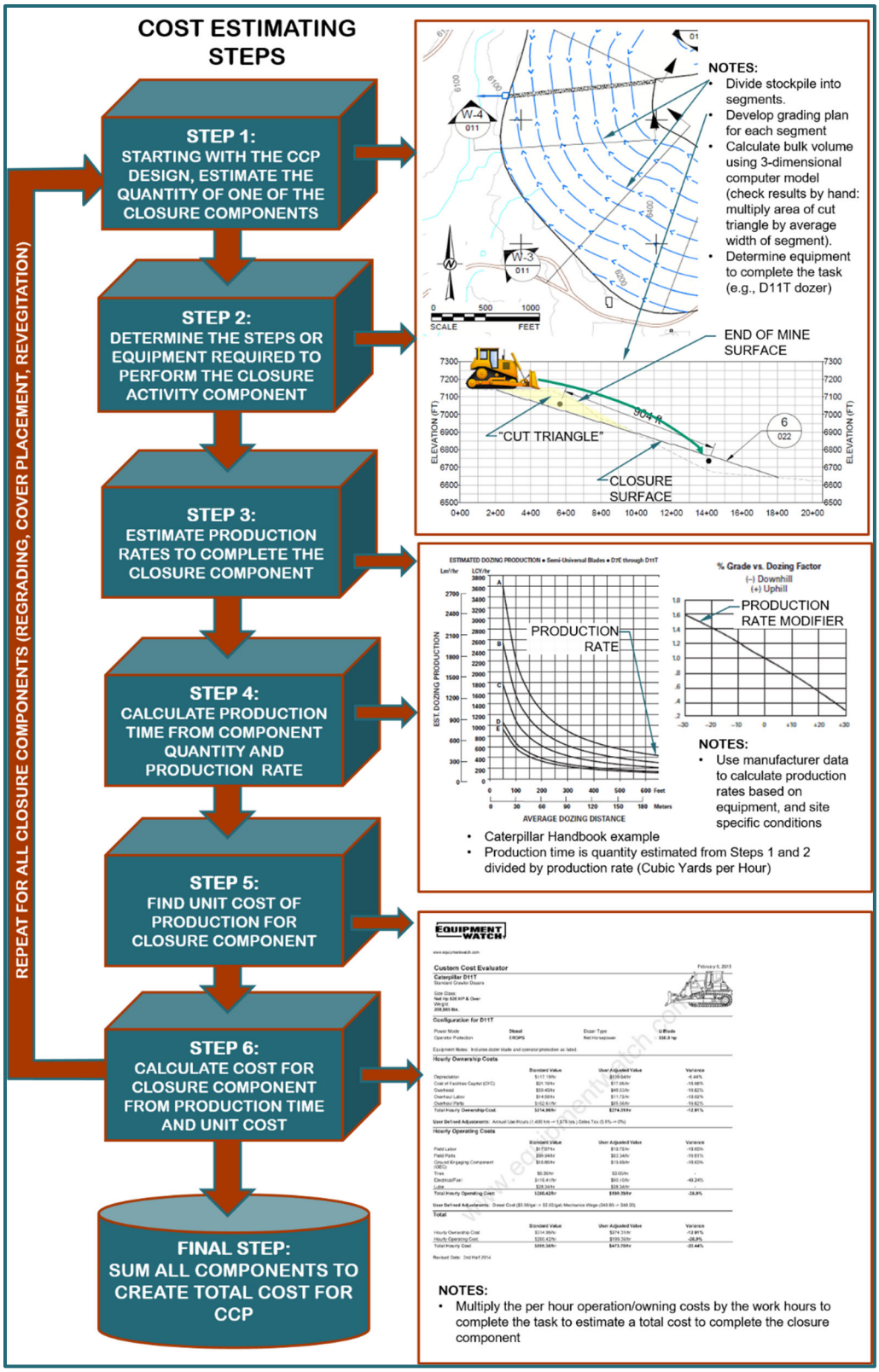

Figure 1 Earthwork Cost Estimating Process

2.4 Cost Spreadsheets

The cost spreadsheets in Appendices B and C are presented as pdfs in these appendices and are also available electronically. Within the spreadsheets, assumptions and other information is provided that may not be captured in the narrative of the appendix texts.

2.5 Indirect Costs

Total indirect costs of 30% are applied to the capital direct costs based on an agreement with the FA Work Group (see Appendix D). The indirect costs include but are not limited to Mobilization and Demobilization, Contingencies, Engineering Redesign Fee, Contractor Profit and Overhead, Project Management Fee, and State Procurement Cost. Total indirect costs of 17.5% are applied for long-term O&M, also as agreed by the FA Work Group for FNMO's RCEs (see Appendix D).

3.0 SUMMARY OF UPDATED COST ESTIMATES

Estimated costs for the FA are presented in Table 2 and Table 3. The total current (2019) dollar cost for earthwork reclamation is $19,292,000 in capital costs plus $3,529,000 in O&M costs for a total of $22,821,000 (Table 2). The total current (2019) dollar cost for water management is $490,000 in capital costs plus $1,655,000 in O&M costs for a total of $2,145,000 (Table 3).

Table 2 Earthwork Costs

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital Item		**30%**	
Tailing Ponds			
Main Tailings Impoundment	$2,233,007	$669,902	$2,902,909
Magnetite Tailings Impoundment	$779,787	$233,936	$1,013,723
Subtotal	$3,012,794	$903,838	$3,916,633
Waste Rock and Ore Piles			
SWRDF	$8,004,435	$2,401,331	$10,405,766
No. 3 Stockpile	$48,381	$14,514	$62,895
Low Grade Ore WRF	$265,991	$79,797	$345,789
Subtotal	$8,318,807	$2,495,642	$10,814,450
Mines			
Hanover Mountain Deposit	$850,562	$255,169	$1,105,730
Continental Pit	$74,070	$22,221	$96,291
Subtotal	$924,632	$277,390	$1,202,021
Surface Impoundments			
Surface Impoundments	$46,041	$13,812	$59,854
Subtotal	$46,041	$13,812	$59,854
Historic Sites			
Pearson-Barnes Mine Area	$113,233	$33,970	$147,202
Subtotal	$113,233	$33,970	$147,202
Other Disturbed Areas			
Miscellaneous Areas	$495,582	$148,675	$644,256
North Overburden Stockpile	$18,072	$5,422	$23,494
Subtotal	$513,654	$154,096	$667,750
Demolition			
Demolition	$1,524,735	$457,421	$1,982,156
Subtotal	$1,524,735	$457,421	$1,982,156
Total Capital Cost without CHR	$14,453,897	$4,336,169	$18,790,066
Cobre Haul Road	$386,053	$115,816	$501,869
Total Capital Cost with CHR	$14,839,950	$4,451,985	$19,291,935
Operations and Maintenance		**17.5%**	
O&M	$3,003,598	$525,630	$3,529,228
Total Earthwork with O&M	**$17,843,000**	**$4,978,000**	**$22,821,000**

Table 3 Water Management Costs

Item	Direct Cost	Indirect Cost	Total Estimated Cost
Water Management Capital		**30%**	
Ponds	$168,022	$50,407	$218,429
Pumps	$0	$0	$0
Pipelines	$0	$0	$0
Electrical	$0	$0	$0
Subtotal	**$168,022**	**$50,407**	**$218,429**
Capital Removal [1]		**30%**	
Pumps	$0	$0	$0
Pipelines	$157,440	$47,232	$204,672
Electrical Infrastructure	$51,298	$15,389	$66,687
Subtotal	**$208,738**	**$62,621**	**$271,359**
Operations and Maintenance		**17.5%**	
Ponds and Tanks	$191,405	$33,496	$224,901
Pumps	$544,615	$95,308	$639,923
Pipelines	$142,143	$24,875	$167,018
Electrical Infrastructure	$121,843	$21,323	$143,166
Electricity and Fuel (Pumps)	$35,074	$6,138	$41,212
Environmental Sampling	$373,198	$65,310	$438,508
Subtotal	**$1,408,278**	**$246,450**	**$1,654,728**
Total Estimated Cost	**$1,785,000**	**$359,000**	**$2,145,000**

[1] Removal costs for ponds and tanks are included in the earthwork portion of the cost estimate.

4.0 REFERENCES

Caterpillar, Inc. (1998). *Caterpillar Performance Handbook, Edition 29.* Peoria, Illinois: Caterpillar, Inc.

Caterpillar, Inc. (2004). *Caterpillar Performance Handbook, Edition 35.* Peoria, Illinois: Caterpillar, Inc.

Caterpillar, Inc. (2011). *Caterpillar Performance Handbook, Edition 41.* Peoria, Illinois: Caterpillar, Inc.

Caterpillar, Inc. (2014). *Caterpillar Performance Handbook, Edition 44.* Peoria, Illinois: Caterpillar, Inc.

Caterpillar, Inc. (2017). *Caterpillar Performance Handbook, Edition 47.* Peoria, Illinois: Caterpillar, Inc.

Caterpillar, Inc. (2018). *Caterpillar Performance Handbook, Edition 48.* Peoria, Illinois: Caterpillar, Inc.

Freeport-McMoRan Copper & Gold. (2012). *Letter to NMED and MMD - Reclamation Cost Estimate Update (September 5).* Tyrone, NM.

NMDOL. (2019). *Prevailing Wage Poster H 2019*. Retrieved January 16, 2019, from New Mexico Department of Labor: https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2019_final.pdf

Penton Media. (2019). *EquipmentWatch Construction Estimator*. Retrieved January and February 2019, from EquipmentWatch: https://equipmentwatch.com

R.S. Means. (2019, February 13). *Heavy Construction Cost Data, Version 8.7*. Retrieved from R.S. Means Data Online: https://www.rsmeansonline.com

Telesto Solutions, Inc. (2014). *Continental Mine Closure/Closeout Plan.* Fort Collins, Colorado: Prepared for Freeport-McMoRan Chino Mining Company, Vanadium, New Mexico.

Telesto Solutions, Inc. (2018). *Continental Mine Closure/Closeout Plan Update.* Fort Collins, Colorado: Prepared for Freeport McMoRan Chino Mining Company, Vanadium, New Mexico.

Appendix A

Facility Characteristics Forms

APPENDIX A

FACILITY CHARACTERISTICS FORMS

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NOTES:

1. Borrow area reclamation costs can be found in the 20190329_Continental_Stockpile_Tailing_Earthwork_RCE spreadsheet presented in Appendix B.1.
2. The costs in these tables only include capital earthwork costs. Building demolition, well closure, water management, and operations and maintenance costs can be found in Appendix B and C.

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Continental Pit

Function	Open Pit
Construction Method	Blasting, loading, and hauling rock in 20-foot benches.
Physical Characteristics	Intrusive and skarn rocks with low primary permeability and medium fracture permeability; Barringer fault trends northeast through the Pit.
Existing Engineering Measures	Visual monitoring, seepage control.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area—Berm and Fence Area Surrounding Pit at Closure (acres)	17.6
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$0
Regrade	$0
Seed & Mulch Berm and Fence Area	$0
Other	$74,070
Capital Cost Totals	**$74,070**
Capital Cost/Acre	**$4,209**

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Low Grade WRF

Function	Inactive; Storage for low grade waste rock
Construction Method	End dumped.
Physical Characteristics	Coarse grained. High saturated hydraulic conductivity.
Existing Engineering Measures	Stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	27.8
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$196,678
Regrade	$46,382
Seed & Mulch	$22,931
Other	$0
Capital Cost Totals	**$265,991**
Capital Cost/Acre	**$9,558**

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Main Tailings Impoundment and Reclaim Pond

Function	Tailings deposition; Inactive since 1999
Notes	Located in Poison Spring; Poison Spring will be diverted into Grape Gulch Drainage at Closure. Both Poison Spring Drainage and Grape Gulch Drainage are tributaries of Hanover Creek.
Construction Method	Upstream tailings, mine waste rock outer dams.
Physical Characteristics	Fine to coarse grained. Low to medium saturated hydraulic conductivity.
Existing Engineering Measures	Decant sump, seepage collection at toe, filter dike, and reclaim pond and pipelines. Embankment buttresses; 6-inch thick cover on top surface.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	177.5
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$1,587,776
Regrade	$149,318
Seed & Mulch	$146,279
Other[1]	$349,634
Capital Cost Totals	**$2,233,007**
Capital Cost/Acre	**$12,578**

[1] Other includes channels, down drains

Note: The Main Tailings Impoundment is unchanged by end of year (EOY) 2023. Reclamation costs for the Reclaim Pond are included with the Main Tailings Impoundment. Cost also includes reclaiming south buttress area and burying tailing pipelines in place.

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Magnetite Tailings Impoundment

Function	Tailings deposition; Inactive since 1980
Construction Method	Upstream tailings construction.
Physical Characteristics	Fine grained. Low to medium saturated hydraulic conductivity.
Existing Engineering Measures	Ongoing tailing removal operation. Soil binding agent added to reduce fugitive dust. HDPE lined seepage collection pond at toe.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	62.5
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$494,977
Regrade	$75,660
Seed & Mulch	$51,473
Other[1]	$157,677
Capital Cost Totals	**$779,787**
Capital Cost/Acre	**$12,483**

[1]Other includes channels and downdrains
[2]Although there is the ongoing sale and shipping of magnetite material, the previous Magnetite Tailings Impoundment reclamation plan, based on 2004 topography, is still valid. Therefore, the updated Magnetite Tailings Impoundment reclamation cost was based on 2004 topography.

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

SWRDF

Function	Planned Waste Rock Stockpile Expansion By EOY 2023 the five WRFs (South, East, West, Buckhorn, Union Hill and additional areas in between) are combined into the South Waste Rock Disposal Facility (SWRDF). By EOY 2023 approximately half the proposed SWRDF material will be placed.
Construction Method	End dumped in 40 to 50 foot lifts; top surface will be bermed.
Physical Characteristics	Fine to coarse grained. Variable saturated hydraulic conductivity.
Engineering Measures	Will be managed similar to existing waste rock facilities consisting of seepage collection sumps, and stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)[1]	469.9
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$4,078,518
Regrade	$1,155,237
Seed & Mulch	$387,214
Other[2]	$2,383,466
Capital Cost Totals	**$8,004,435**
Capital Cost/Acre	**$17,033**

[1]Includes disturbed area adjacent and north of the SWRDF
[2]Other includes channels and downdrains

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Hanover Mountain Deposit

Function	Planned Mine Area
Construction Method	Blasting, loading, and hauling rock (50 foot benches).
Physical Characteristics	NA
Engineering Measures	Maintenance and stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)[1]	93.3
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$680,322
Regrade	$0
Seed & Mulch	$76,876
Other	$93,363
Capital Cost Totals	**$850,562**
Capital Cost/Acre	**$9,116**

[1]Includes berm and fence disturbed area.

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Surface Impoundments

Function	Stormwater / Seepage Collection
Construction Method	Membrane-lined; soil; concrete; unlined.
Physical Characteristics	Varies.
Existing Engineering Measures	Maintenance and Monitoring.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)[1]	5.4
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$41,235
Regrade	$357
Seed & Mulch	$4,449
Other	$0
Capital Cost Totals	**$46,041**
Capital Cost/Acre	**$8,526**

[1]Reclaim Pond included with Main Tailing Impoundment

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Miscellaneous

Function	Unknown
Notes	Includes reclamation of haul and exploration roads, and reclamation of land disturbances not currently foreseen during the next 5 years
Construction Method	Cut and fill for roads; scarifying, discing, drill seeding all areas
Physical Characteristics	12 to 120 feet wide driving surface with roadside berms for roads; as needed in disturbed areas not requiring cover placement
Existing Engineering Measures	Ongoing maintenance and stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	133.4
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$445,863
Regrade	$0
Seed & Mulch	$42,390
Other	$7,329
Capital Cost Totals	**$495,582**
Capital Cost/Acre	**$3,714**

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Cobre Haul Road[1]

Function	Planned Site Traffic
Notes	Haul road from Continental Mine to Chino.
Construction Method	Cut & fill.
Physical Characteristics	120 feet wide driving surface with roadside berms.
Engineering Measures	Maintenance and stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
EOY 2023 Reclaimed Area (acres)	100
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$17,833
Regrade	$285,824
Seed & Mulch	$82,397
Other[1]	$0
Capital Cost Totals	**$386,053**
Capital Cost/Acre	**$3,861**

[1]Cobre Haul Road Closeout Plan was submitted previously. Costs are updated for 2019.

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

Pearson-Barnes Mine Area

Function	Historical Site; Reclaimed in 2005
Notes	Reclaimed mine site and stockpile, currently requires ongoing monitoring and maintenance; ultimately the area will be incorporated into the SWRDF. By EOY 2023 the area is still in its existing configuration.
Construction Method	Stockpile - end dumped, historical shaft, and highwall.
Physical Characteristics	Barringer fault and associated bedrock, low saturated conductivity.
Existing Engineering Measures	Ongoing monitoring and maintenance.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	11.9
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$103,427
Regrade	$0
Seed & Mulch	$9,805
Other	$0
Capital Cost Totals	**$113,233**
Capital Cost/Acre	**$9,515**

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

2019 CCP Update

Facility Characteristics Form

No. 3 Stockpile

Function	Inactive; Stockpile containing overburden removed during advancement of No. 3 Shaft
Construction Method	End dumped.
Physical Characteristics	Coarse grained. High saturated hydraulic conductivity.
Existing Engineering Measures	Stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	5.7
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$39,935
Regrade	$3,749
Seed & Mulch	$4,697
Other	$0
Capital Cost Totals	**$48,381**
Capital Cost/Acre	**$8,488**

[1] No. 3 Stockpile reclamation covered under reclamation of haul road around southwest flank of Hanover Mountain.

2014 Continental Mine Closure/Closeout Plan (CCP) and 2018 Update

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Facility Characteristics Form

North Overburden Stockpile

Function	Various stockpiles containing cover material
Construction Method	End dumped.
Physical Characteristics	Coarse grained. High saturated hydraulic conductivity.
Existing Engineering Measures	Stormwater management.

Matrix of Costs
Capital Cost/Facility

	EOY 2023
Reclaimed Area (acres)	19.1
Item	**Capital Cost**
Cover Material (Load, haul, spread)	$0
Regrade	$2,335
Seed & Mulch	$15,738
Other	$0
Capital Cost Totals	**$18,072**
Capital Cost/Acre	**$946**

Appendix B

Earthwork Costs

Appendix B
Earthwork Cost

Prepared for

Freeport-McMoRan Inc.
Chino Mines Company
99 Santa Rita Mine Road
Vanadium, New Mexico 88043

Prepared by

Telesto Solutions, Inc.
3801 Automation Way, Suite 201
Fort Collins, CO 80525

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Appendix B
Earthwork Cost

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Report Authors and Contributors

Telesto Solutions, Inc.

Fred Charles

_____
Fred Charles, P.E. – Report Author

Walter L. Niccoli

_____
Walt Niccoli P.E. – Report Review

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1.0 INTRODUCTION

1.1 Purpose and Summary

This earthwork reclamation cost estimate update includes reclamation earthwork, demolition, and site operations and maintenance (O&M) costs for the Continental Mine. This estimate is an update to the estimated costs presented in the original 2014 CCP (Telesto, 2014) and the 2018 update (Telesto, 2018).

1.2 Reclamation Overview

A summary of the mine facilities is provided in Table B-1. This document includes all facilities requiring reclamation as of EOY 2023 and O&M for all facilities reclaimed prior to and after EOY 2023.

2.0 COST ESTIMATE

The total current dollar cost for earthwork reclamation is $22,821,000, which includes $19,292,000 in capital costs plus $3,529,000 in O&M costs. A summary of the estimate is provided in Table B-2. The costs presented in this estimate are current (2019) dollar costs. The earthwork reclamation operations are planned to take place over a 4-year period, preceded by 1 year of engineering design and followed by 1 year of reporting.

Table B-1 Facility Overview[1]

Feature	Notes
Main Tailings Impoundment	Remains in existing configuration by EOY 2023
Magnetite Tailings Impoundment	Sale and shipping of magnetite material continues through mine life. Reclamation costs use pre-sales configuration.
No. 3 Shaft Stockpile	Remains in current condition at EOY 2023
South Waste Rock Disposal Facility	Approximately half planned SWRDF placed by EOY 2023
South, East, and Union Hill WRF	Covered by SWRDF by EOY 2023. East side is not buried by the expansion.
West and Buckhorn WRF	Covered by SWRDF by EOY 2023
Low Grade WRF	Remains in existing configuration by EOY 2023
Hanover Mountain Deposit	Mining still in progress by EOY 2023
Pearson Barnes	EOY 2023 the Pearson Barnes Mine area is unchanged
Cobre Haul Road	Constructed by EOY 2018
Haul Roads and Exploration Roads	Various changes to Haul Roads accommodate SWRDF expansion, Hanover Mountain exploration roads are mined out by EOY 2023
Unplanned Future Disturbance Areas	Areas outside immediate footprint which require grading, cover placement, seeding and mulch
Overburden and Topsoil Stockpiles	
East OB Stockpile	EOY 2023 covered by SWRDF
Top Soil Stockpile (TSSP)	Remains in existing configuration by EOY 2023
NOBS	Proposed Topsoil stockpile, in place by EOY 2023
South OB Stockpile	Proposed Topsoil stockpile, in place by EOY 2023
OB Stockpile-1	Remains in existing configuration by EOY 2023
OB Stockpile-2	Remains in existing configuration by EOY 2023
OB Stockpile-3	Remains in existing configuration by EOY 2023
OB Stockpile-4	Remains in existing configuration by EOY 2023
OB Stockpile-5	Remains in existing configuration by EOY 2023
Pit	
Continental Pit	GR002RE 01-1 Pit waiver

[1] See Appendix C for Surface Impoundments

Table B-2 Earthwork Cost Estimate Summary

Item	Subtotal, Direct Costs	Subtotal, Indirect Costs	Total Estimated Cost
Capital Item		**30%**	
Tailing Ponds			
Main Tailings Impoundment	$2,233,007	$669,902	$2,902,909
Magnetite Tailings Impoundment	$779,787	$233,936	$1,013,723
Subtotal	$3,012,794	$903,838	$3,916,633
Waste Rock and Ore Piles			
SWRDF	$8,004,435	$2,401,331	$10,405,766
No. 3 Stockpile	$48,381	$14,514	$62,895
Low Grade Ore WRF	$265,991	$79,797	$345,789
Subtotal	$8,318,807	$2,495,642	$10,814,450
Mines			
Hanover Mountain Deposit	$850,562	$255,169	$1,105,730
Continental Pit	$74,070	$22,221	$96,291
Subtotal	$924,632	$277,390	$1,202,021
Surface Impoundments			
Surface Impoundments	$46,041	$13,812	$59,854
Subtotal	$46,041	$13,812	$59,854
Historic Sites			
Pearson-Barnes Mine Area	$113,233	$33,970	$147,202
Subtotal	$113,233	$33,970	$147,202
Other Disturbed Areas			
Miscellaneous Areas	$495,582	$148,675	$644,256
North Overburden Stockpile	$18,072	$5,422	$23,494
Subtotal	$513,654	$154,096	$667,750
Demolition			
Demolition	$1,524,735	$457,421	$1,982,156
Subtotal	$1,524,735	$457,421	$1,982,156
Total Capital Cost without CHR	$14,453,897	$4,336,169	$18,790,066
Cobre Haul Road	$386,053	$115,816	$501,869
Total Capital Cost with CHR	$14,839,950	$4,451,985	$19,291,935
Operations and Maintenance		**17.5%**	
O&M	$3,003,598	$525,630	$3,529,228
Total Earthwork with O&M	**$17,843,000**	**$4,978,000**	**$22,821,000**

Cost calculations are presented in Appendix B.1 (in the 20190329_Continental_Stockpile_Tailing_Earthwork_RCE.xlsm spreadsheet) and supporting documentation is provided in Appendix B.2. The major assumptions for this cost estimate for specific facilities to be closed are presented in the original 2014 CCP (Telesto, 2014) and the 2018 update (Telesto, 2018). Key assumptions or general data inputs used throughout the cost estimate include the following:

- **Dozer Push Distances:** Dozer push distances represent the distance from the centroid of the cut block to the centroid of the fill block.
- **Cover Placement**: Trucks and loaders with dozer assist perform all cover loading and distribution. The economic optimum number of trucks per loader was used for each haul route.
- **Haul Distances**: Haul distances are calculated along a preferred route and assumed to originate at the approximate centroid of the source and terminate at the approximate centroid of the reclamation area. A maximum of three segments are used for each haul route.
- **Borrow Areas**: Overburden stockpile material was approved for use as cover material (Condition 81; Golder, 2006). Borrow areas are left in a condition such that they can be directly ripped and revegetated (Table B-1 and Table B-2). Per agreement with the agencies, only the North Overburden Stockpile is used in this RCE and is anticipated to be ripped and revegetated when its use as a borrow area is completed.
- **Dust Suppression and Site Maintenance**: A water truck and a motor grader are included as part of the fleet during reclamation (Table B-3). The water truck and grader task time is equal to loader task time.
- **Labor Rates:** All labor rates are developed based on the New Mexico Department of Labor (NMDOL) Type H (Heavy Engineering) labor rates effective January 1, 2019 (NMDOL, 2019). These rates include the base, fringe benefit, and apprenticeship contribution rates (Table B-3).
- **Equipment Rates:** Table B-3 summarizes the earth-moving equipment, commonly be available to a contractor, which are used in the estimate. The equipment unit operating costs are taken from EquipmentWatch (Penton Media, Inc., 2019) Custom Cost Evaluator.
- **Equipment Production Factors:** Table B-4 summarizes equipment production factors from Caterpillar for each type of equipment used as presented in Table B-3. Productivity curves are also developed from Caterpillar information.

Table B-3 Labor and Equipment Unit Costs

Equipment Description	Fuel Cost ($/hr)	Total Rental Cost (w/o fuel) ($/hr)	NMDOL Operator Group	NMDOL Labor Rates	Total Cost (Equipment, Fuel, Labor) ($/hr)
Cat D11T CD, U Blade	$69.62	$254.44	Equipment Operator IV	$27.41	$351.47
Cat D9T, SU Blade	$33.58	$198.37	Equipment Operator IV	$27.41	$259.36
Cat D6T, SU Blade	$16.89	$63.65	Equipment Operator IV	$27.41	$107.96
Cat D6T XL, SU Blade	$18.25	$65.52	Equipment Operator IV	$27.41	$111.18
Cat 319D L	$12.29	$52.38	Equipment Operator VI	$27.70	$92.37
Cat 992K	$59.97	$216.23	Equipment Operator VI	$27.70	$303.90
Cat 988H	$35.57	$128.76	Equipment Operator VI	$27.70	$192.03
Cat 980H	$25.27	$77.56	Equipment Operator VI	$27.70	$130.53
Cat 966H	$19.61	$73.11	Equipment Operator VI	$27.70	$120.42
Cat 16M	$22.23	$93.51	Equipment Operator IV	$27.41	$143.15
Cat 14M	$19.40	$86.71	Equipment Operator IV	$27.41	$133.52
Finn B260	$9.66	$15.92	Truck Driver III	$24.27	$49.85
Cat D11T CD Multi-shank (w/MSR-359H)	$69.62	$259.35	Equipment Operator IV	$27.41	$356.37
Ripper (MSR-189H)	--	$6.77	--	--	$6.77
Deere 7340	$13.99	$38.00	Truck Driver III	$24.27	$76.27
Cat 769D	$22.79	$108.01	Truck Driver III	$24.27	$155.07
Cat 725	$14.09	$73.11	Truck Driver III	$24.27	$111.47
Komatsu 730E/ CAT 789D	$78.34	$221.79	Truck Driver III	$24.27	$324.40
Off-Hwy Water Tanker Truck,6,000-gal.	$26.33	$67.69	Truck Driver III	$24.27	$118.28
1 Deck Screening Plant (5X16, 48X60)	$11.35	$40.59	Laborer I	$23.09	$75.02
3 Deck Screening Plant (5X16, 42X60)	$11.35	$41.16	Laborer I	$23.09	$75.60

Table B-4 Earthwork Equipment Production Factors

Parameter	Value	Comment/Reference
Swell Factor Stockpiles and Tailings[1]	0% Pushdown, 8% load & haul cover 15% load & haul cover	No virgin materials are being regraded as part of closure. Thus a swell factor is not applied when regrading material. Cover material volumes are calculated based on the reclaimed area and the cover depth. This factor accounts for swell when loading trucks. A portion of the excavation for the Reclaim Pond outlet channel is used for cover material. A cover volume was calculated based on an excavation volume; this calculation utilizes a swell factor.
Coarse Regrading Tops and Outslopes (D11T CD)		
Operator Factor [1]	1.0	Due to large job size assume operator with excellent skills (CPH 48: 19-55, excellent)
Material Factor	1.2 1.0	(CPH 48: 19-55) 1.2 for fine grading cover, other surfaces, and channel, 1.0 for coarse regrading stockpiles and tailing
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Grade Factor – Tops	1.0	(CPH 48: 19-55) 1 to 5% Slope
Grade Factor - Outslopes[1]	1.6	(CPH 48: 19-55) 3H:1V Slopes
Material Weight (lb/cy)	3,300 2,900 4,185	Stockpiles Tailing, cover materials Magnetite Tailings
Production Method/Blade Factor	1.2	(CPH 48: 19-55) Slot dozing
Visibility Factor	1.0	(CPH 48: 19-55) Clear, dust controlled by water trucks
Elevation Factor	1.0	(CPH 48: 30-7) Horsepower reduction table
Direct Drive Transmission	1.0	-
Fine Grading Cover, Other Surfaces, and Channels (D11T CD, D9T, D6T, 16M, 14M)		
Material Factor	1.2	(CPH 48: 19-55) fine grading cover
Grade Factor – Tops	1.0	(CPH 48: 19-55) 1-5% slopes
Grade Factor – Outslopes[1]	1.6	(CPH 48: 19-55) 3H:1V Slopes
Material Weight (lb/cy)	2,900	Fine grading cover material and tailing
Production Method/Blade	1.2 1.0	(CPH 48: 19-55, slot dozing) No correction applied channels, downdrains, and benches
Effective Blade Width (feet [ft])	22.0 ft D11T CD Universal Blade 14.08 ft D9T Semi Universal Blade 16 ft 16M, 14 ft 14M 10.67' D6T SU	(CPH 48: 19-17, 19-49) (CPH 48: 19-47) (CPH 48: 11-17) (CPH 48: 19-10, 19-43)
Speed (miles/hr)	2.5 mph D11T CD, 16M, and 14M 1.0 mph D9T and D6T	(CPH 48: 11-19, 19-24, 19-25) maximum equipment speeds based on information provided in the Cat Handbook and Safe mining practices
Operator Factor[1]	0.75	(CPH 48: 19-55) Average operator skill
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Visibility Factor	1.0	(CPH 48: 19-55) Clear, dust controlled by water trucks
Elevation	1.0	(CPH 48: 30-7)
Direct Drive Transmission	1.0	-
Ripper (D11T CD Multi-shank [w/MSR-359H])		
Ripping Length (ft)	1,000 large surface	-

Parameter	Value	Comment/Reference
	areas 100 liners	
Penetration (in)	18	-
Pocket Spacing (in)	59	(CPH 48: 19-72)
Number of Pockets	3	(CPH 48: 19-72)
Turn Time (min/pass)	0.25	(CPH 48: 19-72 to 19-75)
Speed (mph)	1	(CPH 48: 19-72 to 19-75)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Distance between passes (in)	59	Maintain pocket spacing value between passes
Loader (992K)		
Struck Capacity (cy)	16.0	(CPH 48: 23-223, 23-365)
Loader Cycle Time (load, dump, and maneuver; min)	0.65	(CPH 48: 23-287)
Bucket Fill Factor	0.875	(CPH 48: 23-287) ≥ 1" Loose Material
Speed (mph)	7.6 12.8	(CPH 48: 23-18) 7.6 mph loaded, forward 2nd gear; 12.8 mph empty, forward 3rd gear
Work Hour (min/hr)	50	(CPH 48: 19-55)
Loaders (988H, 980H)		
Struck Capacity (cy)	8.3 (988H) 7.5 (980H)	(CPH 41: 19-75) (CPH 48: 23-213, 23-214)
Loader Cycle Time (load, dump, and maneuver; min)	0.575 (988H) 0.525 (980H)	(CPH 44: 23-223) (CPH 48: 23-287)
Bucket Fill Factor	0.875	(CPH 48: 23-287) ≥ 1" Loose Material
Speed (mph)	7.3 12.9	(CPH 41: 12-7 [988H], 48:23-17 [980H]) 7.3 mph loaded, forward 2nd gear; 12.9 mph empty, forward 3rd gear
Work Hour (min/hr)	50	(CPH 48: 19-55)
Loader (966H)		
Struck Capacity (cy)	5.5	(CPH 48: 23-209, 23-210)
Loader Cycle Time (load, dump, and maneuver; min)	0.525	(CPH 48: 23-287)
Bucket Fill Factor	0.875	(CPH 48: 23-287) ≥ 1" Loose Material
Speed (mph)	7.8 13.7	(CPH 48: 23-16) 7.8 mph loaded, forward 2nd gear; 13.7 mph empty, forward 3rd gear
Work Hour (min/hr)	50	(CPH 48: 19-55)
Trucks (CAT 789D/Komatsu 730E) (2)		
Struck Capacity (cy)	101	EquipmentWatch Spec for Komatsu 730E
Heaped Capacity (cy)	145	EquipmentWatch Spec for Komatsu 730E
Rolling Resistance	2.5%	(CPH 48: 30-2) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 48: 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 48: 10-20) Avg. 1.0-1.2
Speed (mph)	35.5	(CPH 48: 10-14) top speed (loaded)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Trucks (CAT 769D)		
Struck Capacity (cy)	22.2	(CPH 29: 9-2) Capacity assumed for bench channel materials
Heaped Capacity (cy)	31.7	(CPH 29: 9-2) Capacity assumed for bench channel materials
Rolling Resistance	2.5%	(CPH 48: 30-2) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 48: 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 48: 10-20) Avg. 1.0-1.2
Speed (mph)	47	(CPH 29: 9-2) top speed (loaded)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency

Parameter	Value	Comment/Reference
Trucks (CAT 725)		
Struck Capacity (cy)	14.5	EquipmentWatch spec
Heaped Capacity (cy)	19.0	EquipmentWatch spec
Rolling Resistance	2.5%	(CPH 48: 30-2) Radial tires, dirt road maintained fairly regularly, watered, flexing slightly
Truck Exchange Time (min)	0.7	(CPH 48: 10-20) Avg. 0.6-0.8
Dump/Maneuver Time (min)	1.1	(CPH 48: 10-20) Avg. 1.0-1.2
Speed (mph)	34	(CPH 48: 1-2) top speed (loaded)
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Excavator (319D L)		
Work Hour (min/hr)	50	(CPH 48: 19-55) Job efficiency
Heaped Capacity (cy)	1	EquipmentWatch spec
Sheepsfoot Roller Length (ft)	3	Estimated
Maximum Reach at Ground Level (in)	380	EquipmentWatch spec
Swing Time (Loaded) (min)	0.09	(CPH 48: 7-247)
Swing Time (Empty) (min)	0.07	(CPH 48: 7-247)
Deere 7430 (and Finn B260 Mulcher, MSR-189H Ripper)		
Operating Width (ft)	12	Assigned based on typical width of revegetation equipment/implements
Speed (mph)	3	Assigned as average speed of tractor pulling revegetation equipment/implements
Work Hour (min/hr)	50	Assigned for consistency with other earthwork operations

CPH = Caterpillar Performance Handbook Editions 29, 41, 44, 47, and 48 (Caterpillar, Inc., 1998; Caterpillar, Inc., 2011; Caterpillar, Inc., 2014; Caterpillar, Inc., 2017; Caterpillar, Inc., 2018)

(1) The swell and operator factors used are consistent with factors presented to MMD and NMED in meetings with Tyrone on June 11, 2012, November 2, 2012, and a letter to MMD and NMED from Tyrone dated September 5, 2012 (Freeport-McMoRan Copper & Gold, 2012)..

(2) Performance information for the CAT 789D is used for parameters unavailable for the Komatsu 730E.

- **Fuel Costs**: Table B-5 lists the off-road diesel fuel cost for 2019 based on discussions with the FA Work Group in the fall of 2018; historical local quotes are correlated with public data to estimate the fuel cost (see Appendix D).
- **Capital Indirect Costs**: Total indirect costs of 30% are applied to the capital direct costs based on discussions involving the FA Work Group as agreed in January 2019. The indirect costs include but are not limited to Mobilization and Demobilization, Contingencies, Engineering Redesign Fee, Contractor Profit and Overhead, Project Management Fee, and State Procurement Cost (see Appendix D).
- **Operations and Maintenance Indirect Costs**: Total indirect costs of 17.5% are applied for long-term O&M, also as agreed by the FA Work Group for FNMO's RCEs. The indirect costs include but are not limited to Mobilization and Demobilization, Contingencies, Engineering Redesign Fee, Contractor Profit and Overhead, Project Management Fee, and State Procurement Cost (see Appendix D).
- **Revegetation Unit Costs**: The revegetation unit cost (Table B-5) is based on R.S. Means (2019) and EquipmentWatch (Penton Media, 2019) as agreed by the FA Work Group (Appendix D).

- **Riprap**: The riprap unit cost is based on a production schedule from T. G. McMauley, Inc. (Table B-5).
- **Downdrains**: Articulated Concrete Blocks (ACBs) are used for downdrains instead of riprap. The ACB unit cost is based on a quote for materials and installation obtained in September 2018 from the Armortec Area Manager (West) for Contech Engineered Solutions (ES), the manufacturer and distributor of ACBs. The number of ACB downdrains is based on the areal extents of the facilities.
- **Miscellaneous Unit Costs**: Other miscellaneous unit costs shown in Table B-5 are taken from several sources including R.S. Means Heavy Construction Cost Online Data (R.S. Means, 2019). All costs taken from R.S. Means are adjusted for the location of Las Cruces.
- **Well Abandonment**: The well abandonment unit costs are based on a quote from Layne Christensen Company obtained in July 2018.

3.0 MAIN TAILINGS IMPOUNDMENT

The Main Tailings Impoundment (MTI) reclamation cost was based on 2013 topography. The MTI is unchanged by EOY 2023. The Reclaim Pond is assumed to be reclaimed with MTI by reclamation year 5. The main activities involved in closing the tailing ponds include:

- Regrading top surface and southeast rock embankment
- Constructing surface water channels to route stormwater
- Constructing downdrains
- Hauling and grading cover material
- Scarifying and revegetating covered areas

4.0 MAGNETITE TAILINGS IMPOUNDMENT

The Magnetite Tailings Impoundment (MGTI) reclamation cost was based on 2004 topography, prior to the sale and shipping of magnetite material. The main activities involved in closing the MGTI include:

- Regrading top and outslope areas
- Constructing a downdrain
- Hauling and grading cover material
- Scarifying and revegetating covered areas

Table B-5 Miscellaneous Unit Costs

Activity	Base Per Unit Cost	Fuel Per Unit Cost	Units	Source	Reference
Fuel	$2.34	-	gal	N/A	Diesel fuel cost is estimated by correlating historical local quotes with public data, as agreed upon in November 2018 discussions with the agencies. Fuel cost includes direct and indirect costs at $2.34/gal.
Revegetation	$820.12	$3.85	ac	N/A	See unit rates calculations - Cost is based on a calculated unit rate that includes tractor rental and maintenance, fuel, scarifying, discing, drill seeding, mulching, crimping, seed, and mulch.
Erosion Control	$2,923.36	$382.26	day	Means Modified Crew B-13A	Erosion control for O&M - includes 1 foreman, 2 laborers, 1 equipment operator, 2 truck drivers, 1 loader (4 cy), 2 dump trucks (8 cy)
Building Demolition Cover	$1.88	-	cy	N/A	Assumed same as cover unit cost for No. 3 Stockpile
3:1 Stockpile Bench Grading	$1.74	$0.41	ft	N/A	Excavate and waste 9.26 cy/lf on slopes with D11T CD, 87-foot push. Finish grade with D9T SU 1/10th excavation volume
3:1 Tailings Bench Grading	$1.62	$0.40	ft	N/A	Excavate and waste 9.26 cy/lf on slopes with D11T CD, 87-foot push. Finish grade with D9T SU 1/10th excavation volume
2.5:1 Stockpile Bench Grading	$1.60	$0.38	ft	N/A	Excavate and waste 9.52 cy/lf on slopes with D11T CD, 78-foot push. Finish grade with D9T SU 1/10th excavation volume
Bench Channel Construction, 3:1 Tailings and 3:1 Waste Rock	$8.01	$1.64	ft	N/A	Excavate and waste 0.43 cy/lf with D11T CD, 175-foot excavation, 200-foot lateral waste push. Finish grade with D6T XL SU 1/10th excavation volume. Includes filter and riprap. Calculated based on rip-rap production sequence by TG McCauley – assumed hauled average of cover haul distance.
Bench Channel Construction, 2.5:1 Waste Rock	$7.61	$1.56	ft	N/A	Same as for 3:1 tailing and waste rock, but with different channel cross section
Top Channel Construction Type I	$18.43	$3.84	ft	N/A	Excavate and waste 2.4 cy/lf with D11T CD, 175-foot excavation, 200-foot lateral waste push. Finish grade with D9T SU 1/10th volume as excavation. Includes filter and riprap costs
Top Channel Construction Type II	$45.34	$9.49	ft	N/A	Excavate and waste 2.4 cy/lf with D11T CD, 175-foot excavation, 200-foot lateral waste push. Finish grade with D9T SU 1/10th volume as excavation. Includes filter and riprap costs.
Downdrain Construction	$374.34	$0.19	ft	N/A	Articulated Concrete Block (ACB) installation for downdrains. See unit rate calculations.
Dissipater Construction	$14,556.48	-	ft	N/A	ACB installation for dissipater basins. See unit rate calculations.
Structure Demolition	$0.25	-	cf	Means Line Item 024116.13 0100	Building demolition, large urban projects, mixture of types, excludes foundation demolition, dump fees
Well Plug & Abandon	$10.47	-	ft	N/A	Layne Christensen Company, 7/31/18 Tyrone estimate is $10,000 mobilization and demobilization plus $5,704.94 for one 1500 ft well
Cleanup & Disposal of Wastes Requiring Special Handling	$335.20	-	ton	Means Line Item 028120.10 1120/1130	Solid pickup; average of minimum and maximum
Transport of Wastes Requiring Special Handling	$4.78	-	mile	Means Line Item 028120.10 1260/1270	Transportation to disposal site (Truckload = 80 drums or 25 cy or 18 tons); average of minimum and maximum
Berming	$2.64	-	Ft	N/A	2018 price inflated by 2%
Fencing (chain link), open pit perimeters	$23.05	-	ft	Means Line Item 323113.20 0800	Fence, chain link industrial, schedule 40, including concrete, 6 ga. wire, 6' high, but omit barbed wire, galv. Steel.
Disc Harrow Attachment, for Tractor	$616.33	-	month	Means Line Item 015433.20 1500	Equipment rental costs
Cast-in-Place Concrete	$254.97	-	cy	Means Line Item 033053.40 6200	Structural concrete, in place, gravity retaining wall (3000 psi), includes forms and reinforcement
Road Maintenance	$4,945.96	$1,240.32	month	N/A	Road maintenance for O&M - includes one 14M motor grader and one 6,000-gal water truck

R.S. Means data are obtained from R.S. Means online (2019) with location adjustment for Las Cruces.

5.0 WASTE ROCK FACILITIES

The existing Waste Rock Facilities (WRF) include the No. 3 Shaft Stockpile, and five contiguous waste rock piles: the South, East, West, Buckhorn, and Union Hill. By EOY 2023 the five facilities are combined into the South Waste Rock Disposal Facility (SWRDF). The SWRDF is at less than half of its anticipated maximum capacity by EOY 2023. This reclamation cost estimate is based on the 2023 projected configuration of the SWRDF. During mining, SWRDF material is placed at a 3.5H:1V overall slope (3H:1V interbench slope). Material placed on the east side is placed at 3H:1V overall slope (2.5H:1V interbench slope) to preserve the road located at the toe of the stockpile. The main activities involved in closing the SWRDF include:

- Regrading top surfaces and outslope areas
- Hauling and grading cover material
- Completing surface water channels to route stormwater
- Constructing downdrains
- Scarifying and revegetating covered areas
- Scarifying and revegetating the disturbed area adjacent and North of the SWRDF

Due to its small size, the No. 3 Shaft Stockpile would not require benching or drainage channels.

6.0 OTHER STOCKPILES

The cost estimate includes reclamation of the Low-Grade Waste Rock Stockpiles, located east of the Continental Pit. The main activities involved in closing the ore stockpiles include:

- Surface grading
- Hauling and grading cover material
- Constructing surface water channels to route stormwater
- Scarifying and revegetating covered areas

7.0 HANOVER MOUNTAIN DEPOSIT

In the 2014 CCP (Telesto, 2014), the proposed Hanover Mountain Deposit was planned to be mined from 2015 through 2020. Mining commenced in mid-2018. The main activities involved in closing the mining of the Hanover Mountain Deposit include:

- Hauling and grading cover material
- Scarifying and revegetating covered areas
- Installing safety fencing and constructing berms to prevent run-on

8.0 CONTINENTAL PIT

In the MMD permit GR002RE 01-1 the Continental Pit was granted a conditional waiver from achieving a self-sustaining ecosystem. The Continental Pit extent was delineated using 2013 topography. Reclamation of the open pit consists of a combination of fencing and berms to prevent access and minimize runoff into the open pit.

9.0 BUILDING DEMOLITION/RECLAMATION

A number of facilities are used for Industrial Post Mining Land Use (PMLU). Those facilities not designated for Industrial PMLU will be demolished, removed, and/or buried or otherwise closed in accordance with an approved plan.

10.0 OTHER MISCELLANEOUS COSTS

This category includes miscellaneous estimated closure costs such as wells, surface impoundments, Pearson-Barnes Mine Area, and roads. Additionally, an unplanned future disturbance area of 50 acres was added to account for disturbances not specifically foreseen, but which might be incurred during the term of this closure-closeout plan. Post-closure capital and O&M costs associated with utilities such as tanks, ponds, pumps, pipelines, and electrical infrastructure are located in a separate water management cost estimate.

10.1 Wells

Costs are included for the abandonment of post-closure monitoring wells. It was assumed that 7 monitoring wells are used for post-closure monitoring and are abandoned at the end of the 100-year post-closure period (Appendix B.1).

10.2 Surface impoundments

Surface impoundments are stormwater and seepage retention structures. The O&M costs for surface impoundments are included in a separate water management cost estimate. Costs are included to close non-Industrial PMLU surface impoundments used during reclamation years 0 to 12. A table describing water management surface impoundments is included in Table C-1 in Appendix C of the 2014 CCP (Telesto, 2014). The main activities involved in closing surface impoundments include:

- Ripping liners and burying in place
- Hauling and grading cover material
- Scarifying and revegetating covered areas

10.3 Pearson-Barnes Mine Area

The Pearson-Barnes Mine Area is ultimately incorporated into the SWRDF expansion. By EOY 2023 the Pearson-Barnes Mine area is unchanged. The main activities involved in closing the Pearson-Barnes Mine Area include:

- Hauling and grading cover material
- Scarifying and revegetating covered areas

10.4 Roads

A closeout plan, including reclamation costs, was recently completed for the Cobre Haul Road. The costs have been updated and are included in Table B-2. The main activities involved in closing other roads not needed during post-closure include:

- Hauling and grading cover material
- Scarifying and revegetating covered areas

10.5 Unplanned Future Disturbance Areas

A 50-acre area was added to account for unplanned future surface disturbances which might become necessary during the term of this plan. An example would be the potential need for linear infrastructure (road, pipeline, etc.). This part of the cost estimate accounts for scarifying and revegetating these potential future disturbance areas. The estimated costs are included with miscellaneous areas in Table B-2.

11.0 OPERATIONS AND MAINTENANCE

Operations and maintenance estimated costs relate to periodic erosion control, road maintenance, vegetation maintenance, and groundwater monitoring. Operations and maintenance costs are assumed to diminish with time as shown in the following listing.

Erosion Control:

- Reclamation Years 0–12: 12 days/year
- Reclamation Years 13–39: 4 days/year
- Reclamation Years 40–99: 1 day/year

Road Maintenance:

- Reclamation Years 0–19: 4 months/year at 24 hours/month
- Reclamation Years 20–39: 2 months/year at 24 hours/month
- Reclamation Years 40–99: 1 month/year at 24 hours/month

Vegetation Maintenance:

- Reclamation Years 0–11: Based on observations of previously reclaimed areas, the annual vegetation failure is conservatively estimated to be 2% failure every year for a total of 12 years, starting the year reclamation is completed.

Groundwater Monitoring:

- Reclamation Years 0–19: 4 days/year
- Reclamation Years 20–39: 2 days/year
- Reclamation Years 40–99: 1 day/year

12.0 REFERENCES

Caterpillar, Inc. 1998. Caterpillar Performance Handbook, Edition 29. Peoria, Illinois: Caterpillar, Inc.

Caterpillar, Inc. 2011. Caterpillar Performance Handbook, Edition 41. Peoria, Illinois: Caterpillar, Inc.

Caterpillar, Inc. 2014. Caterpillar Performance Handbook, Edition 44. Peoria, Illinois: Caterpillar Inc.

Caterpillar, Inc. 2017. Caterpillar Performance Handbook, Edition 47. Peoria, Illinois: Caterpillar Inc.

Caterpillar, Inc. 2018. Caterpillar Performance Handbook, Edition 48. Peoria, Illinois: Caterpillar, Inc.

Freeport-McMoRan Copper & Gold. 2012. Reclamation Cost Estimate Update, GR010RE, DP-1341 Operator Factor and Swell Factor. Letter to MMD and NMED dated September 5, 2012.

Golder Associates (Golder). 2006. Supplemental Borrow Materials Investigation, Continental Mine, Grant County, New Mexico. Prepared for Cobre Mining Company, Hurley, New Mexico by Golder Associates Inc., Albuquerque, New Mexico. February 1, 2006.

NMDOL. 2019. Prevailing Wage Poster H 2019. Retrieved January 16, 2019, from New Mexico Department of Labor: https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2019_final.pdf

R.S. Means. 2019. Heavy Construction Cost Data, Version 8.7. Retrieved from R.S. Means Data Online: https://www.rsmeansonline.com

Penton Media. 2019. EquipmentWatch Construction Estimator. Retrieved January and February 2019, from EquipmentWatch: https://equipmentwatch.com

Telesto Solutions, Inc. (Telesto). 2014. Continental Mine Closure/Closeout Plan. Prepared for Freeport-McMoRan Chino Mining Company, Vanadium, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. December 2014.

Telesto Solutions, Inc. (Telesto). 2018. Continental Mine Closure/Closeout Plan Update. Prepared for Freeport-McMoRan Chino Mining Company, Vanadium, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. May 2018.

Appendix B.1

Cost Calculations

Appendix B.1.1

Equations and Calculation Processes

Note: These are provided for example use only. Values and equations may not match current spreadsheet.

EQUATIONS USED IN CAPITAL COST SPREADSHEET

Sheet #4 Earthwork:

Bank Volume (bcy)= Loose Volume(cy)/(1+Swell Factor)

*Loose Volume (lcy)= Area (ac)*Cover Depth (in)*43560 (ft^2/ac)/(12 (in/ft)*27 (cy/ft^3))*

*** Swell Factor only applies to the cover material volume calculations*

Sheet #5 Dozer (Grading):

Productivity Example for D11T CD:

*Normal productivity (cy/hr) = 162,758.76 * Centroid to Centroid Push Distance(ft)$^{-0.866691}$*

(Caterpillar Performance Handbook Edition 47 page 19-51)

$$Productivity\ (cy/hr) = Normal\ Production\ (cy/hr) * Operator * Material * \frac{Work\ Hour\ (min/hr)}{60\ (min/hr)} * Grade\ Factor * \frac{2300\ (lbs/cy)}{Material\ Weight\ (lbs/cy)} * Prod.\ Method * Visibility * Elev. * Drive\ Trans.$$

$$Total\ Task\ Time\ (hr) = \frac{Loose\ or\ Stockpile\ Volume\ (cy)}{\text{Productivity}\ (cy/hr)}$$

$$Grade\ (Dozing\ Factor) = -0.02 * Grade\ (\%) + 1$$

$$(Caterpillar\ Performance\ Handbook\ Edition\ 48\ page\ 19-55)$$

Sheet #7 Ripper:

$$\text{Productivity } (acres/hr) = \frac{Work\ Hour\ (min/hr)}{\left[\left(\frac{Ripping\ Length\ (ft)}{5280(ft/mi) * \frac{Speed\ (mi/hr)}{60\ (min/hr)}}\right) + Turn\ Time\ (min/pass)\right] * Passes/Acre^{*}}$$

$$Task\ Time\ (hr) = \frac{Area\ (acres)}{\text{Productivity } (acres/hr)}$$

$$Passes/Acre^{*} = \frac{43560\ (ft^2/acre)}{Ripping\ Length\ (ft) * Ripped\ Width\ Plus\ Distance\ b/n\ Passes\ (ft)}$$

**Passes are 1000 ft for large surface areas and 100 ft for reservoirs*

$$Ripped\ Width\ Plus\ Distance\ b/n\ Passes\ (ft) = ((Pocket\ Spacing\ (in) + Distance\ Between\ Passes\ (in)) * No.Shank\ Pockets)/(12(in/ft))$$

Sheet #8 Excavator:

$$Task\ Time\ (hr) = (Cycle\ Time\ (min))/(60(min/hr)) * (Area\ (ac) * 0.5 * 43560(ft^2/ac))/(Sheepsfoot\ Roller\ Width\ (ft) * Maximum\ Reach\ (ft))$$

Sheet #9 Trucks:

$$Truck\ Cycle\ Time\ (min) = Haul\ Time\ (min) + \text{Return } Time\ (min) + Loading\ Time\ (min) + Truck\ Exchange\ Time\ (min) + Dump/Maneuver\ Time\ (min)$$

$$\text{Productivity } (cy/hr) = Work\ Hour\ (min/hr) * Loader/Shovel\ Cycles\ Per\ Truck * Loader/Shovel\ Net\ Bucket\ Cap\ (cy) * \frac{Optimum\ Number\ of\ Trucks}{Truck\ Cycle\ Time\ (min)}$$

$$Task\ Time\ (hr) = Maximum\ \left[\frac{Volume\ (cy)}{\text{Productivity } (cy/hr)}, Loader\ Task\ Time\ (hr)\right]$$

$$Loader/\ Shovel\ Cycles\ Per\ Truck$$
$$= Maximum\ \left[\frac{Truck\ Struck\ Capacity\ (cy)}{Loader/Shovel\ Net\ Bucket\ Capacity\ (cy)}, \frac{Truck\ Heaped\ Capacity\ (cy)}{Loader/Shovel\ Net\ Bucket\ Capacity\ (cy)}\right]$$

$$Total\ Haul\ \text{Distance}\ (ft) = \sum Segment\ Haul\ \text{Distance}\ (ft)$$

$$Haul\ \text{Distance}\ Segment\ (m) = Haul\ \text{Distance}\ (ft) * 0.3048\ \left(\frac{m}{ft}\right)$$

$$Haul\ Effective\ Grade\ (\%) = If(Haul\ Grade\ (\%) \geq$$
$$Rolling\ Resistance\ (\%), \big(Haul\ Grade\ (\%) +$$
$$Rolling Resistance\ (\%)\big), Absolute\ Value(Haul\ Grade\ (\%) + Rolling Resistance\ (\%))$$

$$\text{Return}\ Effective\ Grade\ (\%) = If(-Haul\ Grade\ (\%) \geq$$
$$Rolling\ Resistance\ (\%), \big(-Haul\ Grade\ (\%) +$$
$$Rolling Resistance\ (\%)\big), Absolute\ Value(-Haul\ Grade\ (\%) + Rolling Resistance\ (\%))$$

Travel Time Loaded and Empty (Uphill)Example for 777F:

$$777F\ Segment\ Travel\ Time\ Loaded\ Uphill\ (min/m) =$$
$$6.43 * Haul\ Effective\ Grade\ Segment\ (\%)^{4}$$
$$- 3.2933 * Haul\ Effective\ Grade\ Segment\ (\%)^{3}$$
$$+ 0.6548 * Haul\ Effective\ Grade\ Segement\ (\%)^{2}$$
$$- 0.005 * Haul\ Effective\ Grade\ Segment\ (\%) + 0.0009$$

$$777F\ Segment\ Travel\ Time\ Empty\ Uphill\ (min/m) =$$
$$- 0.0197 * \text{Return}\ Effective\ Grade\ Segment\ (\%)^{4}$$
$$+ 0.0276 * \text{Return}\ Effective\ Grade\ Segment\ (\%)^{3}$$
$$+ 0.011 * \text{Return}\ Effective\ Grade\ Segement\ (\%)^{2}$$
$$+ 0.0008 * \text{Return}\ Effective\ Grade\ Segement\ (\%) + 2.147$$
$$(Caterpillar\ Performance\ Handbook\ Edition\ 41\ page\ 9 - 39)$$
$$This\ is\ repeated\ for\ loaded\ and\ empty\ downhill\ travel\ times$$

$$Haul\ Time\ (min)$$
$$= \sum (Segment\ Travel\ Time\ Loaded\ (min/m)$$
$$* Segment\ Haul\ Dist\ (m))$$

$$\text{Return } Time\ (min) = \sum (Segment\ Travel\ Time\ Empty\ (min/m) * Segment\ Haul\ Dist\ (m))$$

$$Loading\ Time\ (min) = Loader/Shovel\ Cycle\ Time\ (min)$$

Sheet #10 Loader or Shovel:

$$Net\ Bucket\ Capacity\ (cy) = Struck\ (Rated)\ Bucket\ Capacity\ (cy) * Bucket\ Fill\ Factor$$

$$\text{Productivity } (cy/hr) = \frac{Net\ Bucket\ Capcity\ (cy) * Work\ Hour\ (min/hr)}{Loader/Shovel\ Cycle\ Time\ (min)}$$

$$Task\ Time\ (hr) = \frac{Volume\ (cy)}{\text{Productivity } (cy/hr)}$$

Sheet #11 Scraper:

$$Effective\ Grade\ Uphill\ (\%) = If(Haul\ Grade\ (\%) + Rolling\ Resistance\ (\%) > 0, \big(Absolute\ Value\ (Haul\ Grade\ (\%)) + Rolling Resistance\ (\%)\big), 0)$$

$$Effective\ Grade\ Downhill\ (\%) = If(Haul\ Grade\ (\%) - Rolling\ Resistance\ (\%) < 0, 0, \Big(Absolute\ Value\ \big(Haul\ Grade\ (\%)\big) - Rolling Resistance\ (\%)\Big))$$

Travel Time/Speed Loaded Speed (Downhill & Uphill) Example for 657G:

*Loaded Downhill Speed (mph) = 1/(0*Effective Grade Downhill^4 - 0.1612* Effective Grade Downhill ^3+0.1031* Effective Grade Downhill ^2 - 0.0081* Effective Grade Downhill +0.0016)*1609.344 m/mi/60 min/hr)*

(unless speed <0 then 0 or unless speed>maximum speed then maximum speed)

*Loaded Uphill Speed (mph) = 1/(0.3036*Effective Grade Uphill^4 - 0.4512* Effective Grade Uphill ^3+0.2181* Effective Grade Uphill ^2 - 0.0034* Effective Grade Uphill +0.0013)*1609.344 m/mi/60 min/hr)*

(unless speed <0 then 0 or unless speed>maximum speed then maximum speed)

$(Caterpillar\ Performance\ Handbook\ Edition\ 47\ page\ 24 - 30)$

$This\ is\ repeated\ for\ empty\ downhill\ and\ uphill\ travel\ times$

$$Scraper\ Return\ Cycle\ Task\ Time\ (min) = \frac{Total\ Haul\ Distance\ One\ Way(ft)}{Empty\ Scraper\ Return\ Speed\ (mph) * 88\left(\frac{ft}{mi}\right)\left(\frac{hr}{min}\right)} + \frac{Total\ Haul\ Distance\ One\ Way(ft)}{Full\ Scraper\ Haul\ Speed\ (mph) * 88\left(\frac{ft}{mi}\right)\left(\frac{hr}{min}\right)} + LoadTime(min) + Maneuver\&\ Spread\ Time(min)$$

$$Cycles\ Per\ Scraper\ Per\ Hour = Work\ Hour\ (min/hr)/ Scraper\ Return\ Cycle\ Task\ Time\ (min)$$

$$Productivity\ Per\ Heaped\ Scraper\ (cyhr) = Cycles\ Per\ Scraper\ Per\ Hour * Minimum(Heaped\ Capacity\ (cy), Rated\ Load\ (lb)/Soil\ Weight\ (lb/cy))$$

$$Total\ Task\ Time(hr) = Volume(cy)/(Productivuty\ Per\ Heaped\ Scrapper\ (cy/hr))$$

$$Task\ Time\ All\ Scrapers\ (hrs) = (Total\ Task\ Time\ (hr))/(Number\ of\ Scrapers)$$

Sheet #12 M'grader

$$Grader\ Shaping\ Productivity\ (acre/hr) = WorkHour(min/hr)/(60\ (min/hr)) * MaterialFactor * ((2300\ (lb/cy))/MaterialWeight(lb/cy)) * ProductionMethod, Blade * OperatorFactor * GradeFactor * Speed\ (mph) * (Eff.Blade\ Width(ft) - Pass\ Overlap(ft)) * 5280(ft/mi)/43560(ft\text{^}2/ac)$$

(Motor Grader Productivity, Caterpillar Performance Handbook Edition 48)

$$Task\ Time(hr) = Area(acre)/(GradingShapingProductivity(acre/hr))$$

$$Grade\ Factor = -0.02 * \%\ Final\ Grade + 1$$

Sheet #13 Earth Sum:

$$Direct\ Equipment\ Cost\ (\$) = [Lube, Tires, GEC, \&\ Field\ Parts\ Adjusted\ Rental\ Cost\left(\frac{\$}{hr}\right) + Labor\ Cost\ \left(\frac{\$}{hr}\right) + Field\ Cost\ \left(\frac{\$}{hr}\right)] * TimeRequired\ (hr) * Number\ of\ Units\ of\ Equipment$$

Sheet #14 Reveg:

$$Direct\ Fuel\ Cost\ (\$) = Fuel\ Unit\ Cost(\$/acre) * Area(acre)$$

$$Direct\ Reveg.Cost\ (\$) = Reveg.Unit\ Cost(\$/acre) * Area(acre)$$

Sheet #15 Other:

$$Fuel\ Direct\ Cost\ (\$/units) = Quantity\ (units) * Fuel\ Unit\ Cost(\$/unit)$$

$$Direct\ Cost(\$) = Quantity\ (units) * \ Unit\ Cost(\$/unit)$$

Sheet #16 Sum:

$$\begin{aligned} Subtotal\ Direct\ Costs\ (\$) \\ &= \ Facility\ and\ Structure\ Removal\ Total\ Direct\ Cost\ (\$) \\ &+ \ Earthmoving\ Total\ Direct\ Cost\ (\$)\ + Reveg.Total\ Direct\ Cost\ (\$) \\ &+ \ Other\ Total\ Direct\ Cost\ (\$) \end{aligned}$$

$$\boldsymbol{Subtotal\ Indirect\ Costs}(\$) = \boldsymbol{SubTotal\ Direct\ Cost}\ (\$) * \frac{\boldsymbol{Indirect\ Costs}\ (\%)}{\mathbf{100}}$$

$$\boldsymbol{Total\ Cost}\ (\$) = \boldsymbol{Subtotal\ Direct\ Cost}\ (\$) + \boldsymbol{Subtotal\ Indirect\ Cost}\ (\$)$$

Sheet #18 Truck Optimization:

$$Loader/Shovel\ Time\ Per\ Truck = (Loader/Shovel\ Cycles\ per\ Truck) * (Loader/Shovel\ Cycle\ Time)$$

$$Maximum\ Number\ of\ Trucks\ Per\ Loader/Shovel = (Truck\ Cycle\ Time\ Per\ Truck)/(Loader/Shovel\ Time\ per\ Truck)$$

$$\begin{aligned} &\text{Productivity}\ (cy/hr) = \\ &\quad Work\ Hour\ (min/hr) * Loader/Shovel\ Cycles\ Per\ Truck \\ &\qquad * Loader/Shovel\ Net\ Bucket\ Capacity\ (cy) * \frac{Number\ of\ Trucks[n]}{Truck\ Cycle\ Time\ (min)} \end{aligned}$$

$$Task\ Time\ (hr) = (Haul\ Volume(cy))/Productivity(cy/hr)$$

$$Cost\ of\ [n]\ Trucks\ per\ Loader\ (\$) = MAX(Truck\ Task\ Time, Loader\ Task\ Time) * (Loader\ Cost\ (\$/hr) +\ [n] * Truck\ Cost\ (\$/hr))$$

Sheet #19 Scraper Optimization:

$$Max\ No. Scrapers\ Per\ Dozer = (Scraper\ Return\ Cycle\ Task\ Time\ (min))/ (Pusher\ Cycle\ Time\ (min/cycle)\ )$$

$$Task\ Time\ per\ [n] Scrapers\ (hr) = Task\ Time\ for\ 1\ Scraper\ (hr)/[n]$$

$$\begin{aligned} Cost\ of\ [n]\ Scrapers\ per\ Dozer\ (\$) \\ &= (Task\ Time\ per\ [n] Scrapers\ (hr) * [n] * Scraper\ Cost(\$/hr)) \\ &+ (Task\ Time\ per\ [n] Scrapers * Dozer\ Cost\ (\$/hr)) \end{aligned}$$

Earthwork RCE Calculation Summary

Calculation Documentation

Problem Statement:

Freeport-McMoRan's Chino Mines Company has utilized a spreadsheet developed by the New Mexico Mining and Minerals Division (MMD) to estimate the earthwork's closure costs associated with the Chino Mine Closure/Closeout Plan (CCP). The spreadsheets are intricate and complex and require careful study to master their structure. Each worksheet groups similar activities, and each line on each worksheet documents one construction step required to complete reclamation. All lines totaled equal the entire earthworks for the CCP. The sheer amount of information in the spreadsheet makes review of the cost estimate difficult for a site as complex as the Chino Mine.

Objective:

1. Provide a guide to the earthwork spreadsheets.
2. Note that this calculation set presents the approach, data and assumptions, and calculations and results for developing the unit cost. It is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Approach:

1. Identify worksheets within the spreadsheet.
2. Provide a general equation or explanation of the calculation performed in each worksheet.
3. Use a graphic of each worksheet to illustrate the equations and augment the explanations pertaining to the specific worksheet.

Results:

The following worksheets are included within the earthwork RCE spreadsheet and covered in this calculation documentation:

Databases:

1. Quantities
2. Activity-Material Codes
3. Unit Rates
4. Equipment

Earthwork Calculations:

1. General
2. Demo
3. Material
4. Earthwork
5. Dozer
6. Site Maint
7. Ripper
8. Excavator
9. Trucks
10. Shovel
11. Scrapers
12. M'grader
13. Earth Sum
14. Revegetation
15. Other
16. Summary
17. Facility Characteristics

Results:

The following worksheets are included within the earthwork RCE spreadsheet and covered in separate calculation documentations:

Equipment Optimization:
1. Truck Optimization
2. Scraper Optimization

O&M:
1. Full Site Vegetation Maintenance
2. Full Site O&M
3. Full Site O&M Summary

Building Demolition:
1. Building Demo
2. Building Cover
3. Building Vegetation
4. Building Hazardous Waste
5. Building Summary

Unit Costs:
1. Bench Grading
2. Bench Channel
3. Top Channel
4. Downdrain
5. Haul Road
6. Pipeline
7. Revegetation

Results Cont'd

Sheet 1 – General: A summary of the overall costs (before escalation and discounting for the time-value of money) are included on this sheet along with the applicant's information.

	A	B	C
1			Chino
2			Stockpile Spreadsheet Worksheet #1
3	***General Information***		2/12/2019
4			
5	Applicant	Chino Mines Company	
6		Hurley, New Mexico 88043	
7			
8			
9			
10			
11	Disturbed Surface Area (acres)	6,657	
12			
13	Type of Operation	Existing/Surface/Copper	
14			
15			
16			
17	*Current value of earthwork and O&M before escalation and discounting*	**$217,256,147**	
18			
19			
20			
21			
22			**Stockpiles, Tailing,**
23	*Based on Golder 2018 Closure/Closeout Plan*		**Reservoirs, Haul Roads**
24			**and Disturbed Areas**

Quantities Sheet: This sheet assigns an item code to a facility and corresponding sub-area code with a description of the facility and sub-area. This sheet provides raw data and factors (such as area, volume, distances, grades, etc.) to be used in calculations within all the other worksheets. Each facility is broken down into sub-areas to account for differing reclamation quantities to more accurately determine the amount of work required for each facility. The Quantities sheet includes 42 columns of hard-wired (hand entered) data associated with each facility. Columns A through R for Triangle Stockpile and South Stockpile are shown as an example:

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
1																		
2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
3	Item	Facility	Sub Area	Description	Area (sf)	Volume (cy)	Push Distance (ft)	Current Grade (%)	Coarse Regrading and Fine Grading (%)	Scraper Haul (ft)	Scraper Grade (%)	Down Drains (ft)	Downdrain ACB (sf)	Downdrain Dissipater (ea)	Bench Channels (ft)	Bench Grading (ft)	Top Area (sf)	Outslope Area (sf)
4	1000	Triangle Stockpile	T-0	Entire Stockpile	3,551,587										13,831	13,831	209,232	3,342,355
5	1001	Triangle Stockpile	T-1	Outslope	3,342,355	3,074,286	703	0.0%	-28.6%							-		
6	1002	Triangle Stockpile	T-2	Top	209,232				-1.0%							-		
7	1100	South Stockpile	S-0	Entire Stockpile	25,465,254							6,474	202,067	2	95,487	95,487	3,729,480	21,735,774
8	1101	South Stockpile	S-1	Outslope	280,820	348,051	389	-37.4%	-28.6%	4,809	7.2%					-		
9	1102	South Stockpile	S-2	Outslope	3,784,164	4,690,126	1,550	-38.5%	-28.6%	5,418	8.4%					-		
10	1103	South Stockpile	S-3	Outslope	3,309,641	4,101,997	1,840	-36.9%	-28.6%	2,633	7.6%					-		
11	1104	South Stockpile	S-4	Outslope	1,649,617	2,044,550	1,204	-35.5%	-28.6%	2,316	12.7%					-		
12	1105	South Stockpile	S-5	Outslope	3,599,540	4,461,300	2,025	-37.0%	-28.6%	1,969	11.8%					-		
13	1106	South Stockpile	S-6	Outslope	3,971,949	4,922,868	2,017	-37.4%	-28.6%	1,927	14.3%					-		
14	1107	South Stockpile	S-7	Outslope	2,075,308	2,572,155	1,206	-37.2%	-28.6%	1,927	14.3%					-		
15	1108	South Stockpile	S-8	Outslope	2,953,650	3,660,779	893	-41.3%	-28.6%	1,761	10.6%					-		
16	1109	South Stockpile	S-9(1)	Outslope	111,085	137,679	158	-43.8%	-28.6%	479	7.5%					-		
17	1110	South Stockpile	S-9(2)	Top	1,996,950	115,155	809	-0.5%	-1.0%							-		
18	1111	South Stockpile	S-9(3)	Top	1,732,530	99,907	648	-0.2%	-1.0%							-		

For example use only. Values may not match the current spreadsheet.

Results Cont'd

Activity-Material Codes Sheet: This sheet assigns an activity code (column A) to each activity (column B)

	A	B	C
1	**Item**	**Activity**	**Description**
2	A	Grade	Rough grading original material or fine grading cover material
3	B	Dozer Assist	Dozer is used to assist loader or shovel at cover stockpile or assist scrapers during rough grading
4	C	Load	Cover material is loaded at borrow areas onto haul trucks
5	D	Haul	Haul trucks transport cover material from borrow areas to destination stockpiles
6	E	Rip	Tops of stockpiles are ripped before placing cover to compensate for compaction of soil during rough grading. Stockpiles are also ripped before rough grading with a scraper. Borrow stockpiles are ripped before revegetation.
7	F	Grade Benches	Benches are graded at stockpiles and tailings after fine grading
8	G	Construct Downdrains	Downdrains are constructed after fine grading and consist of articulated concrete blocks (ACB's)
9	Gb	Construct Downdrain Dissipators	Energy dissipators are specified as part of the downdrains
10	H	Construct Bench Channels	Bench channels are constructed along benches after bench grading. Construction includes excavation and wasting, riprap production, riprap and filter placement, and final grading.
11	I	Construct Top Channels	Top channels are constructed after final grading. Construction includes excavation, wasting, and final grading.
12	J	Revegetate	Occurs after final grading and channel construction and includes tractor rental and maintenance, fuel, scarifying, discing, drill seeding, mulching, crimping, seed, and mulch
13	K	Perforate Liner	Reservoir liners are perforated prior to reclamation
14	L	Replace Infrastructure	Replacing infrastructure is not part of this RCE
15	M	Post-Closure O&M	Includes vegetation maintenance for 12 years after reclamation and erosion control, road maintenance, and groundwater monitoring for 100 years after reclamation
16	N	Plug and Abandon Well	Well borehole is backfilled with cement grout
17	O	Replace Well	Includes borehole drilling, casing, and cementing
18	P	Closure O&M	Dust suppression and site maintenance with water truck and motor grader
19	Q	Construct Haul Road	Upgrade or construct new haul road for cover placement
20			
21	**Item**	**Material**	**Description**
22	a	Existing Facility	Existing ground before rough grading
23	b	Cover	Cover material from cover stockpiles, before being placed at destination location
24	c	Graded Facility	Exisiting ground after rough grading
25	d	Placed Cover	Cover material after being placed at destination location
26	e	Final Grade	Facility material and cover material after rough grading and fine grading

The same is done by assigning a material code (column A) to differentiate the materials used in the spreadsheet.

	A	B	C
21	**Item**	**Material**	**Description**
22	a	Existing Facility	Existing ground before rough grading
23	b	Cover	Cover material from cover stockpiles, before being placed at destination location
24	c	Graded Facility	Exisiting ground after rough grading
25	d	Placed Cover	Cover material after being placed at destination location
26	e	Final Grade	Facility material and cover material after rough grading and fine grading

These codes are used to assign an ID to each task, on the Materials sheet. The codes dictate which earthwork calculation is used for each row of work.

Results Cont'd

Unit Rates Sheet: This sheet applies the same concept as the Quantities and Activity-Material Codes sheets whereby unit rates for particular activities utilized in the development of costs within the spreadsheet are identified and assigned a unit rate code. The unit rates are used throughout the RCE spreadsheet and are referenced from this sheet.

	A	B	C	D	E	F	G
10	Code	Activity	Base Per Unit Cost	Fuel Per Unit Cost	Units	Source	Reference
11	U1	Fuel	$ 2.34	-	gal	N/A	Diesel fuel cost is estimated based on a predictive equation developed by correlating U.S. No. 2 diesel retail prices (U.S. Energy Information Administration) and FMI local fuel quotes, as agreed upon in November 2018 discussions with the agencies. The correlation is based on a dataset for the period from 1995-2018. Fuel cost includes direct and indirect costs at $2.34/gal.
12	U2	Revegetation	$ 816.92	$ 3.85	ac	N/A	See unit rates calculations - Cost is based on a calculated unit rate that includes tractor rental and maintenance, fuel, scarifying, discing, drill seeding, mulching, crimping, seed, and mulch.
13	U2-1	Revegetation - Seed Only	$ 210.00	-	ac	N/A	Rocky Mountain Reclamation, April 2018
14	U2-2	Revegetation - Mulch Only	$ 490.00	-	ac	N/A	Rocky Mountain Reclamation, April 2018: $245 per ton applied at 2 tons per acre
15	U3	Bench Grading Stockpile	$ 1.52	$ 0.37	ft	N/A	See unit rates calculations
16	U4	Bench Grading Tailings Pond	$ 1.58	$ 0.39	ft	N/A	See unit rates calculations
17	U5	Downdrain Construction	$ 374.38	-	ft	N/A	See unit rates calculations
18	U6	Downdrain Dissipater	$ 14,556.48	-	ea	N/A	See unit rates calculations
19	U7	Bench Channel Construction	$ 4.62	$ 0.98	ft	N/A	See unit rates calculations
20	U8	Top Channel Construction	$ 2.12	$ 0.46	ft	N/A	See unit rates calculations
21	U9	Erosion Control	$ 2,923.36	$ 382.26	day	Modified Crew B-13A	Erosion control for O&M - includes 1 foreman, 2 laborers, 1 equipment operator, 2 truck drivers, 1 loader (4 cy), 2 dump trucks (8 cy)
22	U10	Structure Demolition	$ 0.25	-	cf	Means Line Item 024116.13 0100	Structure Demolition, Building Demolition large urban projects includes 20 mile haul no foundation or dump fees mixture of types $0.29/cf volume standing building
23	U11	Concrete Slab Demolition	$ 0.62	-	sf	Means Line Item 024116.17 0400	Building footing and foundation demolition 6 in thick plain concrete
24	U12	Storage Tank Demolition	$ 1,005.97	-	ea	Means Line Item 130505.75 0530	Selective Demolition - Storage Tanks, steel tank, single wall, above ground, not including foundations, pumps or piping, 5,000 thru 10,000 gallon
25	U13	Power Line Demolition	$ 0.63	-	ft	Means Line Item 260505.10 0370	cost to overhead powerlines.
26	U14	Power Pole Demolition	$ 216.24	-	ea	Means Line Item 024113.80 0200	Selective Demolition - wood utility poles 35-45 ft high
27	U15	Pipeline (small HDPE pipe)	$ 2.29	-	ft	Means Line Item 024113.38 1700	excludes excavation
28	U16	Pipeline (medium HDPE pipe)	$ 3.82	-	ft	Means Line Item 024113.38 1800	excludes excavation
29	U17	Pipeline (large HDPE pipe)	$ 5.72	-	ft	Means Line Item 024113.38 1900	excludes excavation
30	U18	Well Plug & Abandon	$ 10.47	-	ft	N/A	Layne Christensen Company, 7/31/18 Tyrone estimate is $10,000 mobilization and demobilization plus $5,704.94 for one 1500 ft well
31	U19	Well Replacement	$ 66.43	-	ft	N/A	Wilcox Professional Services, 8/2011, est. cost for 5 ¼ in bore, $173,500 for 3000 ft total ($57.83/ft). Escalated 2% 2011-2018= $66.43/ft
32	U20	Reinforced Concrete Wall Demolition	$ 199.20	-	hr	Means Crew B-12C	Standard Union Crew: 1 equipment operator (crane), 1 laborer, 1 hydraulic excavator, 2 cy, approximately 40 hrs to demo 200 ft reinforced concrete dam.
33	U21	Cover Haul Road Construction	$ 7.47	$ 1.85	ft	UC Haul Road Sheet	Assume dozer construction, 1:1 original slope, 120 ft wide
34	U22	Rake, spring tooth, with tractor	$ 2,779.95	-	month	Means Line Item 015433.20 2900	Equipment rental costs
35	U23	Tractor, farm with attachment	$ 2,327.40	-	month	Means Line Item 015433.40 6465	Equipment rental costs
36	U24	Disc harrow attachment, for tractor	$ 616.33	-	month	Means Line Item 015433.20 1500	Equipment rental costs
37	U25	Mulcher, diesel powered, trailer mounted	$ 1,702.45	-	month	Means Line Item 015433.20 2860	Equipment rental costs
38	U26	Cast-In-Place Concrete	$ 254.97	-	cy	Means Line Item 033053.40 6200	reinforcement
39	U27	Hazardous Waste Cleanup & Disposal	$ 335.20	-	ton	Means Line Item 028120.10 1120/1130	Solid pickup; average of minimum and maximum
40	U28	Hazardous Waste Transportation	$ 4.78	-	mile	Means Line Item 028120.10 1260/1270	minimum and maximum
41	U29	Road Maintenance	$ 4,945.96	$ 1,240.32	month		water truck
42	U30	Groundwater Monitoring	$ 2,282.94	-	day		Groundwater monitoring for O&M - includes 1 foreman, 1 laborers, rental equipment, misc. field equipment, and aqueous chemistry

Unit rates are either derived from separate calculations, RSMeans pages, or direct quotes. The unit costs are broken into base per unit cost (column C) and fuel per unit cost (column D) when applicable. If a unit cost is obtained from RSMeans, the Las Cruces, New Mexico, area cost is utilized.

Results Cont'd

Equipment Sheet: This sheet assigns a code to the various types of heavy equipment (bulldozers, wheeled loaders, excavators, etc.) used for mine closure activities. It also delineates a multitude of equipment costs and factors as well as labor costs based on the 2019 New Mexico Department of Labor hourly labor rates associated with each piece of equipment.

Equipment Code

Rental & Operating Equipment Costs

See Dozer sheet (Sheet 5) for development of the Productivity Equation

$$\boldsymbol{Productivity}_{normal} = C * (Distance_{Push}{}^{b})$$

C = Multiplier Constant and b = Exponent Constant

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1		EARTHWORK AND O&M EQUIPMENT													
2	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
3														Dozing Production (lcy/hr)[1]	
4														Production = C(Avg. Dozing distance in ft)[b]	
5	Code	Equipment Description	Equipment Type	Fuel Consumption (gal/hr)	Fuel Cost ($/hr)	Lube Cost ($/hr)	Field Parts ($/hr)	Tire Cost ($/hr)	Ground Engaging Component Cost ($/hr)	Monthly Rental Rate ($/month)	Field Labor Time Cost ($/hr)	Rental Cost (w/o fuel, lube, tires, or field parts) ($/hr)[2]	Lube, Tires, GEC, & Field Parts Adjusted Rental Cost (w/o fuel) ($/hr)	C	b
6	Comb1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	Combo 1	19.54	$ 45.72	$ 12.72	$ 3.75	$ 13.46	$ 1.16	$ 20,078.37	$ 9.23	$ 114.08	$ 154.40	-	-
7	Dz1	Cat D11T, U Blade	Dozer	29.75	$ 69.62	$ 26.23	$ 13.89	$ -	$ 12.22	$ 34,408.41	$ 6.60	$ 195.50	$ 254.44	155,881.59	-0.889952
8	Dz2	Cat D11T CD, U Blade	Dozer[7]	29.75	$ 69.62	$ 26.23	$ 13.89	$ -	$ 12.22	$ 34,408.41	$ 6.60	$ 195.50	$ 254.44	162,758.76	-0.866691
9	Dz3	Cat D9T, SU Blade	Dozer	14.35	$ 33.58	$ 11.22	$ 5.49	$ -	$ 3.98	$ 30,109.48	$ 6.60	$ 171.08	$ 198.37	52,161.03	-0.845532
10	Dz4	Cat D6T, SU Blade	Dozer	7.22	$ 16.89	$ 4.83	$ 2.10	$ -	$ 2.10	$ 8,939.42	$ 3.83	$ 50.79	$ 63.65	13,582.45	-0.74851
11	Dz5	Cat D6T XL, SU Blade	Dozer	7.80	$ 18.25	$ 5.28	$ 2.32	$ -	$ 2.36	$ 9,104.55	$ 3.83	$ 51.73	$ 65.52	13,582.45	-0.74851
12	Ex1	Cat 319D L	Excavator	5.25	$ 12.29	$ 3.47	$ 1.19	$ -	$ 0.84	$ 7,450.15	$ 4.55	$ 42.33	$ 52.38	-	-
13	Ld1	Cat 992K	Loader	25.63	$ 59.97	$ 22.35	$ 4.43	$ 35.39	$ 4.99	$ 25,527.98	$ 4.02	$ 145.05	$ 216.23	-	-
14	Ld2	Cat 988H	Loader	15.20	$ 35.57	$ 11.40	$ 2.11	$ 16.85	$ 1.93	$ 16,272.06	$ 4.02	$ 92.45	$ 128.76	-	-
15	Ld3	Cat 980H	Loader	10.80	$ 25.27	$ 6.70	$ 1.13	$ 7.69	$ 1.03	$ 10,030.76	$ 4.02	$ 56.99	$ 77.56	-	-
16	Ld4	Cat 966H	Loader	8.38	$ 19.61	$ 5.33	$ 0.84	$ 5.71	$ 0.75	$ 9,937.50	$ 4.02	$ 56.46	$ 73.11	-	-
17	Ld5	Cat 993K	Loader	30.40	$ 71.14	$ 20.70	$ 5.32	$ 42.47	$ 4.73	$ 25,527.98	$ 4.02	$ 145.05	$ 228.29	-	-
18	Mg1	Cat 16M	Motor Grader	9.50	$ 22.23	$ 8.69	$ 3.26	$ 10.13	$ 1.76	$ 11,906.70	$ 2.02	$ 67.65	$ 93.51	-	-
19	Mg2	Cat 14M	Motor Grader	8.29	$ 19.40	$ 6.57	$ 2.27	$ 7.04	$ 1.16	$ 11,906.70	$ 2.02	$ 67.65	$ 86.71	-	-
20	Rp1	Cat D11T CD Multi-shank (w/ MSR-359H)	Ripper	29.75	$ 69.62	$ 26.60	$ 14.20	$ -	$ 1.56	$ 36,753.56	$ 8.16	$ 208.83	$ 259.35	-	-
21	Sc1	Cat 637G	Scraper	38.00	$ 88.92	$ 17.07	$ 6.27	$ 7.57	$ 1.28	$ 25,070.00	$ 12.80	$ 142.44	$ 187.43	-	-
22	Sc2	Cat 657G	Scraper	42.86	$ 100.29	$ 20.41	$ 7.73	$ 9.34	$ 2.31	$ 25,070.00	$ 12.80	$ 142.44	$ 195.03	-	-
23	Sh1	Hitachi EX3600-5	Shovel[8]	82.72	$ 193.56	$ 59.15	$ 24.25	$ -	$ 16.56	$ 69,269.00	$ 14.45	$ 393.57	$ 507.98	-	-
24	Tc1	Deere 7430	Tractor	5.98	$ 13.99	$ 2.84	$ 0.61	$ 2.42	$ -	$ 5,210.05	$ 2.53	$ 29.60	$ 38.00	-	-
25	Tk1	Komatsu HD-1500 5	Truck[3]	28.12	$ 65.80	$ 19.90	$ 1.79	$ 25.19	$ -	$ 25,211.93	$ 7.47	$ 143.25	$ 197.60	-	-
26	Tk2	Cat 769D	Truck	9.74	$ 22.79	$ 8.77	$ 1.48	$ 13.72	$ -	$ 14,042.50	$ 4.25	$ 79.79	$ 108.01	-	-
27	Tk3	Cat 725	Truck	6.02	$ 14.09	$ 5.74	$ 0.94	$ 7.11	$ -	$ 9,849.60	$ 3.36	$ 55.96	$ 73.11	-	-
28	Tk4	Komatsu 730E	Truck[4]	33.48	$ 78.34	$ 20.49	$ 1.80	$ 21.21	$ -	$ 29,356.98	$ 11.49	$ 166.80	$ 221.79	-	-
29	Tk5	Cat 777F	Truck	18.76	$ 43.90	$ 19.31	$ 3.03	$ 26.81	$ -	$ 56,160.00	$ 6.38	$ 319.09	$ 374.62	-	-
30	Tw1	Off-Hwy Water Tanker Truck,6,000-gal.	WaterTruck	11.25	$ 26.33	$ 6.15	$ 1.48	$ 6.42	$ -	$ 8,171.67	$ 7.21	$ 46.43	$ 67.69	-	-
31	Tw2	Off-Hwy Water Tanker Truck,10,000-gal.	WaterTruck	15.43	$ 36.11	$ 9.04	$ 2.43	$ 10.47	$ -	$ 12,949.87	$ 10.30	$ 73.58	$ 105.82	-	-
32	X1	2 Deck Screening Plant (5X16, 48X60)	ScreenPlant	4.85	$ 11.35	$ 2.39	$ 1.15	$ 0.40	$ -	$ 5,738.88	$ 4.46	$ 32.61	$ 41.01	-	-
33	X2	3 Deck Screening Plant (5X16, 48X60)	ScreenPlant	4.85	$ 11.35	$ 2.43	$ 1.24	$ 0.39	$ -	$ 5,994.24	$ 4.62	$ 34.06	$ 42.74	-	-
34	X3	1 Deck Screening Plant (5X16, 48X60)	ScreenPlant	4.85	$ 11.35	$ 2.37	$ 1.14	$ 0.39	$ -	$ 5,671.66	$ 4.46	$ 32.23	$ 40.59	-	-
35	X4	3 Deck Screening Plant (5X16, 42X60)	ScreenPlant	4.85	$ 11.35	$ 2.38	$ 1.16	$ 0.37	$ -	$ 5,743.36	$ 4.62	$ 32.63	$ 41.16	-	-

The equipment sheet also contains the production equation coefficients for dozing (columns N-O) and scraper haul travel time coefficients (columns P-AI)

Haul Travel Time (min/m)=*A(Eff. Grade %)*^{4} + *B(Eff. Grade %)*^{3} + *C(Eff. Grade %)*^{2} + *D(Eff. Grade %)* + *E*

where effective grade is the sum of the measured grade and rolling resistance

See Trucks sheet (Sheet 9) for development of the Haul Travel Time Equation

	A	B	C	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	AG	AH	AI
1		EARTHWORK AND O&M EQUIPMENT																					
2	1	2	3	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35
3				Haul Travel Time (min/m) = A(Eff. Grade %)^4 + B(Eff. Grade %)^3 + C(Eff. Grade %)^2 + D(Eff. Grade %) + E																			
4				Loaded Uphill					Empty Uphill					Loaded Downhill					Empty Downhill				
5	Code	Equipment Description	Equipment Type	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E	A	B	C	D	E
6	Comb1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	Combo 1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	Dz1	Cat D11T, U Blade	Dozer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8	Dz2	Cat D11T CD, U Blade	Dozer[7]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
9	Dz3	Cat D9T, SU Blade	Dozer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10	Dz4	Cat D6T, SU Blade	Dozer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
11	Dz5	Cat D6T XL, SU Blade	Dozer	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
12	Ex1	Cat 319D L	Excavator	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13	Ld1	Cat 992K	Loader	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
14	Ld2	Cat 988H	Loader	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
15	Ld3	Cat 980H	Loader	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
16	Ld4	Cat 966H	Loader	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
17	Ld5	Cat 993K	Loader	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
18	Mg1	Cat 16M	Motor Grader	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
19	Mg2	Cat 14M	Motor Grader	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
20	Rp1	Cat D11T CD Multi-shank (w/ MSR-359H)	Ripper	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
21	Sc1	Cat 637G	Scraper	3.2483	-1.9562	0.4337	-0.0026	0.001	0	-0.3247	0.1601	-0.0038	0.0011	0.6464	-0.6147	0.1749	-0.0004	0.0011	0	0	0.0367	0.0018	0.0009
22	Sc2	Cat 657G	Scraper	0.3036	-0.4512	0.2181	-0.0034	0.0013	0	-0.1016	0.0774	-0.0013	0.0012	0	-0.1612	0.1031	-0.0081	0.0016	0	0.1668	-0.094	0.0207	0.0004
23	Sh1	Hitachi EX3600-5	Shovel[8]	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
24	Tc1	Deere 7430	Tractor	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
25	Tk1	Komatsu HD-1500 5	Truck[3]	4.494	-2.4571	0.6319	-0.0051	0.0011	0	-0.2561	0.1351	-0.0004	0.001	0	0	0.0856	0.0135	0.0009	0	0	0	0.0143	0.0005
26	Tk2	Cat 769D	Truck	0.5429	-0.487	0.1823	0.0151	0.0007	0	0.0224	-0.0076	0.0141	0.0007	0	0	-0.0808	0.426	-0.0008	5.6146	-3.6353	0.7823	-0.0535	0.002
27	Tk3	Cat 725	Truck	0.1363	0.1636	-0.04	0.0342	0.0009	0	-0.024	0.0309	0.0099	0.001	0	2.5262	-0.7562	0.095	-0.002	0	0	0	0.0103	0.0009
28	Tk4	Komatsu 730E	Truck[4]	7.5599	-2.711	0.4209	0.005	0.0011	0	-0.0689	0.0501	0.0052	0.001	-	-1.1878	0.325	0.0042	0.001	-3.4907	2.4171	-0.55	0.0643	-0.0011
29	Tk5	Cat 777F	Truck	6.43	-3.2933	0.6548	-0.005	0.0009	0	-0.0197	0.0276	0.011	0.0008	2.147	-1.9812	0.5102	-0.0158	0.0009	0.7651	-0.3831	0.0898	-0.001	0.0008
30	Tw1	Off-Hwy Water Tanker Truck,6,000-gal.	WaterTruck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
31	Tw2	Off-Hwy Water Tanker Truck,10,000-gal.	WaterTruck	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
32	X1	2 Deck Screening Plant (5X16, 48X60)	ScreenPlant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
33	X2	3 Deck Screening Plant (5X16, 48X60)	ScreenPlant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
34	X3	1 Deck Screening Plant (5X16, 48X60)	ScreenPlant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
35	X4	3 Deck Screening Plant (5X16, 42X60)	ScreenPlant	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

For example use only. Values may not match the current spreadsheet.

Results Cont'd

Equipment Sheet cont'd:

Other equipment specifications listed in the equipment sheet can also be found in the Chino RCE report. It is important to note that each piece of equipment is assigned an operator group by which labor rates are assigned according to the most up to date labor rates from NMDOL.

50		**EARTHWORK AND O&M LABOR**	
51		NMDOL Type A	Rate
52		Operator Group	($/hr)
53		Equipment Operator IV	$ 27.41
54		Equipment Operator V	$ 27.52
55		Equipment Operator VI	$ 27.70
56		Laborer I	$ 23.09
57		Laborer II	$ 23.84
58		Truck Driver III	$ 24.27

Sheet 2 – Demolition: Costs are based on square footage (ex: buildings), linear footage (ex: pipeline or power line length), or lump sum per item (ex: power pole, well casing). The costs are derived from the 2019 R.S. Means Online Heavy Construction cost data or actual on-site experience and bids.

Example calculation: (1,825,711 feet of pipeline) x ($6.88 per linear foot)=$12,562,678

	A	B	C	D	E	F	G	H	I
1									Chino
2									Stockpile Spreadsheet Worksheet #2
3	***Demolition***								2/12/2019
4									
5	Building Demolition costs are calculated in "1 BuildingDemo", "2 BuildingCover", "3 BuildingVeg", and "4BuildingHazardousWaste" and summarized on the last line of this table.								
6	This sheet calculates miscellaneous demolition costs associated with the North Mine Area, Pipeline Corridor Area, and South Mine Area.								
7									
8									
9									
10	**Item**	**Activity**	**Quantity**	**Unit**	**Unit Cost[1] ($/unit)**	**Direct Item Cost ($)**	**Reference**	**Means Line Ite**	**Description**
11	NMA & SMA Reclamation	Pipelines Demolition	1,825,711	ft	$6.88	$12,562,678	Means and Other (See Pipeline Unit Cost Sheet)	02 41 13.38 1800	Water and sewer pipeline lengths from 2018 Chino Bluestake map. Unit cost for Selective Demolition - water piping (small = $2.34 per foot, medium = $3.88 per foot, large = $5.83 per foot based on Means (2018) adjusted for local labor and EquipmentWatch rates. Excludes excavation costs. See pipeline unit cost calculation.
12	NMA & SMA Reclamation	Pipeline Corridor Area Revegetation	8.2	ac	$820.77	$6,730	See Revegetation Unit Cost Sheet	N/A	See unit rates calculations. Area based on 30' corridor minus 12' for vehicles (18') multiplied by length of pipeline in Pipeline Corridor Area (length from pg. 249-250 of CCP).
13	NMA & SMA Utilities Reclamation	Power Poles Demolition	246	ea	$216.24	$53,195	Means	024113.80 0200	Number of power poles from 2018 Chino Bluestake map. Unit cost for Selective Demolition - wood utility poles 35-45 feet high.
14	NMA & SMA Utilities Reclamation	Power Lines Demolition	318,553	ft	$0.63	$200,688	Means	260505.10 0370	Wire and cable lengths from from 2018 Chino Bluestake map. Unit cost for Electrical Demolition - Nonmetallic sheathed cable 3 wire; assume similar enough in cost to overhead powerlines.
15	NMA & SMA Utilities Reclamation	Utility Corridors Revegetation	36.6	ac	$820.77	$30,011	See Revegetation Unit Cost Sheet	N/A	See unit rates calculations - Cost is based on a calculated unit rate that includes tractor rental and maintenance, fuel, scarifying, discing, drill seeding, mulching, crimping, seed, and mulch.
16	NMA Reclamation	Concrete Surface Containments	154	hr	$199.20	$30,756	Means	Means Crew B-12C	Standard Union Crew: 1 equipment operator (crane), 1 laborer, 1 hydraulic excavator, 2 cy, approximately 40 hrs to demo 200 ft reinforced concrete dam.
17	Building Demolition	See Building Demo Sheets	N/A	N/A	N/A	$8,374,878	See Building Demo Sheets	N/A	Direct costs only, 20% added to buildings with extra equipment removal.
18									
19									
20									
21									
22									
23					**Total Direct Cost:**	$21,258,937			

For example use only. Values may not match the current spreadsheet.

Results cont'd:

Sheet 3 – Material: No calculations are included on this sheet. Four codes, which can be referenced from the Quantities, Activity-Material Codes, and Equipment or Unit Rates sheets, are entered by hand for each row in Columns A – D. The column labeled ID concatenates the codes. The ID contains the codes for facility location (with sub-area if applicable), work activity, material and equipment used for that particular row of work. This combination determines which equipment production and cost equations are used in the rest of the spreadsheet. The other columns on this sheet then reference the ID to lookup the description from the Activity Material Codes sheet, the source and destination locations from the Quantities sheet, the total haul or push distance and grade from the Quantities sheet, and the equipment (when applicable) from the Equipment sheet.

All activities for the Chino RCE are listed on this sheet and carried through the succeeding worksheets of the RCE. The description (F314) lists the activity, top or outslope (if applicable), and the material. The source location (G314) lists the stockpile name (or sub-area) for the location of the activity. If borrow material is involved, it is transported from a borrow stockpile to a destination stockpile (H314). Push or haul distance (I314) is used as part of calculating equipment production on Sheets 5, 9, and 11. Grade (J314 - haul grade or facility slope) is used as part of calculating equipment production on Sheets 5, 9, 11, and 12. Equipment (K314) lists the name of the equipment referenced in the ID. Blank cells indicate that that column is not relevant to a particular activity.

The ID for the example below is 2323-D-b-Tk4. This indicates that a Komatsu 730E truck (Tk4) will be used to haul (D) cover material (b) from STS2 to the Raffinate Pond (2323). The total haul distance from STS2 to the Raffinate Pond is 22,828 feet, with an average haul grade of 7.7%.

2300-Facility and 23-Sub-area

D-Activity and b-Material

Tk4-Equipment to be used

Chino
Stockpile Spreadsheet Worksheet #3
2/12/2019

Material Handling Plan Summary Sheet

All activities for the Chino RCE are listed on this sheet and carried through the succeeding worksheets of the RCE. The column labeled ID contains the codes for the facility location, activity, material and equipment used for that particular row of work. The description lists the activity, top or outslope (if applicable), and the material. The source location lists the stockpile name (or sub-area) for the location of the activity. If borrow material is involved, it is transported from a borrow stockpile to a destination stockpile. Blank cells indicate that that column is not relevant to a particular activity.

Assumptions:

1 - Haul/Push Distance based on Golder Take-Offs 1401129-004-MTO-RevG_07_Chino_MTOs_05SEP18.xlsx or measured as shown in calc set
2 - Weighted Average Haul Grades based on Golder Take-Offs 1401129-004-MTO-RevG_07_Chino_MTOs_05SEP18.xlsx or measured as shown in calc set
3 - Grade Factors from SOW

Groundhog #5 (Item 2400) previously reclaimed - add 1 ft of cover and continue O&M
Tailings Ponds #1, 2, B, C, 4E, 4W - continue O&M (no other activities)
Santa Rita (Item 1500) has already been rough graded
Slag pile (Item 3301) has already been rough graded

Item	Activity	Material	Eq	ID	Description	Source Location 1	Destination Location 2	Total Haul/Push Distance (ft)[1]	Grade (%)[2,3]	Equipment
2323	D	b	Tk4	2323-D-b-Tk4	Haul-Cover	STS2	Raffinate Pond	22,828	7.7%	Komatsu 730E
2324	D	b	Tk4	2324-D-b-Tk4	Haul-Cover	STS2	Reservoir 2	8,173	2.3%	Komatsu 730E
2327	D	b	Tk4	2327-D-b-Tk4	Haul-Cover	STS2	Reservoir 6	25,168	0.8%	Komatsu 730E
2328	D	b	Tk4	2328-D-b-Tk4	Haul-Cover	STS2	Reservoir 7	25,168	0.8%	Komatsu 730E
2341	D	b	Tk4	2341-D-b-Tk4	Haul-Cover	STS2	Elmo's Pond	5,509	-0.2%	Komatsu 730E
2342	D	b	Tk4	2342-D-b-Tk4	Haul-Cover	STS2	Lower Lined Pond	5,509	-0.2%	Komatsu 730E
2343	D	b	Tk4	2343-D-b-Tk4	Haul-Cover	STS2	Upper Lined Pond	5,509	-0.2%	Komatsu 730E

For example use only. Values may not match the current spreadsheet.

Results cont'd:

Sheet 4 – Earthwork: Repeats the ID, Description, Source Location, and Destination Location for each row from the Materials sheet. The acreage (I325), cover depth (J325), swell factor (L325), and loose/stockpile volume (M325) are referenced from the Quantities sheet. The in-place (i.e., bank) volume (K325) is calculated from the loose/stockpile volume by dividing by the swell factor. Swell is assumed to occur when cover material is moved from the borrow stockpile to the haul truck. Material left in place is assumed to have no swell, meaning the bank and loose volumes are equal.

$$Volume_{loose\_cover} = area * depth_{cover}$$

I325*J325/12*43560/27

	E	F	G	H	I	J	K	L	M
9		***Earthwork Quantity Worksheet***							
10	Assumptions:								
11	1 - Acres and volumes Based on Golder Take-Offs 1401129-004-MTO-RevG_07_Chino_MTOs_05SEP18.xlsx								
12	2 - Cover Material Swell: The 'Loose Volume' is calculated based on the acreage to be covered, 3 ft of cover, and accounts for appropriate swell factor.								
13	3 - 8% swell factor is estimated for cover obtained from a mine stockpile because it is placed loose and is looser than cover borrowed from a natural deposit.								
14	ID	Description	Source Location 1	Destination Location 2	Area (ac)[1]	Cover Depth (in)	Bank/Stock pile Volume (bcy)[1]	Swell Factor (%)[3]	Loose/Stockpile Volume (lcy)[2]
325	3307-D-b-Tk6	Haul-Cover	West of Borrow E&H	35 Acre Misc. Area	35.0	36	156,852	8%	169,400

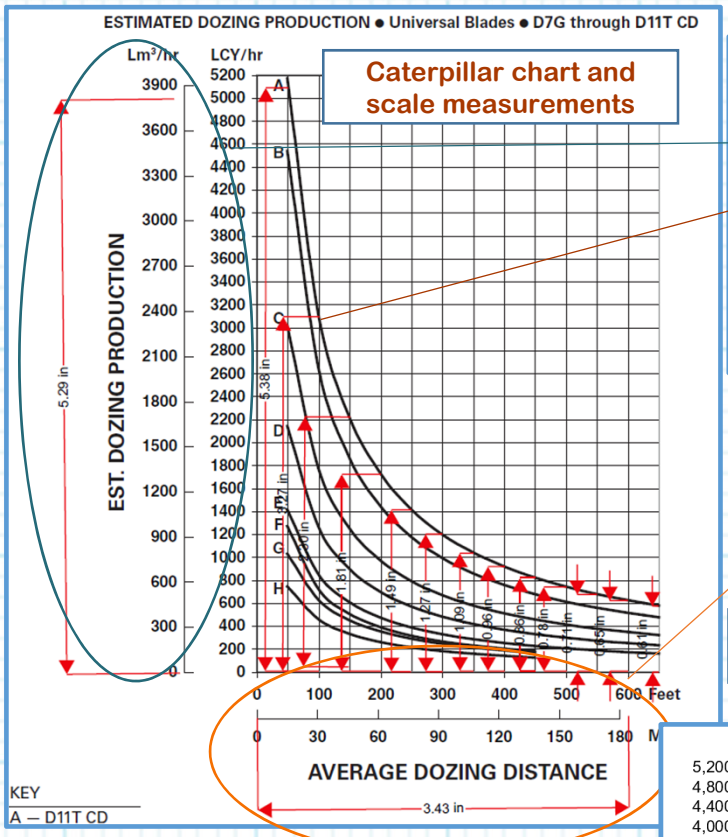
$$Volume_{bank} = \frac{Volume_{loose}}{(1 + F_{swell})_{bank}}$$

M325/(1+L325)

Sheet 5 – Dozer: Dozers are used for rough grading facilities, assisting loaders or shovels at borrow stockpiles, or pushing scrapers for grading facilities. See page 11 of this calculation documentation for a screenshot of the Dozer sheet. Columns E through J repeats ID, activity, locations, equipment from Sheet 3 (Material) and volumes from Sheet 4 (Earthwork). Columns K and U are the results of the dozer productivity calculations for grading (the multiplier and exponent coefficients C and b, respectively, for the normal productivity equation can be found in columns N and O of the Equipment sheet). Column O is the calculated task time. If the task is for dozer assist of scrapers or loaders/shovels, the dozer task time is equal to the task time of the scraper or loader/shovel, respectively. Columns L, M, and N are calculated on the scraper and loader sheets and repeated on the dozer sheet. The remaining columns are the input factors that produce the calculation result of bulldozer material handling productivity in cubic yards per hour based on material weight, grade, dozing type, push distance, and operating conditions such as visibility, operator experience, and elevation.

Results cont'd:

Sheet 5 – Dozer cont'd: Input values, power curves and capacities are taken from the 2017 and 2018 Caterpillar (Cat) Performance Handbook (CPH) (Editions 47 and 48) for the specific model dozer. Determining actual productivity starts by calculating the *normal* production factor using a formula derived by curve fit to productivity graphs provided in the CPH for the specific dozer. This is accomplished by scaling values from the figures and using the curve fitting tools within Microsoft Excel:

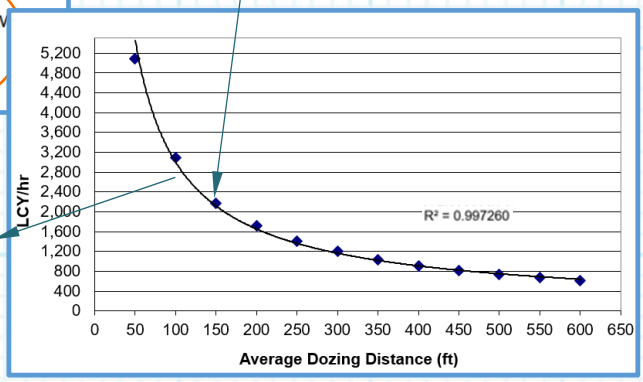


Caterpillar chart and scale measurements

	A	B	C	D	E	F	G	H
1	D11T CD							
2	Dozer production data (based on Caterpillar Handbook)							
3						PDF		
4	Maximum					Caterpillar Image Conversions		
5	Push	Adobe	Normal			Scaled Value (in)	Chart Value	
6	Distance	Measuremen	Production			5.29	5000	LCY
7	(feet)	(in)	(cy/hr)			3.43	600	Ft
8								
9	50	5.38	5,085					
10	100	3.27	3,091					
11	150	2.3	2,174					
12	200	1.81	1,711					
13	250	1.49	1,408					
14	300	1.27	1,200					
15	350	1.09	1,030					
16	400	0.96	907					
17	450	0.86	813					
18	500	0.78	737					
19	550	0.71	671					
20	600	0.65	614					
21	650	0.61	577					

=B10/F6*G6

Graph these two columns and find best fit equation



$$Productivity_{normal} = 159{,}372.008958 * Distance_{Push}^{-0.862481}$$

For example use only. Values may not match the current spreadsheet.

Results cont'd:

Sheet 5 – Dozer cont'd: The *normal* production curves assume a flat surface with a pushed material density of 2,300 lb/cy and a material that is not loose. To account for slope, operator experience, equipment specifications, and other site-specific factors, the CPH modifies the normal production curve by multiplying various factors to obtain the overall productivity:

$$Production_{normal} = C * Distance_{Push}^{b}$$

Productivity and Hours Required for Dozer Use---Earthmoving

Assumptions:
Uses volumes of outslope sections and dam breaches to calculate productivity
Uses push distances of outslope sections for grading productivity
Uses scraper push cycle time for dozer assist with scraper
Uses loader cycle time for dozer assist with loader at cover stockpiles
Grade Factor = -0.02(Grade %) + 1

	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
13												PERFORMANCE FACTORS											
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Loose /Stockpile Volume (cy)	Productivity (cy/hr)	Scraper Pusher Cycle Time (min)	Cycles per Scraper per Hr	Loader Cycle Time (hr)	Total Task Time (hrs)	Material Factor	Grade Factor	Material Weight (lb/cy)	Production Method/Blade	Centroid to Centroid Push Distance (ft)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans.	Cut to Fill Haul Grade (%)
54	1101-B-a-Dz3	Dozer Assist-Outslope-Existing Facility	South Stockpile S-1	-	Cat D9T, SU Blade	348,051	369	1.09	7.58	-	0.1	1.0	1.6	3,300	1.2	389	337	1.00	50	1.0	1.0	1.0	-28.6%

$$Productivity = F_{mat'l} * F_{grade} * F_{prod-method} * F_{operator} * F_{visibility} * F_{elev} * F_{drive} * \frac{WorkHour}{60min/hr} * \frac{2{,}300\ lb/cy}{Mat'l\ Weight} * Production_{normal}$$

=P54*Q54*S54*V54*X54*Y54*Z54*(W54/60)*(R54/2300)*U54

Sheet 6 –Road Maint: This sheet calculates the time required for a water truck and motor grader to be used for dust suppression and site maintenance during earthwork reclamation. Columns E through I repeats ID, activity, locations, and equipment. The Operational Maintenance Time (Column J) is assumed to be equal to the loader/shovel task time.

	E	F	G	H	I	J
1						Chino
2						Stockpile Spreadsheet Worksheet #6
3						01/10/19
4						
5		***Productivity and Hours Required for Dust Suppression and Site Maintenance***				
6						
7		Assumptions:				
8		6,000 gal water truck and 14M motor grader cost added with loader cost (water truck hours and 14M hours the same as loader hours) for dust suppression and site maintenance				
9						
10		**Sheet to which to tie hrs**	10 Loader			
11		**Equipment for hrs**	Sh1			
12						
13						
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Operational Maintenance Time (hrs)
553	1000-P-b-Comb1	Operational Maintenance-Cover	Upper South	Triangle Stockpile	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	130

Equals loading time on Loader/Shovel sheet

For example use only. Values may not match the current spreadsheet.

Results cont'd:

Sheet 7 – Ripper: Rippers are used after rough grading, before placing cover, at all facilities (or before revegetation at borrow stockpiles) to promote revegetation. Rippers are also used to loosen the existing ground before rough grading with scrapers. Columns E through J repeat the ID, title of the activity, locations, equipment and areas from Sheets 3 & 4. Columns K and L are the results of the dozer ripper productivity calculations. The remaining columns are the inputs that allow the calculation of bulldozer ripper productivity in acres per hour based on ripper performance factors:

	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1																	Chino
2																Stockpile Spreadsheet Worksheet #7	
3		***Productivity and Hours Required for Ripper---Equipped Dozer Use***															01/10/19
4																	
5		**Assumptions:**															
6		Uses area to calculate task time															
7		88 ft/min = 1 mph															
13									PERFORMANCE FACTORS								
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Area (ac)	Productivity (ac/hr)	Task Time (hrs)	Ripping Length (ft)	Ripper Penetration (in)	Pocket Spacing (in)	Number of Shank Pockets	Turn Time (min/pass)	Work Hour (min/hr)	Speed (mph)	1000 Foot Passes/Acre	Ripped Width Plus Distance b/n Passes (ft)
16	1102-E-a-Rp1	Rip-Outslope-Existing Facility	South Stockpile S-2	-	Cat D11T CD Multi-shank	86.9	3	25.5	1,000	18	69	3	0.25	50	1	1.3	35

=R16/((M16/(5280*S16/60)+Q16)*T16)

=43560/(M16*U16)

=J16/K16

=P16*2*O16/12

Unit conversion factors

Sheet 8 – Excavator: An excavator with a sheepsfoot attachment is used for perforating liners before reclamation of lined impoundments. Columns E through J repeat the ID, title of the activity, locations, equipment and areas from Sheets 3 & 4. Task time (column N) to complete compacting the entire area is calculated using the inputs from columns J-M, which are referenced from the Equipment sheet.

	E	F	G	H	I	J	K	L	M	N
3		***Productivity and Hours Required for Hydraulic Excavator***								
5		**Assumptions:**								
6		Uses area to calculate time for perforating liners								
7		3' sheepsfoot roller								
8		50% of area is perforated								
9										
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Area (ac)	Sheepsfoot Roller Width (ft)	Maximum Reach at Ground Level (ft)	Cycle Time (min)	Task Time (hr)
45	2216-K-a-Ex3	Perforate Liner-Entire Facility-Existing Facility	Dams and Reservoirs Reservoir 17	-	Cat 319D L	3.4	3.0	31.7	0.16	2.1

=M45*(J45*0.5*43560)/(K45*L45)/60

50% of liner area is perforated

Unit conversion factors

For example use only. Values may not match the current spreadsheet.

Results cont'd

Sheet 9 – Trucks: Trucks are used to haul cover material from borrow stockpiles to destination facilities. Columns E through J repeat the ID, title of the activity, locations, equipment and volumes from Sheets 3 & 4. Column K sums the truck cycle, which includes the haul time loaded, return time empty, loading time, truck exchange time, and the dump/maneuver time. Column L reports the optimum number of trucks as limited by the number and size of loaders (calculated on the Truck Optimization sheet, as shown in the Equipment Optimization calculation summary). Column M lists the loader or shovel net bucket capacity, referenced from the Shovel sheet. Column O lists the loader or shovel task time, referenced from the Shovel sheet. Columns N and P calculate the overall productivity and time required of the load-haul-dump operations, respectively. Column P calculates the time for the truck to complete that task and compares that time to the loader task time, because the truck will have to idle while the loader/shovel finishes loading if the loader/shovel task time is longer than the truck task time (or vice versa). If the loader task time is longer, the loader task time is listed. If the truck task time is longer, the truck task time is listed.

Productivity and Hours Required for Truck Use

Assumptions:
Uses haul distance to calculate haul and return time (total task time includes loading, manuevering, dumping, hauling and return time) - moves from cover stockpile to destination stockpile
Volume of cover material based on area of destination
Cycles per truck = the greater of Heaped capacity or Struck capacity divided by Loader's per bucket capacity
1 mph = 88 ft/min
1 m/min = 0.03728227153424 mph
See Truck Optimization optimum number of trucks per loader
Haul Grade (%) assumes postive is uphill while the Effective Haul Grade (%) and Effective Return Grade (%) are postive for downhill and uphill

	E	F	G	H	I	J	K	L	M	N	O	P
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Loose/Stockpile Volume (cy)	Truck Cycle Time (min)	Optimum Number of Trucks	Loader/Shovel Net Bucket Capacity (cy)	Productivity (cy/hr)	Loader/Shovel Task Time(hrs)	Truck Task Time (hrs)
297	1000-D-b-Tk4	Haul-Cover	Upper South	Triangle Stockpile	Komatsu 730E	394,621	8	3	27.4	2,569	129.6	153.6

=SUM(AK297:AO297)

=AP297*S297*M297*L297/K297

=IF(OR(J297=0,N297=0),0,IF(J297/N297<O297,O297,J297/N297))

Columns Q and R are equipment specifications from the CPH. Column S calculates the loader or shovel cycles per truck, based on loader/shovel bucket capacity and truck capacity. The total haul distance (column T) can be divided into three segments (columns U-W) if the route varies greatly in slope. The average grade for each segment is calculated and entered in Columns X-Z. Columns T through Z are obtained from the Quantities sheet. Column AA is the rolling resistance for the assumed underfooting and tires per the CPH. Columns AB-AD convert segment distances from feet to meters for application of the performance equations from the CPH.

Chino
Stockpile Spreadsheet Worksheet #9
02/12/19

PERFORMANCE FACTORS

	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
14	Struck Capacity (cy)	Heaped Capacity (cy)	Loader/Shovel Cycles per Truck	Total Haul Distance (ft)	Haul Distance Segment 1 (ft)	Haul Distance Segment 2 (ft)	Haul Distance Segment 3 (ft)	Haul Grade Segment 1 (%)	Haul Grade Segment 2 (%)	Haul Grade Segment 3 (%)	Rolling Resistance (%)	Haul Distance Segment 1 (meters)	Haul Distance Segment 2 (meters)	Haul Distance Segment 3 (meters)
297	101	145	5	4,778	4,778	-	-	-4.2%	0.0%	0.0%	2.5%	1,456	-	-

=SUM(U297:W297)

=TRUNC(R297/ M297)

For example use only. Values may not match the current spreadsheet.

Results cont'd

Sheet 9 – Trucks cont'd: Columns AE through AJ calculate the effective grade of the segment (physical grade plus the rolling resistance). Haul time (column AK) and return time (column AL) are calculated by multiplying travel times (per distance) by haul/return distance. Loading time (column AM) is based on loader/shovel productivity (Sheet 10). Times in columns AN, AO, and AP are referenced from the Equipment sheet.

=AQ297*AB297+AR297*AC297+AD297*AS297

	AE	AF	AG	AH	AI	AJ	AK	AL	AM	AN	AO	AP
14	Effective Haul Grade Segment 1 (%)	Effective Haul Grade Segment 2 (%)	Effective Haul Grade Segment 3 (%)	Effective Return Grade Segment 1 (%)	Effective Return Grade Segment 2 (%)	Effective Return Grade Segment 3 (%)	Haul Time (min)	Return Time (min)	Loading Time (min)	Truck Exchange Time (min)	Dump/Maneuver Time (min)	Work Hour (min/hr)
297	1.7%	2.5%	2.5%	6.7%	2.5%	2.5%	1.7	2.3	2.3	0.7	1.1	50

=IF(X297>=$AA297, X297+$AA297, ABS(X297+$AA297))

=IF(-X297>=$AA297, -X297+$AA297, ABS(-X297+$AA297))

=AT297*AB297+AU297*AC297+AD297*AV297

Columns AQ through AV calculate the travel time (per distance) from a curve fit based on CPH production factors, as explained on the following page. Travel time is dependent on effective grade. If the haul grade is positive (uphill), the loaded or empty uphill travel time is calculated, within the maximum speed of the truck. If the grade is negative (downhill), the loaded or empty downhill travel time is calculated, within the maximum speed of the truck.

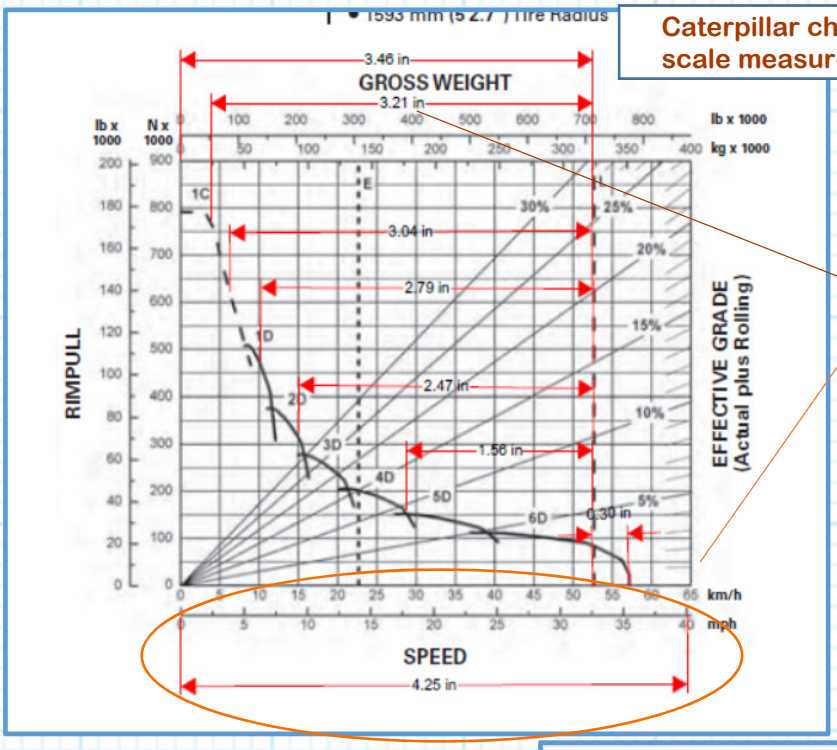
	AQ	AR	AS	AT	AU	AV
1						Chino
2						Stockpile Spreadsheet Worksheet #9
3						02/12/19
14	Travel Time Loaded Segment 1 (min/m)	Travel Time Loaded Segment 2 (min/m)	Travel Time Loaded Segment 3 (min/m)	Travel Time Empty Segment 1 (min/m)	Travel Time Empty Segment 2 (min/m)	Travel Time Empty Segment 3 (min/m)
297	0.0012	-	-	0.0016	-	-

For example use only. Values may not match the current spreadsheet.

Results cont'd

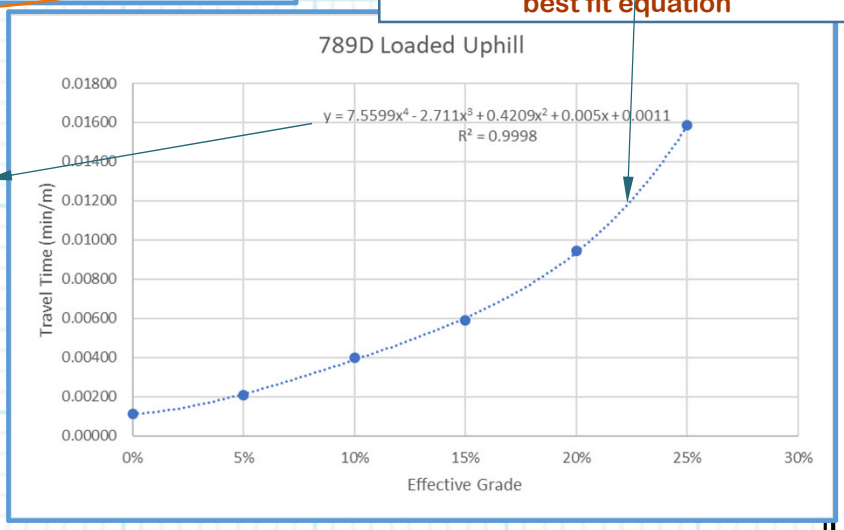
Sheet 9 – Trucks cont'd: Haul times are calculated for the trucks by using rimpull-speed-gradeability curves and retarding curves to create a relationship for travel time vs. effective resistance for travel uphill and downhill, respectively. A formula is derived by curve fit to the rimpull-speed-gradeability curves and retarding curves provided in the CPH for the specific truck. Similar to the dozer productivity curves, this is accomplished by scaling values from the figures and using the curve fitting tools within Microsoft Excel. Input values are taken from the 1998, 2011, 2017 and 2018 Caterpillar (Cat) Performance Handbook (CPH) (Editions 29, 41, 47, and 48) for the specific model truck. The example below shows how travel time is calculated for uphill routes, assuming a loaded truck:

Caterpillar chart and scale measurements



	B	C	D	E	F
1	Loaded Up Hill				
2	Measurement	Speed (mph)			
3	4.25	40			
4	3.46	32.6			
5					
6	Measurement	Speed (mph)	Travel Time (min/m)	Effective Grade	
7	3.21	2.35	0.01585	25%	
8	3.04	3.95	0.00943	20%	
9	2.79	6.31	0.00591	15%	
10	2.47	9.32	0.00400	10%	
11	1.56	17.88	0.00209	5%	
12	0	32.56	0.00114	0%	

Graph these two columns and find best fit equation



Haul Travel Time (min/m)=7.5599(Eff. Grade %)^4 + -2.711(Eff. Grade %)^3 + 0.4209(Eff. Grade %)^2 + 0.005(Eff. Grade %) + 0.0011

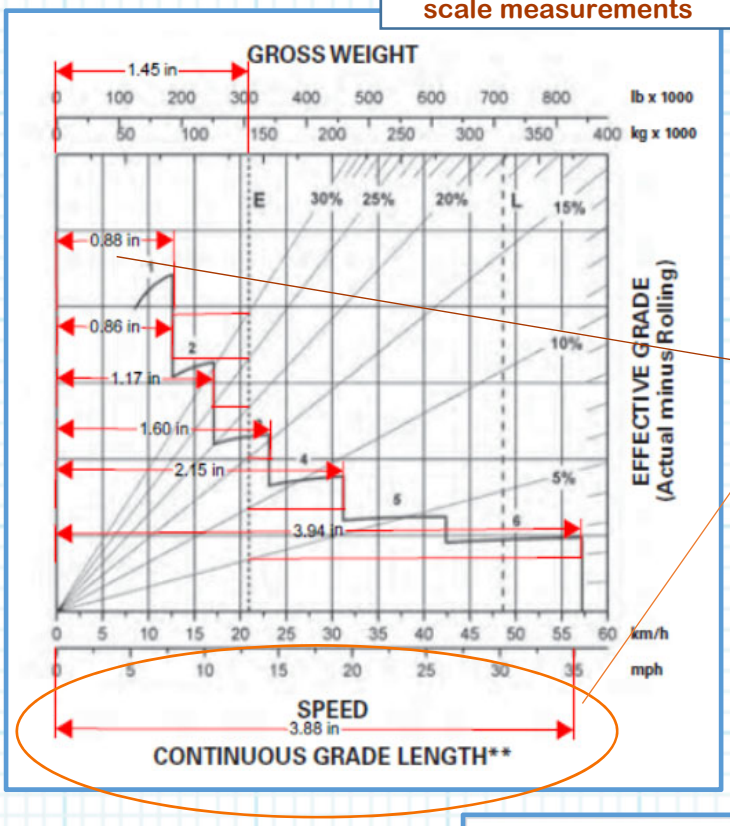
These coefficients are listed for each type of truck in columns P-AI of the Equipment sheet.

For example use only. Values may not match the current spreadsheet.

Results cont'd

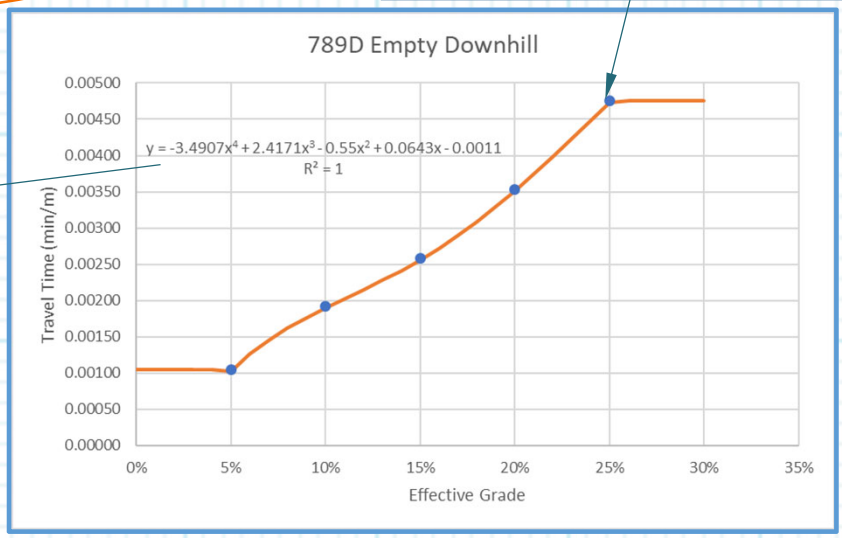
Sheet 9 – Trucks cont'd: The example below shows how travel time is calculated for downhill routes, assuming an empty truck:

Caterpillar chart and scale measurements



	B	C	D	E	F
1					
2	Measurement	Speed (mph)			
3	3.88	35			
4					
5	Measurement	Speed (mph)	Travel Time (min/m)	Effective Grade	
6	0.87	7.85	0.00475	30%	
7	0.87	7.85	0.00475	25%	
8	1.17	10.55	0.00353	20%	
9	1.6	14.43	0.00258	15%	
10	2.15	19.39	0.00192	10%	
11	3.95	35.63	0.00105	5%	
12	3.95	35.63	0.00105	0%	
13					

Graph these two columns and find best fit equation



Haul Travel Time (min/m)= -3.4907(Eff. Grade %)^4 + 2.4171(Eff. Grade %)^3 + 0.0643(Eff. Grade %)^2 + 0.0643(Eff. Grade %) + 0.0011

Fit has been adjusted to only include travel times for effective grades 5%-25%. If statements have been included in truck sheet to make travel time constant if effective grade is above 25% or below 5% for this truck type.

These coefficients are listed for each type of truck in columns P-AI of the Equipment sheet.

Results cont'd:

Sheet 10 –Shovel: Shovels (or loaders) are used to load cover material onto haul trucks at borrow stockpiles. Columns E through I repeat the ID, title of the activity, locations, and equipment from Sheet 3. Column J is from Sheet 4 and contains the total amount of material to be loaded/moved. Loader/shovel cycle time (column K), net bucket capacity (column O), and work hour (column P) are from the Equipment sheet. Per Loader/Shovel Productivity (cy/hr) (columns L) and Loader/Shovel Task Time (hrs) (column M) are calculated directly. Similar to the truck task time calculation, the maximum of either the loader/shovel task time or the truck task time is used (column N).

Chino
Stockpile Spreadsheet Worksheet #10
2/12/2019

Productivity and Hours Required for Front End Loader Use or Hydraulic Shovel Use

Assumptions:
Uses cover volume to calculate loading time of cover material

PERFORMANCE FACTORS

	E	F	G	H	I	J	K	L	M	N	O	P
13	1	2	3	4	5	6	7	8	9	10	11	12
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Loose/Stockpile Volume (cy)	Loader/Shovel Cycle Time (min)	Per Loader/Shovel Productivity (cy/hr)	Loader/Shovel Task Time (hrs)	Max of Loader/Shovel or Truck Task Time (hrs)	Net Bucket Capacity (cy)	Work Hour (min/hr)
262	1000-C-b-Sh1	Load-Cover	Upper South	Triangle Stockpile	Hitachi EX3600-5	394,621	0.45	3,044	129.6	153.6	27.4	50

=O262/K262*P262

=J262/L262

Sheet 11 – Scrapers: Scrapers are used for rough grading existing ground or for hauling, placing, and fine grading cover material. Columns E through I repeat the ID, title of the activity, locations, and equipment from Sheet 3. Column J is from Sheet 4 and contains the total amount of material to be moved. Column K and L are the total travel distance and average grade of the task. Column M is the rolling resistance per the CPH. Columns N and O add the rolling resistance to the haul & scrape grade to calculate the effective uphill and downhill grades.

Productivity for Scrapers

Assumptions:
Uses volumes of stockpile or cover for hauling and grading times
Haul & Scrape Grade (%) assumes positive is downhill

Number of scrapers used for grading cover = 6
1609.344 meters/mile

	E	F	G	H	I	J	K	L	M	N	O
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Loose/Stockpile Volume (cy)	Total Haul Distance One Way (feet)	Haul & Scrape Grade (%)	Rolling Resistance (%)	Effective Grade Uphill (%)	Effective Grade Downhill (%)
84	1101-A-a-Sc2	Grade-Outslope-Existing Facility	South Stockpile S-1	-	Cat 657G	348,051	4,809	7.15%	2.5%	9.7%	4.7%

Results cont'd

Sheet 11 – Scrapers cont'd: Columns P, Q, U, V, and X are equipment specifications from the CPH. Column Y assumes a 50 min work hour. The full scraper haul speed (column R) and the empty scraper return speed (column S) are calculated for the scraper in a similar way that haul/return times are calculated for the haul trucks. Rimpull-speed-gradeability curves and retarding curves are used to create an equation for travel time vs. effective resistance for travel uphill and downhill, respectively. Input values are taken from the 2014, 2017 and 2018 Caterpillar (Cat) Performance Handbook (CPH) (Editions 44, 47, and 48) for the specific model scraper. These coefficients are listed for each type of scraper in columns P-AI of the Equipment sheet. Total load, haul, maneuver and spread cycle time is calculated in column T while column Z calculates the number of scraper cycles per hour. Soil weight (column W) is referenced from the Quantities sheet. Productivity is calculated in column AA, assuming a heaped load capacity is used for the scraper. The total task time is calculated in column AB. However, during rough grading multiple scrapers are used per push dozer, with the optimum ratio calculated on the Scraper Optimization sheet (see Equipment Optimization calculation documentation). For fine grading of cover, the scrapers are not paired with a push dozer but 6 scrapers are assumed to be used per fine grading task. Column AD calculates the task time with the optimum number of scrapers.

	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD
1															Chino
2															Stockpile Spreadsheet Worksheet #11
3															2/12/2019
14	Load Time (min)	Maneuver & Spread Time (min)	Full Scraper Haul Speed (mph)	Empty Scraper Return Speed (mph)	Scraper R/T Cycle Task Time (min)	Pusher Cycle Time (min/cycle)	Rated Load (lb)	Soil Weight (lbs/cy)	Heaped Capacity (cy)	Work Hour (min/hr)	Cycles per Scraper per Hr	Productivity per Heaped Scraper (cy/hr)	Total Task Time (hrs)	Number of Scrapers	Task Time w All Scrapers (hrs)
84	0.9	0.7	26	22	6.1	1.4	104,000	3,300	44	50	8	252	1,380	5	276

=(K84/(S84*88))+(K84/(R84*88))+P84+Q84

Unit conversion factors

=Y84/T84

=(TRUNC(Z84))*(MIN(X84,(V84/W84)))

=IF(AA84>0,J84/AA84,0)

=IF(AC84>0,AB84/AC84,0)

For example use only. Values may not match the current spreadsheet.

Results cont'd:

Sheet 12 – M'Grader: Motor graders are used for rough grading tops of stockpiles or for fine grading cover material. Columns E through I repeat the ID, title of the activity, locations, and equipment from Sheet 3. Column J is from Sheet 4 and contains the area of material to be graded. The grade factor (Column M) is calculated based on percent grade. Column K, shaping productivity, is calculated from the speed and effective blade width. Column L is calculated directly. Column N is an assumed material handling factor and Column U is a factor based on operator experience. Columns O-T are based on material properties and equipment information.

Productivity and Hours Required for Motorgrader Use---Grading

Assumptions:

Productivity (based on area of overall stockpile) = Sq.ft per hour = Speed x (Eff. Blade L -Blade Overlap) x Efficiency (*Cat. Handbook Edition 47* pg 11-27)

Max. safe slope for motor graders is 2:1 (50%), proposed final grade for Chino cover grading on stockpiles is 33%, therefore use of graders an option (Cat. Handbook Edition 46 pg 11-30)

50 min work hour applied to productivity

For comparison of motorgrader to dozer for grading on top of stockpiles change the equipment used in the '3 Material' sheet

	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
14	ID	Task Description	Source Location 1	Destination Location 2	Grading Equipment	Area (ac)	Grading Shaping Productivity (ac/hr)	Task Time (hrs)	Grade Factor	Material Factor	Material Weight (lb/cy)	Production Method/ Blade	Effective Blade Width (ft)	Pass Overlap (ft)	Speed (mph)	Work Hour (min/hr)	Operator Factor
115	1111-A-a-Mg1	Grade-Top-Existing Facility	South Stockpile S-9(3)	-	Cat 16M	40	3	13.2	1.0	1.0	3,300	1.20	16.00	2.00	2.50	50	1.00

=(T115/60)*N115*(2300/O115)*P115*U115*M115*S115 *(Q115-R115)*5280/43560

=IF(K115>0,J115/K115,0)

Unit conversion factors

Soil weight (lb/cy) assumed in CPH

Sheet 13 – EarthSum: This sheet summarizes all of the quantities and production rates on the individual sheets (5, and 7 through 12) and applies costs from Equipment Watch, the New Mexico labor rates table, fuel quotes, etc. Columns E through I repeat the ID, title of the activity, locations, equipment from Sheet 3. Columns J through L list the fuel, rental and maintenance, and labor unit costs from the Equipment sheet for the associated piece of equipment. The number of units of equipment is assumed to be one except for trucks and scrapers, which use an optimum number of units, calculated on the truck and scraper optimization sheets. The time required is taken from each of the equipment sheets (Sheets 5-12). The fuel, rental and maintenance, and labor costs are calculated by multiplying the unit costs by the time required for each task. The total equipment cost (column R) is the sum of the fuel, rental and maintenance, and labor costs. The total production volumes and areas are repeated from Sheet 4.

Summary Calculation of Earthmoving Costs

Summarizes all earthmoving quantities and costs

	E	F	G	H	I	J	K	L
14	ID	Description	Source Location 1	Destination Location 2	Equipment	Fuel Cost ($/hr)	Lube, Tires, GEC, & Field Parts Adjusted Rental Cost (w/o fuel) ($/hr)	Labor Cost ($/hr)
15	1101-E-a-Rip1	Rip-Outslope-Existing Facility	South Stockpile S-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41

For example use only. Values may not match the current spreadsheet.

Results cont'd

Sheet 13 – EarthSum cont'd:

Chino
Stockpile Spreadsheet Worksheet #13
02/12/19

Number of Units (Equipment)	Time Req'd (hrs)	Direct Fuel Cost ($)	Direct Lube, Tires, GEC, & Field Parts Adjusted Rental Cost (w/o fuel) ($)	Direct Labor Cost ($)	Total Equipment Cost ($)	Total Production Volume (CY)	Total Production Area (AC)
1	2.2	$154	$573	$61	$788	-	6.4

=J15*N15*M15

=SUM(O15:Q15)

Sheet 14 – Revegetation: Columns E through I repeat the ID, title of the activity, locations, and areas from Sheets 3 & 4. The calculated unit rates for revegetation (reveg fuel cost and reveg cost without fuel) are multiplied by the corresponding areas to calculate the associated direct revegetation costs for each location. The total revegetation direct cost is then the sum of all direct costs related to each location.

Chino
Stockpile Spreadsheet Worksheet #14
02/12/19

Revegetation Costs

Description:
Includes scarifying (ripping), discing, rangeland drill seeding, mulching, crimping, and daily per diem

	ID	Description	Source Location 1	Destination Location 2	Area (ac)	Fuel Unit Cost ($/ac)	Reveg w/o Fuel Unit Cost ($/ac)	Fuel Direct Cost ($)	Reveg w/o Fuel Direct Cost ($)
472	1000-J-e-U2	Revegetate-Entire Stockpile-Final Grade	Triangle Stockpile	-	81.5	$ 3.85	$ 816.92	$ 314	$ 66,606
473	1100-J-e-U2	Revegetate-Entire Stockpile-Final Grade	South Stockpile	-	584.6	$ 3.85	$ 816.92	$ 2,250	$ 477,574
474	1200-J-e-U2	Revegetate-Entire Stockpile-Final Grade	West Stockpile	-	626.4	$ 3.85	$ 816.92	$ 2,411	$ 511,745
475	1300-J-e-U2	Revegetate-Entire Stockpile-Final Grade	Lambright Stockpile	-	785.4	$ 3.85	$ 816.92	$ 3,022	$ 641,589
476	1400-J-e-U2	Revegetate-Entire Stockpile-Final Grade	Southwest Lampbright	-	94.3	$ 3.85	$ 816.92	$ 363	$ 77,034
477	1500-J-e-U2	Revegetate-Entire Stockpile-Final Grade	Santa Rita Stockpile	-	60.6	$ 3.85	$ 816.92	$ 233	$ 49,466
478	1600-J-e-U2	Revegetate-Entire Stockpile-Final Grade	Northwest Stockpile	-	8.2	$ 3.85	$ 816.92	$ 32	$ 6,714
479	1700-J-e-U2	Revegetate-Entire Stockpile-Final Grade	LeeHill Stockpile	-	25.4	$ 3.85	$ 816.92	$ 98	$ 20,755
480	1800-J-e-U2	Revegetate-Entire Stockpile-Final Grade	Northeast Stockpile	-	12.2	$ 3.85	$ 816.92	$ 47	$ 10,005
481	1900-J-e-U2	Revegetate-Entire Stockpile-Final Grade	North Stockpile	-	6.9	$ 3.85	$ 816.92	$ 27	$ 5,644
482	2000-J-e-U2	Revegetate-Entire Stockpile-Final Grade	STS2	-	83.8	$ 3.85	$ 816.92	$ 322	$ 68,440
483	2100-J-e-U2	Revegetate-Entire Stockpile-Final Grade	Upper South	-	142.7	$ 3.85	$ 816.92	$ 549	$ 116,542
484	2200-J-e-U2	Revegetate-Entire Stockpile-Final Grade	9 Waste Rock	-	161.2	$ 3.85	$ 816.92	$ 620	$ 131,688
485	2309-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Dam 15	-	0.1	$ 3.85	$ 816.92	$ 0	$ 82
486	2313-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Dam 20	-	0.3	$ 3.85	$ 816.92	$ 1	$ 261
487	2316-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Reservoir 17	-	3.4	$ 3.85	$ 816.92	$ 13	$ 2,745
488	2317-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Rustler Canyon	-	1.4	$ 3.85	$ 816.92	$ 5	$ 1,111
489	2318-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Fleming Pond	-	0.8	$ 3.85	$ 816.92	$ 3	$ 637
490	2320-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs PLS Feed Pond	-	0.5	$ 3.85	$ 816.92	$ 2	$ 400
491	2321-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs PLS Pond & Launder	-	0.3	$ 3.85	$ 816.92	$ 1	$ 212
492	2323-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Raffinate Pond	-	0.1	$ 3.85	$ 816.92	$ 0	$ 90
493	2324-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Reservoir 2	-	0.2	$ 3.85	$ 816.92	$ 1	$ 180
494	2326-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Reservoir 5	-	6.4	$ 3.85	$ 816.92	$ 25	$ 5,228
495	2327-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Reservoir 6	-	11.5	$ 3.85	$ 816.92	$ 44	$ 9,395
496	2328-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Reservoir 7	-	2.4	$ 3.85	$ 816.92	$ 9	$ 1,969
497	2341-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Elmo's Pond	-	1.2	$ 3.85	$ 816.92	$ 5	$ 1,013
498	2342-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Lower Lined Pond	-	2.2	$ 3.85	$ 816.92	$ 9	$ 1,822
499	2343-J-e-U2	Revegetate-Entire Facility-Final Grade	Dams and Reservoirs Upper Lined Pond	-	0.4	$ 3.85	$ 816.92	$ 2	$ 335
500	2400-J-e-U2	Revegetate-Entire Facility-Previously Reclaimed-	Ground Hog #5	-	2.0	$ 3.85	$ 816.92	$ 8	$ 1,634
501	2502-J-e-U2	Revegetate-Entire Facility-Final Grade	Miscellaneous NMA Northwest Haul Road	-	4.8	$ 3.85	$ 816.92	$ 19	$ 3,946
502	2512-J-e-U2	Revegetate-Entire Facility-Final Grade	Miscellaneous NMA East Pit Access Disturbed Area	-	3.7	$ 3.85	$ 816.92	$ 14	$ 2,998
503	2513-J-e-U2	Revegetate-Entire Facility-Final Grade	Miscellaneous NMA Chino part of Cobre Haul Road	-	3.2	$ 3.85	$ 816.92	$ 12	$ 2,622
504	2514-J-e-U2	Revegetate-Entire Facility-Final Grade	Miscellaneous NMA Highway to Heaven Haul Road	-	9.0	$ 3.85	$ 816.92	$ 34	$ 7,314
505	2515-J-e-U2	Revegetate-Entire Facility-Final Grade	Miscellaneous NMA Filter Plant	-	17.0	$ 3.85	$ 816.92	$ 66	$ 13,920
506	2600-J-e-U2	Revegetate-Entire Facility-Final Grade	200 Acre Misc. Area	-	200.0	$ 3.85	$ 816.92	$ 770	$ 163,384
507	3000-J-e-U2	Revegetate-Entire Impoundment-Final Grade	Axiflo	-	97.1	$ 3.85	$ 816.92	$ 374	$ 79,321
508	3100-J-e-U2	Revegetate-Entire Impoundment-Final Grade	Tailings Pond 6	-	261.7	$ 3.85	$ 816.92	$ 1,007	$ 213,754
509	3200-J-e-U2	Revegetate-Entire Impoundment-Final Grade	Tailings Pond 7	-	1660.5	$ 3.85	$ 816.92	$ 6,390	$ 1,356,486
510	3301-J-e-U2	Revegetate-Entire Facility-Final Grade	Miscellaneous SMA Slag Pile Outslopes W side	-	8.2	$ 3.85	$ 816.92	$ 32	$ 6,699
511	3307-J-e-U2	Revegetate-Entire Facility-Final Grade	Miscellaneous SMA 35 Acre Misc. Area	-	35.0	$ 3.85	$ 816.92	$ 135	$ 28,592
518	5001-J-d-U2	Revegetate-Cover Source-Placed Cover	White House	-	62.5	$ 3.85	$ 816.92	$ 241	$ 51,064
519	5105-J-d-U2	Revegetate-Cover Source-Placed Cover	Borrow Area F	-	49.6	$ 3.85	$ 816.92	$ 191	$ 40,532
520	5106-J-d-U2	Revegetate-Cover Source-Placed Cover	North of Borrow Area F	-	67.9	$ 3.85	$ 816.92	$ 261	$ 55,461
521	5107-J-d-U2	Revegetate-Cover Source-Placed Cover	Borrow Area E	-	110.0	$ 3.85	$ 816.92	$ 423	$ 89,836
522	5108-J-d-U2	Revegetate-Cover Source-Placed Cover	Borrow Area H	-	165.2	$ 3.85	$ 816.92	$ 636	$ 134,920
523	5109-J-d-U2	Revegetate-Cover Source-Placed Cover	West of Borrow E&H	-	502.0	$ 3.85	$ 816.92	$ 1,932	$ 410,128
616	5005-J-e-U2	Revegetate-Haul Road-Final Grade	Upper South & White House	-	46.8	$ 3.85	$ 816.92	$ 180	$ 38,204
617	5006-J-e-U2	Revegetate-Haul Road-Final Grade	Upper South	-	47.7	$ 3.85	$ 816.92	$ 184	$ 38,983
618									
619				TOTAL	6,058			$ 23,313	$ 4,949,079

=I617*J617

=SUM(M15:M617)

For example use only. Values may not match the current spreadsheet.

Sheet 15 – Other: This sheet contains the direct costs associated with miscellaneous (other) earthwork tasks. These tasks include grading benches, constructing downdrains, constructing downdrain dissipators, constructing bench channels (including filter and riprap production and placement), constructing top channels, plugging and abandoning wells, replacing wells, and constructing haul roads. Columns E through H repeat the ID, description, and locations from Sheet 3. Columns I and J document the quantity and unit associated with each quantity for each task (referenced from the Quantities sheet). The unit costs (columns K and L) are referenced from the Unit Cost sheet. The quantity multiplied by the unit costs give the direct costs for each activity. The direct costs are totaled at the bottom of the sheet.

	E	F	G	H	I	J	K	L	M	N
4		***Other Reclamation Activity Costs***								
5		**Assumptions:**								
6		1 - Downdrain lengths and bench channel lengths based on Golder Take-Offs 1401123-004-MTO-RevG_07_Chino_MTOs_05SEP18.xlsx								
7		2 - Bench grading lengths equal to bench channel lengths								
8		3 - There are no top channels								
9		4 - Cost to construct drain or channel on re-graded stockpile								
10		5 - The downdrain, ACB, well plug & abandon, and well replacement costs include fuel								
11										
12										
13										
14	ID	Description	Source Location 1	Destination Location	Quantity[1]	Uni	Fuel Unit Cost ($/unit)	Unit Cost ($/unit)	Fuel Direct Cost ($/unit)	Direct w/o Fuel Cost ($)
426	1000-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	Triangle Stockpile	-	13,831	ft	$ 0.39	$ 1.58	$ 5,339.36	$ 21,917
427	1100-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	South Stockpile	-	95,487	ft	$ 0.39	$ 1.58	$ 36,862.20	$ 151,313
428	1200-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	West Stockpile	-	108,831	ft	$ 0.39	$ 1.58	$ 42,013.43	$ 172,458
429	1300-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	Lambright Stockpile	-	157,574	ft	$ 0.39	$ 1.58	$ 60,830.31	$ 243,637
430	1400-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	Southwest Lampbright	-	-	ft	$ 0.39	$ 1.58	$ -	$ -
431	1500-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	Santa Rita Stockpile	-	-	ft	$ 0.39	$ 1.58	$ -	$ -
432	1600-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	Northwest Stockpile	-	-	ft	$ 0.39	$ 1.58	$ -	$ -
433	1700-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	LeeHill Stockpile	-	-	ft	$ 0.39	$ 1.58	$ -	$ -
434	2000-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	STS2	-	6,218	ft	$ 0.39	$ 1.58	$ 2,400.41	$ 9,853
435	2100-F-c-U3	Grade Benches-Entire Stockpile-Final Grade	Upper South	-	5,348	ft	$ 0.39	$ 1.58	$ 2,064.56	$ 8,475
436	3000-F-c-U4	Grade Benches-Entire Impoundment-Final Grade	Axiflo	-	3,350	ft	$ 0.39	$ 1.58	$ 1,293.24	$ 5,309
437	3100-F-c-U4	Grade Benches-Entire Impoundment-Final Grade	Tailings Pond 6	-	-	ft	$ 0.39	$ 1.58	$ -	$ -
438	3200-F-c-U4	Grade Benches-Entire Impoundment-Final Grade	Tailings Pond 7	-	42,224	ft	$ 0.39	$ 1.58	$ 16,300.11	$ 66,909
439	1000-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	Triangle Stockpile	-	-	ft	-	$ 348.00	$ -	$ -
440	1100-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	South Stockpile	-	6,474	ft	-	$ 348.00	$ -	$ 2,253,036
441	1200-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	West Stockpile	-	4,493	ft	-	$ 348.00	$ -	$ 1,563,570
442	1300-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	Lambright Stockpile	-	9,299	ft	-	$ 348.00	$ -	$ 3,236,065
443	1400-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	Southwest Lampbright	-	-	ft	-	$ 348.00	$ -	$ -
444	1500-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	Santa Rita Stockpile	-	-	ft	-	$ 348.00	$ -	$ -
445	1600-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	Northwest Stockpile	-	-	ft	-	$ 348.00	$ -	$ -
446	1700-G-c-U5	Construct Downdrains-Entire Stockpile-Final Grade	LeeHill Stockpile	-	-	ft	-	$ 348.00	$ -	$ -
447	3000-G-c-U5	Construct Downdrains-Entire Impoundment-Final Grade	Axiflo	-	-	ft	-	$ 348.00	$ -	$ -
448	3100-G-c-U5	Construct Downdrains-Entire Impoundment-Final Grade	Tailings Pond 6	-	319	ft	-	$ 348.00	$ -	$ 111,034
449	3200-G-c-U5	Construct Downdrains-Entire Impoundment-Final Grade	Tailings Pond 7	-	2,280	ft	-	$ 348.00	$ -	$ 793,553
450	1100-Gb-c-U6	Construct Downdrain Dissipators-Entire Stockpile-Final Grade	South Stockpile	-	2	ea	-	$ 14,267.94	$ -	$ 28,536
451	1200-Gb-c-U6	Construct Downdrain Dissipators-Entire Stockpile-Final Grade	West Stockpile	-	4	ea	-	$ 14,267.94	$ -	$ 57,072
452	1300-Gb-c-U6	Construct Downdrain Dissipators-Entire Stockpile-Final Grade	Lambright Stockpile	-	4	ea	-	$ 14,267.94	$ -	$ 57,072
453	1000-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	Triangle Stockpile	-	13,831	ft	$ 1.48	$ 7.49	$ 20,525.66	$ 103,655
454	1100-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	South Stockpile	-	95,487	ft	$ 1.48	$ 7.49	$ 141,706.35	$ 715,622
455	1200-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	West Stockpile	-	108,831	ft	$ 1.48	$ 7.49	$ 161,508.81	$ 815,625
456	1300-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	Lambright Stockpile	-	157,574	ft	$ 1.48	$ 7.49	$ 233,845.04	$ 1,180,925
457	1400-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	Southwest Lampbright	-	-	ft	$ 1.48	$ 7.49	$ -	$ -
458	1500-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	Santa Rita Stockpile	-	-	ft	$ 1.48	$ 7.49	$ -	$ -
459	1600-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	Northwest Stockpile	-	-	ft	$ 1.48	$ 7.49	$ -	$ -
460	1700-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	LeeHill Stockpile	-	-	ft	$ 1.48	$ 7.49	$ -	$ -
461	2000-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	STS2	-	6,218	ft	$ 1.48	$ 7.49	$ 9,227.72	$ 46,600
462	2100-H-c-U7	Construct Bench Channels-Entire Stockpile-Final Grade	Upper South	-	5,348	ft	$ 1.48	$ 7.49	$ 7,936.61	$ 40,080
463	3000-H-c-U7	Construct Bench Channels-Entire Impoundment-Final Grade	Axiflo	-	3,350	ft	$ 1.48	$ 7.49	$ 4,971.51	$ 25,106
464	3100-H-c-U7	Construct Bench Channels-Entire Impoundment-Final Grade	Tailings Pond 6	-	-	ft	$ 1.48	$ 7.49	$ -	$ -
465	3200-H-c-U7	Construct Bench Channels-Entire Impoundment-Final Grade	Tailings Pond 7	-	42,224	ft	$ 1.48	$ 7.49	$ 62,661.17	$ 316,441
570	1200-N-c-U18	Plug and Abandon Well-Entire Stockpile-Final Grade	West Stockpile	-	1,700	ft	-	$ 10.47	$ -	$ 17,799
571	1200-O-c-U19	Replace Well-Entire Stockpile-Final Grade	West Stockpile	-	1,700	ft	-	$ 66.43	$ -	$ 112,935
605	5005-Q-c-U21	Construct Haul Road-Cover Source-Graded Facility	Upper South & White House	-	17,438	ft	$ 1.85	$ 7.15	$ 32,177.38	$ 124,629
606	5006-Q-c-U21	Construct Haul Road-Cover Source-Graded Facility	Upper South	-	17,323	ft	$ 1.85	$ 7.15	$ 31,965.18	$ 123,807
613										
614								TOTAL	$ 873,623	$ 12,409,158

=I606*K606

=SUM(M15:M617)

For example use only. Values may not match the current spreadsheet.

Results cont'd

Sheet 16 – Sum: This sheet summarizes the direct costs from Sheets 2, 13, 14 and 15. The indirect costs are added as a percentage of the direct costs.

	A	B	C	D	E
1					Chino
2					Stockpile Spreadsheet Worksheet #16
3					2/12/2019
4					
5	***Chino Mine***				
6	DRAFT Reclamation Summary Stockpiles, Haul Roads, Reservoirs, and Disturbed Areas				
7	Based on Golder 2018 Closure/Closeout Plan				
8				**Current Value**	
9	**DIRECT COSTS**	Facility and Structure Removal		$21,258,937	
10		Earthmoving		$111,231,288	
11		Revegetation		$4,972,392	
12		Other		$12,924,307	
13		**Subtotal, Direct Costs**		**$150,386,924**	
14					
15	**INDIRECT COSTS[1]**	**Subtotal, Indirect Costs**	**30.0%**	**$45,116,077**	
16					
17					
18	**TOTAL COST**			**$195,503,001**	
19		Fifteen Year Annual Expenditure		$13,033,533.43	
20					
21					
22	Notes:				
23	Indirect costs are based on 2019 agreement between FMI and agencies				
24	Indirect costs include mobilization and demobilization, engineering redesign fee, contingencies, contractor				
25	profit and overhead, project management fee, and state procurement cost				

='2 Demo'!F23

='13 EarthSum'!R620

='14 Revegetation'!M619+'14 Revegetation'!L619

='15 Other'!N619+'15 Other'!M619

=SUM(D9:D12)

=C15*D13

=(D13+D15)

=D18/15

Total indirect costs of 30% are applied to the capital direct costs based on discussions involving the FA Work Group completed in December 2018. The FA Work Group involved representatives of Freeport-McMoRan New Mexico Operations (FNMO), MMD, NMED, and Gila Resources Information Project (GRIP). The indirect costs incorporate Mobilization and Demobilization, Contingencies, Engineering Redesign Fee, Contractor Profit and Overhead, Project Management Fee, and other administrative costs. The RCE report provides further information on the FA Work Group agreement.

Results cont'd:

Sheets 17-Facility Characteristics- This sheet summarizes direct and indirect cost for each facility in the Chino RCE spreadsheet. The first four facilities listed on this sheet are shown below:

	A	B	C	D	E	F
1						
2						
3	**Facility Characteristics**					
4	Facilities are categorized in this listing to meet the MMD reporting					
5	requirement					
6			1000	1100	1200	1300
7		**Facility**	**Triangle Stockpile**	**South Stockpile**	**West Stockpile**	**Lambright Stockpile**
8						
9		**Reclaimed Acres**	81.5	584.6	626.4	785.4
10						
11		**Item**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**
12	Direct Costs	Cover Material Excav, Haul, Grade[1]	$348,297	$2,871,554	$4,618,554	$6,954,185
13		Top/Outslope Adjustment Grading[2]	$1,779,123	$25,724,715	$12,316,669	$25,612,852
14		Scarify, Seed & Mulch, Reveg[3]	$66,920	$479,824	$514,155	$644,611
15		Channels & Benches[4]	$103,502	$3,167,496	$2,554,736	$4,718,769
16		Demolition				
17		Other[5]	$0	$0	$130,734	$0
18		**Capital Cost Totals**	**$2,297,842**	**$32,243,589**	**$20,134,849**	**$37,930,417**
19		**Capital Cost/Acre**	**$28,183**	**$55,155**	**$32,142**	**$48,296**
20						
21	Indirect Costs	Cover Material Excav, Haul, Grade1	$104,489	$861,466	$1,385,566	$2,086,256
22		Top/Outslope Adjustment Grading[2]	$533,737	$7,717,415	$3,695,001	$7,683,856
23		Scarify, Seed & Mulch, Reveg[3]	$20,076	$143,947	$154,247	$193,383
24		Channels & Benches[4]	$31,051	$950,249	$766,421	$1,415,631
25		Demolition	$0	$0	$0	$0
26		Other[5]	$0	$0	$39,220	$0
27		**Indirect Cost Totals**	**$689,353**	**$9,673,077**	**$6,040,455**	**$11,379,125**
28		**Indirect Cost/Acre**	**$8,455**	**$16,546**	**$9,643**	**$14,489**
29						
30						
31						
32		**Total Cost**	**$2,987,195**	**$41,916,666**	**$26,175,303**	**$49,309,543**
33		Total Cost Cover	$452,787	$3,733,021	$6,004,120	$9,040,441
34		Total Cost Top/Outslope Adjustment	$2,312,859	$33,442,130	$16,011,670	$33,296,708
35		Total Cost Earthwork	$2,765,646	$37,175,150	$22,015,790	$42,337,149
36		Capital Cost Re-Veg	$86,996	$623,771	$668,402	$837,995
37		Capital Cost Other[5]	$0	$0	$169,954	$0
38						
39		**Total Cost/Acre**	**$36,638**	**$71,701**	**$41,785**	**$62,785**
40		Total Cost/Acre Cover	5,553	6,386	9,585	11,511
41		Total Cost/Acre Top/Outslope Adjustment	28,367	57,205	25,560	42,396
42		Total Cost/Acre Earthwork	$33,920	$63,591	$35,145	$53,907
43		Capital Cost/Acre Re-Veg	1,067	1,067	1,067	1,067
44		Capital Cost/Acre Other[5]	$0	$0	$271	$0
45						

The Direct and Indirect Costs are each broken down into the following sections: Cover Material, Top/Outslope Adjustment Grading, Revegetation, Channels & Benches, Demolition, and Other. Demolition is not divided by location but is given as a total.

For example use only. Values may not match the current spreadsheet.

Results cont'd:

Remaining Sheets: The remaining sheets and data supporting the earthwork calculations described in this calculation documentation are described in the following calculation summaries:

- Equipment Optimization
- O&M
- Building Demo
- Bench Grading Unit Cost
- Bench Channel Unit Cost
- Top Channel Unit Cost
- Downdrain Unit Cost
- Haul Road Unit Cost
- Pipeline Unit Cost
- Revegetation Unit Cost
- Fuel Unit Cost

Fuel Cost

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes fuel price information as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). A reliable estimate of the local 2019 fuel price is needed, based on local and national data for past years.

Objective:

1. Develop an equation to predict the estimated 2019 local fuel price for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM.

Approach:

1. Identify existing data used for the calculation.
2. Correlate local and national data for fuel price, paired by year.
3. Estimate 2019 fuel price for use in the earthwork closure costs.

Data and Assumptions:

1. Data used for the calculations are shown below (1995-2018) and include (a) U.S. No. 2 Diesel Retail Prices (annual national) and (b) FMI quotes (for specific dates within a year) for the local Silver City area. All prices are in $/gallon.

Fuel Price Data

Data 1: U.S. No 2 Diesel Retail Prices (Dollars per Gallon)

Date	U.S. No 2 Diesel Retail Prices[1]
1995	1.109
1996	1.235
1997	1.198
1998	1.044
1999	1.121
2000	1.491
2001	1.401
2002	1.319
2003	1.509
2004	1.81
2005	2.402
2006	2.705
2007	2.885
2008	3.803
2009	2.467
2010	2.992
2011	3.84
2012	3.968
2013	3.922
2014	3.825
2015	2.707
2016	2.304
2017	2.65
2018	3.178

Date	U.S. No 2 Diesel Retail Prices[1]
Jan 2019	2.98

FMI Fuel Quotes[2]

Site	Date	Dyed, low-sulfur diesel	Notes
Continental	1/21/2005	$1.40	Tom Shelley - quote from fuel broker
Chino & Tyrone	5/9/2007	$2.41	Porter Oil Quote (7500 gal capacity)
Continental	1/23/2009	$1.80	Porter Oil Quote (7500 gal capacity)
Tyrone (Little Rock)	1/14/2010	$2.49	Porter Oil Quote (7500 gal capacity)
Tyrone	7/7/2012	$3.13	Western Refining Oil
Continental	6/18/2014	$3.22	Western Refining Oil
Chino (North Lampbright)	11/5/2015	$1.74	Western Refining Oil
Chino	5/20/2016	$1.66	Western Refining Oil
Tyrone (Little Rock)	4/24/2017	$1.90	Western Refining Oil
Continental	3/12/2018	$2.75	Griffin Propane
Chino	10/10/2018	$2.75	Griffin Propane

1. U.S. Energy Information Administration
http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_NUS_DPG&f=M
2. Quotes obtained from Freeport-McMoRan (FMI)

For example use only. Values may not match the current spreadsheet.

Data and Assumptions (continued):

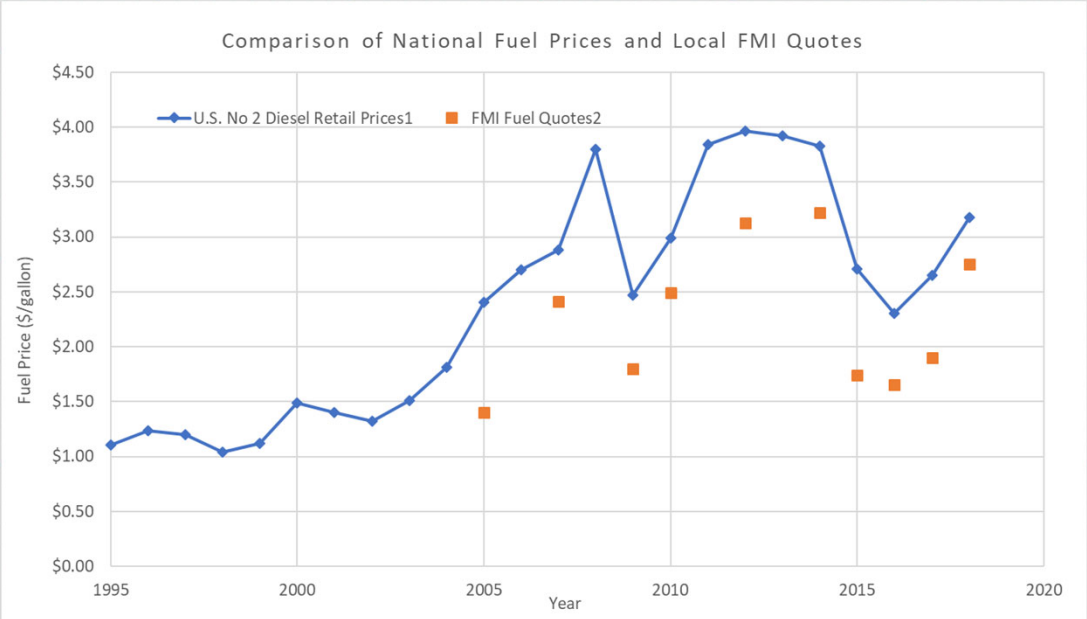
2. The local FMI fuel quotes and annual national retail fuel (U.S. No. 2) prices are assumed to trend similarly – if the national prices increase the local prices also increase.
3. A correlation between national and local fuel prices is assumed to be a reasonable predictor of local fuel prices for any time period (e.g., annual, monthly, etc).

Calculations and Results:

1. The annual national retail fuel prices (U.S. Energy Information Administration) dataset is tabulated and plotted for comparison with the available annual local FMI fuel quotes (note that quotes are not available for blank years).

Year	U.S. No 2 Diesel Retail Prices[1]	FMI Fuel Quotes[2]
1995	1.109	
1996	1.235	
1997	1.198	
1998	1.044	
1999	1.121	
2000	1.491	
2001	1.401	
2002	1.319	
2003	1.509	
2004	1.81	
2005	2.402	$1.40
2006	2.705	
2007	2.885	$2.41
2008	3.803	
2009	2.467	$1.80
2010	2.992	$2.49
2011	3.84	
2012	3.968	$3.13
2013	3.922	
2014	3.825	$3.22
2015	2.707	$1.74
2016	2.304	$1.66
2017	2.65	$1.90
2018	3.178	$2.75

1. U.S. Energy Information Administration
http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_NUS_DPG&f=M
2. Quotes obtained from Freeport-McMoRan (FMI)



For example use only. Values may not match the current spreadsheet.

Calculations and Results (continued):

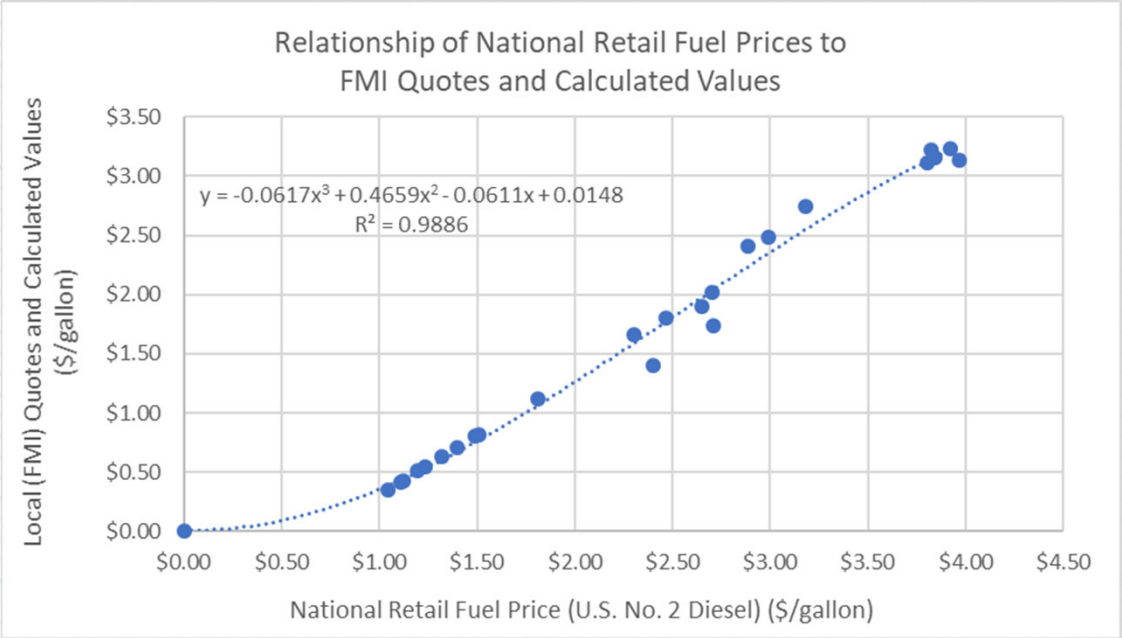
2. The annual national fuel retail prices are ranked from lowest to highest, and corresponding local FMI fuel quotes are listed for matching years in which they are available. (see Col. A and B, below)
3. The difference between the national fuel retail prices and FMI fuel quotes is calculated for each pairing. Note that FMI fuel quotes are all lower than the corresponding national fuel retail prices. The differences for all pairs are averaged. (Col. C)
4. For each year without an FMI quote, the average difference ($0.69) is subtracted from the national fuel retail prices. This results in a calculated FMI value for each unpaired data year. (Col. D)
5. The available FMI fuel quotes and calculated FMI values are combined into one column for a full listing of calculated FMI values and FMI quotes. (Col. E)
6. The annual national fuel retail prices (Col. A) are plotted vs FMI calculated values and quotes (Col. E), and a correlation is developed with national fuel prices as the independent variable and FMI values and quotes as the dependent (i.e., estimated) variable. (see Col. F and graph below)

A	B	C	D	E	F
U.S. No. 2 Diesel Retail Prices[1]	FMI Fuel Quotes[2]	Difference Between Retail Prices and FMI Quotes	Calculated FMI Values Based on Average Difference	Calculated FMI Values and Quotes	y = -0.0617x3 + 0.4659x2 - 0.0611x + 0.0148
$0.00				$0.00	$0.01
$1.11			$0.42	$0.42	$0.44
$1.24			$0.55	$0.55	$0.53
$1.20			$0.51	$0.51	$0.50
$1.04			$0.36	$0.36	$0.39
$1.12			$0.43	$0.43	$0.44
$1.49			$0.80	$0.80	$0.75
$1.40			$0.71	$0.71	$0.67
$1.32			$0.63	$0.63	$0.60
$1.51			$0.82	$0.82	$0.77
$1.81			$1.12	$1.12	$1.06
$2.40	$1.40	$1.00		$1.40	$1.70
$2.71			$2.02	$2.02	$2.04
$2.89	$2.41	$0.47		$2.41	$2.23
$3.80			$3.11	$3.11	$3.13
$2.47	$1.80	$0.67		$1.80	$1.77
$2.99	$2.49	$0.50		$2.49	$2.35
$3.84			$3.15	$3.15	$3.16
$3.97	$3.13	$0.84		$3.13	$3.25
$3.92			$3.23	$3.23	$3.22
$3.83	$3.22	$0.61		$3.22	$3.14
$2.71	$1.74	$0.97		$1.74	$2.04
$2.30	$1.66	$0.65		$1.66	$1.59
$2.65	$1.90	$0.75		$1.90	$1.98
$3.18	$2.75	$0.43		$2.75	$2.89
	Average	$0.69			

1. U.S. Energy Information Administration
http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_NUS_DPG&f=M
2. Quotes obtained from Freeport-McMoRan (FMI)

For example use only. Values may not match the current spreadsheet.

Calculations and Results (continued):



7. The prediction equation (and coefficient of determination, R^2) is shown in the above graph where x = national retail fuel price ($/gallon) and y = predicted local fuel price ($/gallon).
8. Based on this equation, and a national retail fuel price in January 2019 of $2.98, the predicted local FMI fuel price for U.S. No. 2 diesel (January 2019) is

$$Local\ fuel\ price = (-0.0617)(2.98)^3 + (0.4659)(2.98)^2 - (0.0611)(2.98) + 0.0148 = \$2.34/gallon$$

Summary and Conclusions:

1. National and local (FMI) fuel price data were used to develop a strongly-correlated (R^2 = 0.9886) prediction equation by which local FMI fuel prices can be predicted from national fuel price data. Note that the relationship developed in this analysis applies only to FMI operations in the Silver City (Grant County), NM area.
2. The following prediction equation developed in these calculations can be used to predict the estimated 2019 local fuel price for use in earthwork closure costs:

$$Local\ fuel\ price = -0.0617x^3 + 0.4659x^2 - 0.0611x + 0.0148$$

where x = national retail fuel price ($/gallon) and y = predicted local fuel price ($/gallon)

Bench Grading
Unit Cost

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes unit cost information for bench grading on side slopes of stockpiles and tailing ponds as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). The unit costs need to account for the earthwork process and site-specific conditions, equipment productivity, equipment rental rates, and associated equipment maintenance, fuel costs, and labor rates.

This calculation set presents a summary of the approach and results for estimating the unit cost for bench grading. Detailed information is presented in the earthwork reclamation cost estimate (RCE) spreadsheet file.

This calculation set is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Objective:

1. Develop a bench grading unit cost ($/ft) for stockpile side slopes and tailing pond side slopes for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM. Account for equipment and fuel costs in the estimate.

Approach:

1. The data, assumptions, calculations, and results for the bench grading unit cost estimate are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in a sheet (tab) named "Bench Grading_UC".
2. The approach for estimating bench grading unit costs is as follows:
   - Compile data and assumptions used in the calculations. Data obtained from the CCP or Scope of Work include:
     - Material factors
     - Grade factors
     - Soil weight
     - Production method/blade factors
     - Centroid to centroid push distance
     - Operator factor
     - Work hour
     - Visibility factor
     - Elevation factor
     - Transmission factor
     - Number of passes to finish grade
     - Speed
     - Volume

Approach:

- Equipment costs are referenced from the Equipment Sheet
- Estimate the unit cost for bench grading on sides slopes of the stockpiles and tailing ponds. The unit cost for bench grading operations is calculated based on two construction steps: excavate and final grade.
  - Productivity in cy/hr is calculated for excavation using the following equation:

$$Productivity\ (cy/hr) = Normal\ Production\ (cy/hr) * Operator * Material * \frac{Work\ Hour\ (min/hr)}{60\ (min/hr)} * Grade\ Factor * \frac{2300\ (lbs/cy)}{Material\ Weight\ (lbs/cy)} * Prod.\ Method * Visibility * Elev. * Drive\ Trans.$$

  - Productivity in hrs/ft is calculated for finish grade by using the following equation:

$$Productivity\ (hrs/ft) = \left(Operator * Material * Grade\ Factor * \frac{Work\ Hour\ (min/hr)}{60\ (min/hr)} * \frac{2300\ \left(\frac{lbs}{cy}\right)}{Material\ Weight\ \left(\frac{lbs}{cy}\right)} * Prod.\ Method * Visibility * Elev. * Drive\ Trans. * Speed\ (mi/hr) * 5280\ (ft/mi) * \frac{1}{\#\ Passes} \right)^{-1}$$

Results:

1. The results of the bench grading unit cost calculations are shown below (some of the final results may vary from what is shown). These results are used in the overall earthwork RCE.

Bench Grading Unit Cost					
Bench Grading - Stockpiles					
Task Description	Equipment	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)		
Excavate	Cat D11T CD	$1.43	$0.35		
Finish Grade	Cat D6T XL, SU Blade	$0.09	$0.02		
		$1.52	$0.37	**$1.89**	**Total**
Bench Grading -Tailings					
Task Description	Equipment	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)		
Excavate	Cat D11T CD	$1.43	$0.35		
Finish Grade	Cat D6T XL, SU Blade	$0.09	$0.02		
		$1.52	$0.37	**$1.89**	**Total**

Top Channel Unit Cost

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes unit cost information for top channel construction on stockpiles as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). The unit cost needs to account for the earthwork process and site-specific conditions, equipment productivity, equipment rental rates, and associated equipment maintenance, fuel costs, and labor rates.

This calculation set presents a summary of the approach and results for estimating the unit cost for channel construction. Detailed information is presented in the earthwork reclamation cost estimate (RCE) spreadsheet file.

This calculation set is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Objective:

1. Develop a top channel construction unit cost ($/ft) for stockpiles for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM. Account for equipment and fuel costs in the estimate.

Approach:

1. The data, assumptions, calculations, and results for the top channel construction unit cost estimate are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in a sheet (tab) named "Top Channel_UC".
2. The approach for estimating the top channel construction unit cost is as follows:
   - Compile data and assumptions used in the calculations. Data obtained from the CCP or Scope of Work include:
     - Material factors
     - Grade factors
     - Soil weight
     - Production method/blade factors
     - Centroid to centroid push distance
     - Operator factor
     - Work hour
     - Visibility factor
     - Elevation factor
     - Transmission factor

Approach (con'd):

- Equipment costs are referenced from the Equipment Sheet
- Estimate the unit cost for top channel construction on stockpiles. The unit cost for top channel construction operations is calculated based on three construction steps: excavate, waste, and final grade.
  - Calculate the unit volume (cy/ft) for excavation and wasting using top channel design drawings. The finish grade volume is assumed to be 40% of the excavation and wasting volume.
  - Productivity in cy/hr is calculated using the following equation:

$$Productivity\ (cy/hr) = Normal\ Production\ (cy/hr) * Operator * Material * \frac{Work\ Hour\ (min/\ hr)}{60\ (min/\ hr)} * Grade\ Factor * \frac{2300\ (lbs/cy)}{Material\ Weight\ (lbs/cy)} * Prod.\ Method * Visibility * Elev. * Drive\ Trans.$$

  - Productivity in hrs/ft is calculated by dividing the productivity in cy/hr by the unit volume in cy/ft.

Results:

1. The results of the top channel construction unit cost calculations are shown below (some of the final results may vary from what is shown). These results are used in the overall earthwork RCE.

Top Channel Unit Cost

Task Description	Equipment	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)		
Excavate	Cat D11T CD	$0.68	$0.17		
Waste	Cat D11T CD	$0.75	$0.18		
Finish Grade	Cat D9T, SU Blade	$0.61	$0.09		
		$2.04	$0.44	**$2.48**	**Total**

Bench Channel
Unit Cost

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes bench channel unit cost information as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). The unit cost for bench channel construction needs to account for the earthwork process and site-specific conditions, equipment productivity, equipment rental rates, and associated equipment maintenance, fuel costs, and labor rates.

Objectives:

1. Develop a bench channel unit cost ($/ft) for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM.
2. Note that this calculation set presents the approach, data and assumptions, and calculations and results for developing the unit cost. It is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Approach:

1. The data, assumptions, calculations, and results for the bench channel unit cost estimate are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in the sheet (tab) named "Bench Channel_UC".
2. The approach for the calculations is as follows:
   - Using reclamation design quantities and calculations, for each facility determine volumes of excavation, bench channel filter, and bench channel riprap, and haul distances.
   - Calculate travel times for the equipment, incorporating distances and travel speeds.
   - Estimate the unit cost for each of the five following bench channel construction steps:
     - Earthwork excavate and waste
     - Load and transfer riprap and filter
     - Haul riprap and filter
     - Place riprap and filter
     - Finish grade channel and riprap
   - Estimate the cost to produce riprap and filter where these materials are obtained.
   - Combine equipment and fuel costs for the bench channel operations and riprap and filter production for a total bench channel unit cost.

Data and Assumptions:

1. Bench channel earthwork quantities for each facility are obtained from the reclamation design, with additional calculations presented below in Calculations and Results). Basic channel dimensions are shown in Table 1.

Table 1

BENCH CHANNELS			
Dimensions:			
Left Side Slope:[1]	3.00	H:1V	
Left Side Slope:[1]	2.50	H:1V	
Depth:[1]	2.00	ft	
Left Side Slope Length:[1]	3.61		
Right Side Slope Length:[1]	3.20		
Bottom Width:	5.00	ft	
Left Anchor[1]	0.00	ft	
Right Anchor[1]	0.00	ft	
Perimeter:[1]	11.81	ft	
Excavation Area:[1]	21.00	sf	
Filter Area	5.90	sf	bench cross width* 6" thickness
RipRap Area	4.77	sf	(27* Total Riprap Volume)/Total Bench Length

2. Equipment and fuel cost information used for bench channel unit cost calculations is developed in the Equipment sheet of the separate Earthwork RCE spreadsheet calculation set.
3. Equipment rates from Equipment Watch include overhaul labor, parts, and time, and are corrected for a 50-minute work hour.
4. Other equipment parameters used in the calculations are from Tables 3 and 4 of the Process Summary (SOW), Nov 2017 (Telesto).
5. The work day is set at 8 hours/day, 50 minutes/hour.
6. The following assumptions/data inputs apply to riprap and filter production:
   - For riprap and filter production, the primary plant is fed directly by two 769D haul trucks, 300 to 400 yd haul.
   - 400 tons input/hr (per Rusty McCauley, equipment peak production is 900 tons/hr).
   - 30% - 60% waste depending on smallest rip rap size used. (per Rusty McCauley, consistent w/ Mc+C63Cain Springs waste rate of 43% - 1" minus).
   - 3650 lb/cy (Caterpillar Performance Handbook p. 27-4, consistent with 1.8 tons/cy riprap unit weight).

For example use only. Values may not match the current spreadsheet.

Data and Assumptions (continued):

6. Key assumptions/data inputs for riprap and filter production equipment and labor are shown in Table 2.

Table 2

Equipment & Labor	Rate ($/hr)	Comment
One 988H Loader with Operator (bucket = 8.3 cy)	$ 156.46	Used to load stockpiled material to 769D trucks and 777 haul trucks
Three 769D haul trucks with drivers (22 cy, 36 ton payload each)	$ 396.83	Option: Two used to directly feed primary screening plant, one used to move material from end of conveyor
One 1 Deck Portable Screening Plant w/ 5x16 screen & 48"x60' conveyor + 1 Operator	$ 63.68	Primary screening plant, grizzly used to split oversized, 6" - 12" and 6" minus (2 conveyers) One operator required in tower to run screening plant
One 3 Deck Portable Screening Plant w/ 5x16 screen & 42"x60' conveyor + 1 Operator	$ 64.25	One operator required in tower to run screening plant Fed with 6" minus, Produce 6" - 6", 1.5" - 3", 3/8" - 1.5", 3/8 minus One operator required in tower to run screening plant
Two Cat 980H Loaders with Operator (bucket = 7.5 cy)	$ 210.53	Used move material to conveyors or load trucks
Zero Cat 992K Loaders with Operator (bucket = 16 cy)	$ -	Unused loader option
One Cat 966H Loader with Operator (bucket = 5.5 cy)	$ 100.81	Used to move material from end of conveyors & load trucks
One Water Truck with Driver (10,000 gal)	$ 91.96	Dust suppression
One Foreman	$ 23.84	

Calculations and Results:

1. Volumes of excavation, bench channel filter, and bench channel riprap for each facility and haul distances are presented in Table 3, with a summary of the calculations presented after Table 3.

Table 3

	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
2		Bench Channels (ft)	Excavation (cy)	Bench Channel Filter (cy)	Bench Channel Riprap (cy)	Haul Dist (ft)	Weighted Filter	Weighted Riprap	Weighted Filter Haul (ft)	Weighted Riprap Haul (ft)
3										
4	South Stockpile	95,487	74,268	20,878	17,399	8,173	170,638,277	142,198,564	14,487.63	14,786.34
5	STS2	6,218	4,837	1,360	1,133	-	-	-		
6	Lambright Stockpile	157,574	122,557	34,454	28,711	17,438	600,801,207	500,667,673		
7	Southwest Lampbright	-	-	-	-	17,323	-	-		
8	West Stockpile	108,831	84,647	23,796	19,830	22,486	535,069,876	445,891,564		
9	Northwest Stockpile	-	-	-	-	23,749	-	-		
10	LeeHill Stockpile	-	-	-	-	25,168	-	-		
11	Northeast Stockpile	-	-	-	-	29,443	-	-		
12	North Stockpile	-	-	-	-	27,241	-	-		
13	Santa Rita Stockpile	-	-	-	-	21,949	-	-		
14	Upper South	5,348	4,160	1,169	975	-	-	-		
15	Triangle Stockpile	13,831	10,757	3,024	2,520	4,778	14,449,396	12,041,164		
16	9 Waste Rock	14,085	10,955	3,080	-	5,132	15,804,963	-		
17	Axiflo	3,350	2,606	732	591	5,128	3,756,252	3,032,979		
18	Tailings Pond 7	42,224	32,841	9,232	7,693	8,800	81,238,952	67,699,127		
19	Tailings Pond-6W	3,498	2,720	765	637	10,300	7,877,551	6,564,626		
20	Tailings Pond-6E	2,999	2,333	656	547	10,300	6,755,330	5,629,442		
21		453,446	352,680	99,146	80,055	237,408				

Bench channel length in Col. AD is from the reclamation design. Along with bench channel length, excavation area (see Table 1) is used to calculate the excavation volume (Col. AE) as follows, with an example calculation for South Stockpile shown:

$$Excavation\ Volume = Bench\ channel\ length\ x\ Excavation\ area$$

$$Excavation\ Volume\ (South\ Stockpile) =$$
$$95{,}487\ ft\ x\ 21\ square\ feet\ (sf)/(27\ cf/cy) = 74{,}268\ \text{cy}$$

Bench channel length and filter area (and riprap area) (see Table 1) are used to calculate the bench channel filter volume (and riprap volume) for each facility as follows, with an example calculation for filter volume for South Stockpile shown:

$$Filter\ or\ Riprap\ Volume = Bench\ channel\ length\ x\ Filter\ or\ Riprap\ area$$

$$Filter\ Volume\ (South\ Stockpile) =$$
$$95{,}487\ ft\ x\ 5.904\ square\ feet\ (sf)/(27\ cf/cy) = 20{,}878\ \text{cy}$$

For example use only. Values may not match the current spreadsheet.

Calculations and Results (continued):

1. Volumes and haul distances (continued)

Haul distances (Col. AH) are assumed to be equal to cover haul distances and are referenced from the Quantities Sheet.

The volume-weighted average filter and riprap haul distances are calculated (Col. AK and AL, respectively) for hauling of filter and riprap to facilitate bench channel unit cost calculation, rather than calculating hauling distances for each individual facility. To calculate the weighted haul distance for filter (same type of calculation for riprap also), first a weighted value is calculated for each facility (Col. AI and AJ, respectively) and then the weighted values are summed – South Stockpile is shown as an example:

$Weighted\ Filter\ (South\ Stockpile) = Filter\ Haul\ Distance\ x\ Filter\ Volume =$
8,173 ft x 20,878 cy = 170,638,277 ft-cy

$Weighted\ Filter\ Haul\ (all\ facilities) =$
$(Sum\ of\ Weighted\ Filter\ Values)/(Total\ Volume\ of\ Bench\ Channel\ Filter) =$
(1,436,391,805 ft-cy)/(99,146 cy) = 14,488 ft

2. Travel times are calculated for the equipment, incorporating distances and travel speeds, as shown in Table 4, with a summary of the calculations presented after Table 4.

Table 4

	AC	AD	AE	AF	AG	AH	AI	AJ	AK	AL
27	Cat 992K	Full	Tram Distance							
28			175	ft at	7.6	mph	11.15	ft/sec	0.26	min
29										
30	Komatsu 730E	Full	Haul Distance							
31			14488	ft at	12	mph	17.60	ft/sec	13.7	min
32										
33	Komatsu 730E	Empty	Haul Distance							
34			14488	ft at	35	mph	51.33	ft/sec	4.7	min
35										
36	Cat 725	Full	Haul Distance							
37			5153	ft at	10	mph	14.67	ft/sec	5.9	min
38										
39	Cat 725	Empty	Haul Distance							
40			5153	ft at	34	mph	49.87	ft/sec	1.7	min

Calculations and Results (continued):

2. Travel times (continued):

The equipment used for hauling is listed in Col. AC, and Full or Empty is listed in Col. AD.

Haul or tram travel distances (Col. AE) are calculated based on the equipment used and basis for the distance. Tram distance using the Cat 992K is assigned at 175 ft and the haul distance for the Komatsu 730E utilizes the weighted filter haul distance (14,488 ft). The riprap/filter placement distance calculation assumes an average of 7 bench channels and 2 downdrains per stockpile; riprap/filter material is hauled 1/4 of the length of a downdrain and then 1/4 of the length of a bench channel distance for an average placement distance:

$$Riprap/filter\ Placement\ Distance\ for\ Cat\ 725 =$$
$$0.5\ \text{x}\frac{\text{Average bench channel length}}{\text{7 bench channels per stockpile}} + 0.25\text{xAverage downdrain length}/2$$

= 0.5 x (41,222 ft)/7 + 0.25 x (3419 ft)/2 = 1,380 ft

Travel speeds are shown in Col. AG:

- The tram speed of 7.6 mph is from equipment information.
- For the Komatsu 730E, the full speed is 12 mph and empty speed is 35 mph – the full speed is going uphill with 7.5% effective grade.
- For the Cat 725, the full speed is 10 mph and empty speed is 34 mph – the full speed involves dumping going uphill, and the empty speed is going downhill.

From the information discussed above, travel times (Col. AK) are calculated as follows, with an example calculation shown for the Cat 992K:

$$Travel\ time = (Travel\ distance)/Travel\ speed) =$$

(175 ft)/[(7.6 mile/hour)(1 hour/60 minutes)(5280 ft/mile)] = 0.26 minute

Calculations and Results (continued):

Next, the unit costs for each of the five following bench channel construction steps are developed:

- Earthwork excavate and waste
- Load and transfer riprap and filter
- Haul riprap and filter
- Place riprap and filter
- Finish grade channel and riprap

3. Excavate and waste (earthwork) operations comprise the first construction step. The unit cost is calculated based on both steps using a Cat D11T CD, U Blade dozer. Table 5 (split into 3 segments due to many columns) shows the progression of the calculations to estimate the cost for these operations. This table is followed by the calculations (or assigned parameters) for the "Excavate" row.

Table 5

	B	C	D	E	F	G	H	I	J
5		Task Description	Equipment	Volume (cy/ft)	Productivity (cy/hr)	Material Factor[2]	Grade Factor[2]	Material Weight[2] (lb/cy)	Production Method/ Blade Factor[2]
6	Bench Channels	Excavate	Cat D11T CD, U Blade	0.78	1123	1.20	1.0	2900	1.00
7	Bench Channels	Waste	Cat D11T CD, U Blade	0.78	1001	1.20	1.0	2900	1.00

	B	C	K	L	M	N	O	P	Q
5		Task Description	Centroid to Centroid Push Distance[2] (feet)	Normal Production (cy/hr)	Operator Factor[2]	Work Hour[2] (min/hr)	Visibility Factor[2]	Elevation Factor[2]	Transmission Factor[2]
6	Bench Channels	Excavate	175	1851	0.75	50	1.00	1.00	1.00
7	Bench Channels	Waste	200	1649	0.75	50	1.00	1.00	1.00

	B	C	R	S	T	U	V	W	X	Y
5		Task Description	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	Total $/ft
6	Bench Channels	Excavate	0.0007	69.62	254.44	27.41	281.85	0.20	0.05	
7	Bench Channels	Waste	0.0008	69.62	254.44	27.41	281.85	0.22	0.05	
8								0.41	0.10	$ 0.52

The following parameters used in the calculations are from Tables 3 and 4 of the Process Summary (SOW), Nov 2017 (Telesto) – also see Equipment sheet in the separate Earthwork RCE spreadsheet calculation set: Material Factor (Col. G), Grade Factor (Col. H), Material Weight (Col. I), Production Method/Blade Factor (Col. J), Centroid to Centroid Push Distance (Col. K), Operator Factor (Col. M), Work Hour (Col. N), Visibility Factor (Col. O), Elevation Factor (Col. P), and Transmission Factor (Col. Q).

Calculations and Results (continued):

3. Excavate and waste (earthwork) calculations (continued)

$$Volume(Col.E) = \frac{(Table\ 3\ Cell\ AE21)}{(Table\ 3\ Cell\ AD21)} = \frac{352{,}680\ cy}{453{,}446\ ft} = 0.78\ cy/ft$$

$$Productivity(Col.F) = \text{Col.}L\ x\ M\ x\ G\ x \left(\frac{N}{60}\right) x\ H\ x \left(\frac{2300}{I}\right) x\ J\ x\ O\ x\ P\ x\ Q =$$

$$1851\frac{cy}{hr}\ x\ 0.75\ x\ 1.20\ x \left(\frac{50\ min/hr}{60\ min}\right) x\ 1.0\ x \frac{2300\ lb/cy}{2900\ lb/cy}\ x\ 1.00\ x\ 1.00\ x\ 1.00\ x\ 1.00 =$$

1123 cy/hr

Normal Production (Col. L): If Centroid to Centroid Push Distance is not 0, then, for the equipment used, look up the production curve fit parameters C and b for equation: $C\ x\ (Average\ dozing\ distance\ [ft])^b = 162{,}758.76\ x\ (175\ ft)^{-0.86691} =$ *1851 cy/hr*

$$Productivity(Col.R) = \frac{\left(Volume, \frac{cy}{ft}[Col.E]\right)}{\left(Productivity, \frac{cy}{hr}[Col.F]\right)}$$ = (0.78 cy/ft)/(1123 cy/hr) = 0.00069 hr/ft (or 0.0007 hr/ft)

Fuel Cost (Col. S), Equipment Cost (Col. T), and Operator (IV) Cost (Col. U) are from Equipment cost calcs (presented in the Earthwork RCE spreadsheet calculation set).

$$Dozer\ Cost\ (Col.\ V) = \frac{\$254.44}{hr}(equipment) + \frac{\$27.41}{hr}(operator) = \frac{\$281.85}{hr}$$

Bench equipment cost (Col. W) =
$\left(Dozer\ cost, \frac{\$}{hr}[Col.V]\right) x \left(Productivity, \frac{hr}{ft}[Col.R]\right) =$ (\$281.85/hr) x (0.00069 hr/ft) = *\$0.20/ft*

Bench Fuel Cost (Col. X) =
$\left(Fuel\ cost, \frac{\$}{hr}[Col.S]\right) x \left(Productivity, \frac{hr}{ft}[Col.R]\right) =$ (\$69.62/hr) x (0.00069 hr/ft) = *\$0.05/ft*

The total unit cost for the earthwork (excavate and waste) = \$0.52/ft

Calculations and Results (continued):

4. Load riprap and filter, and transfer for placing, unit cost is calculated based on the following separate operations: load riprap, load filter, transfer riprap for placing, and transfer filter for placing. A Cat 992K is used for these operations. Table 6 (split into 3 segments due to many columns) shows the progression of the calculations to estimate the cost for these operations. This table is followed by the calculations (or assigned parameters) for the "Load Riprap" row.

Table 6

	B	C	D	E	F	G	H	I
11		Task Description	Equipment	Volume (cy/ft)	Load, Dump, Maneuver Time (min)	Delivery Travel Time (min)	Return Travel Time (min)	Total Time Per Load (min)
12	Bench Channels	Load riprap	Cat 992K	0.18	0.65	0.26	0.26	1.17
13	Bench Channels	Load filter	Cat 992K	0.22	0.65	0.26	0.26	1.17
14	Bench Channels	Transfer riprap for placing	Cat 992K	0.18	0.65	0.26	0.26	1.17
15	Bench Channels	Transfer filter for placing	Cat 992K	0.22	0.65	0.26	0.26	1.17

	B	C	J	K	L	M	N	O	P
11		Task Description	Work Time[2] (min)	Loads/ hr	Equipment Cost ($/load)	Net Bucket (cy/load)	Fuel Use Gal per Hour	Fuel Cost ($/hr)	Equipment Cost ($/hr)
12	Bench Channels	Load riprap	50	42.61	5.72	14.00	25.63	59.97	216.23
13	Bench Channels	Load filter	50	42.61	5.72	14.00	25.63	59.97	216.23
14	Bench Channels	Transfer riprap for placing	50	42.61	5.72	14.00	25.63	59.97	216.23
15	Bench Channels	Transfer filter for placing	50	42.61	5.72	14.00	25.63	59.97	216.23

	B	C	Q	R	S	T	U	V	W	X
11		Task Description	Operator Cost ($/hr)	Loader Cost ($/hr)	Equipment Cost ($/cy)	Fuel Cost ($/load)	Fuel Cost ($/cy)	Equipment Cost ($/ft)	Fuel Cost ($/ft)	Total $/ft
12	Bench Channels	Load riprap	27.70	243.93	0.41	1.41	0.10	0.07	0.02	
13	Bench Channels	Load filter	27.70	243.93	0.41	1.41	0.10	0.09	0.02	
14	Bench Channels	Transfer riprap for placing	27.70	243.93	0.41	1.41	0.10	0.07	0.02	
15	Bench Channels	Transfer filter for placing	27.70	243.93	0.41	1.41	0.10	0.09	0.02	
16								0.32	0.08	0.40

The following parameters used in the calculations are developed in the Equipment sheet as described for the separate Earthwork RCE spreadsheet calculation set: Load, Dump, Maneuver Time (min) (Col. F); Net Bucket (cy/load) (Col. M); Fuel Use Gal per Hour (Col. N); Fuel Cost ($/hr) (Col. O); Equipment Cost ($/hr) (Col. P); and Operator Cost ($/hr) (Col. Q).

$$Volume(Col.E) = \frac{(Table\ 3\ Cell\ AG21)}{(Table\ 3\ Cell\ AD21)} = \frac{80{,}055\ cy}{453{,}446\ ft} = 0.18\ cy/ft$$

$$Delivery\ Travel\ Time\ (Col.G) = \text{Return Travel Time (Col. H)}$$
$$= \text{Table 4}\ Cell\ AK28\ (for\ Cat\ 992K) = 0.26\ min$$

$$Total\ Time\ Per\ Load\ (Col.I) = \text{Col. F + Col G. + Col. H} = 0.65 + 0.26 + 0.26 = 1.17\ min$$

Calculations and Results (continued):

4. Load/transfer riprap and filter (continued)

Work Time (Col. J) = 50 min per hour

Loads/hr (Col. K) = (Col. J)/(Col. I) = 50/1.17 = 42.61 loads/hr

Loader Cost/hr (Col. R) = Equipment Cost (Col. P) + Operator Cost (Col. Q)
= $216.23/hr + $27.70/hr = $243.93/hr

Equipment Cost/load (Col. L) = [Loader Cost, $/hr (Col. R)]/[Loads/hr (Col. K)]
= ($243.93/hr)/(42.61 loads/hr) = $5.72/load

Equipment Cost/cy (Col. S) = [Equipment Cost/load (Col. L)]/[(Net Bucket cy/load, Col. M)]
= ($5.72/load)/(14.00 cy/load) = $0.41/cy

Fuel Cost/load (Col. T) = [Fuel Cost/hr (Col. O)]/[Loads/hr (Col. K)]
= ($59.97/hr)/(42.61 loads/hr) = $1.41/load

Fuel Cost/cy (Col. U) = [Fuel Cost/load (Col. T)]/[Net Bucket cy/load (Col. M)]
= ($1.41/load)/(14.00 cy/load) = $0.10/cy

Equipment Cost/ft (Col. V) = [Equipment Cost/cy (Col. S)] x [Volume, cy/ft (Col. E)]
= ($0.41/cy) x (0.18 cy/ft) = $0.07/ft

Fuel Cost/ft (Col. W) = [Fuel Cost/cy (Col. U)] x [Volume, cy/ft (Col. E)]
= ($0.10/cy) x (0.18 cy/ft) = $0.02/ft

The total unit cost for the loading and transferring (for placing) riprap and filter = total for equipment + total for fuel = $0.32/ft + $0.08/ft = $0.40/ft

Calculations and Results (continued):

5. Haul riprap and filter unit cost is calculated based on the following separate operations: haul riprap and haul filter. A Komatsu 730E is used for these operations. Table 7 (split into 3 segments due to many columns) shows the progression of the calculations to estimate the cost for these operations. This table is followed by the calculations (or assigned parameters) for the "Haul Riprap" row.

Table 7

	B	C	D	E	F	G	H	I	J
19		Task Description	Equipment	Volume (cy/ft)	Exchange Time (min)	Delivery Travel Time (min)	Unload and Maneuver Time (min)	Return Travel Time (min)	Load Time (min)
20	Bench Channels	Haul riprap	Komatsu 730E	0.18	0.70	13.72	1.10	4.70	6.73
21	Bench Channels	Haul filter	Komatsu 730E	0.22	0.70	13.72	1.10	4.70	6.73

	B	C	K	L	M	N	O	P	Q	R
19		Task Description	Total Time (min)	Work Time[2] (min)	Loads/ hr	Equipment Cost ($/load)	Heaped Capacity (cy/load)	Fuel Use Gal per Hour	Fuel Cost ($/hr)	Equipment Cost ($/hr)
20	Bench Channels	Haul riprap	26.96	50	1.85	132.65	145	33.48	78.34	221.79
21	Bench Channels	Haul filter	26.96	50	1.85	132.65	145	33.48	78.34	221.79

	B	C	S	T	U	V	W	X	Y	Z
19		Task Description	Operator Cost ($/hr)	Truck Cost ($/hr)	Equipment Cost ($/cy)	Fuel Cost ($/load)	Fuel Cost ($/cy)	Equipment Cost ($/ft)	Fuel Cost ($/ft)	Total $/ft
20	Bench Channels	Haul riprap	24.27	246.06	0.91	42.24	0.29	0.16	0.05	
21	Bench Channels	Haul filter	24.27	246.06	0.91	42.24	0.29	0.20	0.06	
22								0.36	0.12	0.48

The following parameters used in the calculations are developed in the Equipment sheet as described for the separate Earthwork RCE spreadsheet calculation set: Exchange Time (min) (Col. F); Unload and Maneuver Time (min) (Col. H); Heaped Capacity (cy/load) (Col. O); Fuel Use Gal per Hour (Col. P); Fuel Cost ($/hr) (Col. Q); Equipment Cost ($/hr) (Col. R); and Operator Cost ($/hr) (Col. S).

$$Volume(Col.E) = \frac{(Table\ 3\ Cell\ AG21)}{(Table\ 3\ Cell\ AD21)} = \frac{80{,}055\ cy}{453{,}446\ ft} = 0.18\ cy/ft$$

$$Delivery\ Travel\ Time\ (Col.G) = \text{Table 4}\ Cell\ AK31\ (for\ Komatsu\ 730E) = 13.72\ min$$

$$Return\ Travel\ Time\ (Col.I) = \text{Table 4}\ Cell\ AK34\ (for\ Komatsu\ 730E) = 4.70\ min$$

Calculations and Results (continued):

5. Haul riprap and filter (continued)

Load Time (Col. J)
= Dump, Maneuver Time (Col. F in load/transfer riprap)
x [Heaped Capacity, cy/load (Col. O)]/[Bucket, cy/load (Col. M in load/transfer riprap)]
= 0.65 min x (145 cy/load)/(14.00 cy/load) = 6.73 min

Total Time (Col. K) = Exchange Time (Col. F) + Delivery Travel Time (Col. G) + Unload and Maneuver Time (Col. H) + Return Travel Time (Col. I) + Load Time (Col. J)
= 0.70 + 13.72 + 1.10 + 4.70 + 6.73 = 26.96 min

Work Time (Col. L) = 50 min per hour

Loads/hr (Col. M) = [Work Time (Col. L)]/[Total Time (Col. K)] = 50/26.96 = 1.85 loads/hr

Equipment Cost/load (Col. N) = [Truck Cost/hr (Col. T]/[Loads/hr (Col. M)]
= ($246.06/hr)/(1.85 loads/hr) = $132.65/load

Truck Cost/hr (Col. T) = Equipment Cost/hr (Col. R) + Operator Cost/hr (Col. S)
= $221.79 + $24.27 = $246.06/hr

Equipment Cost/cy (Col. U)
= [Equipment Cost/load (Col. N)]/[(Heaped Capacity, cy/load (Col. O)]
= ($132.65/load)/(145 cy/load) = $0.91/cy

Fuel Cost/load (Col. V) = [Fuel Cost/hr (Col. Q)]/[Loads/hr (Col. M)]
= ($78.34/hr)/(1.85 loads/hr) = $42.24/load

Fuel Cost/cy (Col. W) = [Fuel Cost/load (Col. V)]/[Heaped Capacity, cy/load (Col. O)]
= ($42.24/load)/(145 cy/load) = $0.29/cy

Equipment Cost/ft (Col. X) = [Equipment Cost/cy (Col. U)] x [Volume, cy/ft (Col. E)]
= ($0.91/cy) x (0.18 cy/ft) = $0.16/ft

Fuel Cost/ft (Col. Y) = [Fuel Cost/cy (Col. W)] x [Volume, cy/ft (Col. E)]
= ($0.29/cy) x (0.18 cy/ft) = $0.05/ft

The total unit cost for the hauling riprap and filter = total for equipment + total for fuel = $0.36/ft + $0.12/ft = $0.48/ft

Calculations and Results (continued):

6. Place riprap and filter unit cost is calculated based on the following separate operations: place riprap and place filter. A Cat 725 is used for these operations. The sequence of calculations for the place riprap and filter unit cost is the same as for load/transfer riprap and filter calculations, above. Inputs to the calculations for placing riprap and filter are generally the same except that Cat 725 operating parameters and costs are used. This includes different delivery and return travel times (different equipment than for load/transfer riprap and filter) which are shown in Table 4, and different heaped capacity, among other operating parameters.

Table 8 (split into 3 segments due to many columns) shows the progression of the calculations to estimate the cost for these operations.

Table 8

	B	C	D	E	F	G	H	I	J
25		Task Description	Equipment	Volume (cy/ft)	Exchange Time (min)	Delivery Travel Time (min)	Unload and Maneuver Time (min)	Return Travel Time (min)	Load Time (min)
26	Bench Channels	Place riprap	Cat 725	0.18	0.70	5.86	1.10	1.72	0.87
27	Bench Channels	Place filter	Cat 725	0.22	0.70	5.86	1.10	1.72	0.87

	B	C	K	L	M	N	O	P	Q	R
25		Task Description	Total Time (min)	Work Time[2] (min)	Loads/ hr	Equipment Cost ($/load)	Heaped Capacity (cy/load)	Fuel Use Gal per Hour	Fuel Cost ($/hr)	Equipment Cost ($/hr)
26	Bench Channels	Place riprap	10.25	50	4.88	19.96	19	6.02	14.09	73.11
27	Bench Channels	Place filter	10.25	50	4.88	19.96	19	6.02	14.09	73.11

	B	C	S	T	U	V	W	X	Y	Z
25		Task Description	Operator Cost ($/hr)	Truck Cost ($/hr)	Equipment Cost ($/cy)	Fuel Cost ($/load)	Fuel Cost ($/cy)	Equipment Cost ($/ft)	Fuel Cost ($/ft)	Total $/ft
26	Bench Channels	Place riprap	24.27	97.38	1.06	2.89	0.15	0.19	0.03	
27	Bench Channels	Place filter	24.27	97.38	1.06	2.89	0.15	0.23	0.03	
28								0.42	0.06	0.48

Calculations and Results (continued):

7. Finish grade unit cost is calculated based on the following separate operations: finish grade channel and finish grade riprap. A Cat D6T, SU Blade is used for these operations. The sequence of calculations for the finish grade unit cost is the same as for the first operation for bench channel construction – earthwork (excavate and waste) (see those calculations, above, for details). Inputs to the finish grade channel and finish grade riprap calculations are generally the same with the following exceptions:
   - Cat D6T, SU Blade operating parameters and costs are used.
   - Volume per ft for finish grading is set at 40% (0.4) of the full material grading volume per ft because of the reduced grading required for finish grading.
   - Material Factor (Col. G) and Material Weight (Col. I) for riprap are used, which are different than for the excavate and waste, and channel grading, materials.

Table 9 (split into 3 segments due to many columns) shows the progression of the calculations to estimate the cost for these operations.

Table 9

	B	C	D	E	F	G	H	I	J
31		Task Description	Equipment	Volume (cy/ft)	Productivity (cy/hr)	Material Factor[2,3]	Grade Factor[2]	Material Weight[2] (lb/cy)	Production Method/ Blade Factor[2]
32	Bench Channels	Finish grade - Channel	Cat D6T, SU Blade	0.31	173	1.20	1.0	2900	1.00
33	Bench Channels	Finish grade - Riprap	Cat D6T, SU Blade	0.07	80	0.70	1.0	3650	1.00

	B	C	K	L	M	N	O	P	Q
31		Task Description	Centroid to Centroid Push Distance[2] (feet)	Normal Production (cy/hr)	Operator Factor[2]	Work Hour[2] (min/hr)	Visibility Factor[2]	Elevation Factor[2]	Transmission Factor[2]
32	Bench Channels	Finish grade - Channel	175	284	0.75	50	1.00	1.00	1.00
33	Bench Channels	Finish grade - Riprap	175	284	0.75	50	1.00	1.00	1.00

	B	C	R	S	T	U	V	W	X	Y
31		Task Description	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	Total $/ft
32	Bench Channels	Finish grade - Channel	0.0018	16.8948	63.65	27.41	91.06	0.16	0.03	
33	Bench Channels	Finish grade - Riprap	0.0009	16.8948	63.65	27.41	91.06	0.08	0.01	
34								0.24	0.05	0.29

Calculations and Results (continued):

8. Riprap and filter production costs (where the material source is located) are estimated according to Table 10, with a summary of the calculations provided after Table 10.

Table 10

	B	C	D	E	F	G	H	I
41	Equipment	Equipment Cost	Fuel Cost	# Equipment	Operator	# Operator	Total Equipment Cost	Total Fuel Cost
42		($/hr)	($/hr)		($/hr)		($/hr)	($/hr)
43	Cat 988H	$ 128.76	$ 35.57	1	$ 27.70	1	$ 156.46	$ 35.57
44	Cat 769D	$ 108.01	$ 22.79	3	$ 24.27	3	$ 396.83	$ 68.37
45	1 Deck Screening Plant (5X16, 48X60)	$ 40.59	$ 11.35	1	$ 23.09	1	$ 63.68	$ 11.35
46	3 Deck Screening Plant (5X16, 42X60)	$ 41.16	$ 11.35	1	$ 23.09	1	$ 64.25	$ 11.35
47	Cat 980H	$ 77.56	$ 25.27	2	$ 27.70	2	$ 210.53	$ 50.54
48	Cat 992K	$ 216.23	$ 59.97	0	$ 27.70	0	$ -	$ -
49	Cat 966H	$ 73.11	$ 19.61	1	$ 27.70	1	$ 100.81	$ 19.61
50	Off-Hwy Water Tanker Truck,6,000-gal.	$ 67.69	$ 26.33	1	$ 24.27	1	$ 91.96	$ 26.33
51	Supervisor	$ -	-	0	$ 23.84	1	$ 23.84	$ -
52								
53					Direct Costs	Equipment	Fuel	
54						$ 1,108	$ 223	$/hr
55						8	8	hr/work day
56						$ 8,867	$ 1,785	$/day
57								
58					Production			
59						400	tons input/hr (total)	
60						0.30	% waste	
61						0.70	% rip rap and gravel/filter	
62						280	tons produced/hr (net)	
63						560,000	lb/hr	
64						3,650	lb/cy	
65						153	cy/hr	
66						8	hr/day (net (60 min/hr))	
67						1,227	cy/day net production	
68								
69					Total	$ 7.22	$ 1.45	$/cy
70					Volume	0.40	0.40	cy/ft
71								
72					Total Cost	$ 2.85	$ 0.57	$/ft

Calculations and Results (continued):

8. Riprap and filter production calculations (continued):

For each type of equipment used, the costs calculated (see Earthwork RCE spreadsheet calculation set) are tabulated in Table 10, including Equipment Cost (Col. C), Fuel Cost (Col. D), and Operator Cost (Col. F).

The number of pieces of equipment (Col. E) and number of operators (Col. G) are assigned based on the logistical requirements for production. Pieces of equipment match the number of operators, except for addition of a Supervisor.

Total equipment cost (Col. H) is calculated as follows, with an example calculation shown for the Cat 988H:

$$Total\ Equipment\ Cost, \$/hr = \{(Equip\ Cost\ [Col.C])\ x\ (\#\ Equipment\ [Col.E])\} + \{(Operator\ Cost\ [Col.F])\ x\ (\#\ Operator\ [Col.G])\} = \{(\$128.76)x(1)\} + \{(\$27.70)x(1)\} = \$156.46/hr$$

Total fuel cost (Col. I) is calculated as follows, with an example calculation shown for the Cat 988H:

$$Total\ Fuel\ Cost, \$/hr = \{(Fuel\ Cost\ [Col.D])\ x\ (\#\ Equipment\ [Col.E])\} = \{(\$35.57)x(1)\} = \$35.57/hr$$

The daily cost is calculated for all equipment by summing the total equipment cost (Cell G56) and total fuel cost (Cell H56), as follows:

$$Daily\ Total\ Equipment\ Cost, \frac{\$}{day} = \left(Sum\ for\ all\ equipment, \frac{\$}{hr}\right) x \left(8\frac{hr}{day}\right) = \left(\frac{\$1{,}108}{hr}\right) x \left(8\frac{hr}{day}\right) = \frac{\$8{,}867}{day}$$

$$Daily\ Total\ Fuel\ Cost, \frac{\$}{day} = \left(Sum\ for\ all\ fuel, \frac{\$}{hr}\right) x \left(8\frac{hr}{day}\right) = \left(\frac{\$223}{hr}\right) x \left(8\frac{hr}{day}\right) = \frac{\$1{,}785}{day}$$

Calculations and Results (continued):

8. Riprap and filter production calculations (continued):

Next, the production calculations are summarized (see Rows 59-67 in Table 10). Daily net production is calculated via the following sequence:

- 400 tons input/hr (total) – see production assumptions
- 30% waste – see production assumptions
- 70 % riprap and gravel/filter = 100 minus % waste
- 280 tons produced/hr (net) = (400 tons input/hr) x (70%)
- 560,000 lb/hr = (280 tons) x (2,000 lb/ton)
- 3,650 lb/cy – see production assumptions
- 153 cy/hr = (560,000 lb/hr)/(3,650 lb/cy)
- 8 hr/day (net [60 min/hr]) – see production assumptions
- 1,227 cy/day net production = (153 cy/hr) x (8 hr/day)

The total cost for production (see Rows 69-70 in Table 10) is calculated separately for equipment and fuel as follows:

- Equipment portion of the cost = ($8,867/day)/(1,227 cy/day) = $7.22/cy
- Fuel portion of the cost = ($1,785/day)/(1,227 cy/day) = $1.45/cy
- This yields a total cost of $8.67/cy

Converting to units of $/ft of bench first requires cy/ft of filter and riprap to be calculated; these values are presented in Table 3 (filter cy in Cell AF21, riprap cy in Cell AG21, and bench length in Cell AD21):

- Filter cy/ft = (Filter Volume)/(Bench Length, ft) = (99,146 cy)/(453,446 ft) = 0.22 cy/ft
- Riprap cy/ft = (Riprap Volume)/(Bench Length, ft) = (80,055 cy)/(453,446 ft) = 0.18 cy/ft
- This yields a total volume per bench length of 0.40 cy/ft

Calculation of the total production cost per bench length is calculated as follows:

- Equipment portion of the cost = $7.22/cy x 0.40 cy/ft = $2.85/ft
- Fuel portion of the cost = $1.45/cy x 0.40 cy/ft = $0.57/ft

Summary and Conclusions:

1. The bench channel unit cost ($/ft) was calculated, as shown in this calculation set, for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM. The unit cost consists of calculations for each of the five following bench channel excavation and placement construction steps:
    - Earthwork excavate and waste = $0.41/ft (equipment) + $0.10/ft (fuel)
    - Load and transfer riprap and filter = $0.32/ft (equipment) + $0.08/ft (fuel)
    - Haul riprap and filter = $0.36/ft (equipment) + $0.12/ft (fuel)
    - Place riprap and filter = $0.42/ft (equipment) + $0.06/ft (fuel)
    - Finish grade channel and riprap = $0.24/ft (equipment) + $0.05/ft (fuel)
    - The total for all 5 construction steps is:
        - Equipment = $1.76/ft
        - Fuel = $0.40/ft
2. The riprap and filter production unit cost ($/ft) is
    - Equipment = $2.85/ft
    - Fuel = $0.57/ft
3. The total unit cost for bench channel construction is equal to the grand total of production cost + excavation and placement activities, as follows:
    - Equipment = $2.85/ft + $1.76/ft = $4.62/ft
    - Fuel = $0.57/ft + $0.40/ft = $0.98/ft

Downdrain/ Dissipater Unit Cost

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes downdrain/dissipater unit cost information as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). Downdrains are constructed on regraded side slopes of rock or tailing piles to convey runoff. Dissipaters are constructed as needed at the bottom end (downslope) of specific downdrains to dissipate the energy of the downdrain runoff flow. The unit cost needs to account for excavation/preparation of the subgrade, material and placement costs to install articulated concrete blocks (ACBs) in the downdrains and dissipaters, and installation of a concrete cutoff wall at the downslope end of each dissipater.

Objective:

1. Develop unit costs for downdrains ($/ft) and dissipaters ($/each) for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM.
2. Note that this calculation set presents the approach, data and assumptions, and calculations and results for developing the unit cost. It is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Approach:

1. The data, assumptions, calculations, and results for the downdrain/dissipater unit cost estimate are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in the sheet (tab) named "Downdrain_UC".
2. The approach for the calculations is as follows:
   - Identify locations and lengths required for downdrains. Use reclamation design drawings and quantities.
   - Identify excavation equipment and estimate cost to complete the rough grade where the downdrains and dissipaters will be constructed. Use equipment cost information and calculations as also developed for other earthwork operations in the overall earthwork cost estimate.
   - Estimate cost to finish grade and place ACBs in downdrains and dissipaters. Use available unit costs from Contech Engineered Solutions (Contech ES), the manufacturer and installer of ACBs in the area.
   - Estimate cost to install cast-in-place concrete cutoff wall at downslope end of dissipaters. Use online RS Means data.

Data and Assumptions (continued):

1. Locations and dimensions of downdrains and dissipaters are shown in Attachment A, as well as the following key quantity data used to develop unit costs (note that Attachment A also includes the calculations and results presented in this calculation set):
   - Downdrain base excavation area = 52 square feet/foot of length (sf/ft)
   - Downdrain ACB area coverage = 31 sf/ft
   - Dissipater area (middle [Area 2]) = 320 sf
   - Dissipater area (each side [Area 1 = Area 3]) = 253 sf
   - Cutoff wall concrete volume (each dissipater) = 14 cubic yards
2. Unit cost data from Contech ES (February 2019, see Attachment A) include the following:
   - Material costs for ACBs (includes non-woven geotextile and microgrid/geogrid) are as follows:
     - $7.42/sf (Block Class 40T, for the channel of each downdrain and both side areas of each dissipater)
     - $10.65/sf (Block Class 70T, for the center area of each dissipater)
   - Installation cost is $4.63/sf, which covers the following installation process for both sizes of ACBs: off-load the truck and place delivered ACBs in temporary storage area, fine grade base/subgrade soils, compact soils to 90% Standard Proctor (D698), place and secure filter fabric (non-woven geotextile), place 4- to 6-inch drainage layer overlaid by geogrid, place ACBs in final configuration, grout seams, and backfill ACBs with crushed stone. The installation cost includes crushed stone.
3. Cost data from RS Means for installation of a concrete cutoff wall at the downslope end of each dissipater are presented in Appendix A. The online RS Means cost is $254.97/cubic yard.

Calculations and Results:

1. The estimated cost to excavate the rough grade (where the downdrains will be constructed) is developed in the same manner as excavation costs prepared for bench channel unit costs. Therefore, see the bench channel unit cost calculation set for details. The downdrain rough grade cost = $0.83/ft.
2. The estimated cost to install ACBs in downdrains includes the finish grade and subsequent placement of ACBs. This estimated cost is developed from the Contech ES quotes (as listed above in Data and Assumptions), as follows:
   - Downdrain material cost for 40T ACBs is $7.42/sf
   - Downdrain installation cost for 40T ACBs is $4.63/sf
   - The cost per ft of downdrain ($/ft) = ($7.42/sf + $4.63/sf) x (31 sf/ft) = $12.05/sf x 31 sf/ft = $373.55/ft

$$\boldsymbol{Total\ downdrain\ installation\ cost\ (after\ rough\ grading) = \$373.55/ft}$$

For example use only. Values may not match the current spreadsheet.

Calculations and Results (continued):

3. Similarly, the estimated cost to install ACBs in dissipaters includes the finish grade and subsequent placement of ACBs. This estimated cost is developed from the Contech ES quotes (as listed above in Data and Assumptions), as follows:

   - Dissipater material cost for 40T ACBs is $7.42/sf
   - Dissipater material cost for 70T ACBs is $10.65/sf
   - Dissipater installation cost for 40T and 70T ACBs is $4.63/sf
   - For each dissipater, 40T ACBs cover 506 sf and 70T ACBs cover 320 sf
   - The cost for the 40T part of each downdrain ($/each) =
     ($7.42/sf + $4.63/sf) x (506 sf) = $12.05/sf x 506 sf = $6,097.30/each
   - The cost for the 70T part of each downdrain ($/each) =
     ($10.65/sf + $4.63/sf) x (320 sf) = $15.28/sf x 320 sf = $4,889.60/each
   - The total cost for ACBs in each dissipater = $6,097.30 + $4,889.60 = $10,986.90

4. The estimated cost for installing a cast-in-place concrete cutoff wall at the downslope end of each dissipater is based on on-line cost data from RS Means and the required concrete volume:

   - Cast-in-place concrete cutoff wall (RS Means) cost = $254.97/cubic yard
   - Each dissipater requires cutoff wall concrete volume of 14 cubic yard
   - The total cost for cutoff wall installation at each dissipater =
     ($254.97/cubic yard) x (14 cubic yard) = $3,569.58

   $\boldsymbol{Total\ dissipater\ installation\ cost\ (after\ rough\ grading) =}$
   $10,986.90 + $3,569.58 = $14,556.48

Summary and Conclusions:

1. Unit costs for installing downdrains ($/ft) and dissipaters ($/each) were developed for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM. Note that the estimated unit cost developed in this analysis applies only to FMI operations in the Silver City (Grant County), NM area.
2. Downdrain cost = $0.83/ft (rough grading) + $373.55/ft (after rough grading) = **$374.38/ft**
3. Dissipater cost = $10,986.90/each (rough grading is included in downdrain cost) + $3,569.58/each (cutoff wall) = **$14,556.48/each**

Downdrain Unit Cost

Rough Grade

Task Description	Equipment	Productivity (cy/hr)	Material Factor[5]	Grade Factor[5]	Soil Weight[5] (lb/cy)	Production Method/Blade Factor[5]	Centroid to Centroid Push Distance[5] (ft)	Normal Production (cy/hr)	Operator Factor[5]	Work Hour[5] (min/hr)	Visibility Factor[5]	Elevation Factor[5]	Transmission Factor[5]	Volume (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Equipment w/o Fuel Cost ($/ft)	Fuel Cost ($/ft)	Total Excavation Cost ($/ft)
Excavate	Cat D11T CD	1731	1.2	1.6	2900	1.0	175	1851	0.75	50	1.0	1.0	1.0	1.9	0.0011	$69.62	$254.44	$27.41	$281.85	$0.31	0.0774699	$0.39
Waste	Cat D11T CD	1542	1.2	1.6	2900	1.0	200	1649	0.75	50	1.0	1.0	1.0	1.9	0.0012	$69.62	$254.44	$27.41	$281.85	0.3521381	0.086975	$0.44
								.												$0.67	$0.16	$0.83

Finish Grade & Place ACB

	Area (sf/ft)	Unit Cost ($/sf)	$/ft
Downdrain ACBs			
40T[1]	31	$7.42	$230.02
Installation[1]	31	$4.63	$143.53
		ACB Cost/ft	**$373.55**

Total Downdrain Cost ($/ft)	**$374.38**

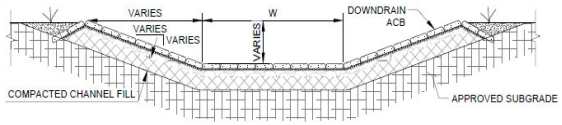
Place ACB

Dissipater ACBs	Area (sf)	Unit Cost ($/sf)	$/sf
70T[1]	320	$10.65	$3,408.00
Installation[1]	320	$4.63	$1,481.60
40T[1]	506	$7.42	$3,754.52
Installation[1]	506	$4.63	$2,342.78
		ACB Cost per Dissipater	**$10,986.90**

Install Cutoff Wall

Cutoff Wall (cast in p	cubic yard	$/cubic yard	**$/dissipater[3]**
RSMeans (2019)	14	$ 254.97	**$3,569.58**

Total Dissipator Cost ($/each)	**$14,556.48**

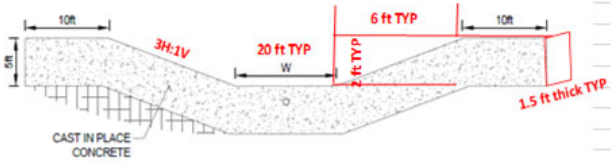


N.T.S AU 022A TYPICAL DOWNDRAIN SECTION

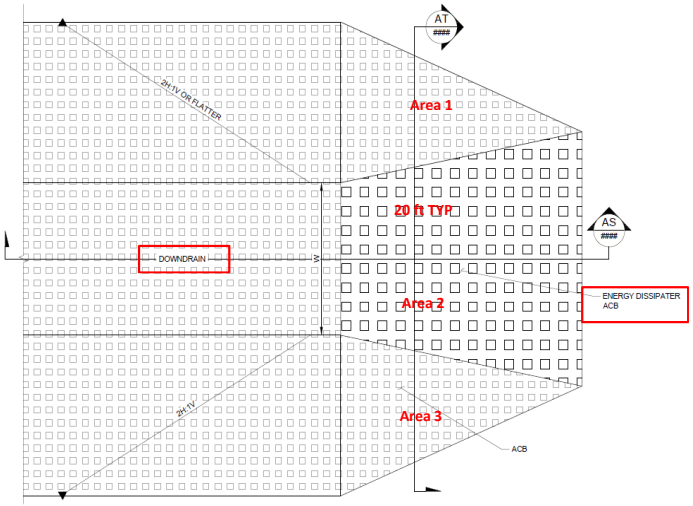
	Downdrains Lengths [2] (ft)	Downdrain Dissipators [2] (ft)
South	6474	2
STS2	0	0
Main LB	9299	4
South LB	0	0
West	4493	4
NW	0	0
LH	0	0
NE	0	0
N	0	0
3A	0	0
Santa Rita	0	0
Upper South	0	0
Triangle	0	0
Axiflow	0	0
TP7	2280	0
TP-6W & TP-6E	319	0
	22866	10

DOWNDRAIN Dimensions:		
Left Side Slope:[2]	3	H:1V
Left Side Slope:[2]	3	H:1V
Depth:[2]	2	ft
Perimeter:[2]	31	ft
Excavation Area[2]	52	sf
ACB Area[2]	31	sf

DISSIPATERS		**ACB[2]**				**Cutoff Wall[2,4]**		
		Surface Area 1	**Surface Area 2**	**Surface Area 3**	**Total**	**Cross-Sectional Area**	**Thickness**	**Volume**
		(sf)	**(sf)**	**(sf)**	**(sf)**	**(sf)**	**(ft)**	**(cy)**
Main Lampbright	1	253	320	253	825	260	1.5	14
	2	253	320	253	825	260	1.5	14
	3	253	320	253	825	260	1.5	14
	4	253	320	253	825	260	1.5	14
West Stockpile	1	253	320	253	825	260	1.5	14
	2	253	320	253	825	260	1.5	14
	3	253	320	253	825	260	1.5	14
	4	253	320	253	825	260	1.5	14
South Stockpile	1	253	320	253	825	260	1.5	14
	2	253	320	253	825	260	1.5	14



N.T.S. AX 022A TYPICAL CUTTOFF WALL SECTION



N.T.S 8 022A TYPICAL TOE ENERGY DISSIPATOR PLAN DETAIL

1. Quote from Contech ES 2018; Downdrain ACB installation includes fine grade base/subgrade soils (assuming subgrade at + 0.5 ft); equipment is D6 LGP dozer with Power Angle Tilt Blade (PAT) and GPS Blade Control
2. Data from Golder Takeoffs Spreadsheet 2018
3. One cutoff wall per dissipator
4. Typical flow depth is 2'; concrete depth is 5' (diagram is not drawn to scale); concrete thickness is 1.5'
5. Data from Table 3 and 4 of the Process Summary (SOW), Nov 2017 (Telesto)
6. Excavation volume is smaller than SOW because ACB's require less excavation than riprap

Truck and Scraper Optimization

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes truck optimization and scraper optimization information to develop the most efficient proportions of equipment as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). Optimization needs to account for the time required and associated costs for truck loading and hauling operations for cover material and scraper/dozer productivity for rough grading.

Objectives:

1. Develop optimization calculations to determine the most efficient number of trucks (2 to 9 and a calculated maximum) per loader or shovel for loading cover material at borrow stockpiles, and the most efficient number of scrapers (2 to 9 and a calculated maximum) per dozer (the dozer assists scrapers for rough grading at waste rock stockpiles).
2. Note that this calculation set presents the approach and calculations and results for optimizing equipment for earthwork. It is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Approach:

1. The data, calculations, and results for the optimization calculations are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in two sheets (tabs) named "18 Truck Optimization" and "19 Scraper Optimization".
2. Truck optimization is calculated for each cover material source and destination based on
   - The truck cycle time for 1 roundtrip between a cover material source and destination and the maximum number of trucks per loader/shovel.
   - For X number of trucks (2 to 9 and a calculated maximum), the productivity, task time, cost of using X trucks per loader, the optimum number of trucks per loader/shovel, and the maximum number of trucks per loader/shovel.
3. Scraper optimization is calculated for each area requiring rough grading based on
   - The time required for 1 scraper to rough grade.
   - For X number of scrapers per dozer (2 to 9 and a calculated maximum), the task time, cost of using X scrapers per dozer, the optimum number of scrapers per dozer, and the maximum number of scrapers per dozer.

Calculations and Results:

1. The truck optimization calculations are set up as shown in Table 1, which is a snapshot of a row of data/calculations in the "18 Truck Optimization" sheet. Table 1 is shown in 6 parts due to the many columns in the spreadsheet. Key calculation steps are listed after Table 1, with referencing to the Column identifier in Table 1 (and the spreadsheet).

Table 1

	E	F	G	H	I	J	K	L
13								
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Work Hour (min/hr)	Loader/Shovel Cycles per Truck	Loader/Shovel Cycle Time (min)
299	1200-D-b-Tk4	Haul-Cover	Upper South	West Stockpile	Komatsu 730E	50	5	0.45

	M	N	O	P	Q	R	S	T	U
13									
14	Loader/Shovel Time Per Truck (min)	Truck Cycle Time Per Truck (min)	Trucks Per Loader/ Shovel	Loader/ Shovel Type	Loader/ Shovel Cost ($/hr)	Loader Net Bucket Capacity (cy)	Haul Volume (cy)	Max Trucks Round Up	Max Trucks Round Down
299	2.25	22.7	10.1	Sh1	$ 535.68	27.4	3,031,924	3,317	3,016

	V	W	X	Y	Z	AA	AB	AC
13	Productivity for X Trucks (cy/hr)							
14	9	8	7	6	5	4	3	2
299	2,714	2,412	2,111	1,809	1,508	1,206	905	603

	AD	AE	AF	AG	AH	AI	AJ	AK	AL	AM
13	Task Time for X Trucks (hr)									
14	Max Trucks Round Up	Max Trucks Round Down	9	8	7	6	5	4	3	2
299	914.0	1,005.4	1,117.2	1,256.8	1,436.4	1,675.7	2,010.9	2,513.6	3,351.5	5,027.2

	AN	AO	AP	AQ	AR	AS	AT	AU
13			Cost of Using X Trucks per Loader ($					
14	Loader/ Shovel Task Time (hr)	Truck Cost ($/hr)	Max Trucks Round Up	Max Trucks Round Down	9	8	7	6
299	995.9	$ 246.06	$ 3,229,021	$ 3,012,613	$ 3,072,458	$ 3,147,264	$ 3,243,442	$ 3,371,681

	AV	AW	AX	AY	AZ	BA	BB
13	$)						
14	5	4	3	2	Lowest Cost ($)	Optimum Number of Trucks Per Loader/ Shovel	Optimum Number of Trucks Per Loader/ Shovel Within Max
299	$ 3,551,215	$ 3,820,515	$ 4,269,350	$ 5,167,019	$ 3,012,613	10	10

For example use only. Values may not match the current spreadsheet.

Calculations and Results:

1. Truck optimization (continued)

- Calculate the number of loader/shovel (or referred to as loader) cycles to load a truck and the loading time required per truck (Columns K, L, and M) – this calculation uses data from the "9 Trucks" and "10 Shovel" sheets.

Loader Time Per Truck (Col. M) =
[Loader Cycles per Truck (Col. K)] x [Loader Cycle Time, min (Col. L)]
= (5 cycles/truck) x (0.45 min/cycle) = 2.25 min/truck

- Using the truck cycle time for 1 roundtrip between a cover material source and destination (data from the "9 Trucks" sheet), calculate the maximum number of trucks per loader/shovel.

Max Number Trucks Per Loader (Col. O) = [Truck Cycle Time, min (Col. N)]/[Loader Time, min/truck (Col. M)]
= (22.7 min)/(2.25 loader min/truck) = 10.1 trucks/loader

- Calculate the productivity (cy/hr) for X number of trucks (2 to 9 and a calculated maximum).

For X=6 trucks, Productivity, cy/hr (Col. Y) =
(X) x Work Hour, min/hr (Col. J) x Loader Cycles/Truck (Col. K) x [Loader Net Bucket Capacity, cy (Col. R)]/[Truck Cycle Time Per Truck, min (Col. N)]
= [6 x (50 min/hr) x (5 loader cycles/truck) x (27.4 cy/loader cycle)]/(22.7 min/truck cycle) = 1,809 cy/hr

- Using the productivity and total volume of cover material to be hauled, calculate the task time for X trucks (2 to 9).

For X=6 trucks, Task Time, hr (Col. AI) =
[Haul Volume, cy (Col. S)]/[Productivity, cy/hr (Col. Y)]
= (3,031,924 cy)/(1,809 cy/hr) = 1,676 hr

Calculations and Results (continued):

1. Truck optimization (continued):

- Calculate the cost of using X trucks per loader (2 to 9 and a calculated maximum) using data for loader/shovel task time in "9 Trucks" (for each cover material source and destination), loader/shovel cost ($/hr), truck cost ($/hr), and task time for the number of trucks.

For X=6 trucks, Cost of Using X Trucks per Loader, $ (Col. AU) =
[Max of Task Time for Trucks (Col AI) or Loader/Shovel Task Time (Col. AN)] x
{(Loader Cost, $/hr (Col. Q) + [(X) x (Truck Cost, $/hr (Col. AO)]}
= (1,675.7 hr) x {($535.68/hr + [6 x $246.06/hr]} = $3,371,681

- The optimum number of trucks per loader is the lowest cost number of trucks per loader/shovel. This optimum number is compared with the maximum number of trucks per loader/shovel, to ensure the optimum number is within the maximum.

For this row of data, the optimum number of trucks per loader = 10, which is the same within the max.

Calculations and Results (continued):

2. The scraper optimization calculations are set up as shown in Table 2, which is a snapshot of a row of data/calculations in the "19 Scraper Optimization" sheet. Table 2 is shown in 5 parts due to the many columns in the spreadsheet. Key calculation steps are listed after Table 2, with referencing to the Column identifier in Table 2 (and the spreadsheet).

Table 2

	E	F	G	H	I	J
13						
14	ID	Task Description	Source Location 1	Destination Location 2	Equipment	Scraper R/T Task Time (min)
84	1101-A-a-Sc2	Grade-Outslope-Existing Ground	South Stockpile S-1	-	Cat 657G	6.1

	K	L	M	N	O
13					
14	Pusher Cycle Time (min/cycle)	Max Number of Scrapers per Dozer	Dozer Type	Dozer Cost ($/hr)	Task Time for one Scraper (hr)

	P	Q	R	S	T	U	V	W	X	Y	Z
13	Task Time for X Scrapers (hr)										
14	Max Scrapers Round Up	Max Scrapers Round Down	9	8	7	6	5	4	3	2	Scrapers Cost ($/hr)
84	276	345	153	173	197	230	276	345	460	690	222.44

	AA	AB	AC	AD	AE	AF	AG	AH
13	Cost of Using X Scrapers per Dozer ($)							
14	Max Scrapers Round Up	Max Scrapers Round Down	9	8	7	6	5	4
84	$ 369,418	$ 385,002	$ 341,712	$ 346,041	$ 351,607	$ 359,028	$ 369,418	$ 385,002

	AI	AJ	AK	AL	AM	AN
13						
14	3	2	1	Lowest Cost ($)	Optimum Number of Scrapers Per Dozer	Optimum Number of Scrapers Per Dozer Within Max
84	$ 410,975	$ 462,922	$ 618,764	$ 341,712	9	5

For example use only. Values may not match the current spreadsheet.

Calculations and Results (continued):

2. Scraper optimization (continued)

- Calculate the maximum number of scrapers per dozer based on scraper roundtrip time and pusher cycle time.

Max Number of Scrapers per Dozer (Col. L) = [Scraper Roundtrip Task Time, min (Col. J)]/[Pusher Cycle Time, min/cycle (Col. K)]
= (6.1 min scraper/cycle)/(1.44 min pusher/cycle) = 4.2 scrapers/dozer (max)

- Using the task time required for 1 scraper (at a given rough grading area), calculate the task time for X number of scrapers (2 to 9 and a calculated maximum).

For X=6 scrapers, the Task Time for X Scrapers (Col. U) =
[Task Time for one Scraper, hr (Col. O)]/(X)
= (1,380 hr/scraper)/(6 scrapers) = 230 hr

- Calculate the cost of using X scrapers per dozer (2 to 9 and a calculated maximum) using task time for X scrapers, number of scrapers per dozer, scraper cost ($/hr), and dozer cost ($/hr).

For X=6 scrapers, the Cost of Using X Scrapers per Dozer (Col. AF) =
{[Task Time for X Scrapers, hr (Col. U)] x [X] x [Scraper Cost, $/hr (Col. Z)] +
{[Task Time for X Scrapers, hr (Col. U)] x [Dozer Cost, $/hr (Col. N)]
= [(230 hr) x (6 scrapers/dozer) x ($222.44/hr/scraper)] + [(230 hr) x ($225.78/hr/dozer)] = $359,028

- The optimum number of scrapers per dozer is the lowest cost number of scrapers per dozer. This optimum number is compared with the maximum number of scrapers per dozer, to ensure the optimum number is within the maximum.

For this row of data, the optimum number of scrapers per dozer = 9. However, the number of scrapers per dozer within the maximum = 5 (rounded up from the calculation for Max Number of Scrapers per Dozer [Col. L], see above).

Building Demolition Cost

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes cost information for demolition of buildings (including storage tanks) as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). The demolition costs need to account for site-specific conditions including building dimensions and footprint areas which are used with available construction/earthwork unit rates to estimate the demolition cost.

This calculation set presents a summary of the approach and results for estimating the building demolition cost. Detailed information is presented in the earthwork reclamation cost estimate (RCE) spreadsheet file.

This calculation set is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Objective:

1. Develop a cost estimate for demolition of buildings (including storage tanks) for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM.

Approach:

1. The data, assumptions, calculations, and results for the building demolition cost estimate are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in a series of 4 sheets (tabs) named "1 BuildingDemo", "2 BuildingCover", "3 BuildingVeg", and "4 BuildingHazardousWaste ". An additional tab named "5 BuildingSum" presents a summary of the costs.
2. The approach for estimating building demolition costs is as follows:
   - Compile building and storage tank dimension/footprint area data and assumptions used in the calculations.
   - Estimate the cost for demolition to account for volume of structural materials, volume of cover material placement, area of revegetation, and tonnage of waste requiring special handling.

Results:

1. The results of the building demolition cost calculations are summarized below (some of the final results may vary from what is shown). These results are used in the overall earthwork RCE.
2. The indirect costs are set at 30% of direct costs, based on an agreement between FMI and the agencies in January 2019. Indirect costs include but are not limited to mobilization and demobilization, contingencies, engineering redesign fees, contractor profit and overhead, project management, administrative expenses, etc.

Chino Mine

DRAFT Facility Demolition Summary

			Current Value
DIRECT COSTS	Facility and Structure Removal		$666,916
	Cover		$24,132
	Ripping & Revegetation		$2,061
	Hazardouse Waste Removal		$2,534,217
	Subtotal, Direct Costs		**$3,227,325**
INDIRECT COSTS[1]	**Subtotal, Indirect Costs**	**30.0%**	**$968,198**
TOTAL COST			**$4,195,523**

For example use only. Values may not match the current spreadsheet.

Revegetation Unit Cost

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes revegetation unit cost information as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). The unit cost for revegetation needs to account for equipment rental rates and associated maintenance, fuel costs, and labor rates.

Objectives:

1. Develop a revegetation unit cost ($/acre) for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM.
2. Note that this calculation set presents the approach, data and assumptions, and calculations and results for developing the unit cost. It is intended to serve as a guide/example even if the actual quantities and/or cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Approach:

1. The data, assumptions, calculations, and results for the revegetation unit cost estimate are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in sheet "Revegetation_UC".
2. The approach for the calculations is as follows:
   - Identify equipment types for scarifying, discing, drill seeding, mulching, crimping.
   - Obtain equipment information from EquipmentWatch (EQW) and RS Means, labor rates from NMDOL; revegetation material costs (seed, mulch) from FMI and/or their supplier; and the current fuel price from fuel cost calculations.
   - Determine the equipment traveling distance and time to cover 1 acre.
   - For each of the key operations, estimate the operating cost ($/hour).
   - Combine all operations and material costs, calculate the total unit cost.

Data and Assumptions:

1. Rental and operating cost information is accessed online from EQW for tractor (Deere 7340), ripper, and mulcher, and from RS Means for disc harrow (see Attachment A). Monthly rental rates are converted to hourly rates assuming 176 hours/month.
2. Equipment information is not available in EQW nor RS Means for drill seeding and crimping. Therefore, the drill seeder cost is assumed to be an average of the mulcher and disc (complexity is between the two, thus an average is assumed), and the crimper rental cost is assumed to be equal to the disc harrow (similar type of equipment).
3. Costs are included in the ripper and disc harrow (and drill seeder and crimper) to account for the ground engaging component (GEC) of these implements. The GEC cost for the ripper is applied to each of these other implements.
4. Local fuel price is developed from fuel cost calculations also prepared for earthwork closure cost estimates – the estimated 2019 fuel price is $2.34/gallon.
5. Revegetation material costs are from a quote by Rocky Mountain Reclamation, based on typical sources for seed and mulch (see Attachment A). The cost for seed is $210/acre and for mulch is $245/ton which, at 2 tons/acre, is $490/acre.

Data and Assumptions (continued):

6. Labor rates are from NMDOL (see Attachment A).
7. Equipment typical net coverage (width) is set at 12 feet, and equipment travel speed is set at 3 miles/hour (mph) for a 60-minute hour.

Calculations and Results:

1. The Deere 7340 tractor data, along with labor and fuel costs, are tabulated in the following table:

	B	C	D	E
5	**Tractor used for each operation is Deere 7430**	**Cost**	**Unit**	**Information or Calculation**
6	EQW base rate for tractor rental	$ 5,210.05	$ per month	EQW for Deere 7430
7	EQW base rate for tractor rental	$ 29.60	$ per hour	= ($/month)/176
8	EQW field labor rate per hour of operation	$ 2.53	$ per hour	EQW for Deere 7430, which includes mechanic's wage of $23.09 (NMDOL, 2019)
9	EQW lube material cost	$ 2.84	$ per hour	EQW for Deere 7430
10	EQW field parts cost	$ 0.61	$ per hour	EQW for Deere 7430
11	EQW tire material cost	$ 2.42	$ per hour	EQW for Deere 7430
12	EQW fuel burn rate	5.98	gallons per hour	EQW for Deere 7430
13	Local fuel cost	$ 2.34	$ per gallon	Local quote
14	Fuel cost	$ 13.99	$ per hour	= (EQW fuel burn rate) x (local fuel cost)
15	NM Department of labor equipment operator rate	$ 24.27	$ per hour	NM Department of Labor (NMDOL)
16	**Total tractor cost**	**$ 76.27**	**$ per hour**	**Sum of $ per hour costs shown in boxes**

Data in Rows 6 and 8-12 are from EQW, data in Row 8 also incorporates an NMDOL labor rate in the EQW cost, Row 13 is the estimated local fuel cost of $2.34/gallon, and Row 15 shows an NMDOL labor rate. Costs in other rows (7, 14, and 16) are calculated as follows:

$$EQW\ base\ rate\ for\ tractor\ rental = (\$5{,}210.05/\text{month})/(176\ \text{hours/month}) = \$29.60/\text{hour}$$

$$Fuel\ cost = (\text{EQW burn rate}) \text{ x (local fuel cost)} = (5.98\ \text{gallons/hour}) \text{ x } (\$2.34/\text{gallon}) = \$13.99/\text{hour}$$

$$Total\ tractor\ cost = \text{sum of rows } 7, 8, 9, 10, 11, 14, 15 = 29.60 + 2.53 + 2.84 + 0.61 + 2.42 + 13.99 + 24.27 = \$76.27/\text{hour}$$

2. Based on an equipment typical net width of 12 feet, and equipment net travel speed of 2.5 mph (3 mph x 50/60 to adjust for a 50-minute hour), each operation will travel a distance of 3,630 feet to cover 1 acre, and will require 0.275 hour to travel this distance (see calc steps in the table below). The resulting fuel cost is $3.85/acre.

	B	C	D	E
18	**Tractor coverage/rate of operation, fuel cost per acre**			
19	Tractor/equipment net width	12	feet	Assigned as a typical net width of coverage for each pass
20	Tractor/equipment travel speed	2.5	miles per hour	Assigned as approximate average speed of equipment (3 mph for 50 min/hr)
21	For 1 acre, total traveling distance	3630	feet per acre	= (43560 sf/ac)/(net width)
22	Time of travel over 1 acre	0.275	hour per acre	= [(traveling distance feet/acre)/(5280 ft/mile)]/(travel speed)
23	**Fuel cost per acre**	**$ 3.85**	**$ per acre**	**Already included in total tractor cost... Fuel cost/acre = (fuel cost/hour) x (travel time hour/acre)**

For example use only. Values may not match the current spreadsheet.

Calculations and Results (continued):

3. Operating costs for each of the 5 revegetation operations are calculated as shown in the following table. Calculation equations are also noted in the table. Note the total cost for each operation includes fuel.

	B	C	D	E
25	**Operation**			
26	*Scarifying*			
27	Base rate for ripper rental	$ 898.90	per month	EQW Ripper, Miscellaneous MSR-189H, to 260 HP
28	Base rate for ripper rental	$ 5.11	$ per hour	= ($/month)/176
29	Lube labor rate per hour of operation	$ 0.57	$ per hour	EQW for ripper, incl mechanic's wage $23.09 (NMDOL, 2019)
30	Lube material cost	$ 0.15	$ per hour	EQW for ripper
31	Field parts cost	$ 0.16	$ per hour	EQW for ripper
32	Ground Engaging Component cost	$ 0.78	$ per hour	EQW for ripper
33	**Total cost with tractor+operator included**	**$ 83.03**	**per hour**	
35	*Discing*			
36	Disc harrow attachment, for tractor	$ 616.33	per month	RS Means 01 54 33 20 1500
37	Disc harrow attachment, for tractor	$ 3.50	per hour	= ($/month)/176
38	Ground Engaging Component (GEC) cost	$ 0.78	$ per hour	Assume similar to GEC cost for ripper (EQW)
39	**Total cost with tractor+operator included**	**$ 80.55**	**per hour**	
41	*Drill seeding (assume similar to discing)*			
42	Disc harrow attachment, for tractor	$ 616.33	per month	RS Means 01 54 33 20 1500
43	Disc harrow attachment, for tractor	$ 3.50	per hour	= ($/month)/176
44	Ground Engaging Component cost	$ 0.78	$ per hour	Assume similar to GEC cost for ripper (EQW)
45	**Total cost with tractor+operator included**	**$ 80.55**	**per hour**	
47	*Mulching*			
48	Mulcher, diesel powered, trailer mounted	$ 2,167.95	per month	EQW for trailer mounted mulcher (Finn B260)
49	Mulcher, diesel powered, trailer mounted	$ 12.32	per hour	= ($/month)/176
50	Lube labor rate per hour of operation	$ 1.25	$ per hour	EQW for trailer mounted mulcher (Finn B260), incl mechanic's wage $23.09 (NMDOL, 2019)
51	Lube material cost	$ 1.60	$ per hour	EQW for trailer mounted mulcher (Finn B260)
52	Field parts cost	$ 0.15	$ per hour	EQW for trailer mounted mulcher (Finn B260)
53	Tire material cost	$ 0.60	$ per hour	EQW for trailer mounted mulcher (Finn B260)
54	Fuel burn rate	4.13	gallons per hour	EQW for trailer mounted mulcher (Finn B260)
55	Local fuel cost	$ 2.34	$ per gallon	Local quote
56	Fuel cost	$ 9.66	$ per hour	= (EQW fuel burn rate) x (local fuel cost)
57	NM Department of labor equipment operator rate	$ 24.27	$ per hour	NM Department of Labor (NMDOL)
58	**Total cost with tractor+operator included**	**$ 126.12**	**per hour**	
60	*Crimping (assume similar to discing)*			
61	Disc harrow attachment, for tractor	$ 616.33	per month	RS Means 01 54 33 20 1500
62	Disc harrow attachment, for tractor	$ 3.50	per hour	= ($/month)/176
63	Ground Engaging Component cost	$ 0.78	$ per hour	Assume similar to GEC cost for ripper (EQW)
64	**Total cost with tractor+operator included**	**$ 80.55**	**per hour**	
66	*Summary for operations*			

Calculations and Results (continued):

5. The hourly operating cost for each operation (includes fuel) is summed for a total cost of $450.79/hour. The cost for each operations is as follows:

   - Scarifying = $83.03/hour
   - Discing = $80.55/hour
   - Drill seeding = $80.55/hour
   - Mulching = $126.12/hour
   - Crimping = $80.55/hour

6. The total combined equipment operating cost with fuel ($/acre) is then calculated based on the operating cost per hour and the time of travel over 1 acre, as follows:

$$Total\ combined\ operating\ cost = \left(\frac{\$450.79}{hour}\right) x \left(0.275\frac{hour}{acre}\right) = \$123.97/acre$$

7. Seed and mulch costs are added to the total combined operating cost ($/acre) to calculate the total revegetation unit cost as follows:

   - Total combined operating cost = $123.97/acre
   - Seed = $210/acre
   - Mulch = $490/acre

$Total\ revegetation\ unit\ cost =$ *Total combined operating cost + Seed + Mulch = $123.97/acre + $210/acre + $490/acre = $823.97/acre ($824/acre)*

Summary and Conclusions:

1. A revegetation unit cost was developed for use in estimating earthwork closure costs at FMI's mining operations in Grant County, NM. Note that the estimated unit cost developed in this analysis applies only to FMI operations in the Silver City (Grant County), NM area.
2. The total revegetation unit cost is $824/acre.

EquipmentWatch

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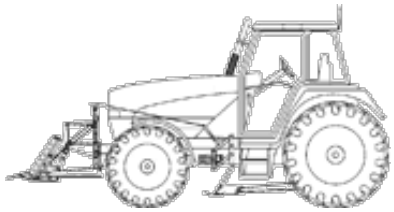
All prices shown in US$

Adjustments for MANDYLILLA27 in All Saved Models

January 17, 2019

Deere 7430 (disc. 2011)
Wheel Tractors

Size Class:
125 to 174 hp
Weight:
N/A



Configuration for 7430 (disc. 2011)

Power Mode **Diesel**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$12.48/hr	$11.70/hr	-6.3%
Cost of Facilities Capital (CFC)	$3.12/hr	$2.43/hr	-22.1%
Overhead	$4.42/hr	$3.35/hr	-24.2%
Overhaul Labor	$6.46/hr	$1.92/hr	-70.3%
Overhaul Parts	$5.55/hr	$4.20/hr	-24.3%
Total Hourly Ownership Cost:	**$32.03/hr**	**$23.60/hr**	**-26.3%**

User Defined Adjustments: Annual Use Hours (1,030hrs -> 1,359hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$8.51/hr	$2.53/hr	-70.3%
Field Parts	$4.86/hr	$0.61/hr	-87.4%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$2.42/hr	-	-
Electrical/Fuel	$19.54/hr	$5.98/hr	-69.4%
Lube	$2.84/hr	-	-
Total Operating Ownership Cost:	**$38.17/hr**	**$14.38/hr**	**-62.3%**

User Defined Adjustments: Annual Field Repair Parts Cost ($4,174.20 -> $0.20) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$32.03/hr	$23.60/hr	-26.3%
Hourly Operating Costs	$38.17/hr	$14.38/hr	-62.3%
Total Hourly Cost	**$70.20**	**$37.98/hr**	**-45.9%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$20.02/hr	$17.48/hr	-12.7%
Idle	$51.57/hr	$29.58/hr	-42.6%

Revised Date: 1st Half 2019

The equipment represented in this report has been exclusively prepared for MANDY LILLA (mlilla@fmi.com)

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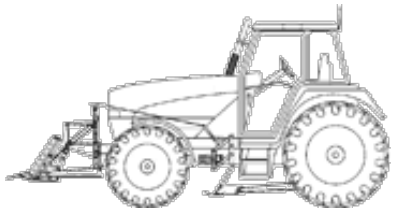
Adjustments for MANDYLILLA27 in All Saved Models

January 17, 2019

Deere 7430 (disc. 2011)
Wheel Tractors

Size Class:
125 to 174 hp
Weight:
N/A



Configuration for 7430 (disc. 2011)

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$3,891.00	$1,303.00	$463.00
Adjustments			
Region (New Mexico: 134%)	$1,319.05	$441.72	$156.96
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$5,210.05**	**$1,744.72**	**$619.96**

Date Last Updated: Oct 01, 2018

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Custom Cost Evaluator

February 21, 2019

Miscellaneous MSR-189H
Crawler Tractor Multi-Shank Rippers

Size Class:
To 260 HP
Weight:
3,557 lbs.

Model Image

Configuration for MSR-189H

Engine Horsepower	**130 - 189**	Number of Shanks	**3**
Ripper Type	**Parallelogram**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$2.64/hr	$2.50/hr	-5.3%
Cost of Facilities Capital (CFC)	$0.38/hr	$0.31/hr	-18.4%
Overhead	$0.66/hr	$0.52/hr	-21.2%
Overhaul Labor	$1.10/hr	$0.34/hr	-69.1%
Overhaul Parts	$0.95/hr	$0.75/hr	-21.1%
Total Hourly Ownership Cost:	**$5.73/hr**	**$4.42/hr**	**-22.9%**

User Defined Adjustments: Annual Use Hours (1,285hrs -> 1,629hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$1.83/hr	$0.57/hr	-68.9%
Field Parts	$1.18/hr	$0.16/hr	-86.4%
Ground Engaging Component (GEC)	$0.99/hr	$0.78/hr	-21.2%
Tire	$0.00/hr	-	-
Electrical/Fuel	$0.00/hr	-	-
Lube	$0.15/hr	-	-
Total Operating Ownership Cost:	**$4.15/hr**	**$1.66/hr**	**-60%**

User Defined Adjustments: Annual Field Repair Parts Cost ($1,268.18 -> $0.18) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$5.73/hr	$4.42/hr	-22.9%
Hourly Operating Costs	$4.15/hr	$1.66/hr	-60%
Total Hourly Cost	**$9.88**	**$6.08/hr**	**-38.5%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$3.68/hr	$3.33/hr	-9.5%
Idle	$5.73/hr	$4.42/hr	-22.9%

Revised Date: 1st Half 2019

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Rental Rate Blue Book®

February 21, 2019

Miscellaneous MSR-189H
Crawler Tractor Multi-Shank Rippers

Size Class:
To 260 HP
Weight:
3,557 lbs.

Model Image

Configuration for MSR-189H

Engine Horsepower	**130 - 189**	Number of Shanks	**3**
Ripper Type	**Parallelogram**		

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$1,010.00	$285.00	$71.00	$11.00	$4.15	$9.89
Adjustments						
Region (Las Cruces, New Mexico: 89%)	($111.10)	($31.35)	($7.81)	($1.21)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$898.90**	**$253.65**	**$63.19**	**$9.79**	**$4.15**	**$9.26**

Non-Active Use Rates

	Hourly
Standby Rate	$3.52
Idling Rate	$5.11

Rate Element Allocation

Element	Percentage	Value
Depreciation (ownership)	50%	$505.00/mo
Overhaul (ownership)	31%	$313.10/mo
CFC (ownership)	7%	$70.70/mo
Indirect (ownership)	12%	$121.20/mo

Fuel cost data is not available for these rates.

Revised Date: 1st Half 2019

These are the most accurate rates for the selected Revision Date(s). However, due to more frequent online updates, these rates may not match Rental Rate Blue Book Print. Visit the Cost Recovery Product Guide on our Help page for more information.

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Custom Cost Evaluator

February 21, 2019

Finn B260
Trailer Mounted Mulchers

Size Class:
51 HP & Over
Weight:
4,880 lbs.

Model Image

Configuration for B260

Power Mode **Diesel** Horsepower **115**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$5.80/hr	$5.45/hr	-6%
Cost of Facilities Capital (CFC)	$0.88/hr	$0.69/hr	-21.6%
Overhead	$1.18/hr	$0.90/hr	-23.7%
Overhaul Labor	$3.36/hr	$1.00/hr	-70.2%
Overhaul Parts	$2.54/hr	$1.92/hr	-24.4%
Total Hourly Ownership Cost:	**$13.76/hr**	**$9.96/hr**	**-27.6%**

User Defined Adjustments: Annual Use Hours (1,050hrs -> 1,388hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$4.20/hr	$1.25/hr	-70.2%
Field Parts	$1.47/hr	$0.15/hr	-89.8%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$0.60/hr	-	-
Electrical/Fuel	$13.50/hr	$4.13/hr	-69.4%
Lube	$1.60/hr	-	-
Total Operating Ownership Cost:	**$21.37/hr**	**$7.73/hr**	**-63.8%**

User Defined Adjustments: Annual Field Repair Parts Cost ($1,342.66 -> $0.66) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$13.76/hr	$9.96/hr	-27.6%
Hourly Operating Costs	$21.37/hr	$7.73/hr	-63.8%
Total Hourly Cost	**$35.13**	**$17.69/hr**	**-49.6%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$7.86/hr	$7.04/hr	-10.4%
Idle	$27.26/hr	$14.09/hr	-48.3%

Revised Date: 1st Half 2019

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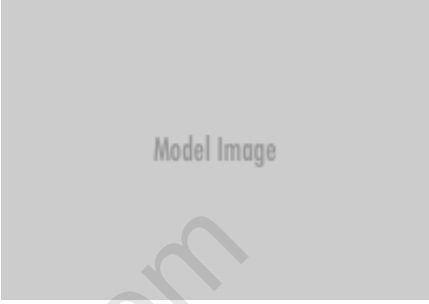
Rental Rate Blue Book®

February 21, 2019

Finn B260

Trailer Mounted Mulchers

Size Class:
51 HP & Over
Weight:
4,880 lbs.



Configuration for B260

Power Mode	**Diesel**	Horsepower	**115**

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$2,425.00	$680.00	$170.00	$26.00	$21.35	$35.13
Adjustments						
Region (Las Cruces, New Mexico: 89.4%)	($257.05)	($72.08)	($18.02)	($2.76)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$2,167.95**	**$607.92**	**$151.98**	**$23.24**	**$21.35**	**$33.67**

Non-Active Use Rates

	Hourly
Standby Rate	$6.16
Idling Rate	$25.82

Rate Element Allocation

Element	**Percentage**	**Value**
Depreciation (ownership)	37%	$897.25/mo
Overhaul (ownership)	50%	$1,212.50/mo
CFC (ownership)	6%	$145.50/mo
Indirect (ownership)	7%	$169.75/mo
Fuel (operating) @ 3.27	63%	$13.50/hr

Revised Date: 1st Half 2019

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RS Means Online Data
Accessed February 13, 2019

Revegetation

Line Number	Description	Unit	Material	Labor	Equipment	Total	Data Release	CCI Location
015433201500	Rent disc harrow attchment for tractor, Excl. Hourly Oper. Cost.	Month	$ -	$ -	$ 616.33	$ 616.33	Year 2019	NEW MEXICO / LAS CRUCES (880)

Labor Rates

NMDOL Type A Operator Group	Base rate	Fringe rate	Apprenticeship		Total 2019 Rate ($/hr)
Equipment Operator IV	20.87	5.94	0.6	$	27.41
Equipment Operator V	20.98	5.94	0.6	$	27.52
Equipment Operator VI	21.16	5.94	0.6	$	27.70
Laborer I	16.86	5.63	0.6	$	23.09
Laborer II	17.61	5.63	0.6	$	23.84
Truck Driver III	16.15	7.52	0.60	$	24.27

Labor rates based on NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, and apprenticeship contribution rates.

https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2019_final.pdf

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FREEPORT MCMORAN – NEW MEXICO MINING OPERATIONS

PRICE ESTIMATES FOR REVEGETATION SERVICES FOR BUDGETING ESTIMATES

Table 1 –Freeport McMoRan, New Mexico Mining Operations – Price Estimates for Revegetation Services for Budgeting Estimates, prepared April, 2018.

	REVEGETATION OPERATION	ESTIMATED QUANTITY	UNITS	COST/UNIT ($)	TOTAL COST
I.	**OPERATIONS:**				
1	**SCARIFYING**	500	Acres	$30.00	$15,000.00
2	**DISCING**	500	Acres	$20.00	$10,000.00
3	**DRILL SEEDING (special Rangeland Drill)**	500	Acres	$80.00	$40,000.00
4	**MULCHING**	500	Acres	$148.00	$74,000.00
5	**CRIMPING**	500	Acres	$55.00	$27,500.00
6	**DAILY PER DIEM, ETC.**	50	Days	$385.00	$19,250.00
7	**MOBILIZATION**	1	Each	$13,500.00	$13,500.00
	Subtotal				**$199,250.00**
II.	**MATERIALS:**				
1	**SEED** at 8.9 PLS/acre	500	Acres	$210.00	$105,000.00
2	**HAY MULCH** - nox. weed free, native	1000	Tons	$245.00	$245,000.00
	Subtotal				**$350,000.00**
	TOTAL ESTIMATED REVEGETATION COST BEFORE TAX				**$549,250.00**
	Add New Mexico Gross Receipts Tax	5.9375	%		**$32,611.72**
	ESTIMATED REVEGETATION COST PER ACRE:			**$1,163.72**	
	TOTAL ESTIMATED REVEGETATION COST				**$581,861.72**

Estimate prepared by Ron Schreibeis, Rocky Mountain Reclamation, for use for Budgeting Estimates.

O&M Costs

Calculation Documentation

Problem Statement:

Freeport-McMoRan's (FMI's) Chino Mines Company utilizes cost information for operations and maintenance (O&M) as part of earthwork closure cost estimation associated with the Chino Mine Closure/Closeout Plan (CCP). The O&M costs need to account for vegetation maintenance costs for a 12-year period after completion of initial revegetation activities in each area, along with ongoing erosion control, road maintenance, and groundwater monitoring for a 100-year period.

This calculation set presents a summary of the approach and results for estimating O&M costs. Detailed information is presented in the earthwork reclamation cost estimate (RCE) spreadsheet file.

This calculation set is intended to serve as a guide/example even if the actual cost data used in these calculations change due to updates or application to a different Freeport NM Operations mine.

Objective:

1. Develop the estimated O&M costs for vegetation maintenance for a 12-year period after completion of initial revegetation activities in each area, along with ongoing erosion control, road maintenance, and groundwater monitoring activities for a 100-year period. The O&M costs are used as part of the earthwork RCE for FMI's mining operations in Grant County, NM.

Approach:

1. The data, assumptions, calculations, and results for the O&M cost estimate are presented within the earthwork RCE spreadsheet file "[YrMoDa]_Chino_Stockpile_Tailing_Earthwork_RCE.xlsx" in two sheets (tabs) named "1 Full SiteVeg Maint" and "2 Full Site O&M". Also, a summary of results is presented in the "3 Full Site O&M Summ" sheet.
2. The approach for estimating vegetation maintenance O&M costs is as follows:
   - For each facility (stockpile, tailing pond, reservoirs, etc), the total area is listed, along with approximate year of reclamation start, vegetation maintenance start, and vegetation maintenance complete. A 2% loss per year (i.e., 2% of vegetation fails each year) for 12 years is assumed to estimate the acreage requiring vegetation maintenance for each year.
   - Revegetation unit costs (equipment and fuel) are applied to the loss of acreage for each year to calculate the vegetation maintenance cost for each facility.

Approach (continued):

3. The approach for estimating erosion control, road maintenance, and groundwater monitoring ("Other") O&M costs is as follows:
   - For erosion control and road maintenance
     - Determine base costs ($/day) for equipment and fuel base. Also, estimate the number of days/yr for erosion control and road maintenance for three periods: Years 0-19, 20-39, and 40-99.
     - Calculate the annual equipment and fuel costs, based on days/yr, for the same three periods.
   - For groundwater monitoring
     - Determine base costs ($/day) for equipment and aqueous chemistry (lab analytical), and days/yr for groundwater monitoring for three periods: Years 0-19, 20-39, and 40-99.
     - Calculate the annual equipment and annual aqueous chemistry costs, based on days/yr, for the same three periods.
   - For all three "Other" O&M activities
     - While reclamation is ongoing (not completed in all areas) in Years 0-19, adjust the O&M costs accordingly based on the proportion of reclamation completed as of each year – when reclamation is complete, then the full annual cost applies.
     - For years after reclamation is complete, assign the O&M costs for each year based on the annual costs calculated for Years 0-19, 20-39, and 40-99.

Results:

1. The vegetation maintenance and "Other" O&M costs are summed for all years, as shown in the summary table below (some of the final results may vary from what is shown). These results are used in the overall earthwork RCE.
2. The indirect costs are set at 17.5% of direct costs, based on an agreement between FMI and the agencies in January 2019. Indirect costs include but are not limited to mobilization and demobilization, contingencies, engineering redesign fees, contractor profit and overhead, project management, administrative expenses, etc.

Chino Mine			
DRAFT Operations and Maintenance Summary			
			Current Value
DIRECT COSTS	Facility and Structure Removal		$0
	Earthmoving		$0
	Vegetation		$1,328,888
	Other		$6,202,825
	Subtotal, Direct Costs		**$7,531,713**
INDIRECT COSTS[1]	**Subtotal, Indirect Costs**	**17.5%**	**$1,318,050**
TOTAL COST			**$8,849,763**

For example use only. Values may not match the current spreadsheet.

Appendix B.1.2

Spreadsheet Cost Calculations

Unit Rates

Code	Activity	Base Per Unit Cost	Fuel Per Unit Cost	Units	Source	Reference
U1	**Fuel**	$ 2.34	-	gal	N/A	Diesel fuel cost is estimated by correlating historical local quotes with public data, as agreed upon in November 2018 discussions with the agencies. Fuel cost includes direct and indirect costs at $2.34/gal.
U2	**Revegetation**	$ 820.12	$ 3.85	ac	N/A	See unit rates calculations - Cost is based on a calculated unit rate that includes tractor rental and maintenance, fuel, scarifying, discing, drill seeding, mulching, crimping, seed, and mulch.
U3a	**Bench Grading Stockpile 3:1**	$ 1.74	$ 0.41	ft	N/A	See unit rates calculations
U3b	**Bench Grading Stockpile 2.5:1**	$ 1.60	$ 0.38	ft		See unit rates calculations
U4	**Bench Grading Tailings Pond**	$ 1.62	$ 0.40	ft	N/A	See unit rates calculations
U5a	**Downdrain Construction**	$ 374.34	$ 0.19	ft	N/A	See unit rates calculations
U5b	**Dissipator Construction**	$ 14,556.48	-	ea	N/A	See downdrain unit rate calculation
U6a	**Bench Channel Construction WR 3:1**	$ 8.01	$ 1.64	ft	N/A	See unit rates calculations
U6b	**Bench Channel Construction WR 2.5:1**	$ 7.61	$ 1.56	ft	N/A	See unit rates calculations
U6c	**Bench Channel Construction Tails 3:1**	$ 8.01	$ 1.64	ft	N/A	See unit rates calculations
U7a	**Top Channel Construction Type I**	$ 18.43	$ 3.84	ft	N/A	See unit rates calculations. Used on SWRDF
U7b	**Top Channel Construction Type II**	$ 45.34	$ 9.49	ft	N/A	See unit rates calculations. Used on MTI
U8	**Erosion Control**	$ 2,923.36	$ 382.26	day	Modified Crew B-13A	Erosion control for O&M - includes 1 foreman, 2 laborers, 1 equipment operator, 2 truck drivers, 1 loader (4 cy), 2 dump trucks (8 cy)
U9	**Structure Demolition**	$ 0.25	-	cf	Means Line Item 024116.13 0100	Building demolition, large urban projects, mixture of types, excludes foundation demolition, dump fees
U17	**Well Plug & Abandon**	$ 10.47	-	ft	N/A	Layne Christensen Company, 7/31/18 Tyrone estimate is $10,000 mobilization and demobilization plus $5,704.9 for one 1500 ft well
U20	**Disc harrow attachment, for tractor**	$ 616.33	-	month	Means Line Item 015433.20 1500	Equipment rental costs
U21	**Cast-In-Place Concrete**	$ 254.97	-	cy	Means Line Item 033053.40 6200	Structural concrete, in place, gravity retaining wall (3000 psi), includes forms and reinforcemen
U22	**Cleanup & Disposal of Wastes Requiring Special Handling**	$ 335.20	-	ton	Means Line Item 028120.10 1120/1130	Solid pickup; average of minimum and maximum
U23	**Tranport of Wastes Requiring Special Handling**	$ 4.78	-	mile	Means Line Item 028120.10 1260/1270	Transporation to disposal site (Truckload = 80 drums or 25 cy or 18 tons); average of minimum and maximum
U24	**Road Maintenance**	$ 4,945.96	$ 1,240.32	month		Road maintenance for O&M - includes one 14M motor grader and one 6,000-gal water truc
U25	**Groundwater Monitoring**	$ 3,587.94	-	day		Groundwater monitoring for O&M - includes 1 foreman, 1 laborers, rental equipment, misc. field equipment, anc aqueous chemistry
U26	**Berming**	$ 2.64	-	ft		2018 price inflated by 2%
U27	**Fencing**	$ 23.05	-	ft	Means Line Item 323113.20 0800	
U28	**Place Holder**	$ 0.01	-	day		-

Location adjustment: New Mexico Las Cruces 85.4%

[1] Applied to RSM derived costs only. EquipmentWatch items and items based on local quotes adjusted at base rate
RS Means Online, 2019

Continental Mine
Stockpile Spreadsheet Worksheet #1
3/29/2019

General Information

Applicant	Chino Mines Company Hurley, New Mexico 88043	
Disturbed Surface Area (acres)		912
Type of Operation	Existing/Surface/Copper	
Current value of earthwork and O&M before escalation and discounting	**$22,821,163**	

Based on 2014 Closure/Closeout Plan (Telesto, 2014) and 2018 Closure/Closeout Plan Update (Telesto, 2018)

Stockpiles, Tailing, Reservoirs, Haul Roads and Disturbed Areas

Demolition

Building Demolition costs are calculated in "1 BuildingDemo", "2 BuildingCover", "3 BuildingVeg", and "4BuildingHazardousWaste" and summarized on the last line of this table.

Item	Activity	Quantity	Unit	Unit Cost[1] ($/unit)	Direct Item Cost ($)	Reference	Means Line Item	Description
Buildings and Associated Facilities	Demolition	See Demo Sheets			$1,524,735			

Total Direct Cost: $1,524,735

Material Handling Plan Summary Sheet

All activities for the Continental Mine RCE are listed on this sheet and carried through the succeeding worksheets of the RCE. The column labeled ID contains the codes for the facility location, activity, material and equipment used for that particular row of work. The description lists the activity, top or outslope (if applicable), and the material. The source location lists the stockpile name (or sub-area) for the location of the activity. If borrow material is involved, it is transported from a borrow stockpile to a destination stockpile. Blank cells indicate that that column is not relevant to a particular activity.

Notes and Assumptions:

1 - Haul/Push Distance based on Continental 2014 CCP or measured/assumed as shown in documentation
2 - Weighted Average Haul Grades based on 2018 Continental RCE Update Submittal
3 - Grade Factors from 2018 Continental RCE Update Submittal

ID	Description	Source Location 1	Destination Location 2	Total Haul/Push Distance (ft)[1]	Grade (%)[2,3]	Equipment
2001-K-a-Rp1	Perforate Liner-Blackman's Seep (Pond #2) -Existing Ground	Containments Cntmnt-02	-	200	0.5%	Cat D11T CD Multi-shank (w/ MSR-359H)
2002-K-a-Rp1	Perforate Liner-Decant Pond #4-Existing Ground	Containments Cntmnt-03	-	200	0.5%	Cat D11T CD Multi-shank (w/ MSR-359H)
2004-K-a-Rp1	Perforate Liner-Grape Gulch Pond #3-Existing Ground	Containments Cntmnt-05	-	200	0.5%	Cat D11T CD Multi-shank (w/ MSR-359H)
2005-K-a-Rp1	Perforate Liner-Magnetite Seepage Pond-Existing Ground	Containments Cntmnt-06	-	200	0.5%	Cat D11T CD Multi-shank (w/ MSR-359H)
2010-K-a-Rp1	Perforate Liner-Upper Creek Containment Pond 1 -Existing Ground	Containments Cntmnt-11	-	200	0.5%	Cat D11T CD Multi-shank (w/ MSR-359H)
1001-A-a-Dz1	Grade-Top-Existing Ground	South Waste Rock Disposal Facility SWRDF-1	-	540	-1.0%	Cat D11T, U Blade
1002-A-a-Dz1	Grade-3:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	Cat D11T, U Blade
1003-A-a-Dz1	Grade-2.5:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	Cat D11T, U Blade
1004-A-a-Dz1	Grade-Laydown Yard N of SWRDF-Existing Ground	South Waste Rock Disposal Facility SWRDF-4	-	99	1.0%	Cat D11T, U Blade
1101-A-a-Dz1	Grade-Top-Existing Ground	No. 3 Shaft Stockpile N3SS-1	-	60	-1.0%	Cat D11T, U Blade
1102-A-a-Dz1	Grade-Outslope-Existing Ground	No. 3 Shaft Stockpile N3SS-2	-	128	-33.0%	Cat D11T, U Blade
1201-A-a-Dz1	Grade-Top-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-1	-	92	-1.0%	Cat D11T, U Blade
1202-A-a-Dz1	Grade-Outslope-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-2	-	163	-33.0%	Cat D11T, U Blade
1301-A-a-Dz1	Grade-Top-Existing Ground	Main Tailings Impoundment MTI-1	-	200	-0.8%	Cat D11T, U Blade
1302-A-a-Dz1	Grade-Outslope-Existing Ground	Main Tailings Impoundment MTI-2	-	250	-33.0%	Cat D11T, U Blade
1303-A-a-Dz1	Grade-Reclaim Pond-Existing Ground	Main Tailings Impoundment MTI-3	-	200	-33.0%	Cat D11T, U Blade
1304-E-a-Rp1	Rip-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	-	0.0%	Cat D11T CD Multi-shank (w/ MSR-359H)
1304-C-a-Ld1	Load-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	-	0.0%	Cat 992K
1304-D-a-Tk4	Haul-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	1,172	0.9%	Komatsu 730E
1401-A-a-Dz1	Grade-Top-Existing Ground	Magnetite Tailings Impoundment MGTI-1	-	300	-3.5%	Cat D11T, U Blade
1402-A-a-Dz1	Grade-Outslope-Existing Ground	Magnetite Tailings Impoundment MGTI-2	-	250	-33.0%	Cat D11T, U Blade
1502-A-a-Dz1	Grade-Outslope-pushdown-Existing Ground	Cobre Haul Road CHR-2	-	47	40.0%	Cat D11T, U Blade
1503-A-a-Ex1	Grade-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	100	40.0%	Cat 319D L
1503-B-a-Dz1	Dozer Assist Grading-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	100	40.0%	Cat D11T, U Blade
1504-C-a-Ld1	Load-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	100	40.0%	Cat 992K
1504-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	100	40.0%	Cat D11T, U Blade
1504-D-a-Tk3	Haul-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	2,640	7.0%	Cat 725
1505-C-a-Ld1	Load-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	100	50.0%	Cat 992K
1505-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	100	50.0%	Cat D11T, U Blade
1505-D-a-Tk3	Haul-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	2,640	7.0%	Cat 725
1506-C-a-Ex1	Load-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	100	40.0%	Cat 319D L
1506-D-a-Tk3	Haul-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	5,280	7.0%	Cat 725
1507-C-a-Ex1	Load-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	100	40.0%	Cat 319D L
1507-D-a-Tk3	Haul-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	5,280	7.0%	Cat 725
1001-E-c-Rp1	Rip-Top-Rough Graded Material	South Waste Rock Disposal Facility SWRDF-1	-	540	-1.0%	Cat D11T CD Multi-shank (w/ MSR-359H)
1101-E-c-Rp1	Rip-Top-Rough Graded Material	No. 3 Shaft Stockpile N3SS-1	-	60	-1.0%	Cat D11T CD Multi-shank (w/ MSR-359H)
1201-E-c-Rp1	Rip-Top-Rough Graded Material	Low Grade Ore Waste Rock Facility LGWRF-1	-	92	-1.0%	Cat D11T CD Multi-shank (w/ MSR-359H)
1301-E-c-Rp1	Rip-Top-Rough Graded Material	Main Tailings Impoundment MTI-1	-	200	-0.8%	Cat D11T CD Multi-shank (w/ MSR-359H)
1401-E-c-Rp1	Rip-Top-Rough Graded Material	Magnetite Tailings Impoundment MGTI-1	-	300	-3.5%	Cat D11T CD Multi-shank (w/ MSR-359H)
1001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-1	540	-1.0%	Cat D11T, U Blade
1002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-2	99	-27.0%	Cat D11T, U Blade
1003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-3	99	-33.0%	Cat D11T, U Blade
1004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-4	99	1.0%	Cat D11T, U Blade
1101-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-1	60	-1.0%	Cat D11T, U Blade
1102-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-2	128	-33.0%	Cat D11T, U Blade
1201-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-1	92	-1.0%	Cat D11T, U Blade
1202-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-2	163	-33.0%	Cat D11T, U Blade
1301-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-1	200	-0.8%	Cat D11T, U Blade
1302-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-2	250	-33.0%	Cat D11T, U Blade
1303-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-3	200	-33.0%	Cat D11T, U Blade
1401-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-1	300	-3.5%	Cat D11T, U Blade
1402-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-2	250	-33.0%	Cat D11T, U Blade
1601-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	PB-1	200	0.0%	Cat D11T, U Blade
1700-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Hanover Mountain Deposit	250	0.0%	Cat D11T, U Blade
2001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-02	200	0.5%	Cat D11T, U Blade
2002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-03	200	0.5%	Cat D11T, U Blade
2003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-04	200	0.5%	Cat D11T, U Blade
2004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-05	200	0.5%	Cat D11T, U Blade
2005-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-06	200	0.5%	Cat D11T, U Blade
2006-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-07	200	0.5%	Cat D11T, U Blade
2007-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-08	200	0.5%	Cat D11T, U Blade
2008-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-09	200	0.5%	Cat D11T, U Blade
2009-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-10	200	0.5%	Cat D11T, U Blade
2010-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-11	200	0.5%	Cat D11T, U Blade
3001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-1	-	0.0%	Cat D11T, U Blade
3004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-4	-	0.0%	Cat D11T, U Blade
1001-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-1	540	-1.0%	Cat 992K
1002-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-2	99	-27.0%	Cat 992K
1003-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-3	99	-33.0%	Cat 992K
1004-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-4	99	1.0%	Cat 992K
1101-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-1	60	-1.0%	Cat 992K
1102-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-2	128	-33.0%	Cat 992K
1201-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-1	92	-1.0%	Cat 992K
1202-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-2	163	-33.0%	Cat 992K
1301-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-1	200	-0.8%	Cat 992K
1302-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-2	250	-33.0%	Cat 992K
1303-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-3	200	-33.0%	Cat 992K
1401-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-1	300	-3.5%	Cat 992K
1402-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-2	250	-33.0%	Cat 992K
1601-C-b-Ld1	Load-Cover	North Overburden Stockpile	PB-1	200	0.0%	Cat 992K
1700-C-b-Ld1	Load-Cover	North Overburden Stockpile	Hanover Mountain Deposit	250	0.0%	Cat 992K
2001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-02	200	0.5%	Cat 992K
2002-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-03	200	0.5%	Cat 992K
2003-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-04	200	0.5%	Cat 992K
2004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-05	200	0.5%	Cat 992K
2005-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-06	200	0.5%	Cat 992K
2006-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-07	200	0.5%	Cat 992K
2007-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-08	200	0.5%	Cat 992K
2008-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-09	200	0.5%	Cat 992K
2009-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-10	200	0.5%	Cat 992K
2010-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-11	200	0.5%	Cat 992K
3001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-1	-	0.0%	Cat 992K
3004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-4	-	0.0%	Cat 992K
1001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-1	12,559	-1.6%	Komatsu 730E
1002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-2	12,559	-1.6%	Komatsu 730E
1003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-3	12,559	-1.6%	Komatsu 730E
1004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-4	12,559	-1.6%	Komatsu 730E
1101-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-1	4,243	-3.7%	Komatsu 730E
1102-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-2	4,243	-3.7%	Komatsu 730E
1201-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-1	7,620	-5.6%	Komatsu 730E
1202-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-2	7,620	-5.6%	Komatsu 730E
1301-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-1	7,563	-1.3%	Komatsu 730E
1302-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-2	7,563	-1.3%	Komatsu 730E
1303-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-3	7,563	-1.3%	Komatsu 730E
1401-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-1	6,190	-6.0%	Komatsu 730E
1402-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-2	6,190	-6.0%	Komatsu 730E
1601-D-b-Tk4	Haul-Cover	North Overburden Stockpile	PB-1	12,559	-1.6%	Komatsu 730E
1700-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	5,707	-6.5%	Komatsu 730E
2001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-02	3,856	-8.4%	Komatsu 730E
2002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-03	4,110	-5.5%	Komatsu 730E
2003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-04	4,110	-5.5%	Komatsu 730E
2004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-05	3,856	-8.4%	Komatsu 730E
2005-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-06	6,480	-6.2%	Komatsu 730E
2006-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-07	4,110	-5.5%	Komatsu 730E
2007-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-08	12,559	-1.6%	Komatsu 730E
2008-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-09	12,559	-1.6%	Komatsu 730E
2009-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-10	12,559	-1.6%	Komatsu 730E
2010-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-11	3,856	-8.4%	Komatsu 730E
3001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-1	8,495	-3.2%	Komatsu 730E
3004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-4	7,193	-1.6%	Komatsu 730E
1001-A-d-Mg1	Grade-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	540	-1.0%	Cat 16M
1002-A-d-Mg1	Grade-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	Cat 16M
1003-A-d-Mg1	Grade-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	Cat 16M
1004-A-d-Mg1	Grade-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	99	1.0%	Cat 16M
1101-A-d-Mg1	Grade-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	60	-1.0%	Cat 16M
1102-A-d-Mg1	Grade-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	128	-33.0%	Cat 16M
1201-A-d-Mg1	Grade-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	92	-1.0%	Cat 16M
1202-A-d-Mg1	Grade-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	163	-33.0%	Cat 16M
1301-A-d-Mg1	Grade-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	200	-0.8%	Cat 16M
1302-A-d-Mg1	Grade-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	250	-33.0%	Cat 16M
1303-A-d-Mg1	Grade-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	200	-33.0%	Cat 16M
1401-A-d-Mg1	Grade-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	300	-3.5%	Cat 16M
1402-A-d-Mg1	Grade-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	250	-33.0%	Cat 16M
1601-A-d-Mg1	Grade-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	200	0.0%	Cat 16M
1700-A-d-Mg1	Grade-Top-Placed Cover	Hanover Mountain Deposit	-	250	0.0%	Cat 16M
2001-A-d-Mg1	Grade-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	200	0.5%	Cat 16M
2002-A-d-Mg1	Grade-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	200	0.5%	Cat 16M
2003-A-d-Mg1	Grade-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	200	0.5%	Cat 16M
2004-A-d-Mg1	Grade-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	200	0.5%	Cat 16M
2005-A-d-Mg1	Grade-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	200	0.5%	Cat 16M
2006-A-d-Mg1	Grade-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	200	0.5%	Cat 16M
2007-A-d-Mg1	Grade-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	200	0.5%	Cat 16M
2008-A-d-Mg1	Grade-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	200	0.5%	Cat 16M
2009-A-d-Mg1	Grade-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	200	0.5%	Cat 16M
2010-A-d-Mg1	Grade-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	200	0.5%	Cat 16M
3001-A-d-Mg1	Grade-Unplanned Future Disturbance Areas-Placed Cover	Miscellaneous Misc-1	-	-	0.0%	Cat 16M
3004-A-d-Mg1	Grade-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	-	0.0%	Cat 16M
1002-F-e-U3a	Grade Benches-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	-
1003-F-e-U3b	Grade Benches-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	-
1302-F-e-U4	Grade Benches-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	250	-33.0%	-
1002-H-e-U6a	Construct Bench Channels-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	-
1003-H-e-U6b	Construct Bench Channels-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	-
1302-H-e-U6c	Construct Bench Channels-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	250	-33.0%	-

Material Handling Plan Summary Sheet

All activities for the Continental Mine RCE are listed on this sheet and carried through the succeeding worksheets of the RCE. The column labeled ID contains the codes for the facility location, activity, material and equipment used for that particular row of work. The description lists the activity, top or outslope (if applicable), and the material. The source location lists the stockpile name (or sub-area) for the location of the activity. If borrow material is involved, it is transported from a borrow stockpile to a destination stockpile. Blank cells indicate that that column is not relevant to a particular activity.

Notes and Assumptions:

1 - Haul/Push Distance based on Continental 2014 CCP or measured/assumed as shown in documentation
2 - Weighted Average Haul Grades based on 2018 Continental RCE Update Submittal
3 - Grade Factors from 2018 Continental RCE Update Submittal

ID	Description	Source Location 1	Destination Location 2	Total Haul/Push Distance (ft)[1]	Grade (%)[2,3]	Equipment
1001-I-e-U7a	Construct Top Channels-Top-Final Grade	South Waste Rock Disposal Facility SWRDF-1	-	540	-1.0%	-
1301-I-e-U7b	Construct Top Channels-Top-Final Grade	Main Tailings Impoundment MTI-1	-	200	-0.8%	-
1002-G-e-U5a	Construct Downdrains-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	-
1002-Gb-e-U5b	Construct Downdrain Dissipators-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	-
1003-G-e-U5a	Construct Downdrains-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	-
1003-Gb-e-U5b	Construct Downdrain Dissipators-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	-
1302-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	250	-33.0%	-
1302-Gb-e-U5b	Construct Downdrain Dissipators-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	250	-33.0%	-
1402-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	250	-33.0%	-
1402-Gb-e-U5a	Construct Downdrain Dissipators-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	250	-33.0%	-
1001-J-d-U2	Revegetate-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	540	-1.0%	-
1002-J-d-U2	Revegetate-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	-
1003-J-d-U2	Revegetate-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	-
1004-J-d-U2	Revegetate-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	99	1.0%	-
1101-J-d-U2	Revegetate-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	60	-1.0%	-
1102-J-d-U2	Revegetate-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	128	-33.0%	-
1201-J-d-U2	Revegetate-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	92	-1.0%	-
1202-J-d-U2	Revegetate-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	163	-33.0%	-
1301-J-d-U2	Revegetate-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	200	-0.8%	-
1302-J-d-U2	Revegetate-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	250	-33.0%	-
1303-J-d-U2	Revegetate-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	200	-33.0%	-
1401-J-d-U2	Revegetate-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	300	-3.5%	-
1402-J-d-U2	Revegetate-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	250	-33.0%	-
1501-J-d-U2	Revegetate-Top-Placed Cover	Cobre Haul Road CHR-1	-	-	0.0%	-
1601-J-d-U2	Revegetate-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	200	0.0%	-
1700-J-d-U2	Revegetate-Top-Placed Cover	Hanover Mountain Deposit	-	250	0.0%	-
2001-J-d-U2	Revegetate-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	200	0.5%	-
2002-J-d-U2	Revegetate-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	200	0.5%	-
2003-J-d-U2	Revegetate-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	200	0.5%	-
2004-J-d-U2	Revegetate-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	200	0.5%	-
2005-J-d-U2	Revegetate-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	200	0.5%	-
2006-J-d-U2	Revegetate-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	200	0.5%	-
2007-J-d-U2	Revegetate-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	200	0.5%	-
2008-J-d-U2	Revegetate-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	200	0.5%	-
2009-J-d-U2	Revegetate-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	200	0.5%	-
2010-J-d-U2	Revegetate-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	200	0.5%	-
3001-J-d-U2	Revegetate-Unplanned Future Disturbance Areas-Placed Cover	Miscellaneous Misc-1	-	-	0.0%	-
3004-J-d-U2	Revegetate-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	-	0.0%	-
1001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-1	540	-1.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-2	99	-27.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-3	99	-33.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-4	99	1.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1101-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-1	60	-1.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1102-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-2	128	-33.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1201-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-1	92	-1.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1202-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-2	163	-33.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1301-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-1	200	-0.8%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1302-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-2	250	-33.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1303-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-3	200	-33.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1401-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-1	300	-3.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1402-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-2	250	-33.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1501-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-1	-	0.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1502-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-2	47	40.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1503-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-3	100	40.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1505-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-5	100	50.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1506-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-6	100	40.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1507-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-7	100	40.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1601-P-b-Comb1	Road Maintenance	North Overburden Stockpile	PB-1	200	0.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-02	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-03	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-04	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-05	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2005-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-06	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2006-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-07	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2007-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-08	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2008-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-09	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2009-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-10	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
2010-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-11	200	0.5%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
3001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-1	-	0.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
3004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-4	-	0.0%	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.
1001-M-e-U24	Post-Closure O&M-Top-Final Grade	South Waste Rock Disposal Facility SWRDF-1	-	540	-1.0%	-
1002-M-e-U24	Post-Closure O&M-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	99	-27.0%	-
1003-M-e-U24	Post-Closure O&M-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	99	-33.0%	-
1004-M-e-U24	Post-Closure O&M-Laydown Yard N of SWRDF-Final Grade	South Waste Rock Disposal Facility SWRDF-4	-	99	1.0%	-
1101-M-e-U24	Post-Closure O&M-Top-Final Grade	No. 3 Shaft Stockpile N3SS-1	-	60	-1.0%	-
1102-M-e-U24	Post-Closure O&M-Outslope-Final Grade	No. 3 Shaft Stockpile N3SS-2	-	128	-33.0%	-
1201-M-e-U24	Post-Closure O&M-Top-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-1	-	92	-1.0%	-
1202-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-2	-	163	-33.0%	-
1301-M-e-U24	Post-Closure O&M-Top-Final Grade	Main Tailings Impoundment MTI-1	-	200	-0.8%	-
1302-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	250	-33.0%	-
1303-M-e-U24	Post-Closure O&M-Reclaim Pond-Final Grade	Main Tailings Impoundment MTI-3	-	200	-33.0%	-
1401-M-e-U24	Post-Closure O&M-Top-Final Grade	Magnetite Tailings Impoundment MGTI-1	-	300	-3.5%	-
1402-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	250	-33.0%	-
1501-M-e-U24	Post-Closure O&M-Top-Final Grade	Cobre Haul Road CHR-1	-	-	0.0%	-
1502-M-e-U24	Post-Closure O&M-Outslope-pushdown-Final Grade	Cobre Haul Road CHR-2	-	47	40.0%	-
1503-M-e-U24	Post-Closure O&M-Outslope-pullback Ex Only 2.5:1-Final Grade	Cobre Haul Road CHR-3	-	100	40.0%	-
1505-M-e-U24	Post-Closure O&M-Outslope-pullback LdTk 2:1-Final Grade	Cobre Haul Road CHR-5	-	100	50.0%	-
1506-M-e-U24	Post-Closure O&M-Crossings - earth-Final Grade	Cobre Haul Road CHR-6	-	100	40.0%	-
1507-M-e-U24	Post-Closure O&M-Crossings - concrete-Final Grade	Cobre Haul Road CHR-7	-	100	40.0%	-
1601-M-e-U24	Post-Closure O&M-Top-Final Grade	Pearson Barnes Mine Area PB-1	-	200	0.0%	-
2001-M-e-U24	Post-Closure O&M-Blackman's Seep (Pond #2) -Final Grade	Containments Cntmnt-02	-	200	0.5%	-
2002-M-e-U24	Post-Closure O&M-Decant Pond #4-Final Grade	Containments Cntmnt-03	-	200	0.5%	-
2003-M-e-U24	Post-Closure O&M-East WRF Containment-Final Grade	Containments Cntmnt-04	-	200	0.5%	-
2004-M-e-U24	Post-Closure O&M-Grape Gulch Pond #3-Final Grade	Containments Cntmnt-05	-	200	0.5%	-
2005-M-e-U24	Post-Closure O&M-Magnetite Seepage Pond-Final Grade	Containments Cntmnt-06	-	200	0.5%	-
2006-M-e-U24	Post-Closure O&M-North Tailings Decant Pond-Final Grade	Containments Cntmnt-07	-	200	0.5%	-
2007-M-e-U24	Post-Closure O&M-SWRF Dam 1-Final Grade	Containments Cntmnt-08	-	200	0.5%	-
2008-M-e-U24	Post-Closure O&M-SWRF Dam 2-Final Grade	Containments Cntmnt-09	-	200	0.5%	-
2009-M-e-U24	Post-Closure O&M-SWRF Dam 3-Final Grade	Containments Cntmnt-10	-	200	0.5%	-
2010-M-e-U24	Post-Closure O&M-Upper Creek Containment Pond 1 -Final Grade	Containments Cntmnt-11	-	200	0.5%	-
3001-M-e-U24	Post-Closure O&M-Unplanned Future Disturbance Areas-Final Grade	Miscellaneous Misc-1	-	-	0.0%	-
3004-M-e-U24	Post-Closure O&M-Tailings Pipeline Corridor-Final Grade	Miscellaneous Misc-4	-	-	0.0%	-
3005-N-e-U17	Plug and Abandon Well-Wells-Final Grade	Miscellaneous Misc-5	-	-	0.0%	-
1701-R-e-U26	Construct Berms-Hanover Mountain Perimeter 1-Final Grade	Hanover Mountain Deposit HMM-1	-	6,670	0.0%	-
1801-R-e-U26	Construct Berms-Continental Pit Perimeter 1-Final Grade	Continental Pit CP-1	-	6,635	0.0%	-
1702-S-e-U27	Fencing-Hanover Mountain Perimeter 2-Final Grade	Hanover Mountain Deposit HMM-2	-	3,286	0.0%	-
1802-S-e-U27	Fencing-Continental Pit Perimeter 2-Final Grade	Continental Pit CP-2	-	2,453	0.0%	-
5099-E-c-Rp1	Rip-Cover Material	North Overburden Stockpile	5099	372	1.0%	Cat D11T CD Multi-shank (w/ MSR-359H)
5099-J-e-U2	Revegetate-Cover Material	North Overburden Stockpile	5099	372	1.0%	-

Notes:

Earthwork Quantity Worksheet

Notes and Assumptions:

1 - Acres and volumes based on 2018 Continental RCE Update Submittal
2 - Cover Material Swell: The 'Loose Volume' is calculated based on the acreage to be covered, 3 ft of cover, and accounts for appropriate swell factor.
3 - 8% swell factor is estimated for cover obtained from a mine stockpile because it is placed loose and is looser than cover borrowed from a natural deposit.
4 - Has been agreed upon with State agencies that swell occurs when cover material is moved from source to haul truck but not from the truck to placement on stockpile

5	6	7	8	9	10	11	12	13
ID	**Description**	**Source Location 1**	**Destination Location 2**	**Area (ac)[1]**	**Cover Depth (in)**	**Bank/Stockpile Volume (bcy)[1,4]**	**Swell Factor (%)[3]**	**Loose/Stockpile Volume (lcy)[2]**
2001-K-a-Rp1	Perforate Liner-Blackman's Seep (Pond #2) -Existing Ground	Containments Cntmnt-02	-	0.0	-	-	0%	-
2002-K-a-Rp1	Perforate Liner-Decant Pond #4-Existing Ground	Containments Cntmnt-03	-	0.6	-	-	0%	-
2004-K-a-Rp1	Perforate Liner-Grape Gulch Pond #3-Existing Ground	Containments Cntmnt-05	-	0.4	-	-	0%	-
2005-K-a-Rp1	Perforate Liner-Magnetite Seepage Pond-Existing Ground	Containments Cntmnt-06	-	0.2	-	-	0%	-
2010-K-a-Rp1	Perforate Liner-Upper Creek Containment Pond 1 -Existing Ground	Containments Cntmnt-11	-	1.5	-	-	0%	-
1001-A-a-Dz1	Grade-Top-Existing Ground	South Waste Rock Disposal Facility SWRDF-1	-	-	-	666,680	0%	666,680
1002-A-a-Dz1	Grade-3:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-2	-	-	-	3,150,704	0%	3,150,704
1003-A-a-Dz1	Grade-2.5:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-3	-	-	-	1,450,500	0%	1,450,500
1004-A-a-Dz1	Grade-Laydown Yard N of SWRDF-Existing Ground	South Waste Rock Disposal Facility SWRDF-4	-	-	-	33,719	0%	33,719
1101-A-a-Dz1	Grade-Top-Existing Ground	No. 3 Shaft Stockpile N3SS-1	-	-	-	5,826	0%	5,826
1102-A-a-Dz1	Grade-Outslope-Existing Ground	No. 3 Shaft Stockpile N3SS-2	-	-	-	19,719	0%	19,719
1201-A-a-Dz1	Grade-Top-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-1	-	-	-	8,988	0%	8,988
1202-A-a-Dz1	Grade-Outslope-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-2	-	-	-	243,350	0%	243,350
1301-A-a-Dz1	Grade-Top-Existing Ground	Main Tailings Impoundment MTI-1	-	-	-	50,795	0%	50,795
1302-A-a-Dz1	Grade-Outslope-Existing Ground	Main Tailings Impoundment MTI-2	-	-	-	170,294	0%	170,294
1303-A-a-Dz1	Grade-Reclaim Pond-Existing Ground	Main Tailings Impoundment MTI-3	-	-	-	67,765	0%	67,765
1304-E-a-Rp1	Rip-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	50.0	-	-	15%	-
1304-C-a-Ld1	Load-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	50.0	-	62,226	15%	71,560
1304-D-a-Tk4	Haul-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	50.0	-	62,226	15%	71,560
1401-A-a-Dz1	Grade-Top-Existing Ground	Magnetite Tailings Impoundment MGTI-1	-	-	-	73,482	0%	73,482
1402-A-a-Dz1	Grade-Outslope-Existing Ground	Magnetite Tailings Impoundment MGTI-2	-	-	-	69,996	0%	69,996
1502-A-a-Dz1	Grade-Outslope-pushdown-Existing Ground	Cobre Haul Road CHR-2	-	-	-	24,255	15%	27,893
1503-A-a-Ex1	Grade-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	-	-	28,322	15%	32,570
1503-B-a-Dz1	Dozer Assist Grading-Outslope-pullback Ex Only 2.5:1-Existing Gro	Cobre Haul Road CHR-3	-	-	-	28,322	15%	32,570
1504-C-a-Ld1	Load-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	-	-	35,986	15%	41,384
1504-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2.5:1-Existing Groun	Cobre Haul Road CHR-4	-	-	-	35,986	15%	41,384
1504-D-a-Tk3	Haul-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	-	-	35,986	15%	41,384
1505-C-a-Ld1	Load-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	-	-	67,453	15%	77,571
1505-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	-	-	67,453	15%	77,571
1505-D-a-Tk3	Haul-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	-	-	67,453	15%	77,571
1506-C-a-Ex1	Load-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	-	-	5,731	15%	6,591
1506-D-a-Tk3	Haul-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	-	-	5,731	15%	6,591
1507-C-a-Ex1	Load-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	-	-	672	60%	1,075
1507-D-a-Tk3	Haul-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	-	-	672	60%	1,075
1001-E-c-Rp1	Rip-Top-Rough Graded Material	South Waste Rock Disposal Facility SWRDF-1	-	109.9	-	-	0%	-
1101-E-c-Rp1	Rip-Top-Rough Graded Material	No. 3 Shaft Stockpile N3SS-1	-	1.3	-	-	0%	-
1201-E-c-Rp1	Rip-Top-Rough Graded Material	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	-	-	0%	-
1301-E-c-Rp1	Rip-Top-Rough Graded Material	Main Tailings Impoundment MTI-1	-	108.2	-	-	0%	-
1401-E-c-Rp1	Rip-Top-Rough Graded Material	Magnetite Tailings Impoundment MGTI-1	-	57.2	-	-	0%	-
1001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-1	109.9	36	492,515	8%	531,916
1002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-2	255.6	36	1,145,467	8%	1,237,104
1003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-3	83.5	36	374,374	8%	404,323
1004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-4	20.9	36	93,663	8%	101,156
1101-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-1	1.3	36	5,826	8%	6,292
1102-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-2	4.4	36	19,719	8%	21,296
1201-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-1	5.6	36	24,967	8%	26,964
1202-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-2	22.3	36	99,753	8%	107,733
1301-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-1	108.2	36	484,896	8%	523,688
1302-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-2	36.3	36	162,812	8%	175,837
1303-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-3	33.0	36	147,889	8%	159,720
1401-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-1	57.2	36	256,126	8%	276,616
1402-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-2	5.3	36	23,833	8%	25,739
1601-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	PB-1	11.9	36	53,330	8%	57,596
1700-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Hanover Mountain Deposit	93.3	36	418,122	8%	451,572
2001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-02	0.0	36	45	8%	48
2002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-03	0.6	36	2,779	8%	3,001
2003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-04	0.5	36	2,241	8%	2,420
2004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-05	0.4	36	1,703	8%	1,839
2005-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-06	0.2	36	896	8%	968
2006-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-07	0.5	36	2,061	8%	2,226
2007-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-08	0.5	36	2,330	8%	2,517
2008-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-09	0.3	36	1,524	8%	1,646
2009-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-10	0.8	36	3,764	8%	4,066
2010-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-11	1.5	36	6,857	8%	7,405
3001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-1	50.0	36	224,074	8%	242,000
3004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-4	1.4	36	6,480	8%	6,999
1001-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-1	109.9	36	492,515	8%	531,916
1002-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-2	255.6	36	1,145,467	8%	1,237,104
1003-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-3	83.5	36	374,374	8%	404,323
1004-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-4	20.9	36	93,663	8%	101,156
1101-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-1	1.3	36	5,826	8%	6,292
1102-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-2	4.4	36	19,719	8%	21,296
1201-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-1	5.6	36	24,967	8%	26,964
1202-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-2	22.3	36	99,753	8%	107,733
1301-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-1	108.2	36	484,896	8%	523,688
1302-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-2	36.3	36	162,812	8%	175,837
1303-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-3	33.0	36	147,889	8%	159,720
1401-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-1	57.2	36	256,126	8%	276,616
1402-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-2	5.3	36	23,833	8%	25,739
1601-C-b-Ld1	Load-Cover	North Overburden Stockpile	PB-1	11.9	36	53,330	8%	57,596
1700-C-b-Ld1	Load-Cover	North Overburden Stockpile	Hanover Mountain Deposit	93.3	36	418,122	8%	451,572
2001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-02	0.0	36	45	8%	48
2002-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-03	0.6	36	2,779	8%	3,001
2003-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-04	0.5	36	2,241	8%	2,420
2004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-05	0.4	36	1,703	8%	1,839
2005-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-06	0.2	36	896	8%	968
2006-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-07	0.5	36	2,061	8%	2,226
2007-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-08	0.5	36	2,330	8%	2,517
2008-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-09	0.3	36	1,524	8%	1,646
2009-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-10	0.8	36	3,764	8%	4,066
2010-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-11	1.5	36	6,857	8%	7,405
3001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-1	50.0	36	224,074	8%	242,000
3004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-4	1.4	36	6,480	8%	6,999
1001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-1	109.9	36	492,515	8%	531,916
1002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-2	255.6	36	1,145,467	8%	1,237,104
1003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-3	83.5	36	374,374	8%	404,323
1004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-4	20.9	36	93,663	8%	101,156
1101-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-1	1.3	36	5,826	8%	6,292
1102-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-2	4.4	36	19,719	8%	21,296
1201-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-1	5.6	36	24,967	8%	26,964
1202-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-2	22.3	36	99,753	8%	107,733
1301-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-1	108.2	36	484,896	8%	523,688
1302-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-2	36.3	36	162,812	8%	175,837
1303-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-3	33.0	36	147,889	8%	159,720
1401-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-1	57.2	36	256,126	8%	276,616
1402-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-2	5.3	36	23,833	8%	25,739
1601-D-b-Tk4	Haul-Cover	North Overburden Stockpile	PB-1	11.9	36	53,330	8%	57,596
1700-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	93.3	36	418,122	8%	451,572
2001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-02	0.0	36	45	8%	48
2002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-03	0.6	36	2,779	8%	3,001
2003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-04	0.5	36	2,241	8%	2,420
2004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-05	0.4	36	1,703	8%	1,839
2005-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-06	0.2	36	896	8%	968
2006-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-07	0.5	36	2,061	8%	2,226
2007-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-08	0.5	36	2,330	8%	2,517
2008-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-09	0.3	36	1,524	8%	1,646
2009-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-10	0.8	36	3,764	8%	4,066
2010-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-11	1.5	36	6,857	8%	7,405
3001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-1	50.0	36	224,074	8%	242,000
3004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-4	1.4	36	6,480	8%	6,999
1001-A-d-Mg1	Grade-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	109.9	36	531,916	0%	531,916
1002-A-d-Mg1	Grade-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	255.6	36	1,237,104	0%	1,237,104
1003-A-d-Mg1	Grade-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	83.5	36	404,323	0%	404,323
1004-A-d-Mg1	Grade-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	20.9	36	101,156	0%	101,156

Earthwork Quantity Worksheet

Notes and Assumptions:

1 - Acres and volumes based on 2018 Continental RCE Update Submittal
2 - Cover Material Swell: The 'Loose Volume' is calculated based on the acreage to be covered, 3 ft of cover, and accounts for appropriate swell factor.
3 - 8% swell factor is estimated for cover obtained from a mine stockpile because it is placed loose and is looser than cover borrowed from a natural deposit.
4 - Has been agreed upon with State agencies that swell occurs when cover material is moved from source to haul truck but not from the truck to placement on stockpile

5	6	7	8	9	10	11	12	13
ID	**Description**	**Source Location 1**	**Destination Location 2**	**Area (ac)[1]**	**Cover Depth (in)**	**Bank/Stockpile Volume (bcy)[1,4]**	**Swell Factor (%)[3]**	**Loose/Stockpile Volume (lcy)[2]**
1101-A-d-Mg1	Grade-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	1.3	36	6,292	0%	6,292
1102-A-d-Mg1	Grade-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	4.4	36	21,296	0%	21,296
1201-A-d-Mg1	Grade-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	36	26,964	0%	26,964
1202-A-d-Mg1	Grade-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	36	107,733	0%	107,733
1301-A-d-Mg1	Grade-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	108.2	36	523,688	0%	523,688
1302-A-d-Mg1	Grade-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	36.3	36	175,837	0%	175,837
1303-A-d-Mg1	Grade-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	33.0	36	159,720	0%	159,720
1401-A-d-Mg1	Grade-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	57.2	36	276,616	0%	276,616
1402-A-d-Mg1	Grade-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	5.3	36	25,739	0%	25,739
1601-A-d-Mg1	Grade-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	11.9	36	57,596	0%	57,596
1700-A-d-Mg1	Grade-Top-Placed Cover	Hanover Mountain Deposit	-	93.3	36	451,572	0%	451,572
2001-A-d-Mg1	Grade-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	0.0	36	48	0%	48
2002-A-d-Mg1	Grade-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	0.6	36	3,001	0%	3,001
2003-A-d-Mg1	Grade-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	0.5	36	2,420	0%	2,420
2004-A-d-Mg1	Grade-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	0.4	36	1,839	0%	1,839
2005-A-d-Mg1	Grade-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	0.2	36	968	0%	968
2006-A-d-Mg1	Grade-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	0.5	36	2,226	0%	2,226
2007-A-d-Mg1	Grade-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	0.5	36	2,517	0%	2,517
2008-A-d-Mg1	Grade-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	0.3	36	1,646	0%	1,646
2009-A-d-Mg1	Grade-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	0.8	36	4,066	0%	4,066
2010-A-d-Mg1	Grade-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	1.5	36	7,405	0%	7,405
3001-A-d-Mg1	Grade-Unplanned Future Disturbance Areas-Placed Cover	Miscellaneous Misc-1	-	50.0	36	242,000	0%	242,000
3004-A-d-Mg1	Grade-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	1.4	36	6,999	0%	6,999
1002-F-e-U3a	Grade Benches-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	-	3,150,704	0%	3,150,704
1003-F-e-U3b	Grade Benches-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	-	1,450,500	0%	1,450,500
1302-F-e-U4	Grade Benches-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	-	170,294	0%	170,294
1002-H-e-U6a	Construct Bench Channels-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	-	3,150,704	0%	3,150,704
1003-H-e-U6b	Construct Bench Channels-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	-	1,450,500	0%	1,450,500
1302-H-e-U6c	Construct Bench Channels-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	-	170,294	0%	170,294
1001-I-e-U7a	Construct Top Channels-Top-Final Grade	South Waste Rock Disposal Facility SWRDF-1	-	109.9	-	666,680	0%	666,680
1301-I-e-U7b	Construct Top Channels-Top-Final Grade	Main Tailings Impoundment MTI-1	-	108.2	-	50,795	0%	50,795
1002-G-e-U5a	Construct Downdrains-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	-	3,150,704	0%	3,150,704
1002-Gb-e-U5b	Construct Downdrain Dissipators-3:1 Interbench Outslope-Final Gr	South Waste Rock Disposal Facility SWRDF-2	-	255.6	-	3,150,704	0%	3,150,704
1003-G-e-U5a	Construct Downdrains-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	-	1,450,500	0%	1,450,500
1003-Gb-e-U5b	Construct Downdrain Dissipators-2.5:1 Interbench Outslope-Final G	South Waste Rock Disposal Facility SWRDF-3	-	83.5	-	1,450,500	0%	1,450,500
1302-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	-	170,294	0%	170,294
1302-Gb-e-U5b	Construct Downdrain Dissipators-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	-	170,294	0%	170,294
1402-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	5.3	-	69,996	0%	69,996
1402-Gb-e-U5a	Construct Downdrain Dissipators-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	5.3	-	69,996	0%	69,996
1001-J-d-U2	Revegetate-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	109.9	-	-	0%	-
1002-J-d-U2	Revegetate-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	255.6	-	-	0%	-
1003-J-d-U2	Revegetate-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	83.5	-	-	0%	-
1004-J-d-U2	Revegetate-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	20.9	-	-	0%	-
1101-J-d-U2	Revegetate-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	1.3	-	-	0%	-
1102-J-d-U2	Revegetate-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	4.4	-	-	0%	-
1201-J-d-U2	Revegetate-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	-	-	0%	-
1202-J-d-U2	Revegetate-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	-	-	0%	-
1301-J-d-U2	Revegetate-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	108.2	-	-	0%	-
1302-J-d-U2	Revegetate-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	36.3	-	-	0%	-
1303-J-d-U2	Revegetate-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	33.0	-	-	0%	-
1401-J-d-U2	Revegetate-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	57.2	-	-	0%	-
1402-J-d-U2	Revegetate-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	5.3	-	-	0%	-
1501-J-d-U2	Revegetate-Top-Placed Cover	Cobre Haul Road CHR-1	-	100.0	-	-	0%	-
1601-J-d-U2	Revegetate-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	11.9	-	-	0%	-
1700-J-d-U2	Revegetate-Top-Placed Cover	Hanover Mountain Deposit	-	93.3	-	-	0%	-
2001-J-d-U2	Revegetate-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	0.0	-	-	0%	-
2002-J-d-U2	Revegetate-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	0.6	-	-	0%	-
2003-J-d-U2	Revegetate-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	0.5	-	-	0%	-
2004-J-d-U2	Revegetate-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	0.4	-	-	0%	-
2005-J-d-U2	Revegetate-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	0.2	-	-	0%	-
2006-J-d-U2	Revegetate-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	0.5	-	-	0%	-
2007-J-d-U2	Revegetate-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	0.5	-	-	0%	-
2008-J-d-U2	Revegetate-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	0.3	-	-	0%	-
2009-J-d-U2	Revegetate-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	0.8	-	-	0%	-
2010-J-d-U2	Revegetate-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	1.5	-	-	0%	-
3001-J-d-U2	Revegetate-Unplanned Future Disturbance Areas-Placed Cover	Miscellaneous Misc-1	-	50.0	-	-	0%	-
3004-J-d-U2	Revegetate-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	1.4	-	-	0%	-
1001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-1	109.9	-	-	8%	-
1002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-2	255.6	-	-	8%	-
1003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-3	83.5	-	-	8%	-
1004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-4	20.9	-	-	8%	-
1101-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-1	1.3	-	-	8%	-
1102-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-2	4.4	-	-	8%	-
1201-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-1	5.6	-	-	8%	-
1202-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-2	22.3	-	-	8%	-
1301-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-1	108.2	-	-	8%	-
1302-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-2	36.3	-	-	8%	-
1303-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-3	33.0	-	-	8%	-
1401-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-1	57.2	-	-	8%	-
1402-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-2	5.3	-	-	8%	-
1501-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-1	100.0	-	-	8%	-
1502-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-2	-	-	-	8%	-
1503-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-3	-	-	-	8%	-
1505-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-5	-	-	-	8%	-
1506-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-6	-	-	-	8%	-
1507-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-7	-	-	-	8%	-
1601-P-b-Comb1	Road Maintenance	North Overburden Stockpile	PB-1	11.9	-	-	8%	-
2001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-02	0.0	-	-	8%	-
2002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-03	0.6	-	-	8%	-
2003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-04	0.5	-	-	8%	-
2004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-05	0.4	-	-	8%	-
2005-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-06	0.2	-	-	8%	-
2006-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-07	0.5	-	-	8%	-
2007-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-08	0.5	-	-	8%	-
2008-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-09	0.3	-	-	8%	-
2009-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-10	0.8	-	-	8%	-
2010-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-11	1.5	-	-	8%	-
3001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-1	50.0	-	-	8%	-
3004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-4	1.4	-	-	8%	-
1001-M-e-U24	Post-Closure O&M-Top-Final Grade	South Waste Rock Disposal Facility SWRDF-1	-	109.9	-	666,680	0%	666,680
1002-M-e-U24	Post-Closure O&M-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	-	3,150,704	0%	3,150,704
1003-M-e-U24	Post-Closure O&M-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	-	1,450,500	0%	1,450,500
1004-M-e-U24	Post-Closure O&M-Laydown Yard N of SWRDF-Final Grade	South Waste Rock Disposal Facility SWRDF-4	-	20.9	-	33,719	0%	33,719
1101-M-e-U24	Post-Closure O&M-Top-Final Grade	No. 3 Shaft Stockpile N3SS-1	-	1.3	-	5,826	0%	5,826
1102-M-e-U24	Post-Closure O&M-Outslope-Final Grade	No. 3 Shaft Stockpile N3SS-2	-	4.4	-	19,719	0%	19,719
1201-M-e-U24	Post-Closure O&M-Top-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	-	8,988	0%	8,988
1202-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	-	243,350	0%	243,350
1301-M-e-U24	Post-Closure O&M-Top-Final Grade	Main Tailings Impoundment MTI-1	-	108.2	-	50,795	0%	50,795
1302-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	-	170,294	0%	170,294
1303-M-e-U24	Post-Closure O&M-Reclaim Pond-Final Grade	Main Tailings Impoundment MTI-3	-	33.0	-	67,765	0%	67,765
1401-M-e-U24	Post-Closure O&M-Top-Final Grade	Magnetite Tailings Impoundment MGTI-1	-	57.2	-	73,482	0%	73,482
1402-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	5.3	-	69,996	0%	69,996
1501-M-e-U24	Post-Closure O&M-Top-Final Grade	Cobre Haul Road CHR-1	-	100.0	-	-	0%	-
1502-M-e-U24	Post-Closure O&M-Outslope-pushdown-Final Grade	Cobre Haul Road CHR-2	-	-	-	24,255	0%	24,255
1503-M-e-U24	Post-Closure O&M-Outslope-pullback Ex Only 2.5:1-Final Grade	Cobre Haul Road CHR-3	-	-	-	28,322	0%	28,322
1505-M-e-U24	Post-Closure O&M-Outslope-pullback LdTk 2:1-Final Grade	Cobre Haul Road CHR-5	-	-	-	67,453	0%	67,453
1506-M-e-U24	Post-Closure O&M-Crossings - earth-Final Grade	Cobre Haul Road CHR-6	-	-	-	5,731	0%	5,731
1507-M-e-U24	Post-Closure O&M-Crossings - concrete-Final Grade	Cobre Haul Road CHR-7	-	-	-	672	0%	672
1601-M-e-U24	Post-Closure O&M-Top-Final Grade	Pearson Barnes Mine Area PB-1	-	11.9	-	-	0%	-
2001-M-e-U24	Post-Closure O&M-Blackman's Seep (Pond #2) -Final Grade	Containments Cntmnt-02	-	0.0	-	-	0%	-
2002-M-e-U24	Post-Closure O&M-Decant Pond #4-Final Grade	Containments Cntmnt-03	-	0.6	-	592	0%	592
2003-M-e-U24	Post-Closure O&M-East WRF Containment-Final Grade	Containments Cntmnt-04	-	0.5	-	80	0%	80
2004-M-e-U24	Post-Closure O&M-Grape Gulch Pond #3-Final Grade	Containments Cntmnt-05	-	0.4	-	592	0%	592
2005-M-e-U24	Post-Closure O&M-Magnetite Seepage Pond-Final Grade	Containments Cntmnt-06	-	0.2	-	592	0%	592

Earthwork Quantity Worksheet

Notes and Assumptions:

1 - Acres and volumes based on 2018 Continental RCE Update Submittal
2 - Cover Material Swell: The 'Loose Volume' is calculated based on the acreage to be covered, 3 ft of cover, and accounts for appropriate swell factor.
3 - 8% swell factor is estimated for cover obtained from a mine stockpile because it is placed loose and is looser than cover borrowed from a natural deposit.
4 - Has been agreed upon with State agencies that swell occurs when cover material is moved from source to haul truck but not from the truck to placement on stockpile

5	6	7	8	9	10	11	12	13
ID	**Description**	**Source Location 1**	**Destination Location 2**	**Area (ac)[1]**	**Cover Depth (in)**	**Bank/Stockpile Volume (bcy)[1,4]**	**Swell Factor (%)[3]**	**Loose/Stockpile Volume (lcy)[2]**
2006-M-e-U24	Post-Closure O&M-North Tailings Decant Pond-Final Grade	Containments Cntmnt-07	-	0.5	-	592	0%	592
2007-M-e-U24	Post-Closure O&M-SWRF Dam 1-Final Grade	Containments Cntmnt-08	-	0.5	-	108	0%	108
2008-M-e-U24	Post-Closure O&M-SWRF Dam 2-Final Grade	Containments Cntmnt-09	-	0.3	-	61	0%	61
2009-M-e-U24	Post-Closure O&M-SWRF Dam 3-Final Grade	Containments Cntmnt-10	-	0.8	-	94	0%	94
2010-M-e-U24	Post-Closure O&M-Upper Creek Containment Pond 1 -Final Grade	Containments Cntmnt-11	-	1.5	-	592	0%	592
3001-M-e-U24	Post-Closure O&M-Unplanned Future Disturbance Areas-Final Gra	Miscellaneous Misc-1	-	50.0	-	-	0%	-
3004-M-e-U24	Post-Closure O&M-Tailings Pipeline Corridor-Final Grade	Miscellaneous Misc-4	-	1.4	-	-	0%	-
3005-N-e-U17	Plug and Abandon Well-Wells-Final Grade	Miscellaneous Misc-5	-	-	-	-	0%	-
1701-R-e-U26	Construct Berms-Hanover Mountain Perimeter 1-Final Grade	Hanover Mountain Deposit HMM-1	-	-	-	-	0%	-
1801-R-e-U26	Construct Berms-Continental Pit Perimeter 1-Final Grade	Continental Pit CP-1	-	0.0	-	0	0%	0
1702-S-e-U27	Fencing-Hanover Mountain Perimeter 2-Final Grade	Hanover Mountain Deposit HMM-2	-	-	-	-	0%	-
1802-S-e-U27	Fencing-Continental Pit Perimeter 2-Final Grade	Continental Pit CP-2	-	-	-	-	0%	-
5099-E-c-Rp1	Rip-Cover Material	North Overburden Stockpile	5099	19.1	-	-	0%	-
5099-J-e-U2	Revegetate-Cover Material	North Overburden Stockpile	5099	19.1	-	-	0%	-

Productivity and Hours Required for Dozer Use---Earthmoving

Notes and Assumptions:
Uses volumes of outslope sections and dam breaches to calculate productivity
Uses push distances of outslope sections for grading productivity
Uses scraper push cycle time for dozer assist with scraper (not used in this RCE - maintains option for alternative testing)
Uses loader cycle time for dozer assist with loader at cover stockpiles
Grade Factor = -0.02(Grade %) + 1
May filter on equipement (D14) to show pertinent rows

ID	Task Description	Source Location 1	Destination Location 2	Equipment	Type of Equipment to Assist	Number of Dozers per Assist	Loose /Stockpile Volume (cy)	Productivity (cy/hr)	Scraper Pusher Cycle Time (min)	Cycles per Scraper per Hr	Loader/Shovel/ Excavator Cycle Time (hr)	Total Task Time (hrs)	PERFORMANCE FACTORS Material Factor	Grade Factor	Material Weight (lb/cy)	Production Method/Blade	Centroid to Centroid Push Distance (ft)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Direct Drive Trans.
1001-A-a-Dz1	Grade-Top-Existing Ground	South Waste Rock Disposal Facility SWRDF-1	-	Cat D11T, U Blade	--	--	666,680	410	-	-	-	1,625.6	1.0	1.0	3,300	1.2	540	577	1.00	50	1.0	1.0	1.0
1002-A-a-Dz1	Grade-3:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-2	-	Cat D11T, U Blade	--	--	3,150,704	2,802	-	-	-	1,124.3	1.0	1.5	3,300	1.2	99	2,611	1.00	50	1.0	1.0	1.0
1003-A-a-Dz1	Grade-2.5:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-3	-	Cat D11T, U Blade	--	--	1,450,500	3,023	-	-	-	479.9	1.0	1.7	3,300	1.2	99	2,613	1.00	50	1.0	1.0	1.0
1004-A-a-Dz1	Grade-Laydown Yard N of SWRDF-Existing Ground	South Waste Rock Disposal Facility SWRDF-4	-	Cat D11T, U Blade	--	--	33,719	1,783	-	-	-	18.9	1.0	1.0	3,300	1.2	99	2,611	1.00	50	1.0	1.0	1.0
1101-A-a-Dz1	Grade-Top-Existing Ground	No. 3 Shaft Stockpile N3SS-1	-	Cat D11T, U Blade	--	--	5,826	2,898	-	-	-	2.0	1.0	1.0	3,300	1.2	60	4,077	1.00	50	1.0	1.0	1.0
1102-A-a-Dz1	Grade-Outslope-Existing Ground	No. 3 Shaft Stockpile N3SS-2	-	Cat D11T, U Blade	--	--	19,719	2,403	-	-	-	8.2	1.0	1.7	3,300	1.2	128	2,077	1.00	50	1.0	1.0	1.0
1201-A-a-Dz1	Grade-Top-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-1	-	Cat D11T, U Blade	--	--	8,988	1,981	-	-	-	4.5	1.0	1.0	3,300	1.2	92	2,787	1.00	50	1.0	1.0	1.0
1202-A-a-Dz1	Grade-Outslope-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-2	-	Cat D11T, U Blade	--	--	243,350	1,939	-	-	-	125.5	1.0	1.7	3,300	1.2	163	1,676	1.00	50	1.0	1.0	1.0
1301-A-a-Dz1	Grade-Top-Existing Ground	Main Tailings Impoundment MTI-1	-	Cat D11T, U Blade	--	--	50,795	1,125	-	-	-	45.1	1.0	1.0	2,900	1.2	200	1,396	1.00	50	1.0	1.0	1.0
1302-A-a-Dz1	Grade-Outslope-Existing Ground	Main Tailings Impoundment MTI-2	-	Cat D11T, U Blade	--	--	170,294	1,507	-	-	-	113.0	1.0	1.7	2,900	1.2	250	1,145	1.00	50	1.0	1.0	1.0
1303-A-a-Dz1	Grade-Reclaim Pond-Existing Ground	Main Tailings Impoundment MTI-3	-	Cat D11T, U Blade	--	--	67,765	1,616	-	-	-	41.9	1.0	1.7	3,300	1.2	200	1,396	1.00	50	1.0	1.0	1.0
1401-A-a-Dz1	Grade-Top-Existing Ground	Magnetite Tailings Impoundment MGTI-1	-	Cat D11T, U Blade	--	--	73,482	572	-	-	-	128.4	1.0	1.1	4,185	1.2	300	973	1.00	50	1.0	1.0	1.0
1402-A-a-Dz1	Grade-Outslope-Existing Ground	Magnetite Tailings Impoundment MGTI-2	-	Cat D11T, U Blade	--	--	69,996	1,044	-	-	-	67.0	1.0	1.7	4,185	1.2	250	1,145	1.00	50	1.0	1.0	1.0
1502-A-a-Dz1	Grade-Outslope-pushdown-Existing Ground	Cobre Haul Road CHR-2	-	Cat D11T, U Blade	--	--	27,893	706	-	-	-	39.5	1.0	0.2	3,300	1.2	47	5,066	1.00	50	1.0	1.0	1.0
1503-B-a-Dz1	Dozer Assist Grading-Outslope-pullback Ex Only 2.5:1-Existir	Cobre Haul Road CHR-3	-	Cat D11T, U Blade	Ex1	2	32,570	361	-	-	29.0	57.9	1.0	0.2	3,300	1.2	100	2,588	1.00	50	1.0	1.0	1.0
1504-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2.5:1-Existing	Cobre Haul Road CHR-4	-	Cat D11T, U Blade	Ld1	2	41,384	361	-	-	38.4	76.9	1.0	0.2	3,300	1.2	100	2,588	1.00	50	1.0	1.0	1.0
1505-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2:1-Existing G	Cobre Haul Road CHR-5	-	Cat D11T, U Blade	Ld1	2	77,571	-	-	-	72.1	144.1	1.0	-	3,300	1.2	100	2,588	1.00	50	1.0	1.0	1.0
1001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-1	Cat D11T, U Blade	Ld1	1	531,916	-	-	-	506.4	506.4	-	-	-	-	-	-	-	50	-	-	-
1002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-2	Cat D11T, U Blade	Ld1	1	1,237,104	-	-	-	1,177.7	1,177.7	-	-	-	-	-	-	-	50	-	-	-
1003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-3	Cat D11T, U Blade	Ld1	1	404,323	-	-	-	384.9	384.9	-	-	-	-	-	-	-	50	-	-	-
1004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-4	Cat D11T, U Blade	Ld1	1	101,156	-	-	-	96.3	96.3	-	-	-	-	-	-	-	50	-	-	-
1101-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-1	Cat D11T, U Blade	Ld1	1	6,292	-	-	-	5.8	5.8	-	-	-	-	-	-	-	50	-	-	-
1102-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-2	Cat D11T, U Blade	Ld1	1	21,296	-	-	-	19.8	19.8	-	-	-	-	-	-	-	50	-	-	-
1201-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-1	Cat D11T, U Blade	Ld1	1	26,964	-	-	-	25.3	25.3	-	-	-	-	-	-	-	50	-	-	-
1202-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-2	Cat D11T, U Blade	Ld1	1	107,733	-	-	-	100.9	100.9	-	-	-	-	-	-	-	50	-	-	-
1301-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-1	Cat D11T, U Blade	Ld1	1	523,688	-	-	-	620.9	620.9	-	-	-	-	-	-	-	50	-	-	-
1302-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-2	Cat D11T, U Blade	Ld1	1	175,837	-	-	-	208.5	208.5	-	-	-	-	-	-	-	50	-	-	-
1303-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-3	Cat D11T, U Blade	Ld1	1	159,720	-	-	-	189.4	189.4	-	-	-	-	-	-	-	50	-	-	-
1401-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-1	Cat D11T, U Blade	Ld1	1	276,616	-	-	-	290.3	290.3	-	-	-	-	-	-	-	50	-	-	-
1402-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-2	Cat D11T, U Blade	Ld1	1	25,739	-	-	-	27.0	27.0	-	-	-	-	-	-	-	50	-	-	-
1601-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	PB-1	Cat D11T, U Blade	Ld1	1	57,596	-	-	-	54.8	54.8	-	-	-	-	-	-	-	50	-	-	-
1700-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Cat D11T, U Blade	Ld1	1	451,572	-	-	-	518.3	518.3	-	-	-	-	-	-	-	50	-	-	-
2001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-02	Cat D11T, U Blade	Ld1	1	48	-	-	-	0.0	0.0	-	-	-	-	-	-	-	50	-	-	-
2002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-03	Cat D11T, U Blade	Ld1	1	3,001	-	-	-	2.8	2.8	-	-	-	-	-	-	-	50	-	-	-
2003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-04	Cat D11T, U Blade	Ld1	1	2,420	-	-	-	2.2	2.2	-	-	-	-	-	-	-	50	-	-	-
2004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-05	Cat D11T, U Blade	Ld1	1	1,839	-	-	-	1.7	1.7	-	-	-	-	-	-	-	50	-	-	-
2005-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-06	Cat D11T, U Blade	Ld1	1	968	-	-	-	1.0	1.0	-	-	-	-	-	-	-	50	-	-	-
2006-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-07	Cat D11T, U Blade	Ld1	1	2,226	-	-	-	2.1	2.1	-	-	-	-	-	-	-	50	-	-	-
2007-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-08	Cat D11T, U Blade	Ld1	1	2,517	-	-	-	2.4	2.4	-	-	-	-	-	-	-	50	-	-	-
2008-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-09	Cat D11T, U Blade	Ld1	1	1,646	-	-	-	1.6	1.6	-	-	-	-	-	-	-	50	-	-	-
2009-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-10	Cat D11T, U Blade	Ld1	1	4,066	-	-	-	3.9	3.9	-	-	-	-	-	-	-	50	-	-	-
2010-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-11	Cat D11T, U Blade	Ld1	1	7,405	-	-	-	7.0	7.0	-	-	-	-	-	-	-	50	-	-	-
3001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-1	Cat D11T, U Blade	Ld1	1	242,000	-	-	-	277.6	277.6	-	-	-	-	-	-	-	50	-	-	-
3004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-4	Cat D11T, U Blade	Ld1	1	6,999	-	-	-	8.1	8.1	-	-	-	-	-	-	-	50	-	-	-

Productivity and Hours Required for Dust Suppression and Road Maintenance

Notes and Assumptions:
6,000 gal water truck and 14M motor grader for dust suppression and site maintenance (water truck hours and 14M hours tied to loading time for cover material)
May filter on equipement (D14) to show pertinent rows

Sheet to which to tie hrs 10 Shovel
Equipment for hrs Ld1

ID	Task Description	Source Location 1	Destination Location 2	Equipment	Road Maintenance Time (hrs)
1001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	506
1002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	1,178
1003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-3	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	385
1004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-4	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	96
1101-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	6
1102-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	20
1201-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	25
1202-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	101
1301-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	621
1302-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	208
1303-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-3	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	189
1401-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	290
1402-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	27
1501-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	-
1502-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	-
1503-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-3	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	-
1505-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-5	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	72
1506-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-6	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	-
1507-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-7	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	-
1601-P-b-Comb1	Road Maintenance	North Overburden Stockpile	PB-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	55
2001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-02	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	0
2002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-03	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	3
2003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-04	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	2
2004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-05	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	2
2005-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-06	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	1
2006-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-07	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	2
2007-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-08	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	2
2008-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-09	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	2
2009-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-10	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	4
2010-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-11	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	7
3001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	278
3004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-4	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	8

Productivity and Hours Required for Ripper---Equipped Dozer Use

Notes and Assumptions:
Uses area to calculate task time
88 ft/min = 1 mph
May filter on equipement (D14) to show pertinent rows
Task time is less than 1 hour for areas smaller than productivity rate (ac/hr)

							PERFORMANCE FACTORS					
Task Description	**Source Location 1**	**Destination Location 2**	**Equipment**	**Area (ac)**	**Productivity (ac/hr)**	**Task Time (hrs)**	**Ripping Length (ft)**	**Ripper Penetration (in)**	**Pocket Spacing (in)**	**Distance b/n Passes (in)**	**Number of Shank Pockets**	**Turn Time (min/pass)**
Perforate Liner-Blackman's Seep (Pond #2) -Existing Ground	Containments Cntmnt-02	-	Cat D11T CD Multi-shank (w/ MSR-359H)	0.01	2.7	0.0	250	18	59	59	3	0.25
Perforate Liner-Decant Pond #4-Existing Ground	Containments Cntmnt-03	-	Cat D11T CD Multi-shank (w/ MSR-359H)	0.62	2.7	0.2	250	18	59	59	3	0.25
Perforate Liner-Grape Gulch Pond #3-Existing Ground	Containments Cntmnt-05	-	Cat D11T CD Multi-shank (w/ MSR-359H)	0.38	2.7	0.1	250	18	59	59	3	0.25
Perforate Liner-Magnetite Seepage Pond-Existing Ground	Containments Cntmnt-06	-	Cat D11T CD Multi-shank (w/ MSR-359H)	0.20	2.7	0.1	250	18	59	59	3	0.25
Perforate Liner-Upper Creek Containment Pond 1 -Existing Grour	Containments Cntmnt-11	-	Cat D11T CD Multi-shank (w/ MSR-359H)	1.53	2.7	0.6	250	18	59	59	3	0.25
Rip-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50.00	2.9	17.5	500	18	59	59	3	0.25
Rip-Top-Rough Graded Material	South Waste Rock Disposal Facility SWRDF-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	109.90	2.9	37.7	1,000	18	59	59	3	0.25
Rip-Top-Rough Graded Material	No. 3 Shaft Stockpile N3SS-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	1.30	2.9	0.4	1,000	18	59	59	3	0.25
Rip-Top-Rough Graded Material	Low Grade Ore Waste Rock Facility LGWRF-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	5.57	2.9	1.9	1,000	18	59	59	3	0.25
Rip-Top-Rough Graded Material	Main Tailings Impoundment MTI-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	108.20	2.9	37.1	1,000	18	59	59	3	0.25
Rip-Top-Rough Graded Material	Magnetite Tailings Impoundment MGTI-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	57.15	2.9	19.6	1,000	18	59	59	3	0.25
Rip-Cover Material	North Overburden Stockpile	5099	Cat D11T CD Multi-shank (w/ MSR-359H)	19.10	2.9	6.6	1,000	18	59	59	3	0.25

Productivity and Hours Required for Ripper---Equipped Dozer Use

Notes and Assumptions:
Uses area to calculate task time
88 ft/min = 1 mph
May filter on equipement (D14) to show pertinent rows
Task time is less than 1 hour for areas smaller than productivity rate (ac/hr)

Task Description	Source Location 1	Destination Location 2	Equipment	Work Hour (min/hr)	Speed (mph)	1000 Ft or 100 Ft Passes/Acre	Ripped Width Plus Distance b/n Passes (ft)
Perforate Liner-Blackman's Seep (Pond #2) -Existing Ground	Containments Cntmnt-02	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	5.9	30
Perforate Liner-Decant Pond #4-Existing Ground	Containments Cntmnt-03	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	5.9	30
Perforate Liner-Grape Gulch Pond #3-Existing Ground	Containments Cntmnt-05	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	5.9	30
Perforate Liner-Magnetite Seepage Pond-Existing Ground	Containments Cntmnt-06	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	5.9	30
Perforate Liner-Upper Creek Containment Pond 1 -Existing Grour	Containments Cntmnt-11	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	5.9	30
Rip-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	3.0	30
Rip-Top-Rough Graded Material	South Waste Rock Disposal Facility SWRDF-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	1.5	30
Rip-Top-Rough Graded Material	No. 3 Shaft Stockpile N3SS-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	1.5	30
Rip-Top-Rough Graded Material	Low Grade Ore Waste Rock Facility LGWRF-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	1.5	30
Rip-Top-Rough Graded Material	Main Tailings Impoundment MTI-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	1.5	30
Rip-Top-Rough Graded Material	Magnetite Tailings Impoundment MGTI-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	1.5	30
Rip-Cover Material	North Overburden Stockpile	5099	Cat D11T CD Multi-shank (w/ MSR-359H)	50	1.0	1.5	30

Productivity and Hours Required for Hydraulic Excavator

Notes and Assumptions:

Uses area to calculate time for perforating liners

3' sheepsfoot roller

Can be used for excavating and loading, or sheepsfoot compaction using a roller
May filter on equipement (D14) to show pertinent rows

5	6	7	8	9	10	11	12	13	14
ID	**Task Description**	**Source Location 1**	**Destination Location 2**	**Equipment**	**Area (ac) or Volume (lcy)**	**Sheepsfoot Roller Width (ft) or Bucket Capacity (cy)**	**Maximum Reach at Ground Level (ft)**	**Cycle Time (min)**	**Task Time (hr)**
1503-A-a-Ex1	Grade-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	Cat 319D L	32,570.3	3.0	31.7	0.16	28.95
1506-C-a-Ex1	Load-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	Cat 319D L	6,590.7	0.9	31.7	0.16	20.09
1507-C-a-Ex1	Load-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	Cat 319D L	1,075.2	0.9	31.7	0.16	3.28

Productivity and Hours Required for Truck Use

Notes and Assumptions:
Uses haul distance to calculate haul and return time (total task time includes loading, manuevering, dumping, hauling and return time) - moves from cover stockpile to destination stockpile
Volume of cover material based on area of destination
Cycles per truck = the greater of Heaped capacity or Struck capacity divided by Loader's per bucket capacity
1 mph = 88 ft/min
1 mi/min = 0.03728227153424 mph
See Truck Optimization optimum number of trucks per loader
Haul Grade (%) assumes postive is uphill while the Effective Haul Grade (%) and Effective Return Grade (%) are postive for downhill and uphill
May filter on equipement (D14) to show pertinent rows

PERFORMANCE FACTORS

5	6		7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
ID	**Task Description**	**Source Location 1**	**Destination Location 2**	**Equipment**	**Loading Equipment ID**	**Loose/Stockpile Volume (cy)**	**Truck Cycle Time (min)**	**Optimum Number of Trucks**	**Loader/Shovel/Excavator Net Bucket Capacity (cy)**	**Productivity (cy/hr)**	**Loader/Shovel/ Excavator Task Time(hrs)**	**Truck Task Time (hrs)**	**Struck Capacity (cy)**	**Heaped Capacity (cy)**	**Loader/Shovel Cycles per Truck**	**Total Haul Distance (ft)**	**Haul Distance Segment 1 (ft)**	**Haul Distance Segment 2 (ft)**	**Haul Distance Segment 3 (ft)**	**Haul Grade Segment 1 (%)**	**Haul Grade Segment 2 (%)**	**Haul Grade Segment 3 (%)**	**Rolling Resistance (%)**	**Haul Distance Segment 1 (meters)**	**Haul Distance Segment 2 (meters)**	**Haul Distance Segment 3 (meters)**
1304-D-a-Tk4	Haul-Reclaim Ponc	Main Tailings Impoundment MTI-4	-	Komatsu 730E	Ld1	71,560	9.3	1	14.0	755.3	66.4	94.7	101.0	145.0	10.0	1,172	1,172	-	-	0.9%	0.0%	0.0%	2.5%	357	-	-
1504-D-a-Tk3	Haul-Outslope-pull	Cobre Haul Road CHR-4	-	Cat 725	Ld1	41,384	6.5	10	14.0	1,076.6	38.4	38.4	14.3	18.8	1.0	2,640	2,640	-	-	7.0%	0.0%	0.0%	2.5%	805	-	-
1505-D-a-Tk3	Haul-Outslope-pull	Cobre Haul Road CHR-5	-	Cat 725	Ld1	77,571	6.5	10	14.0	1,076.6	72.0	72.1	14.3	18.8	1.0	2,640	2,640	-	-	7.0%	0.0%	0.0%	2.5%	805	-	-
1506-D-a-Tk3	Haul-Crossings - ex	Cobre Haul Road CHR-6	-	Cat 725	Ex1	6,591	13.3	4	0.9	277.1	20.1	23.8	14.3	18.8	21.0	5,280	5,280	-	-	7.0%	0.0%	0.0%	2.5%	1,609	-	-
1507-D-a-Tk3	Haul-Crossings - co	Cobre Haul Road CHR-7	-	Cat 725	Ex1	1,075	13.3	4	0.9	277.1	3.3	3.9	14.3	18.8	21.0	5,280	5,280	-	-	7.0%	0.0%	0.0%	2.5%	1,609	-	-
1001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-1	Komatsu 730E	Ld1	531,916	20.0	3	14.0	1,050.4	493.9	506.4	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
1002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-2	Komatsu 730E	Ld1	1,237,104	20.0	3	14.0	1,050.4	1,148.7	1,177.7	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
1003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-3	Komatsu 730E	Ld1	404,323	20.0	3	14.0	1,050.4	375.4	384.9	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
1004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-4	Komatsu 730E	Ld1	101,156	20.0	3	14.0	1,050.4	93.9	96.3	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
1101-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-1	Komatsu 730E	Ld1	6,292	11.4	2	14.0	1,224.3	5.8	5.8	101.0	145.0	10.0	4,243	1,357	1,443	1,443	-1.8%	-3.3%	-2.2%	2.5%	414	440	440
1102-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-2	Komatsu 730E	Ld1	21,296	11.4	2	14.0	1,224.3	19.8	19.8	101.0	145.0	10.0	4,243	1,357	1,443	1,443	-1.8%	-3.3%	-2.2%	2.5%	414	440	440
1201-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-1	Komatsu 730E	Ld1	26,964	13.1	2	14.0	1,067.5	25.0	25.3	101.0	145.0	10.0	7,620	2,310	2,310	3,000	-8.9%	-2.3%	0.0%	2.5%	704	704	914
1202-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-2	Komatsu 730E	Ld1	107,733	13.1	2	14.0	1,067.5	100.0	100.9	101.0	145.0	10.0	7,620	2,310	2,310	3,000	-8.9%	-2.3%	0.0%	2.5%	704	704	914
1301-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-1	Komatsu 730E	Ld1	523,688	16.6	2	14.0	843.4	486.3	620.9	101.0	145.0	10.0	7,563	2,310	2,310	2,943	-8.9%	1.6%	3.6%	2.5%	704	704	897
1302-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-2	Komatsu 730E	Ld1	175,837	16.6	2	14.0	843.4	163.3	208.5	101.0	145.0	10.0	7,563	2,310	2,310	2,943	-8.9%	1.6%	3.6%	2.5%	704	704	897
1303-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-3	Komatsu 730E	Ld1	159,720	16.6	2	14.0	843.4	148.3	189.4	101.0	145.0	10.0	7,563	2,310	2,310	2,943	-8.9%	1.6%	3.6%	2.5%	704	704	897
1401-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-1	Komatsu 730E	Ld1	276,616	14.7	2	14.0	953.0	256.9	290.3	101.0	145.0	10.0	6,190	2,310	1,940	1,940	-8.9%	1.5%	-4.0%	2.5%	704	591	591
1402-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-2	Komatsu 730E	Ld1	25,739	14.7	2	14.0	953.0	23.9	27.0	101.0	145.0	10.0	6,190	2,310	1,940	1,940	-8.9%	1.5%	-4.0%	2.5%	704	591	591
1601-D-b-Tk4	Haul-Cover	North Overburden Stockpile	PB-1	Komatsu 730E	Ld1	57,596	20.0	3	14.0	1,050.4	53.5	54.8	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
1700-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Komatsu 730E	Ld1	451,572	16.1	2	14.0	871.3	419.3	518.3	101.0	145.0	10.0	5,707	1,759	2,466	1,482	-9.9%	-8.1%	6.7%	2.5%	536	752	452
2001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-02	Komatsu 730E	Ld1	48	13.3	2	14.0	1,055.5	0.0	0.0	101.0	145.0	10.0	3,856	2,310	1,546	-	-8.9%	-7.8%	-	2.5%	704	471	-
2002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-03	Komatsu 730E	Ld1	3,001	12.7	2	14.0	1,101.5	2.8	2.8	101.0	145.0	10.0	4,110	2,310	1,800	-	-8.9%	-1.1%	-	2.5%	704	549	-
2003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-04	Komatsu 730E	Ld1	2,420	12.7	2	14.0	1,101.5	2.2	2.2	101.0	145.0	10.0	4,110	2,310	1,800	-	-8.9%	-1.1%	-	2.5%	704	549	-
2004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-05	Komatsu 730E	Ld1	1,839	13.3	2	14.0	1,055.5	1.7	1.7	101.0	145.0	10.0	3,856	2,310	1,546	-	-8.9%	-7.8%	-	2.5%	704	471	-
2005-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-06	Komatsu 730E	Ld1	968	14.9	2	14.0	937.6	0.9	1.0	101.0	145.0	10.0	6,480	2,310	1,940	2,230	-8.9%	1.6%	-4.0%	2.5%	704	591	680
2006-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-07	Komatsu 730E	Ld1	2,226	12.7	2	14.0	1,101.5	2.1	2.1	101.0	145.0	10.0	4,110	2,310	1,800	-	-8.9%	-1.1%	-	2.5%	704	549	-
2007-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-08	Komatsu 730E	Ld1	2,517	20.0	3	14.0	1,050.4	2.3	2.4	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
2008-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-09	Komatsu 730E	Ld1	1,646	20.0	3	14.0	1,050.4	1.5	1.6	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
2009-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-10	Komatsu 730E	Ld1	4,066	20.0	3	14.0	1,050.4	3.8	3.9	101.0	145.0	10.0	12,559	2,310	7,312	2,937	-8.9%	-1.0%	4.1%	2.5%	704	2,229	895
2010-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-11	Komatsu 730E	Ld1	7,405	13.3	2	14.0	1,055.4	6.9	7.0	101.0	145.0	10.0	3,856	2,310	1,546	-	-8.9%	-7.8%	-	2.5%	704	471	-
3001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-1	Komatsu 730E	Ld1	242,000	16.1	2	14.0	871.6	224.7	277.6	101.0	145.0	10.0	8,495	2,264	3,691	2,540	-7.5%	-2.2%	2.4%	2.5%	690	1,125	774
3004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-4	Komatsu 730E	Ld1	6,999	16.3	2	14.0	859.9	6.5	8.1	101.0	145.0	10.0	7,193	2,310	1,940	2,943	-8.9%	1.6%	3.6%	2.5%	704	591	897

d Hours Required for Truck Use

ptions:
to calculate haul and return time (total task time includes loading, manuevering, dumping, hauling and return time) - moves f
aterial based on area of destination
he greater of Heaped capacity or Struck capacity divided by Loader's per bucket capacity

227153424 mph
ition optimum number of trucks per loader
umes postive is uphill while the Effective Haul Grade (%) and Effective Return Grade (%) are postive for downhill and uphill
ment (D14) to show pertinent rows

6		7	8	9	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49
Task Description	**Source Location 1**	**Destination Location 2**	**Equipment**	**Effective Haul Grade Segment 1 (%)**	**Effective Haul Grade Segment 2 (%)**	**Effective Haul Grade Segment 3 (%)**	**Effective Return Grade Segment 1 (%)**	**Effective Return Grade Segment 2 (%)**	**Effective Return Grade Segment 3 (%)**	**Haul Time (min)**	**Return Time (min)**	**Loading Time (min)**	**Truck Exchange Time (min)**	**Dump/Maneuver Time (min)**	**Work Hour (min/hr)**	**Travel Time Loaded Segment 1 (min/m)**	**Travel Time Loaded Segment 2 (min/m)**	**Travel Time Loaded Segment 3 (min/m)**	**Travel Time Empty Segment 1 (min/m)**	**Travel Time Empty Segment 2 (min/m)**	**Travel Time Empty Segment 3 (min/m)**
Haul-Reclaim Ponc	Main Tailings Impoundment MTI-4	-	Komatsu 730E	3.4%	2.5%	2.5%	1.6%	2.5%	2.5%	0.6	0.4	6.50	0.7	1.1	50	0.00166	-	-	0.00105	-	-
Haul-Outslope-pull	Cobre Haul Road CHR-4	-	Cat 725	9.5%	2.5%	2.5%	4.5%	2.5%	2.5%	3.2	0.9	0.65	0.7	1.1	50	0.00394	-	-	0.00110	-	-
Haul-Outslope-pull	Cobre Haul Road CHR-5	-	Cat 725	9.5%	2.5%	2.5%	4.5%	2.5%	2.5%	3.2	0.9	0.65	0.7	1.1	50	0.00394	-	-	0.00110	-	-
Haul-Crossings - ex	Cobre Haul Road CHR-6	-	Cat 725	9.5%	2.5%	2.5%	4.5%	2.5%	2.5%	6.3	1.8	3.36	0.7	1.1	50	0.00394	-	-	0.00110	-	-
Haul-Crossings - cc	Cobre Haul Road CHR-7	-	Cat 725	9.5%	2.5%	2.5%	4.5%	2.5%	2.5%	6.3	1.8	3.36	0.7	1.1	50	0.00394	-	-	0.00110	-	-
Haul-Cover	North Overburden Stockpile	SWRDF-1	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	SWRDF-2	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	SWRDF-3	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	SWRDF-4	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	N3SS-1	Komatsu 730E	0.7%	0.8%	0.3%	4.3%	5.8%	4.7%	1.4	1.8	6.50	0.7	1.1	50	0.00105	0.00105	0.00105	0.00131	0.00146	0.00135
Haul-Cover	North Overburden Stockpile	N3SS-2	Komatsu 730E	0.7%	0.8%	0.3%	4.3%	5.8%	4.7%	1.4	1.8	6.50	0.7	1.1	50	0.00105	0.00105	0.00105	0.00131	0.00146	0.00135
Haul-Cover	North Overburden Stockpile	LGWRF-1	Komatsu 730E	6.4%	0.2%	2.5%	11.4%	4.8%	2.5%	2.4	2.5	6.50	0.7	1.1	50	0.00229	0.00105	-	0.00214	0.00136	-
Haul-Cover	North Overburden Stockpile	LGWRF-2	Komatsu 730E	6.4%	0.2%	2.5%	11.4%	4.8%	2.5%	2.4	2.5	6.50	0.7	1.1	50	0.00229	0.00105	-	0.00214	0.00136	-
Haul-Cover	North Overburden Stockpile	MTI-1	Komatsu 730E	6.4%	4.1%	6.1%	11.4%	0.9%	1.1%	5.1	3.2	6.50	0.7	1.1	50	0.00228	0.00185	0.00246	0.00214	0.00105	0.00105
Haul-Cover	North Overburden Stockpile	MTI-2	Komatsu 730E	6.4%	4.1%	6.1%	11.4%	0.9%	1.1%	5.1	3.2	6.50	0.7	1.1	50	0.00228	0.00185	0.00246	0.00214	0.00105	0.00105
Haul-Cover	North Overburden Stockpile	MTI-3	Komatsu 730E	6.4%	4.1%	6.1%	11.4%	0.9%	1.1%	5.1	3.2	6.50	0.7	1.1	50	0.00228	0.00185	0.00246	0.00214	0.00105	0.00105
Haul-Cover	North Overburden Stockpile	MGTI-1	Komatsu 730E	6.4%	4.0%	1.5%	11.4%	1.0%	6.5%	3.4	3.0	6.50	0.7	1.1	50	0.00229	0.00182	0.00113	0.00214	0.00105	0.00153
Haul-Cover	North Overburden Stockpile	MGTI-2	Komatsu 730E	6.4%	4.0%	1.5%	11.4%	1.0%	6.5%	3.4	3.0	6.50	0.7	1.1	50	0.00229	0.00182	0.00113	0.00214	0.00105	0.00153
Haul-Cover	North Overburden Stockpile	PB-1	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Komatsu 730E	7.4%	5.6%	9.2%	12.4%	10.6%	4.2%	4.5	3.2	6.50	0.7	1.1	50	0.00261	0.00205	0.00355	0.00228	0.00203	0.00105
Haul-Cover	North Overburden Stockpile	Cntmnt-02	Komatsu 730E	6.4%	5.3%	2.5%	11.4%	10.3%	2.5%	2.5	2.4	6.50	0.7	1.1	50	0.00228	0.00195	-	0.00214	0.00199	-
Haul-Cover	North Overburden Stockpile	Cntmnt-03	Komatsu 730E	6.4%	1.4%	2.5%	11.4%	3.6%	2.5%	2.2	2.2	6.50	0.7	1.1	50	0.00228	0.00112	-	0.00214	0.00125	-
Haul-Cover	North Overburden Stockpile	Cntmnt-04	Komatsu 730E	6.4%	1.4%	2.5%	11.4%	3.6%	2.5%	2.2	2.2	6.50	0.7	1.1	50	0.00228	0.00112	-	0.00214	0.00125	-
Haul-Cover	North Overburden Stockpile	Cntmnt-05	Komatsu 730E	6.4%	5.3%	2.5%	11.4%	10.3%	2.5%	2.5	2.4	6.50	0.7	1.1	50	0.00228	0.00195	-	0.00214	0.00199	-
Haul-Cover	North Overburden Stockpile	Cntmnt-06	Komatsu 730E	6.4%	4.1%	1.5%	11.4%	1.0%	6.5%	3.5	3.2	6.50	0.7	1.1	50	0.00228	0.00183	0.00114	0.00214	0.00105	0.00154
Haul-Cover	North Overburden Stockpile	Cntmnt-07	Komatsu 730E	6.4%	1.4%	2.5%	11.4%	3.6%	2.5%	2.2	2.2	6.50	0.7	1.1	50	0.00228	0.00112	-	0.00214	0.00125	-
Haul-Cover	North Overburden Stockpile	Cntmnt-08	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	Cntmnt-09	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	Cntmnt-10	Komatsu 730E	6.4%	1.5%	6.6%	11.4%	3.5%	1.6%	6.5	5.2	6.50	0.7	1.1	50	0.00228	0.00114	0.00262	0.00214	0.00124	0.00105
Haul-Cover	North Overburden Stockpile	Cntmnt-11	Komatsu 730E	6.4%	5.3%	2.5%	11.4%	10.3%	2.5%	2.5	2.4	6.50	0.7	1.1	50	0.00228	0.00195	-	0.00214	0.00199	-
Haul-Cover	North Overburden Stockpile	Misc-1	Komatsu 730E	5.0%	0.3%	4.9%	10.0%	4.7%	0.1%	4.1	3.7	6.50	0.7	1.1	50	0.00187	0.00105	0.00208	0.00195	0.00135	0.00105
Haul-Cover	North Overburden Stockpile	Misc-4	Komatsu 730E	6.4%	4.1%	6.1%	11.4%	0.9%	1.1%	4.9	3.1	6.50	0.7	1.1	50	0.00229	0.00185	0.00246	0.00214	0.00105	0.00105

Productivity and Hours Required for Front End Loader Use or Hydraulic Shovel Use

Assumptions:
Uses cover volume to calculate loading time of cover material
May filter on equipement (D14) to show pertinent rows

											PERFORMANCE FACTORS	
5	6	7	8	9	10	11	12	13	14	15	16	17
ID	**Task Description**	**Source Location 1**	**Destination Location 2**	**Equipment**	**Loaded Truck ID**	**Loose/Stockpile Volume (cy)**	**Loader/Shovel Cycle Time (min)**	**Per Loader/Shovel Productivity (cy/hr)**	**Loader/Shovel Task Time (hrs)**	**Max of Loader/Shovel or Truck Task Time (hrs)**	**Net Bucket Capacity (cy)**	**Work Hour (min/hr)**
1304-C-a-Ld1	Load-Reclaim Pond Outle	Main Tailings Impoundment MTI-4	-	Cat 992K	Tk4	71,560	0.65	1,076.9	66.4	94.7	14.0	50
1504-C-a-Ld1	Load-Outslope-pullback L	Cobre Haul Road CHR-4	-	Cat 992K	Tk3	41,384	0.65	1,076.9	38.4	38.4	14.0	50
1505-C-a-Ld1	Load-Outslope-pullback L	Cobre Haul Road CHR-5	-	Cat 992K	Tk3	77,571	0.65	1,076.9	72.0	72.1	14.0	50
1001-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-1	Cat 992K	Tk4	531,916	0.65	1,076.9	493.9	506.4	14.0	50
1002-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-2	Cat 992K	Tk4	1,237,104	0.65	1,076.9	1,148.7	1,177.7	14.0	50
1003-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-3	Cat 992K	Tk4	404,323	0.65	1,076.9	375.4	384.9	14.0	50
1004-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-4	Cat 992K	Tk4	101,156	0.65	1,076.9	93.9	96.3	14.0	50
1101-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-1	Cat 992K	Tk4	6,292	0.65	1,076.9	5.8	5.8	14.0	50
1102-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-2	Cat 992K	Tk4	21,296	0.65	1,076.9	19.8	19.8	14.0	50
1201-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-1	Cat 992K	Tk4	26,964	0.65	1,076.9	25.0	25.3	14.0	50
1202-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-2	Cat 992K	Tk4	107,733	0.65	1,076.9	100.0	100.9	14.0	50
1301-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-1	Cat 992K	Tk4	523,688	0.65	1,076.9	486.3	620.9	14.0	50
1302-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-2	Cat 992K	Tk4	175,837	0.65	1,076.9	163.3	208.5	14.0	50
1303-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-3	Cat 992K	Tk4	159,720	0.65	1,076.9	148.3	189.4	14.0	50
1401-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-1	Cat 992K	Tk4	276,616	0.65	1,076.9	256.9	290.3	14.0	50
1402-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-2	Cat 992K	Tk4	25,739	0.65	1,076.9	23.9	27.0	14.0	50
1601-C-b-Ld1	Load-Cover	North Overburden Stockpile	PB-1	Cat 992K	Tk4	57,596	0.65	1,076.9	53.5	54.8	14.0	50
1700-C-b-Ld1	Load-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Cat 992K	Tk4	451,572	0.65	1,076.9	419.3	518.3	14.0	50
2001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-02	Cat 992K	Tk4	48	0.65	1,076.9	0.0	0.0	14.0	50
2002-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-03	Cat 992K	Tk4	3,001	0.65	1,076.9	2.8	2.8	14.0	50
2003-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-04	Cat 992K	Tk4	2,420	0.65	1,076.9	2.2	2.2	14.0	50
2004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-05	Cat 992K	Tk4	1,839	0.65	1,076.9	1.7	1.7	14.0	50
2005-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-06	Cat 992K	Tk4	968	0.65	1,076.9	0.9	1.0	14.0	50
2006-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-07	Cat 992K	Tk4	2,226	0.65	1,076.9	2.1	2.1	14.0	50
2007-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-08	Cat 992K	Tk4	2,517	0.65	1,076.9	2.3	2.4	14.0	50
2008-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-09	Cat 992K	Tk4	1,646	0.65	1,076.9	1.5	1.6	14.0	50
2009-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-10	Cat 992K	Tk4	4,066	0.65	1,076.9	3.8	3.9	14.0	50
2010-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-11	Cat 992K	Tk4	7,405	0.65	1,076.9	6.9	7.0	14.0	50
3001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-1	Cat 992K	Tk4	242,000	0.65	1,076.9	224.7	277.6	14.0	50
3004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-4	Cat 992K	Tk4	6,999	0.65	1,076.9	6.5	8.1	14.0	50

Productivity for Scrapers

Notes and Assumptions:
No Scrapers used in Continental RCE

Productivity and Hours Required for Motorgrader Use---Grading

Notes and Assumptions:
Productivity (based on area of overall stockpile) = Sq.ft per hour = Speed x (Eff. Blade L -Blade Overlap) x Efficiency (*Cat. Handbook Edition 47* pg 11-27)
Max. safe slope for motor graders is 2:1 (50%), proposed final grade for Continental cover grading on stockpiles is 33%, therefore use of graders an option (Cat. Handbook Edition 46 pg 11-30)
Grade Factor = -0.02(Grade %) + 1
May filter on equipement (D14) to show pertinent rows

ID	Task Description	Source Location 1	Destination Location 2	Grading Equipment	Area (ac)	Grading Shaping Productivity (ac/hr)	Task Time (hrs)	Grade Factor	Material Factor	Material Weight (lb/cy)	Production Method/Blade	Effective Blade Width (ft)	Pass Overlap (ft)	Speed (mph)	Work Hour (min/hr)	Operator Factor
1001-A-d-Mg1	Grade-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	Cat 16M	110	3	35.6	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1002-A-d-Mg1	Grade-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	Cat 16M	256	5	54.8	1.5	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1003-A-d-Mg1	Grade-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	Cat 16M	84	5	16.6	1.7	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1004-A-d-Mg1	Grade-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	Cat 16M	21	3	7.0	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1101-A-d-Mg1	Grade-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	Cat 16M	1	3	0.4	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1102-A-d-Mg1	Grade-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	Cat 16M	4	5	0.9	1.7	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1201-A-d-Mg1	Grade-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	Cat 16M	6	3	1.8	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1202-A-d-Mg1	Grade-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	Cat 16M	22	5	4.4	1.7	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1301-A-d-Mg1	Grade-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	Cat 16M	108	3	35.2	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1302-A-d-Mg1	Grade-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	Cat 16M	36	5	7.2	1.7	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1303-A-d-Mg1	Grade-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	Cat 16M	33	5	6.6	1.7	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1401-A-d-Mg1	Grade-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	Cat 16M	57	3	17.6	1.1	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1402-A-d-Mg1	Grade-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	Cat 16M	5	5	1.1	1.7	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1601-A-d-Mg1	Grade-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	Cat 16M	12	3	3.9	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
1700-A-d-Mg1	Grade-Top-Placed Cover	Hanover Mountain Deposit	-	Cat 16M	93	3	30.8	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2001-A-d-Mg1	Grade-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	Cat 16M	0	3	0.0	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2002-A-d-Mg1	Grade-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	Cat 16M	1	3	0.2	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2003-A-d-Mg1	Grade-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	Cat 16M	1	3	0.2	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2004-A-d-Mg1	Grade-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	Cat 16M	0	3	0.1	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2005-A-d-Mg1	Grade-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	Cat 16M	0	3	0.1	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2006-A-d-Mg1	Grade-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	Cat 16M	0	3	0.2	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2007-A-d-Mg1	Grade-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	Cat 16M	1	3	0.2	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2008-A-d-Mg1	Grade-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	Cat 16M	0	3	0.1	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2009-A-d-Mg1	Grade-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	Cat 16M	1	3	0.3	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
2010-A-d-Mg1	Grade-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	Cat 16M	2	3	0.5	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
3001-A-d-Mg1	Grade-Unplanned Future Disturbance Areas-Placed Cov	Miscellaneous Misc-1	-	Cat 16M	50	3	16.5	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75
3004-A-d-Mg1	Grade-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	Cat 16M	1	3	0.5	1.0	1.2	2,900	1.20	16.00	2.00	2.50	50	0.75

Summary Calculation of Earthmoving Costs

Summarizes all earthmoving quantities and costs

Summarizes costs for line items involving earthworks

Notes and Assumptions:
Productivity (based on area of overall stockpile) = Sq.ft per hour = Speed x (Eff. Blade L -Blade Overlap) x Efficiency (*Cat. Handbook Edition 47* pg 11-27)
Max. safe slope for motor graders is 2:1 (50%), proposed final grade for Continental cover grading on stockpiles is 33%, therefore use of graders an option (Cat. Handbook Edition 46 pg 11-30)
Grade Factor = -0.02(Grade %) + 1
May filter on equipement (D14) to show pertinent rows

ID	Description	Source Location 1	Destination Location 2	Equipment	Fuel Cost ($/hr)	Lube, Tires, GEC, & Field Parts Adjusted Rental Cost (w/o fuel)	Labor Cost ($/hr)	Number of Units (Equipment)	Time Req'd (hrs)	Direct Fuel Cost ($)	Direct Lube, Tires, GEC, & Field Parts Adjusted Rental Cost (w/o fuel) ($)	Direct Labor Cost ($)	Total Equipment Cost ($)	Total Production Volume (CY)	Total Production Area (AC)
2001-K-a-Rp1	Perforate Liner-Blackman's Seep (Pond #2) -Existing Ground	Containments Cntmnt-02	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	0.0	$0	$1	$0	$1	-	0.0
2002-K-a-Rp1	Perforate Liner-Decant Pond #4-Existing Ground	Containments Cntmnt-03	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	0.2	$16	$59	$6	$81	-	0.6
2004-K-a-Rp1	Perforate Liner-Grape Gulch Pond #3-Existing Ground	Containments Cntmnt-05	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	0.1	$10	$36	$4	$49	-	0.4
2005-K-a-Rp1	Perforate Liner-Magnetite Seepage Pond-Existing Ground	Containments Cntmnt-06	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	0.1	$5	$19	$2	$26	-	0.2
2010-K-a-Rp1	Perforate Liner-Upper Creek Containment Pond 1 -Existing Ground	Containments Cntmnt-11	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	0.6	$39	$145	$15	$199	-	1.5
1001-A-a-Dz1	Grade-Top-Existing Ground	South Waste Rock Disposal Facility SWRDF-1	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	1,625.6	$113,165	$413,616	$44,557	$571,338	666,680	-
1002-A-a-Dz1	Grade-3:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-2	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	1,124.3	$78,271	$286,080	$30,818	$395,169	3,150,704	-
1003-A-a-Dz1	Grade-2.5:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-3	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	479.9	$33,405	$122,095	$13,153	$168,653	1,450,500	-
1004-A-a-Dz1	Grade-Laydown Yard N of SWRDF-Existing Ground	South Waste Rock Disposal Facility SWRDF-4	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	18.9	$1,316	$4,811	$518	$6,646	33,719	-
1101-A-a-Dz1	Grade-Top-Existing Ground	No. 3 Shaft Stockpile N3SS-1	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	2.0	$140	$511	$55	$706	5,826	-
1102-A-a-Dz1	Grade-Outslope-Existing Ground	No. 3 Shaft Stockpile N3SS-2	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	8.2	$571	$2,088	$225	$2,884	19,719	-
1201-A-a-Dz1	Grade-Top-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-1	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	4.5	$316	$1,154	$124	$1,594	8,988	-
1202-A-a-Dz1	Grade-Outslope-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-2	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	125.5	$8,736	$31,931	$3,440	$44,107	243,350	-
1301-A-a-Dz1	Grade-Top-Existing Ground	Main Tailings Impoundment MTI-1	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	45.1	$3,143	$11,487	$1,237	$15,867	50,795	-
1302-A-a-Dz1	Grade-Outslope-Existing Ground	Main Tailings Impoundment MTI-2	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	113.0	$7,865	$28,748	$3,097	$39,710	170,294	-
1303-A-a-Dz1	Grade-Reclaim Pond-Existing Ground	Main Tailings Impoundment MTI-3	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	41.9	$2,920	$10,673	$1,150	$14,743	67,765	-
1304-E-a-Rp1	Rip-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	17.5	$1,220	$4,543	$480	$6,243	-	50.0
1304-C-a-Ld1	Load-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	Cat 992K	$59.97	$216.23	$27.70	1	94.7	$5,682	$20,487	$2,624	$28,794	71,560	-
1304-D-a-Tk4	Haul-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	Komatsu 730E	$78.34	$221.79	$24.27	1	94.7	$7,423	$21,014	$2,300	$30,736	71,560	-
1401-A-a-Dz1	Grade-Top-Existing Ground	Magnetite Tailings Impoundment MGTI-1	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	128.4	$8,937	$32,664	$3,519	$45,120	73,482	-
1402-A-a-Dz1	Grade-Outslope-Existing Ground	Magnetite Tailings Impoundment MGTI-2	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	67.0	$4,665	$17,052	$1,837	$23,555	69,996	-
1502-A-a-Dz1	Grade-Outslope-pushdown-Existing Ground	Cobre Haul Road CHR-2	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	39.5	$2,749	$10,049	$1,083	$13,881	27,893	-
1503-A-a-Ex1	Grade-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	Cat 319D L	$12.29	$52.38	$27.70	1	29.0	$356	$1,516	$802	$2,674	-	-
1503-B-a-Dz1	Dozer Assist Grading-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	57.9	$4,031	$14,733	$1,587	$20,351	32,570	-
1504-C-a-Ld1	Load-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	Cat 992K	$59.97	$216.23	$27.70	1	38.4	$2,305	$8,312	$1,065	$11,682	41,384	-
1504-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	76.9	$5,352	$19,562	$2,107	$27,022	41,384	-
1504-D-a-Tk3	Haul-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	Cat 725	$14.09	$73.11	$24.27	10	38.4	$5,415	$28,106	$9,330	$42,851	41,384	-
1505-C-a-Ld1	Load-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	Cat 992K	$59.97	$216.23	$27.70	1	72.1	$4,321	$15,580	$1,996	$21,898	77,571	-
1505-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	144.1	$10,032	$36,668	$3,950	$50,650	77,571	-
1505-D-a-Tk3	Haul-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	Cat 725	$14.09	$73.11	$24.27	10	72.1	$10,150	$52,682	$17,488	$80,320	77,571	-
1506-C-a-Ex1	Load-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	Cat 319D L	$12.29	$52.38	$27.70	1	20.1	$247	$1,052	$556	$1,855	-	-
1506-D-a-Tk3	Haul-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	Cat 725	$14.09	$73.11	$24.27	4	23.8	$1,340	$6,957	$2,309	$10,607	6,591	-
1507-C-a-Ex1	Load-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	Cat 319D L	$12.29	$52.38	$27.70	1	3.3	$40	$172	$91	$303	-	-
1507-D-a-Tk3	Haul-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	Cat 725	$14.09	$73.11	$24.27	4	3.9	$219	$1,135	$377	$1,730	1,075	-
1001-E-c-Rp1	Rip-Top-Rough Graded Material	South Waste Rock Disposal Facility SWRDF-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	37.7	$2,624	$9,776	$1,033	$13,433	-	109.9
1101-E-c-Rp1	Rip-Top-Rough Graded Material	No. 3 Shaft Stockpile N3SS-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	0.4	$31	$116	$12	$159	-	1.3
1201-E-c-Rp1	Rip-Top-Rough Graded Material	Low Grade Ore Waste Rock Facility LGWRF-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	1.9	$133	$496	$52	$681	-	5.6
1301-E-c-Rp1	Rip-Top-Rough Graded Material	Main Tailings Impoundment MTI-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	37.1	$2,583	$9,624	$1,017	$13,225	-	108.2
1401-E-c-Rp1	Rip-Top-Rough Graded Material	Magnetite Tailings Impoundment MGTI-1	-	Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	19.6	$1,365	$5,084	$537	$6,986	-	57.2
1001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-1	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	506.4	$35,251	$128,842	$13,880	$177,973	531,916	-
1002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-2	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	1,177.7	$81,985	$299,656	$32,281	$413,921	1,237,104	-
1003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-3	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	384.9	$26,795	$97,937	$10,550	$135,282	404,323	-
1004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-4	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	96.3	$6,704	$24,502	$2,640	$33,846	101,156	-
1101-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-1	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	5.8	$407	$1,487	$160	$2,053	6,292	-
1102-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-2	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	19.8	$1,377	$5,032	$542	$6,950	21,296	-
1201-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-1	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	25.3	$1,758	$6,427	$692	$8,878	26,964	-
1202-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-2	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	100.9	$7,026	$25,678	$2,766	$35,470	107,733	-
1301-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-1	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	620.9	$43,224	$157,985	$17,019	$218,229	523,688	-
1302-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-2	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	208.5	$14,513	$53,046	$5,714	$73,274	175,837	-
1303-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-3	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	189.4	$13,183	$48,184	$5,191	$66,558	159,720	-
1401-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-1	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	290.3	$20,207	$73,856	$7,956	$102,018	276,616	-
1402-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-2	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	27.0	$1,880	$6,872	$740	$9,493	25,739	-
1601-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	PB-1	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	54.8	$3,817	$13,951	$1,503	$19,271	57,596	-
1700-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	518.3	$36,079	$131,869	$14,206	$182,154	451,572	-
2001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-02	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	0.0	$3	$12	$1	$16	48	-
2002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-03	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	2.8	$194	$709	$76	$979	3,001	-
2003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-04	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	2.2	$156	$572	$62	$790	2,420	-
2004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-05	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	1.7	$121	$443	$48	$612	1,839	-
2005-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-06	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	1.0	$72	$263	$28	$363	968	-
2006-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-07	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	2.1	$144	$526	$57	$727	2,226	-
2007-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-08	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	2.4	$167	$610	$66	$842	2,517	-
2008-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-09	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	1.6	$109	$399	$43	$551	1,646	-
2009-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-10	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	3.9	$269	$985	$106	$1,360	4,066	-
2010-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-11	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	7.0	$488	$1,785	$192	$2,466	7,405	-
3001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-1	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	277.6	$19,328	$70,643	$7,610	$97,581	242,000	-
3004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-4	Cat D11T, U Blade	$69.62	$254.44	$27.41	1	8.1	$567	$2,071	$223	$2,861	6,999	-
1001-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-1	Cat 992K	$59.97	$216.23	$27.70	1	506.4	$30,369	$109,490	$14,027	$153,886	531,916	-
1002-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-2	Cat 992K	$59.97	$216.23	$27.70	1	1,177.7	$70,631	$254,648	$32,622	$357,901	1,237,104	-
1003-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-3	Cat 992K	$59.97	$216.23	$27.70	1	384.9	$23,084	$83,227	$10,662	$116,973	404,323	-
1004-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-4	Cat 992K	$59.97	$216.23	$27.70	1	96.3	$5,775	$20,822	$2,667	$29,265	101,156	-
1101-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-1	Cat 992K	$59.97	$216.23	$27.70	1	5.8	$350	$1,263	$162	$1,776	6,292	-
1102-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-2	Cat 992K	$59.97	$216.23	$27.70	1	19.8	$1,186	$4,276	$548	$6,010	21,296	-
1201-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-1	Cat 992K	$59.97	$216.23	$27.70	1	25.3	$1,515	$5,462	$700	$7,676	26,964	-
1202-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-2	Cat 992K	$59.97	$216.23	$27.70	1	100.9	$6,053	$21,821	$2,795	$30,669	107,733	-
1301-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-1	Cat 992K	$59.97	$216.23	$27.70	1	620.9	$37,238	$134,256	$17,199	$188,693	523,688	-
1302-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-2	Cat 992K	$59.97	$216.23	$27.70	1	208.5	$12,503	$45,079	$5,775	$63,357	175,837	-
1303-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-3	Cat 992K	$59.97	$216.23	$27.70	1	189.4	$11,357	$40,947	$5,246	$57,550	159,720	-
1401-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-1	Cat 992K	$59.97	$216.23	$27.70	1	290.3	$17,408	$62,762	$8,040	$88,211	276,616	-
1402-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-2	Cat 992K	$59.97	$216.23	$27.70	1	27.0	$1,620	$5,840	$748	$8,208	25,739	-
1601-C-b-Ld1	Load-Cover	North Overburden Stockpile	PB-1	Cat 992K	$59.97	$216.23	$27.70	1	54.8	$3,288	$11,856	$1,519	$16,663	57,596	-
1700-C-b-Ld1	Load-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Cat 992K	$59.97	$216.23	$27.70	1	518.3	$31,083	$112,063	$14,356	$157,501	451,572	-
2001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-02	Cat 992K	$59.97	$216.23	$27.70	1	0.0	$3	$10	$1	$14	48	-
2002-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-03	Cat 992K	$59.97	$216.23	$27.70	1	2.8	$167	$603	$77	$847	3,001	-
2003-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-04	Cat 992K	$59.97	$216.23	$27.70	1	2.2	$135	$486	$62	$683	2,420	-
2004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-05	Cat 992K	$59.97	$216.23	$27.70	1	1.7	$105	$377	$48	$530	1,839	-
2005-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-06	Cat 992K	$59.97	$216.23	$27.70	1	1.0	$62	$223	$29	$314	968	-
2006-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-07	Cat 992K	$59.97	$216.23	$27.70	1	2.1	$124	$447	$57	$628	2,226	-
2007-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-08	Cat 992K	$59.97	$216.23	$27.70	1	2.4	$144	$518	$66	$728	2,517	-
2008-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-09	Cat 992K	$59.97	$216.23	$27.70	1	1.6	$94	$339	$43	$476	1,646	-
2009-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-10	Cat 992K	$59.97	$216.23	$27.70	1	3.9	$232	$837	$107	$1,176	4,066	-
2010-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-11	Cat 992K	$59.97	$216.23	$27.70	1	7.0	$421	$1,517	$194	$2,132	7,405	-
3001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-1	Cat 992K	$59.97	$216.23	$27.70	1	277.6	$16,651	$60,033	$7,691	$84,374	242,000	-
3004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-4	Cat 992K	$59.97	$216.23	$27.70	1	8.1	$488	$1,760	$225	$2,474	6,999	-
1001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-1	Komatsu 730E	$78.34	$221.79	$24.27	3	506.4	$119,012	$336,926	$36,869	$492,808	531,916	-
1002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-2	Komatsu 730E	$78.34	$221.79	$24.27	3	1,177.7	$276,793	$783,607	$85,748	$1,146,148	1,237,104	-
1003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-3	Komatsu 730E	$78.34	$221.79	$24.27	3	384.9	$90,464	$256,107	$28,025	$374,596	404,323	-
1004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-4	Komatsu 730E	$78.34	$221.79	$24.27	3	96.3	$22,633	$64,074	$7,011	$93,719	101,156	-
1101-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-1	Komatsu 730E	$78.34	$221.79	$24.27	2	5.8	$915	$2,592	$284	$3,791	6,292	-
1102-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-2	Komatsu 730E	$78.34	$221.79	$24.27	2	19.8	$3,098	$8,772	$960	$12,830	21,296	-
1201-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-1	Komatsu 730E	$78.34	$221.79	$24.27	2	25.3	$3,958	$11,204	$1,226	$16,388	26,964	-
1202-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-2	Komatsu 730E	$78.34	$221.79	$24.27	2	100.9	$15,813	$44,766	$4,899	$65,478	107,733	-

Summary Calculation of Earthmoving Costs

Summarizes all earthmoving quantities and costs

Summarizes costs for line items involving earthworks

Notes and Assumptions:
Productivity (based on area of overall stockpile) = Sq.ft per hour = Speed x (Eff. Blade L -Blade Overlap) x Efficiency (*Cat. Handbook Edition 47* pg 11-27)
Max. safe slope for motor graders is 2:1 (50%), proposed final grade for Continental cover grading on stockpiles is 33%, therefore use of graders an option (Cat. Handbook Edition 46 pg 11-30)
Grade Factor = -0.02(Grade %) + 1
May filter on equipment (D14) to show pertinent rows

ID	Description	Source Location 1	Destination Location 2	Equipment	Fuel Cost ($/hr)	Lube, Tires, GEC, & Field Parts Adjusted Rental Cost (w/o fuel)	Labor Cost ($/hr)	Number of Units (Equipment)	Time Req'd (hrs)	Direct Fuel Cost ($)	Direct Lube, Tires, GEC, & Field Parts Adjusted Rental Cost (w/o fuel) ($)	Direct Labor Cost ($)	Total Equipment Cost ($)	Total Production Volume (CY)	Total Production Area (AC)
1301-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-1	Komatsu 730E	$78.34	$221.79	$24.27	2	620.9	$97,288	$275,423	$30,139	$402,850	523,688	-
1302-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-2	Komatsu 730E	$78.34	$221.79	$24.27	2	208.5	$32,666	$92,478	$10,120	$135,264	175,837	-
1303-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-3	Komatsu 730E	$78.34	$221.79	$24.27	2	189.4	$29,672	$84,002	$9,192	$122,866	159,720	-
1401-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-1	Komatsu 730E	$78.34	$221.79	$24.27	2	290.3	$45,480	$128,756	$14,089	$188,326	276,616	-
1402-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-2	Komatsu 730E	$78.34	$221.79	$24.27	2	27.0	$4,232	$11,981	$1,311	$17,524	25,739	-
1601-D-b-Tk4	Haul-Cover	North Overburden Stockpile	PB-1	Komatsu 730E	$78.34	$221.79	$24.27	3	54.8	$12,887	$36,482	$3,992	$53,361	57,596	-
1700-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Komatsu 730E	$78.34	$221.79	$24.27	2	518.3	$81,205	$229,894	$25,157	$336,256	451,572	-
2001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-02	Komatsu 730E	$78.34	$221.79	$24.27	2	0.0	$7	$20	$2	$30	48	-
2002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-03	Komatsu 730E	$78.34	$221.79	$24.27	2	2.8	$437	$1,236	$135	$1,808	3,001	-
2003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-04	Komatsu 730E	$78.34	$221.79	$24.27	2	2.2	$352	$997	$109	$1,458	2,420	-
2004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-05	Komatsu 730E	$78.34	$221.79	$24.27	2	1.7	$273	$773	$85	$1,131	1,839	-
2005-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-06	Komatsu 730E	$78.34	$221.79	$24.27	2	1.0	$162	$458	$50	$670	968	-
2006-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-07	Komatsu 730E	$78.34	$221.79	$24.27	2	2.1	$324	$917	$100	$1,341	2,226	-
2007-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-08	Komatsu 730E	$78.34	$221.79	$24.27	3	2.4	$563	$1,594	$174	$2,332	2,517	-
2008-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-09	Komatsu 730E	$78.34	$221.79	$24.27	3	1.6	$368	$1,042	$114	$1,525	1,646	-
2009-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-10	Komatsu 730E	$78.34	$221.79	$24.27	3	3.9	$910	$2,575	$282	$3,767	4,066	-
2010-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-11	Komatsu 730E	$78.34	$221.79	$24.27	2	7.0	$1,099	$3,112	$341	$4,552	7,405	-
3001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-1	Komatsu 730E	$78.34	$221.79	$24.27	2	277.6	$43,502	$123,156	$13,477	$180,135	242,000	-
3004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-4	Komatsu 730E	$78.34	$221.79	$24.27	2	8.1	$1,275	$3,610	$395	$5,281	6,999	-
1001-A-d-Mg1	Grade-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	Cat 16M	$22.23	$93.51	$27.41	1	35.6	$791	$3,327	$975	$5,093	-	109.9
1002-A-d-Mg1	Grade-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	Cat 16M	$22.23	$93.51	$27.41	1	54.8	$1,218	$5,125	$1,502	$7,846	-	255.6
1003-A-d-Mg1	Grade-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	Cat 16M	$22.23	$93.51	$27.41	1	16.6	$369	$1,554	$456	$2,379	-	83.5
1004-A-d-Mg1	Grade-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	Cat 16M	$22.23	$93.51	$27.41	1	7.0	$157	$659	$193	$1,008	-	20.9
1101-A-d-Mg1	Grade-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	Cat 16M	$22.23	$93.51	$27.41	1	0.4	$9	$39	$12	$60	-	1.3
1102-A-d-Mg1	Grade-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	Cat 16M	$22.23	$93.51	$27.41	1	0.9	$19	$82	$24	$125	-	4.4
1201-A-d-Mg1	Grade-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	Cat 16M	$22.23	$93.51	$27.41	1	1.8	$40	$169	$49	$258	-	5.6
1202-A-d-Mg1	Grade-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	Cat 16M	$22.23	$93.51	$27.41	1	4.4	$98	$414	$121	$634	-	22.3
1301-A-d-Mg1	Grade-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	Cat 16M	$22.23	$93.51	$27.41	1	35.2	$782	$3,289	$964	$5,034	-	108.2
1302-A-d-Mg1	Grade-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	Cat 16M	$22.23	$93.51	$27.41	1	7.2	$161	$676	$198	$1,035	-	36.3
1303-A-d-Mg1	Grade-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	Cat 16M	$22.23	$93.51	$27.41	1	6.6	$146	$614	$180	$940	-	33.0
1401-A-d-Mg1	Grade-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	Cat 16M	$22.23	$93.51	$27.41	1	17.6	$392	$1,649	$483	$2,525	-	57.2
1402-A-d-Mg1	Grade-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	Cat 16M	$22.23	$93.51	$27.41	1	1.1	$24	$99	$29	$151	-	5.3
1601-A-d-Mg1	Grade-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	Cat 16M	$22.23	$93.51	$27.41	1	3.9	$87	$367	$108	$563	-	11.9
1700-A-d-Mg1	Grade-Top-Placed Cover	Hanover Mountain Deposit	-	Cat 16M	$22.23	$93.51	$27.41	1	30.8	$685	$2,881	$845	$4,411	-	93.3
2001-A-d-Mg1	Grade-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	Cat 16M	$22.23	$93.51	$27.41	1	0.0	$0	$0	$0	$0	-	0.0
2002-A-d-Mg1	Grade-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	Cat 16M	$22.23	$93.51	$27.41	1	0.2	$5	$19	$6	$30	-	0.6
2003-A-d-Mg1	Grade-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	Cat 16M	$22.23	$93.51	$27.41	1	0.2	$4	$16	$5	$24	-	0.5
2004-A-d-Mg1	Grade-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	Cat 16M	$22.23	$93.51	$27.41	1	0.1	$3	$12	$3	$18	-	0.4
2005-A-d-Mg1	Grade-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	Cat 16M	$22.23	$93.51	$27.41	1	0.1	$1	$6	$2	$10	-	0.2
2006-A-d-Mg1	Grade-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	Cat 16M	$22.23	$93.51	$27.41	1	0.2	$3	$14	$4	$22	-	0.5
2007-A-d-Mg1	Grade-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	Cat 16M	$22.23	$93.51	$27.41	1	0.2	$4	$16	$5	$25	-	0.5
2008-A-d-Mg1	Grade-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	Cat 16M	$22.23	$93.51	$27.41	1	0.1	$3	$11	$3	$16	-	0.3
2009-A-d-Mg1	Grade-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	Cat 16M	$22.23	$93.51	$27.41	1	0.3	$6	$26	$8	$40	-	0.8
2010-A-d-Mg1	Grade-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	Cat 16M	$22.23	$93.51	$27.41	1	0.5	$11	$48	$14	$73	-	1.5
3001-A-d-Mg1	Grade-Unplanned Future Disturbance Areas-Placed Cover	Miscellaneous Misc-1	-	Cat 16M	$22.23	$93.51	$27.41	1	16.5	$367	$1,544	$453	$2,364	-	50.0
3004-A-d-Mg1	Grade-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	Cat 16M	$22.23	$93.51	$27.41	1	0.5	$11	$45	$13	$68	-	1.4
1001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	506.4	$23,153	$78,185	$23,982	$125,320	-	-
1002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	1,177.7	$53,848	$181,838	$55,776	$291,462	-	-
1003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-3	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	384.9	$17,599	$59,430	$18,229	$95,259	-	-
1004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-4	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	96.3	$4,403	$14,869	$4,561	$23,832	-	-
1101-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	5.8	$267	$902	$277	$1,446	-	-
1102-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	19.8	$904	$3,053	$937	$4,894	-	-
1201-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	25.3	$1,155	$3,900	$1,196	$6,251	-	-
1202-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	100.9	$4,614	$15,582	$4,780	$24,976	-	-
1301-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	620.9	$28,390	$95,869	$29,406	$153,665	-	-
1302-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	208.5	$9,532	$32,190	$9,874	$51,596	-	-
1303-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-3	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	189.4	$8,659	$29,239	$8,969	$46,867	-	-
1401-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	290.3	$13,272	$44,817	$13,747	$71,836	-	-
1402-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	27.0	$1,235	$4,170	$1,279	$6,684	-	-
1501-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	-	$0	$0	$0	$0	-	-
1502-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-2	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	-	$0	$0	$0	$0	-	-
1503-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-3	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	-	$0	$0	$0	$0	-	-
1505-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-5	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	72.1	$3,295	$11,125	$3,413	$17,833	-	-
1506-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-6	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	-	$0	$0	$0	$0	-	-
1507-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-7	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	-	$0	$0	$0	$0	-	-
1601-P-b-Comb1	Road Maintenance	North Overburden Stockpile	PB-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	54.8	$2,507	$8,466	$2,597	$13,570	-	-
2001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-02	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	0.0	$2	$7	$2	$11	-	-
2002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-03	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	2.8	$127	$430	$132	$690	-	-
2003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-04	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	2.2	$103	$347	$106	$556	-	-
2004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-05	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	1.7	$80	$269	$83	$431	-	-
2005-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-06	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	1.0	$47	$159	$49	$256	-	-
2006-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-07	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	2.1	$95	$319	$98	$512	-	-
2007-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-08	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	2.4	$110	$370	$113	$593	-	-
2008-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-09	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	1.6	$72	$242	$74	$388	-	-
2009-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-10	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	3.9	$177	$598	$183	$958	-	-
2010-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-11	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	7.0	$321	$1,083	$332	$1,737	-	-
3001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-1	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	277.6	$12,695	$42,868	$13,149	$68,712	-	-
3004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-4	Cat 14M, Off-Hwy Water Tanker Truck,6,000-gal.	$45.72	$154.40	$47.36	1	8.1	$372	$1,257	$385	$2,014	-	-
5099-E-c-Rp1	Rip-Cover Material	North Overburden Stockpile		5099 Cat D11T CD Multi-shank (w/ MSR-359H)	$69.62	$259.35	$27.41	1	6.6	$456	$1,699	$180	$2,335	-	19.1
								TOTAL		$1,996,874	$6,526,975	$879,242	$9,405,426	19,727,992	1,240

Revegetation Costs

Description:
Includes scarifying (ripping), discing, rangeland drill seeding, mulching, crimping, and daily per diem
May filter on equipement (D14) to show pertinent rows

ID	Description	Source Location 1	Destination Location 2	Area (ac)	Fuel Unit Cost ($/ac)	Reveg w/o Fuel Unit Cost ($/ac)	Fuel Direct Cost ($)	Reveg w/o Fuel Direct Cost ($)
1001-J-d-U2	Revegetate-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	109.9	$ 3.85	$ 820.12	$ 423	$ 90,131
1002-J-d-U2	Revegetate-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ 3.85	$ 820.12	$ 984	$ 209,623
1003-J-d-U2	Revegetate-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ 3.85	$ 820.12	$ 321	$ 68,511
1004-J-d-U2	Revegetate-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	20.9	$ 3.85	$ 820.12	$ 80	$ 17,141
1101-J-d-U2	Revegetate-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	1.3	$ 3.85	$ 820.12	$ 5	$ 1,066
1102-J-d-U2	Revegetate-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	4.4	$ 3.85	$ 820.12	$ 17	$ 3,609
1201-J-d-U2	Revegetate-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	$ 3.85	$ 820.12	$ 21	$ 4,569
1202-J-d-U2	Revegetate-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	$ 3.85	$ 820.12	$ 86	$ 18,255
1301-J-d-U2	Revegetate-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	108.2	$ 3.85	$ 820.12	$ 416	$ 88,737
1302-J-d-U2	Revegetate-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	36.3	$ 3.85	$ 820.12	$ 140	$ 29,795
1303-J-d-U2	Revegetate-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	33.0	$ 3.85	$ 820.12	$ 127	$ 27,064
1401-J-d-U2	Revegetate-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	57.2	$ 3.85	$ 820.12	$ 220	$ 46,872
1402-J-d-U2	Revegetate-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	5.3	$ 3.85	$ 820.12	$ 20	$ 4,361
1501-J-d-U2	Revegetate-Top-Placed Cover	Cobre Haul Road CHR-1	-	100.0	$ 3.85	$ 820.12	$ 385	$ 82,012
1601-J-d-U2	Revegetate-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	11.9	$ 3.85	$ 820.12	$ 46	$ 9,759
1700-J-d-U2	Revegetate-Top-Placed Cover	Hanover Mountain Deposit	-	93.3	$ 3.85	$ 820.12	$ 359	$ 76,517
2001-J-d-U2	Revegetate-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	0.0	$ 3.85	$ 820.12	$ 0	$ 8
2002-J-d-U2	Revegetate-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	0.6	$ 3.85	$ 820.12	$ 2	$ 508
2003-J-d-U2	Revegetate-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	0.5	$ 3.85	$ 820.12	$ 2	$ 410
2004-J-d-U2	Revegetate-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	0.4	$ 3.85	$ 820.12	$ 1	$ 312
2005-J-d-U2	Revegetate-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	0.2	$ 3.85	$ 820.12	$ 1	$ 164
2006-J-d-U2	Revegetate-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	0.5	$ 3.85	$ 820.12	$ 2	$ 377
2007-J-d-U2	Revegetate-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	0.5	$ 3.85	$ 820.12	$ 2	$ 426
2008-J-d-U2	Revegetate-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	0.3	$ 3.85	$ 820.12	$ 1	$ 279
2009-J-d-U2	Revegetate-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	0.8	$ 3.85	$ 820.12	$ 3	$ 689
2010-J-d-U2	Revegetate-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	1.5	$ 3.85	$ 820.12	$ 6	$ 1,255
3001-J-d-U2	Revegetate-Unplanned Future Disturbance Areas-Placed Cov	Miscellaneous Misc-1	-	50.0	$ 3.85	$ 820.12	$ 192	$ 41,006
3004-J-d-U2	Revegetate-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	1.4	$ 3.85	$ 820.12	$ 6	$ 1,186
5099-J-e-U2	Revegetate-Cover Material	North Overburden Stockpile	5099	19.1	$ 3.85	$ 820.12	$ 73	$ 15,664
			TOTAL	1,025			$ 3,943	$ 840,307

Other Reclamation Activity Costs

Assumptions:

1 - Downdrain lengths and bench channel lengths based on 2018 Continental RCE Update Submittal
2 - Bench grading lengths equal to bench channel lengths
3 - Top channels included per 2018 Continental RCE Update Submittal

May filter on equipement (D14) to show pertinent rows

ID	Description	Source Location 1	Destination Location 2	Quantity[1, 2]	Unit	Fuel Unit Cost ($/unit)	Unit Cost w/o Fuel ($/unit)[4]	Fuel Direct Cost ($)[5]	Direct w/o Fuel Cost ($)
1002-F-e-U3a	Grade Benches-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	14,126	ft	$ 0.41	$ 1.74	$ 5,790	$ 24,545
1003-F-e-U3b	Grade Benches-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	25,463	ft	$ 0.38	$ 1.60	$ 9,593	$ 40,825
1302-F-e-U4	Grade Benches-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	3,894	ft	$ 0.40	$ 1.62	$ 1,544	$ 6,317
1002-H-e-U6a	Construct Bench Channels-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	14,126	ft	$ 1.64	$ 8.01	$ 23,145	$ 113,107
1003-H-e-U6b	Construct Bench Channels-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	25,463	ft	$ 1.56	$ 7.61	$ 39,634	$ 193,689
1302-H-e-U6c	Construct Bench Channels-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	3,894	ft	$ 1.64	$ 8.01	$ 6,380	$ 31,179
1001-I-e-U7a	Construct Top Channels-Top-Final Grade	South Waste Rock Disposal Facility SWRI	-	3,964	ft	$ 3.84	$ 18.43	$ 15,206	$ 73,038
1301-I-e-U7b	Construct Top Channels-Top-Final Grade	Main Tailings Impoundment MTI-1	-	2,141	ft	$ 9.49	$ 45.34	$ 20,309	$ 97,064
1002-G-e-U5a	Construct Downdrains-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	2,684	ft	$ 0.19	$ 374.34	$ 521	$ 1,004,753
1002-Gb-e-U5b	Construct Downdrain Dissipators-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	2	ea	-	$ 14,556.48	$ -	$ 29,113
1003-G-e-U5a	Construct Downdrains-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	2,086	ft	$ 0.19	$ 374.34	$ 405	$ 780,990
1003-Gb-e-U5b	Construct Downdrain Dissipators-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRI	-	2	ea	-	$ 14,556.48	$ -	$ 29,113
1302-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	460	ft	$ 0.19	$ 374.34	$ 89	$ 172,194
1302-Gb-e-U5b	Construct Downdrain Dissipators-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	1	ea	-	$ 14,556.48	$ -	$ 14,556
1402-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	420	ft	$ 0.19	$ 374.34	$ 81	$ 157,221
1402-Gb-e-U5a	Construct Downdrain Dissipators-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	1	ea	$ 0.19	$ 374.34	$ 0.19	$ 374
3005-N-e-U17	Plug and Abandon Well-Wells-Final Grade	Miscellaneous Misc-5	-	700	ft	-	$ 10.47	$ -	$ 7,329
1701-R-e-U26	Construct Berms-Hanover Mountain Perimeter 1-Final Grade	Hanover Mountain Deposit HMM-1	-	6,670	ft	-	$ 2.64	$ -	$ 17,621
1801-R-e-U26	Construct Berms-Continental Pit Perimeter 1-Final Grade	Continental Pit CP-1	-	6,635	ft	-	$ 2.64	$ -	$ 17,528
1702-S-e-U27	Fencing-Hanover Mountain Perimeter 2-Final Grade	Hanover Mountain Deposit HMM-2	-	3,286	ft	-	$ 23.05	$ -	$ 75,742
1802-S-e-U27	Fencing-Continental Pit Perimeter 2-Final Grade	Continental Pit CP-2	-	2,453	ft	-	$ 23.05	$ -	$ 56,542
							TOTAL	$ 122,697	$ 2,942,842

Continental Mine

Reclamation Summary Stockpiles, Haul Roads, Reservoirs, and Disturbed Areas
Based on 2014 Closure/Closeout Plan (Telesto, 2014) and

			Current Value
DIRECT COSTS	Facility and Structure Removal		$1,524,735
	Earthmoving		$9,405,426
	Revegetation		$844,249
	Other		$3,065,539
	Subtotal, Direct Costs		**$14,839,950**
INDIRECT COSTS	**Subtotal, Indirect Costs**	**30.0%**	**$4,451,985**
TOTAL COST			**$19,291,935**

Notes:

Indirect costs are based on 2019 agreement between FMI and agencies.

Indirect costs include but are not limited to mobilization and demobilization, engineering redesign fee, contingencies, contractor profit and overhead, project management fee, and state procurement cost.

Reclamation Summary

Notes and Assumptions
Used to summarize costs for Sheet 17b Facilty Characteristics

ID	Description	Source Location 1	Destination Location 2	Area (ac)	Cover Material Excav, Haul, Grade ($)	Cover Material Excav, Haul, Grade Fuel ($)	Cover Material Excav, Haul, Grade Indirects ($)	Top/Outslope Adjustment Grading w/o Fuel ($)	Top/Outslope Adjustment Grading Fuel ($)	Top/Outslope Adjustment Grading Indirects ($)	Scarify, Seed & Mulch, Reveg w/o Fuel ($)	Scarify, Seed & Mulch, Reveg Fuel ($)	Scarify, Seed & Mulch, Reveg Indirects ($)	Channels & Benches ($)	Channels & Benches Fuel ($)	Channels & Benches Indirects ($)	Other ($)	Other Fuel ($)	Other Indirects ($)	Capital Cost Totals ($)	Capital Cost/Acre ($)
2001-K-a-Rp1	Perforate Liner-Blackman's Seep (Pond #2) -Existing Ground	Containments Cntmnt-02	-	0.0	$ -	$ -	$ -	$ 1	$ 0	$ 0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1	$ 130
2002-K-a-Rp1	Perforate Liner-Decant Pond #4-Existing Ground	Containments Cntmnt-03	-	0.6	$ -	$ -	$ -	$ 65	$ 16	$ 24	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 81	$ 130
2004-K-a-Rp1	Perforate Liner-Grape Gulch Pond #3-Existing Ground	Containments Cntmnt-05	-	0.4	$ -	$ -	$ -	$ 40	$ 10	$ 15	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 49	$ 130
2005-K-a-Rp1	Perforate Liner-Magnetite Seepage Pond-Existing Ground	Containments Cntmnt-06	-	0.2	$ -	$ -	$ -	$ 21	$ 5	$ 8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 26	$ 130
2010-K-a-Rp1	Perforate Liner-Upper Creek Containment Pond 1 -Existing Ground	Containments Cntmnt-11	-	1.5	$ -	$ -	$ -	$ 160	$ 39	$ 60	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 199	$ 130
1001-A-a-Dz1	Grade-Top-Existing Ground	South Waste Rock Disposal Facility SWRDF-1	-	109.9	$ -	$ -	$ -	$ 458,173	$ 113,165	$ 171,401	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 571,338	$ 5,199
1002-A-a-Dz1	Grade-3:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ -	$ -	$ -	$ 316,898	$ 78,271	$ 118,551	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 395,169	$ 1,546
1003-A-a-Dz1	Grade-2.5:1 Interbench Outslope-Existing Ground	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ -	$ -	$ -	$ 135,248	$ 33,405	$ 50,596	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 168,653	$ 2,019
1004-A-a-Dz1	Grade-Laydown Yard N of SWRDF-Existing Ground	South Waste Rock Disposal Facility SWRDF-4	-	20.9	$ -	$ -	$ -	$ 5,329	$ 1,316	$ 1,994	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,646	$ 318
1101-A-a-Dz1	Grade-Top-Existing Ground	No. 3 Shaft Stockpile N3SS-1	-	1.3	$ -	$ -	$ -	$ 567	$ 140	$ 212	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 706	$ 543
1102-A-a-Dz1	Grade-Outslope-Existing Ground	No. 3 Shaft Stockpile N3SS-2	-	4.4	$ -	$ -	$ -	$ 2,313	$ 571	$ 865	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,884	$ 655
1201-A-a-Dz1	Grade-Top-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	$ -	$ -	$ -	$ 1,279	$ 316	$ 478	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,594	$ 286
1202-A-a-Dz1	Grade-Outslope-Existing Ground	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	$ -	$ -	$ -	$ 35,370	$ 8,736	$ 13,232	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 44,107	$ 1,982
1301-A-a-Dz1	Grade-Top-Existing Ground	Main Tailings Impoundment MTI-1	-	108.2	$ -	$ -	$ -	$ 12,724	$ 3,143	$ 4,760	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 15,867	$ 147
1302-A-a-Dz1	Grade-Outslope-Existing Ground	Main Tailings Impoundment MTI-2	-	36.3	$ -	$ -	$ -	$ 31,845	$ 7,865	$ 11,913	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 39,710	$ 1,093
1303-A-a-Dz1	Grade-Reclaim Pond-Existing Ground	Main Tailings Impoundment MTI-3	-	33.0	$ -	$ -	$ -	$ 11,823	$ 2,920	$ 4,423	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 14,743	$ 447
1304-E-a-Rp1	Rip-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	50.0	$ -	$ -	$ -	$ 5,023	$ 1,220	$ 1,873	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,243	$ 125
1304-C-a-Ld1	Load-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	50.0	$ -	$ -	$ -	$ 23,111	$ 5,682	$ 8,638	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 28,794	$ 576
1304-D-a-Tk4	Haul-Reclaim Pond Outlet Channel-Existing Ground	Main Tailings Impoundment MTI-4	-	50.0	$ -	$ -	$ -	$ 23,314	$ 7,423	$ 9,221	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,736	$ 615
1401-A-a-Dz1	Grade-Top-Existing Ground	Magnetite Tailings Impoundment MGTI-1	-	57.2	$ -	$ -	$ -	$ 36,183	$ 8,937	$ 13,536	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 45,120	$ 789
1402-A-a-Dz1	Grade-Outslope-Existing Ground	Magnetite Tailings Impoundment MGTI-2	-	5.3	$ -	$ -	$ -	$ 18,889	$ 4,665	$ 7,066	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 23,555	$ 4,429
1502-A-a-Dz1	Grade-Outslope-pushdown-Existing Ground	Cobre Haul Road CHR-2	-	0.0	$ -	$ -	$ -	$ 11,132	$ 2,749	$ 4,164	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,881	$ -
1503-A-a-Ex1	Grade-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	0.0	$ -	$ -	$ -	$ 2,318	$ 356	$ 802	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,674	$ -
1503-B-a-Dz1	Dozer Assist Grading-Outslope-pullback Ex Only 2.5:1-Existing Ground	Cobre Haul Road CHR-3	-	0.0	$ -	$ -	$ -	$ 16,320	$ 4,031	$ 6,105	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 20,351	$ -
1504-C-a-Ld1	Load-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	0.0	$ -	$ -	$ -	$ 9,377	$ 2,305	$ 3,505	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11,682	$ -
1504-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	0.0	$ -	$ -	$ -	$ 21,669	$ 5,352	$ 8,107	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 27,022	$ -
1504-D-a-Tk3	Haul-Outslope-pullback LdTk 2.5:1-Existing Ground	Cobre Haul Road CHR-4	-	0.0	$ -	$ -	$ -	$ 37,435	$ 5,415	$ 12,855	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 42,851	$ -
1505-C-a-Ld1	Load-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	0.0	$ -	$ -	$ -	$ 17,576	$ 4,321	$ 6,569	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 21,898	$ -
1505-B-a-Dz1	Dozer Assist Grading-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	0.0	$ -	$ -	$ -	$ 40,618	$ 10,032	$ 15,195	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 50,650	$ -
1505-D-a-Tk3	Haul-Outslope-pullback LdTk 2:1-Existing Ground	Cobre Haul Road CHR-5	-	0.0	$ -	$ -	$ -	$ 70,170	$ 10,150	$ 24,096	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 80,320	$ -
1506-C-a-Ex1	Load-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	0.0	$ -	$ -	$ -	$ 1,608	$ 247	$ 557	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,855	$ -
1506-D-a-Tk3	Haul-Crossings - earth-Existing Ground	Cobre Haul Road CHR-6	-	0.0	$ -	$ -	$ -	$ 9,266	$ 1,340	$ 3,182	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10,607	$ -
1507-C-a-Ex1	Load-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	0.0	$ -	$ -	$ -	$ 262	$ 40	$ 91	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 303	$ -
1507-D-a-Tk3	Haul-Crossings - concrete-Existing Ground	Cobre Haul Road CHR-7	-	0.0	$ -	$ -	$ -	$ 1,512	$ 219	$ 519	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,730	$ -
1001-E-c-Rp1	Rip-Top-Rough Graded Material	South Waste Rock Disposal Facility SWRDF-1	-	109.9	$ -	$ -	$ -	$ 10,809	$ 2,624	$ 4,030	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,433	$ 122
1101-E-c-Rp1	Rip-Top-Rough Graded Material	No. 3 Shaft Stockpile N3SS-1	-	1.3	$ -	$ -	$ -	$ 128	$ 31	$ 48	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 159	$ 122
1201-E-c-Rp1	Rip-Top-Rough Graded Material	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	$ -	$ -	$ -	$ 548	$ 133	$ 204	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 681	$ 122
1301-E-c-Rp1	Rip-Top-Rough Graded Material	Main Tailings Impoundment MTI-1	-	108.2	$ -	$ -	$ -	$ 10,642	$ 2,583	$ 3,967	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,225	$ 122
1401-E-c-Rp1	Rip-Top-Rough Graded Material	Magnetite Tailings Impoundment MGTI-1	-	57.2	$ -	$ -	$ -	$ 5,621	$ 1,365	$ 2,096	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,986	$ 122
1001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-1	109.9	$ 142,722	$ 35,251	$ 53,392	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 177,973	$ 1,619
1002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-2	255.6	$ 331,936	$ 81,985	$ 124,176	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 413,921	$ 1,619
1003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-3	83.5	$ 108,487	$ 26,795	$ 40,585	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 135,282	$ 1,619
1004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	SWRDF-4	20.9	$ 27,142	$ 6,704	$ 10,154	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 33,846	$ 1,619
1101-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-1	1.3	$ 1,647	$ 407	$ 616	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,053	$ 1,580
1102-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	N3SS-2	4.4	$ 5,574	$ 1,377	$ 2,085	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,950	$ 1,580
1201-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-1	5.6	$ 7,119	$ 1,758	$ 2,663	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,878	$ 1,594
1202-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	LGWRF-2	22.3	$ 28,444	$ 7,026	$ 10,641	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 35,470	$ 1,594
1301-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-1	108.2	$ 175,004	$ 43,224	$ 65,469	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 218,229	$ 2,017
1302-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-2	36.3	$ 58,761	$ 14,513	$ 21,982	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 73,274	$ 2,017
1303-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MTI-3	33.0	$ 53,375	$ 13,183	$ 19,967	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 66,558	$ 2,017
1401-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-1	57.2	$ 81,812	$ 20,207	$ 30,606	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 102,018	$ 1,785
1402-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	MGTI-2	5.3	$ 7,613	$ 1,880	$ 2,848	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,493	$ 1,785
1601-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	PB-1	11.9	$ 15,454	$ 3,817	$ 5,781	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 19,271	$ 1,619
1700-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Hanover Mountain Deposit	93.3	$ 146,075	$ 36,079	$ 54,646	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 182,154	$ 1,952
2001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-02	0.0	$ 13	$ 3	$ 5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16	$ 1,612
2002-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-03	0.6	$ 785	$ 194	$ 294	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 979	$ 1,580
2003-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-04	0.5	$ 633	$ 156	$ 237	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 790	$ 1,580
2004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-05	0.4	$ 491	$ 121	$ 184	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 612	$ 1,612
2005-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-06	0.2	$ 291	$ 72	$ 109	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 363	$ 1,814
2006-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-07	0.5	$ 583	$ 144	$ 218	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 727	$ 1,580
2007-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-08	0.5	$ 675	$ 167	$ 253	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 842	$ 1,619
2008-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-09	0.3	$ 442	$ 109	$ 165	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 551	$ 1,619
2009-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-10	0.8	$ 1,091	$ 269	$ 408	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,360	$ 1,619
2010-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Cntmnt-11	1.5	$ 1,978	$ 488	$ 740	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,466	$ 1,612
3001-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-1	50.0	$ 78,253	$ 19,328	$ 29,274	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 97,581	$ 1,952
3004-B-b-Dz1	Dozer Assist-Cover	North Overburden Stockpile	Misc-4	1.4	$ 2,294	$ 567	$ 858	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,861	$ 1,978
1001-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-1	109.9	$ 123,517	$ 30,369	$ 46,166	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 153,886	$ 1,400
1002-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-2	255.6	$ 287,270	$ 70,631	$ 107,370	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 357,901	$ 1,400
1003-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-3	83.5	$ 93,889	$ 23,084	$ 35,092	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 116,973	$ 1,400
1004-C-b-Ld1	Load-Cover	North Overburden Stockpile	SWRDF-4	20.9	$ 23,490	$ 5,775	$ 8,779	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 29,265	$ 1,400
1101-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-1	1.3	$ 1,425	$ 350	$ 533	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,776	$ 1,366
1102-C-b-Ld1	Load-Cover	North Overburden Stockpile	N3SS-2	4.4	$ 4,824	$ 1,186	$ 1,803	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,010	$ 1,366
1201-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-1	5.6	$ 6,161	$ 1,515	$ 2,303	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,676	$ 1,378
1202-C-b-Ld1	Load-Cover	North Overburden Stockpile	LGWRF-2	22.3	$ 24,617	$ 6,053	$ 9,201	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30,669	$ 1,378
1301-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-1	108.2	$ 151,455	$ 37,238	$ 56,608	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 188,693	$ 1,744
1302-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-2	36.3	$ 50,854	$ 12,503	$ 19,007	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 63,357	$ 1,744
1303-C-b-Ld1	Load-Cover	North Overburden Stockpile	MTI-3	33.0	$ 46,192	$ 11,357	$ 17,265	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 57,550	$ 1,744
1401-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-1	57.2	$ 70,803	$ 17,408	$ 26,463	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 88,211	$ 1,543
1402-C-b-Ld1	Load-Cover	North Overburden Stockpile	MGTI-2	5.3	$ 6,588	$ 1,620	$ 2,462	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 8,208	$ 1,543
1601-C-b-Ld1	Load-Cover	North Overburden Stockpile	PB-1	11.9	$ 13,374	$ 3,288	$ 4,999	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,663	$ 1,400
1700-C-b-Ld1	Load-Cover	North Overburden Stockpile	Hanover Mountain Deposit	93.3	$ 126,419	$ 31,083	$ 47,250	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 157,501	$ 1,688
2001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-02	0.0	$ 11	$ 3	$ 4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 14	$ 1,394
2002-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-03	0.6	$ 680	$ 167	$ 254	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 847	$ 1,366
2003-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-04	0.5	$ 548	$ 135	$ 205	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 683	$ 1,366
2004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-05	0.4	$ 425	$ 105	$ 159	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 530	$ 1,394
2005-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-06	0.2	$ 252	$ 62	$ 94	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 314	$ 1,569
2006-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-07	0.5	$ 504	$ 124	$ 188	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 628	$ 1,366
2007-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-08	0.5	$ 584	$ 144	$ 218	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 728	$ 1,400
2008-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-09	0.3	$ 382	$ 94	$ 143	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 476	$ 1,400
2009-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-10	0.8	$ 944	$ 232	$ 353	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,176	$ 1,400
2010-C-b-Ld1	Load-Cover	North Overburden Stockpile	Cntmnt-11	1.5	$ 1,712	$ 421	$ 640	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,132	$ 1,394
3001-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-1	50.0	$ 67,723	$ 16,651	$ 25,312	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 84,374	$ 1,687
3004-C-b-Ld1	Load-Cover	North Overburden Stockpile	Misc-4	1.4	$ 1,985	$ 488	$ 742	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,474	$ 1,711
1001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-1	109.9	$ 373,795	$ 119,012	$ 147,842	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 492,808	$ 4,484
1002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-2	255.6	$ 869,355	$ 276,793	$ 343,844	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,146,148	$ 4,484
1003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-3	83.5	$ 284,132	$ 90,464	$ 112,379	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 374,596	$ 4,484
1004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-4	20.9	$ 71,086	$ 22,633	$ 28,116	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 93,719	$ 4,484
1101-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-1	1.3	$ 2,875	$ 915	$ 1,137	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,791	$ 2,916
1102-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-2	4.4	$ 9,732	$ 3,098	$ 3,849	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 12,830	$ 2,916
1201-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-1	5.6	$ 12,430	$ 3,958	$ 4,916	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16,388	$ 2,942
1202-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-2	22.3	$ 49,665	$ 15,813	$ 19,643	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 65,478	$ 2,942
1301-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-1	108.2	$ 305,562	$ 97,288	$ 120,855	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 402,850	$ 3,723
1302-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-2	36.3	$ 102,598	$ 32,666	$ 40,579	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 135,264	$ 3,723
1303-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-3	33.0	$ 93,194	$ 29,672	$ 36,860	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 122,866	$ 3,723
1401-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-1	57.2	$ 142,845	$ 45,480	$ 56,498	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 188,326	$ 3,295
1402-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-2	5.3	$ 13,292	$ 4,232	$ 5,257	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 17,524	$ 3,295
1601-D-b-Tk4	Haul-Cover	North Overburden Stockpile	PB-1	11.9	$ 40,475	$ 12,887	$ 16,008	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 53,361	$ 4,484
1700-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	93.3	$ 255,051	$ 81,205	$ 100,877	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 336,256	$ 3,604
2001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-02	0.0	$ 23	$ 7	$ 9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30	$ 2,975
2002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-03	0.6	$ 1,371	$ 437	$ 542	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,808	$ 2,916
2003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-04	0.5	$ 1,106	$ 352	$ 437	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,458	$ 2,916
2004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-05	0.4	$ 857	$ 273	$ 339	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,131	$ 2,975
2005-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-06	0.2	$ 508	$ 162	$ 201	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 670	$ 3,349
2006-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-07	0.5	$ 1,017	$ 324	$ 402	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,341	$ 2,916
2007-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-08	0.5	$ 1,769	$ 563	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,332	$ 4,484
2008-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-09	0.3	$ 1,156	$ 368	$ 457	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,525	$ 4,484
2009-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-10	0.8	$ 2,857	$ 910	$ 1,130	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,767	$ 4,484
2010-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-11	1.5	$ 3,453	$ 1,099	$ 1,366	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,552	$ 2,975
3001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-1	50.0	$ 136,632	$ 43,502	$ 54,040	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 180,135	$ 3,603
3004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-4	1.4	$ 4,006	$ 1,275	$ 1,584	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,281	$ 3,652
1001-A-d-Mg1	Grade-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	109.9	$ 4,302	$ 791	$ 1,528	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,093	$ 46
1002-A-d-Mg1	Grade-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ 6,628	$ 1,218	$ 2,354	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,846	$ 31
1003-A-d-Mg1	Grade-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ 2,010	$ 369	$ 714	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,379	$ 28
1004-A-d-Mg1	Grade-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	20.9	$ 852	$ 157	$ 302	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,008	$ 48
1101-A-d-Mg1	Grade-Top-Placed Cover	No. 3 Shaft Stockpile N3SS-1	-	1.3	$ 51	$ 9	$ 18	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 60	$ 46
1102-A-d-Mg1	Grade-Outslope-Placed Cover	No. 3 Shaft Stockpile N3SS-2	-	4.4	$ 106	$ 19	$ 38	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 125	$ 28
1201-A-d-Mg1	Grade-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	$ 218	$ 40	$ 77	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 258	$ 46
1202-A-d-Mg1	Grade-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	$ 535	$ 98	$ 190	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 634	$ 28
1301-A-d-Mg1	Grade-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	108.2	$ 4,253	$ 782	$ 1,510	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 5,034	$ 47
1302-A-d-Mg1	Grade-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	36.3	$ 874	$ 161	$ 310	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,035	$ 28
1303-A-d-Mg1	Grade-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	33.0	$ 794	$ 146	$ 282	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 940	$ 28
1401-A-d-Mg1	Grade-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	57.2	$ 2,133	$ 392	$ 757	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,525	$ 44
1402-A-d-Mg1	Grade-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	5.3	$ 128	$ 24	$ 45	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 151	$ 28
1601-A-d-Mg1	Grade-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	11.9	$ 475	$ 87	$ 169	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 563	$ 47
1700-A-d-Mg1	Grade-Top-Placed Cover	Hanover Mountain Deposit	-	93.3	$ 3,726	$ 685	$ 1,323	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,411	$ 47
2001-A-d-Mg1	Grade-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	0.0	$ 0	$ 0	$ 0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 0	$ 48
2002-A-d-Mg1	Grade-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	0.6	$ 25	$ 5	$ 9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 30	$ 48
2003-A-d-Mg1	Grade-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	0.5	$ 20	$ 4	$ 7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 24	$ 48
2004-A-d-Mg1	Grade-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	0.4	$ 15	$ 3	$ 5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 18	$ 48
2005-A-d-Mg1	Grade-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	0.2	$ 8	$ 1	$ 3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 10	$ 48
2006-A-d-Mg1	Grade-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	0.5	$ 19	$ 3	$ 7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 22	$ 48
2007-A-d-Mg1	Grade-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	0.5	$ 21	$ 4	$ 7	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 25	$ 48
2008-A-d-Mg1	Grade-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	0.3	$ 14	$ 3	$ 5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 16	$ 48
2009-A-d-Mg1	Grade-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	0.8	$ 34	$ 6	$ 12	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 40	$ 48

Reclamation Summary

Notes and Assumptions
Used to summarize costs for Sheet 17b Facility Characteristics

ID	Description	Source Location 1	Destination Location 2	Area (ac)	Cover Material Excav, Haul, Grade ($)	Cover Material Excav, Haul, Grade Fuel ($)	Cover Material Excav, Haul, Grade Indirects ($)	Top/Outslope Adjustment Grading w/o Fuel ($)	Top/Outslope Adjustment Grading Fuel ($)	Top/Outslope Adjustment Grading Indirects ($)	Scarify, Seed & Mulch, Reveg w/o Fuel ($)	Scarify, Seed & Mulch, Reveg Fuel ($)	Scarify, Seed & Mulch, Reveg Indirects ($)	Channels & Benches ($)	Channels & Benches Fuel ($)	Channels & Benches Indirects ($)	Other ($)	Other Fuel ($)	Other Indirects ($)	Capital Cost Totals ($)	Capital Cost/Acre ($)
2010-A-d-Mg1	Grade-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	1.5	$ 62	$ 11	$ 22	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 73	$ 48
3001-A-d-Mg1	Grade-Unplanned Future Disturbance Areas-Placed Cover	Miscellaneous Misc-1	-	50.0	$ 1,997	$ 367	$ 709	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,364	$ 47
3004-A-d-Mg1	Grade-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	1.4	$ 58	$ 11	$ 21	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 68	$ 47
1002-F-e-U3a	Grade Benches-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 24,545	$ 5,790	$ 9,101	$ -	$ -	$ -	$ 30,336	$ 119
1003-F-e-U3b	Grade Benches-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 40,825	$ 9,593	$ 15,125	$ -	$ -	$ -	$ 50,418	$ 604
1302-F-e-U4	Grade Benches-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,317	$ 1,544	$ 2,358	$ -	$ -	$ -	$ 7,861	$ 216
1002-H-e-U6a	Construct Bench Channels-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 113,107	$ 23,145	$ 40,876	$ -	$ -	$ -	$ 136,252	$ 533
1003-H-e-U6b	Construct Bench Channels-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 193,689	$ 39,634	$ 69,997	$ -	$ -	$ -	$ 233,322	$ 2,793
1302-H-e-U6c	Construct Bench Channels-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 31,179	$ 6,380	$ 11,268	$ -	$ -	$ -	$ 37,559	$ 1,034
1001-I-e-U7a	Construct Top Channels-Top-Final Grade	South Waste Rock Disposal Facility SWRDF-1	-	109.9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 73,038	$ 15,206	$ 26,473	$ -	$ -	$ -	$ 88,244	$ 803
1301-I-e-U7b	Construct Top Channels-Top-Final Grade	Main Tailings Impoundment MTI-1	-	108.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 97,064	$ 20,309	$ 35,212	$ -	$ -	$ -	$ 117,373	$ 1,085
1002-G-e-U5a	Construct Downdrains-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,004,753	$ 521	$ 301,582	$ -	$ -	$ -	$ 1,005,274	$ 3,933
1002-Gb-e-U5b	Construct Downdrain Dissipators-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 29,113	$ -	$ 8,734	$ -	$ -	$ -	$ 29,113	$ 114
1003-G-e-U5a	Construct Downdrains-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 780,990	$ 405	$ 234,418	$ -	$ -	$ -	$ 781,395	$ 9,354
1003-Gb-e-U5b	Construct Downdrain Dissipators-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 29,113	$ -	$ 8,734	$ -	$ -	$ -	$ 29,113	$ 349
1302-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 172,194	$ 89	$ 51,685	$ -	$ -	$ -	$ 172,283	$ 4,742
1302-Gb-e-U5b	Construct Downdrain Dissipators-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 14,556	$ -	$ 4,367	$ -	$ -	$ -	$ 14,556	$ 401
1402-G-e-U5a	Construct Downdrains-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	5.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 157,221	$ 81	$ 47,191	$ -	$ -	$ -	$ 157,302	$ 29,579
1402-Gb-e-U5a	Construct Downdrain Dissipators-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	5.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 374	$ 0	$ 112	$ -	$ -	$ -	$ 375	$ 70
1001-J-d-U2	Revegetate-Top-Placed Cover	South Waste Rock Disposal Facility SWRDF-1	-	109.9	$ -	$ -	$ -	$ -	$ -	$ -	$ 90,131	$ 423	$ 27,166	$ -	$ -	$ -	$ -	$ -	$ -	$ 90,554	$ 824
1002-J-d-U2	Revegetate-3:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ -	$ -	$ -	$ -	$ -	$ -	$ 209,623	$ 984	$ 63,182	$ -	$ -	$ -	$ -	$ -	$ -	$ 210,606	$ 824
1003-J-d-U2	Revegetate-2.5:1 Interbench Outslope-Placed Cover	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 68,511	$ 321	$ 20,650	$ -	$ -	$ -	$ -	$ -	$ -	$ 68,833	$ 824
1004-J-d-U2	Revegetate-Laydown Yard N of SWRDF-Placed Cover	South Waste Rock Disposal Facility SWRDF-4	-	20.9	$ -	$ -	$ -	$ -	$ -	$ -	$ 17,141	$ 80	$ 5,166	$ -	$ -	$ -	$ -	$ -	$ -	$ 17,221	$ 824
1101-J-d-U2	Revegetate-Top-Placed Cover	No. 3 Shaft Stockpile NSSS-1	-	1.3	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,066	$ 5	$ 321	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,071	$ 824
1102-J-d-U2	Revegetate-Outslope-Placed Cover	No. 3 Shaft Stockpile NSSS-2	-	4.4	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,609	$ 17	$ 1,088	$ -	$ -	$ -	$ -	$ -	$ -	$ 3,625	$ 824
1201-J-d-U2	Revegetate-Top-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,569	$ 21	$ 1,377	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,590	$ 824
1202-J-d-U2	Revegetate-Outslope-Placed Cover	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,255	$ 86	$ 5,502	$ -	$ -	$ -	$ -	$ -	$ -	$ 18,341	$ 824
1301-J-d-U2	Revegetate-Top-Placed Cover	Main Tailings Impoundment MTI-1	-	108.2	$ -	$ -	$ -	$ -	$ -	$ -	$ 88,737	$ 416	$ 26,746	$ -	$ -	$ -	$ -	$ -	$ -	$ 89,153	$ 824
1302-J-d-U2	Revegetate-Outslope-Placed Cover	Main Tailings Impoundment MTI-2	-	36.3	$ -	$ -	$ -	$ -	$ -	$ -	$ 29,795	$ 140	$ 8,980	$ -	$ -	$ -	$ -	$ -	$ -	$ 29,935	$ 824
1303-J-d-U2	Revegetate-Reclaim Pond-Placed Cover	Main Tailings Impoundment MTI-3	-	33.0	$ -	$ -	$ -	$ -	$ -	$ -	$ 27,064	$ 127	$ 8,157	$ -	$ -	$ -	$ -	$ -	$ -	$ 27,191	$ 824
1401-J-d-U2	Revegetate-Top-Placed Cover	Magnetite Tailings Impoundment MGTI-1	-	57.2	$ -	$ -	$ -	$ -	$ -	$ -	$ 46,872	$ 220	$ 14,127	$ -	$ -	$ -	$ -	$ -	$ -	$ 47,091	$ 824
1402-J-d-U2	Revegetate-Outslope-Placed Cover	Magnetite Tailings Impoundment MGTI-2	-	5.3	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,361	$ 20	$ 1,315	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,382	$ 824
1501-J-d-U2	Revegetate-Top-Placed Cover	Cobre Haul Road CHR-1	-	100.0	$ -	$ -	$ -	$ -	$ -	$ -	$ 82,012	$ 385	$ 24,719	$ -	$ -	$ -	$ -	$ -	$ -	$ 82,397	$ 824
1601-J-d-U2	Revegetate-Top-Placed Cover	Pearson Barnes Mine Area PB-1	-	11.9	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,759	$ 46	$ 2,942	$ -	$ -	$ -	$ -	$ -	$ -	$ 9,805	$ 824
1700-J-d-U2	Revegetate-Top-Placed Cover	Hanover Mountain Deposit	-	93.3	$ -	$ -	$ -	$ -	$ -	$ -	$ 76,517	$ 359	$ 23,063	$ -	$ -	$ -	$ -	$ -	$ -	$ 76,876	$ 824
2001-J-d-U2	Revegetate-Blackman's Seep (Pond #2) -Placed Cover	Containments Cntmnt-02	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ 8	$ 0	$ 2	$ -	$ -	$ -	$ -	$ -	$ -	$ 8	$ 824
2002-J-d-U2	Revegetate-Decant Pond #4-Placed Cover	Containments Cntmnt-03	-	0.6	$ -	$ -	$ -	$ -	$ -	$ -	$ 508	$ 2	$ 153	$ -	$ -	$ -	$ -	$ -	$ -	$ 511	$ 824
2003-J-d-U2	Revegetate-East WRF Containment-Placed Cover	Containments Cntmnt-04	-	0.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 410	$ 2	$ 124	$ -	$ -	$ -	$ -	$ -	$ -	$ 412	$ 824
2004-J-d-U2	Revegetate-Grape Gulch Pond #3-Placed Cover	Containments Cntmnt-05	-	0.4	$ -	$ -	$ -	$ -	$ -	$ -	$ 312	$ 1	$ 94	$ -	$ -	$ -	$ -	$ -	$ -	$ 313	$ 824
2005-J-d-U2	Revegetate-Magnetite Seepage Pond-Placed Cover	Containments Cntmnt-06	-	0.2	$ -	$ -	$ -	$ -	$ -	$ -	$ 164	$ 1	$ 49	$ -	$ -	$ -	$ -	$ -	$ -	$ 165	$ 824
2006-J-d-U2	Revegetate-North Tailings Decant Pond-Placed Cover	Containments Cntmnt-07	-	0.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 377	$ 2	$ 114	$ -	$ -	$ -	$ -	$ -	$ -	$ 379	$ 824
2007-J-d-U2	Revegetate-SWRF Dam 1-Placed Cover	Containments Cntmnt-08	-	0.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 426	$ 2	$ 129	$ -	$ -	$ -	$ -	$ -	$ -	$ 428	$ 824
2008-J-d-U2	Revegetate-SWRF Dam 2-Placed Cover	Containments Cntmnt-09	-	0.3	$ -	$ -	$ -	$ -	$ -	$ -	$ 279	$ 1	$ 84	$ -	$ -	$ -	$ -	$ -	$ -	$ 280	$ 824
2009-J-d-U2	Revegetate-SWRF Dam 3-Placed Cover	Containments Cntmnt-10	-	0.8	$ -	$ -	$ -	$ -	$ -	$ -	$ 689	$ 3	$ 208	$ -	$ -	$ -	$ -	$ -	$ -	$ 692	$ 824
2010-J-d-U2	Revegetate-Upper Creek Containment Pond 1 -Placed Cover	Containments Cntmnt-11	-	1.5	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,255	$ 6	$ 378	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,261	$ 824
3001-J-d-U2	Revegetate-Unplanned Future Disturbance Areas-Placed Cover	Miscellaneous Misc-1	-	50.0	$ -	$ -	$ -	$ -	$ -	$ -	$ 41,006	$ 192	$ 12,360	$ -	$ -	$ -	$ -	$ -	$ -	$ 41,198	$ 824
3004-J-d-U2	Revegetate-Tailings Pipeline Corridor-Placed Cover	Miscellaneous Misc-4	-	1.4	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,186	$ 6	$ 357	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,191	$ 824
1001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-1	109.9	$ 102,166	$ 23,153	$ 37,596	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 125,320	$ 1,140
1002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-2	255.6	$ 237,614	$ 53,848	$ 87,439	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 291,462	$ 1,140

Reclamation Summary

Notes and Assumptions
Used to summarize costs for Sheet 17b Facility Characteristics

ID	Description	Source Location 1	Destination Location 2	Area (ac)	Cover Material Excav, Haul, Grade ($)	Cover Material Excav, Haul, Grade Fuel ($)	Cover Material Excav, Haul, Grade Indirects ($)	Top/Outslope Adjustment Grading w/o Fuel ($)	Top/Outslope Adjustment Grading Fuel ($)	Top/Outslope Adjustment Grading Indirects ($)	Scarify, Seed & Mulch, Reveg w/o Fuel ($)	Scarify, Seed & Mulch, Reveg Fuel ($)	Scarify, Seed & Mulch, Reveg Indirects ($)	Channels & Benches ($)	Channels & Benches Fuel ($)	Channels & Benches Indirects ($)	Other ($)	Other Fuel ($)	Other Indirects ($)	Capital Cost Totals ($)	Capital Cost/Acre ($)
1003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-3	83.5	$ 77,659	$ 17,599	$ 28,578	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 95,259	$ 1,140
1004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	SWRDF-4	20.9	$ 19,429	$ 4,403	$ 7,150	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 23,832	$ 1,140
1101-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-1	1.3	$ 1,179	$ 267	$ 434	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,446	$ 1,112
1102-P-b-Comb1	Road Maintenance	North Overburden Stockpile	N3SS-2	4.4	$ 3,990	$ 904	$ 1,488	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 4,894	$ 1,112
1201-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-1	5.6	$ 5,096	$ 1,155	$ 1,875	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,251	$ 1,122
1202-P-b-Comb1	Road Maintenance	North Overburden Stockpile	LGWRF-2	22.3	$ 20,362	$ 4,614	$ 7,493	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 24,976	$ 1,122
1301-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-1	108.2	$ 125,275	$ 28,390	$ 46,100	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 153,665	$ 1,420
1302-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-2	36.3	$ 42,063	$ 9,532	$ 15,479	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 51,596	$ 1,420
1303-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MTI-3	33.0	$ 38,208	$ 8,659	$ 14,060	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 46,867	$ 1,420
1401-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-1	57.2	$ 58,564	$ 13,272	$ 21,551	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 71,836	$ 1,257
1402-P-b-Comb1	Road Maintenance	North Overburden Stockpile	MGTI-2	5.3	$ 5,449	$ 1,235	$ 2,005	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 6,684	$ 1,257
1501-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-1	100.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1502-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-2	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1503-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-3	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1505-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-5	0.0	$ 14,538	$ 3,295	$ 5,350	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 17,833	$ -
1506-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-6	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1507-P-b-Comb1	Road Maintenance	North Overburden Stockpile	CHR-7	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1601-P-b-Comb1	Road Maintenance	North Overburden Stockpile	PB-1	11.9	$ 11,063	$ 2,507	$ 4,071	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 13,570	$ 1,140
2001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-02	0.0	$ 9	$ 2	$ 3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 11	$ 1,135
2002-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-03	0.6	$ 562	$ 127	$ 207	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 690	$ 1,112
2003-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-04	0.5	$ 453	$ 103	$ 167	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 556	$ 1,112
2004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-05	0.4	$ 352	$ 80	$ 129	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 431	$ 1,135
2005-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-06	0.2	$ 208	$ 47	$ 77	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 256	$ 1,278
2006-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-07	0.5	$ 417	$ 95	$ 153	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 512	$ 1,112
2007-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-08	0.5	$ 483	$ 110	$ 178	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 593	$ 1,140
2008-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-09	0.3	$ 316	$ 72	$ 116	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 388	$ 1,140
2009-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-10	0.8	$ 781	$ 177	$ 287	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 958	$ 1,140
2010-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Cntmnt-11	1.5	$ 1,416	$ 321	$ 521	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 1,737	$ 1,135
3001-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-1	50.0	$ 56,017	$ 12,695	$ 20,613	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 68,712	$ 1,374
3004-P-b-Comb1	Road Maintenance	North Overburden Stockpile	Misc-4	1.4	$ 1,642	$ 372	$ 604	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,014	$ 1,393
1001-M-e-U24	Post-Closure O&M-Top-Final Grade	South Waste Rock Disposal Facility SWRDF-1	-	109.9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1002-M-e-U24	Post-Closure O&M-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1003-M-e-U24	Post-Closure O&M-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1004-M-e-U24	Post-Closure O&M-Laydown Yard N of SWRDF-Final Grade	South Waste Rock Disposal Facility SWRDF-4	-	20.9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1101-M-e-U24	Post-Closure O&M-Top-Final Grade	No. 3 Shaft Stockpile N3SS-1	-	1.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1102-M-e-U24	Post-Closure O&M-Outslope-Final Grade	No. 3 Shaft Stockpile N3SS-2	-	4.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1201-M-e-U24	Post-Closure O&M-Top-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1202-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1301-M-e-U24	Post-Closure O&M-Top-Final Grade	Main Tailings Impoundment MTI-1	-	108.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1302-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1303-M-e-U24	Post-Closure O&M-Reclaim Pond-Final Grade	Main Tailings Impoundment MTI-3	-	33.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1401-M-e-U24	Post-Closure O&M-Top-Final Grade	Magnetite Tailings Impoundment MGTI-1	-	57.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1402-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	5.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1501-M-e-U24	Post-Closure O&M-Top-Final Grade	Cobre Haul Road CHR-1	-	100.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1502-M-e-U24	Post-Closure O&M-Outslope-pushdown-Final Grade	Cobre Haul Road CHR-2	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1503-M-e-U24	Post-Closure O&M-Outslope-pullback Ex Only 2.5:1-Final Grade	Cobre Haul Road CHR-3	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1505-M-e-U24	Post-Closure O&M-Outslope-pullback Ltd'k 2:1-Final Grade	Cobre Haul Road CHR-5	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1506-M-e-U24	Post-Closure O&M-Crossings - earth-Final Grade	Cobre Haul Road CHR-6	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1507-M-e-U24	Post-Closure O&M-Crossings - concrete-Final Grade	Cobre Haul Road CHR-7	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
1601-M-e-U24	Post-Closure O&M-Top-Final Grade	Pearson Barnes Mine Area PB-1	-	11.9	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2001-M-e-U24	Post-Closure O&M-Blackman's Seep (Pond #2) -Final Grade	Containments Cntmnt-02	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2002-M-e-U24	Post-Closure O&M-Decant Pond #4-Final Grade	Containments Cntmnt-03	-	0.6	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2003-M-e-U24	Post-Closure O&M-East WRF Containment-Final Grade	Containments Cntmnt-04	-	0.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2004-M-e-U24	Post-Closure O&M-Grape Gulch Pond #3-Final Grade	Containments Cntmnt-05	-	0.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2005-M-e-U24	Post-Closure O&M-Magnetite Seepage Pond-Final Grade	Containments Cntmnt-06	-	0.2	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2006-M-e-U24	Post-Closure O&M-North Tailings Decant Pond-Final Grade	Containments Cntmnt-07	-	0.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2007-M-e-U24	Post-Closure O&M-SWRF Dam 1-Final Grade	Containments Cntmnt-08	-	0.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2008-M-e-U24	Post-Closure O&M-SWRF Dam 2-Final Grade	Containments Cntmnt-09	-	0.3	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2009-M-e-U24	Post-Closure O&M-SWRF Dam 3-Final Grade	Containments Cntmnt-10	-	0.8	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
2010-M-e-U24	Post-Closure O&M-Upper Creek Containment Pond 1 -Final Grade	Containments Cntmnt-11	-	1.5	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3001-M-e-U24	Post-Closure O&M-Unplanned Future Disturbance Areas-Final Grade	Miscellaneous Misc-1	-	50.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3004-M-e-U24	Post-Closure O&M-Tailings Pipeline Corridor-Final Grade	Miscellaneous Misc-4	-	1.4	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
3005-N-e-U17	Plug and Abandon Well-Wells-Final Grade	Miscellaneous Misc-5	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 7,329	$ -	$ 2,199	$ 7,329	$ -
1701-R-e-U26	Construct Berms-Hanover Mountain Perimeter 1-Final Grade	Hanover Mountain Deposit HMM-1	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 17,621	$ -	$ 5,286	$ 17,621	$ -
1801-R-e-U26	Construct Berms-Continental Pit Perimeter 1-Final Grade	Continental Pit CP-1	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 17,528	$ -	$ 5,259	$ 17,528	$ 7,635,346,211
1702-S-e-U27	Fencing-Hanover Mountain Perimeter 2-Final Grade	Hanover Mountain Deposit HMM-2	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 75,742	$ -	$ 22,723	$ 75,742	$ -
1802-S-e-U27	Fencing-Continental Pit Perimeter 2-Final Grade	Continental Pit CP-2	-	0.0	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 56,542	$ -	$ 16,962	$ 56,542	$ -
5099-E-e-Rp1	Rip-Cover Material	North Overburden Stockpile	5099	19.1	$ -	$ -	$ -	$ -	$ 1,879	$ 456	$ 700	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 2,335	$ 122
5099-J-e-U2	Revegetate-Cover Material	North Overburden Stockpile	5099	19.1	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ 15,664	$ 73	$ 4,721	$ -	$ -	$ -	$ -	$ -	$ 15,738	$ 824

Facility Characteristics

Facilities are categorized in this listing to meet the MMD reporting requirement

		1000	1100	1200	1300	1400	1500	1600	1700	1800	2000	3000	5099	
	Facility	**South Waste Rock Disposal Facility**	**No. 3 Shaft Stockpile**	**Low Grade Ore Waste Rock Facility**	**Main Tailings Impoundment**	**Magnetite Tailings Impoundment**	**Cobre Haul Road**	**Pearson Barnes Mine Area**	**Hanover Mountain Deposit**	**Continental Pit**	**Containments**	**Miscellaneous**	**North Overburden Stockpile**	**Total**
	Reclaimed Acres[6]	469.94	5.70	27.83	177.53	62.47	100.00	11.90	93.30	17.60	5.40	133.45	19.10	**1124.21**
	Item	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	**Capital Cost**	
Direct Costs	Cover Material Excav, Haul, Grade[1]	$4,078,518	$39,935	$196,678	$1,587,776	$494,977	$17,833	$103,427	$680,322	$0	$41,235	$445,863	$0	**$7,686,565**
	Top/Outslope Adjustment Grading[2]	$1,155,237	$3,749	$46,382	$149,318	$75,660	$285,824	$0	$0	$0	$357	$0	$2,335	**$1,718,861**
	Scarify, Seed & Mulch, Reveg[3]	$387,214	$4,697	$22,931	$146,279	$51,473	$82,397	$9,805	$76,876	$0	$4,449	$42,390	$15,738	**$844,249**
	Channels & Benches[4]	$2,383,466	$0	$0	$349,634	$157,677	$0	$0	$0	$0	$0	$0	$0	**$2,890,777**
	Demolition	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$1,524,735**
	Other[5]	$0	$0	$0	$0	$0	$0	$0	$93,363	$74,070	$0	$7,329	$0	**$174,762**
	Capital Cost Totals	**$8,004,435**	**$48,381**	**$265,991**	**$2,233,007**	**$779,787**	**$386,053**	**$113,233**	**$850,562**	**$74,070**	**$46,041**	**$495,582**	**$18,072**	**$14,839,950**
	Capital Cost/Acre	**$17,033**	**$8,488**	**$9,558**	**$12,578**	**$12,483**	**$3,861**	**$9,515**	**$9,116**	**$4,209**	**$8,526**	**$3,714**	**$946**	**$13,200**
Indirect Costs	Cover Material Excav, Haul, Grade1	$1,223,555	$11,981	$59,004	$476,333	$148,493	$5,350	$31,028	$204,097	$0	$12,371	$133,759	$0	**$2,305,969**
	Top/Outslope Adjustment Grading[2]	$346,571	$1,125	$13,915	$44,795	$22,698	$85,747	$0	$0	$0	$107	$0	$700	**$515,658**
	Scarify, Seed & Mulch, Reveg[3]	$116,164	$1,409	$6,879	$43,884	$15,442	$24,719	$2,942	$23,063	$0	$1,335	$12,717	$4,721	**$253,275**
	Channels & Benches[4]	$715,040	$0	$0	$104,890	$47,303	$0	$0	$0	$0	$0	$0	$0	**$867,233**
	Demolition	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	**$457,421**
	Other[5]	$0	$0	$0	$0	$0	$0	$0	$28,009	$22,221	$0	$2,199	$0	**$52,429**
	Indirect Cost Totals	**$2,401,331**	**$14,514**	**$79,797**	**$669,902**	**$233,936**	**$115,816**	**$33,970**	**$255,169**	**$22,221**	**$13,812**	**$148,675**	**$5,422**	**$4,451,985**
	Indirect Cost/Acre	**$5,110**	**$2,546**	**$2,867**	**$3,773**	**$3,745**	**$1,158**	**$2,855**	**$2,735**	**$1,263**	**$2,558**	**$1,114**	**$284**	**$3,960**
	Total Cost	**$10,405,766**	**$62,895**	**$345,789**	**$2,902,909**	**$1,013,723**	**$501,869**	**$147,202**	**$1,105,730**	**$96,291**	**$59,854**	**$644,256**	**$23,494**	**$19,291,935**
	Total Cost Cover	$5,302,073	$51,916	$255,682	$2,064,109	$643,470	$23,182	$134,456	$884,419	$0	$53,606	$579,622	$0	$9,992,534
	Total Cost Top/Outslope Adjustment	$1,501,809	$4,874	$60,297	$194,113	$98,358	$371,571	$0	$0	$0	$463	$0	$3,035	$2,234,520
	Total Cost Earthwork	$6,803,882	$56,790	$315,978	$2,258,222	$741,828	$394,753	$134,456	$884,419	$0	$54,069	$579,622	$3,035	$12,227,054
	Capital Cost Re-Veg	$503,378	$6,106	$29,810	$190,163	$66,915	$107,116	$12,747	$99,939	$0	$5,784	$55,107	$20,459	$1,097,524
	Capital Cost Other[5]	$0	$0	$0	$0	$0	$0	$0	$121,372	$96,291	$0	$9,528	$0	$227,191
	Total Cost/Acre	**$22,143**	**$11,034**	**$12,425**	**$16,352**	**$16,227**	**$5,019**	**$12,370**	**$11,851**	**$5,471**	**$11,084**	**$4,828**	**$1,230**	**$17,160**
	Total Cost/Acre Cover	11,282	9,108	9,187	11,627	10,300	232	11,299	9,479	0	9,927	4,343	0	$8,888
	Total Cost/Acre Top/Outslope Adjustment	3,196	855	2,167	1,093	1,574	3,716	0	0	0	86	0	159	$1,988
	Total Cost/Acre Earthwork	$14,478	$9,963	$11,354	$12,720	$11,875	$3,948	$11,299	$9,479	$0	$10,013	$4,343	$159	$10,876
	Capital Cost/Acre Re-Veg	1,071	1,071	1,071	1,071	1,071	1,071	1,071	1,071	0	1,071	413	1,071	$976
	Capital Cost/Acre Other[5]	$0	$0	$0	$0	$0	$0	$0	$1,301	$5,471	$0	$71	$0	$202

1 Cover Material includes dozer assist, load, haul, grade cover, and water truck and motor grader for road maintenance and dust control during reclamation
2 Top/Outslope Adjustment Grading includes rough grading and ripping before placing cover
3 Revegetation includes scarifying, discing, drill seeding, mulching, crimping
4 Channels & Benches includes bench channels, downdrains, benches
5 Other includes fence and berm construction, plug and abandon wells
6 Total area does not include previously reclaimed acres

Truck Optimization

Notes and Assumptions

This sheet calculates the most efficient number of trucks (up to 10) per loader or shovel for loading cover material at borrow stockpiles. See the calculation sheet for more information.
May filter on equipement (D14) to show pertinent rows

																Productivity for X Truc				
ID	Task Description	Source Location 1	Destination Location 2	Equipment	Loading Method	Work Hour (min/hr)	Loader/ Shovel/ Excavator/ Cycles per Truck	Loader/Shovel/ Excavator Cycle Time (min)	Loader/Shovel/ Excavator Time Per Truck (min)	Truck Cycle Time Per Truck (min)	Max Number Trucks Per Loader/Shovel/ Excavator	Loader/ Shovel/ Excavator Cost ($/hr)	Loader Net Bucket Capacity (cy)	Haul Volume (cy)	Max Trucks Round Up	Max Trucks Round Down	9	8	7
1304-D-a-Tk4	Haul-Reclaim Pond	Main Tailings Impoundment MTI-4	-	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	9.27	1.43	$ 243.93	14.00	71,559.90	1,510.54	755.27	6,797.44	6,042.17	5,286.90
1504-D-a-Tk3	Haul-Outslope-pull	Cobre Haul Road CHR-4	-	Cat 725	Ld1	50.00	1.00	0.65	0.65	6.50	10.00	$ 243.93	14.00	41,383.90	1,184.21	1,076.55	968.90	861.24	753.59
1505-D-a-Tk3	Haul-Outslope-pull	Cobre Haul Road CHR-5	-	Cat 725	Ld1	50.00	1.00	0.65	0.65	6.50	10.00	$ 243.93	14.00	77,570.95	1,184.21	1,076.55	968.90	861.24	753.59
1506-D-a-Tk3	Haul-Crossings - ea	Cobre Haul Road CHR-6	-	Cat 725	Ex1	50.00	21.00	0.16	3.36	13.26	3.95	$ 80.08	0.88	6,590.65	277.06	207.79	623.37	554.11	484.85
1507-D-a-Tk3	Haul-Crossings - ca	Cobre Haul Road CHR-7	-	Cat 725	Ex1	50.00	21.00	0.16	3.36	13.26	3.95	$ 80.08	0.88	1,075.20	277.06	207.79	623.37	554.11	484.85
1001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-1	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	531,916.00	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
1002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-2	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	1,237,104.00	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
1003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-3	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	404,323.44	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
1004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	SWRDF-4	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	101,156.00	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
1101-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-1	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	11.44	1.76	$ 243.93	14.00	6,292.00	1,224.26	612.13	5,509.18	4,897.05	4,284.92
1102-D-b-Tk4	Haul-Cover	North Overburden Stockpile	N3SS-2	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	11.44	1.76	$ 243.93	14.00	21,296.00	1,224.26	612.13	5,509.18	4,897.05	4,284.92
1201-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-1	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	13.11	2.02	$ 243.93	14.00	26,964.10	1,601.27	1,067.51	4,803.81	4,270.05	3,736.29
1202-D-b-Tk4	Haul-Cover	North Overburden Stockpile	LGWRF-2	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	13.11	2.02	$ 243.93	14.00	107,733.10	1,601.27	1,067.51	4,803.81	4,270.05	3,736.29
1301-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-1	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	16.60	2.55	$ 243.93	14.00	523,688.00	1,265.14	843.42	3,795.41	3,373.69	2,951.98
1302-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-2	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	16.60	2.55	$ 243.93	14.00	175,837.20	1,265.14	843.42	3,795.41	3,373.69	2,951.98
1303-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MTI-3	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	16.60	2.55	$ 243.93	14.00	159,720.00	1,265.14	843.42	3,795.41	3,373.69	2,951.98
1401-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-1	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	14.69	2.26	$ 243.93	14.00	276,615.68	1,429.47	952.98	4,288.41	3,811.92	3,335.43
1402-D-b-Tk4	Haul-Cover	North Overburden Stockpile	MGTI-2	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	14.69	2.26	$ 243.93	14.00	25,739.12	1,429.47	952.98	4,288.41	3,811.92	3,335.43
1601-D-b-Tk4	Haul-Cover	North Overburden Stockpile	PB-1	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	57,596.00	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
1700-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	16.07	2.47	$ 243.93	14.00	451,572.00	1,306.97	871.31	3,920.90	3,485.24	3,049.59
2001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-02	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	13.26	2.04	$ 243.93	14.00	48.40	1,583.29	1,055.52	4,749.86	4,222.09	3,694.33
2002-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-03	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	12.71	1.96	$ 243.93	14.00	3,000.80	1,101.47	550.73	4,956.60	4,405.86	3,855.13
2003-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-04	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	12.71	1.96	$ 243.93	14.00	2,420.00	1,101.47	550.73	4,956.60	4,405.86	3,855.13
2004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-05	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	13.26	2.04	$ 243.93	14.00	1,839.20	1,583.29	1,055.52	4,749.86	4,222.09	3,694.33
2005-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-06	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	14.93	2.30	$ 243.93	14.00	968.00	1,406.44	937.62	4,219.31	3,750.49	3,281.68
2006-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-07	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	12.71	1.96	$ 243.93	14.00	2,226.40	1,101.47	550.73	4,956.60	4,405.86	3,855.13
2007-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-08	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	2,516.80	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
2008-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-09	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	1,645.60	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
2009-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-10	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	19.99	3.08	$ 243.93	14.00	4,065.60	1,400.59	1,050.44	3,151.33	2,801.19	2,451.04
2010-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Cntmnt-11	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	13.27	2.04	$ 243.93	14.00	7,405.20	1,583.07	1,055.38	4,749.21	4,221.52	3,693.83
3001-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-1	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	16.06	2.47	$ 243.93	14.00	242,000.00	1,307.45	871.64	3,922.36	3,486.54	3,050.72
3004-D-b-Tk4	Haul-Cover	North Overburden Stockpile	Misc-4	Komatsu 730E	Ld1	50.00	10.00	0.65	6.50	16.28	2.50	$ 243.93	14.00	6,998.64	1,289.78	859.86	3,869.35	3,439.42	3,009.50

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ates the most efficient number of trucks (up to 10) per loader or shovel for loading cover material at
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ipement (D14) to show pertinent rows

				cks (cy/hr)					Task Time for X Trucks (hr)															
Task Description	**Source Location 1**	**Destination Location 2**	**Equipment**	**6**	**5**	**4**	**3**	**2**	**Max Trucks Round Up**	**Max Trucks Round Down**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**Loader/Shovel Task Time (hr)**	**Truck Cost ($/hr)**	**Max Trucks Round Up**	**Max Trucks Round Down**	**9**	**8**
Haul-Reclaim Ponc	Main Tailings Impoundment MTI-4	-	Komatsu 730E	4,531.63	3,776.36	3,021.08	2,265.81	1,510.54	47.37	94.75	10.53	11.84	13.54	15.79	18.95	23.69	31.58	47.37	66.45	$ 246.06	$ 48,909.23	$ 46,424.88	$ 163,361.89	$ 147,011.51
Haul-Outslope-pulll	Cobre Haul Road CHR-4	-	Cat 725	645.93	538.28	430.62	322.97	215.31	34.95	38.44	42.71	48.05	54.92	64.07	76.88	96.10	128.14	192.21	38.43	$ 97.38	$ 50,538.28	$ 46,812.25	$ 47,854.11	$ 49,156.45
Haul-Outslope-pulll	Cobre Haul Road CHR-5	-	Cat 725	645.93	538.28	430.62	322.97	215.31	65.50	72.06	80.06	90.07	102.94	120.09	144.11	180.14	240.18	360.28	72.03	$ 97.38	$ 94,730.14	$ 87,745.97	$ 89,698.87	$ 92,139.99
Haul-Crossings - ei	Cobre Haul Road CHR-6	-	Cat 725	415.58	346.32	277.06	207.79	138.53	23.79	31.72	10.57	11.89	13.59	15.86	19.03	23.79	31.72	47.58	20.09	$ 97.38	$ 11,171.30	$ 11,806.29	$ 19,212.72	$ 17,256.70
Haul-Crossings - ci	Cobre Haul Road CHR-7	-	Cat 725	415.58	346.32	277.06	207.79	138.53	3.88	5.17	1.72	1.94	2.22	2.59	3.10	3.88	5.17	7.76	3.28	$ 97.38	$ 1,822.49	$ 1,926.08	$ 3,134.37	$ 2,815.26
Haul-Cover	North Overburden Stockpile	SWRDF-1	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	379.78	506.37	168.79	189.89	217.02	253.19	303.82	379.78	506.37	759.56	493.92	$ 246.06	$ 606,619.90	$ 497,312.28	$ 1,214,294.66	$ 1,092,759.71
Haul-Cover	North Overburden Stockpile	SWRDF-2	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	883.27	1,177.70	392.57	441.64	504.73	588.85	706.62	883.27	1,177.70	1,766.54	1,148.74	$ 246.06	$ 1,410,846.65	$ 1,156,624.37	$ 2,824,146.64	$ 2,541,486.65
Haul-Cover	North Overburden Stockpile	SWRDF-3	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	288.68	384.91	128.30	144.34	164.96	192.45	230.94	288.68	384.91	577.36	375.44	$ 246.06	$ 461,107.85	$ 378,020.23	$ 923,017.53	$ 830,635.60
Haul-Cover	North Overburden Stockpile	SWRDF-4	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	72.22	96.30	32.10	36.11	41.27	48.15	57.78	72.22	96.30	144.45	93.93	$ 246.06	$ 115,362.66	$ 94,575.31	$ 230,925.92	$ 207,813.27
Haul-Cover	North Overburden Stockpile	N3SS-1	Komatsu 730E	3,672.79	3,060.65	2,448.52	1,836.39	1,224.26	5.14	10.28	1.14	1.28	1.47	1.71	2.06	2.57	3.43	5.14	5.84	$ 246.06	$ 4,300.41	$ 5,036.49	$ 14,363.81	$ 12,926.18
Haul-Cover	North Overburden Stockpile	N3SS-2	Komatsu 730E	3,672.79	3,060.65	2,448.52	1,836.39	1,224.26	17.39	34.79	3.87	4.35	4.97	5.80	6.96	8.70	11.60	17.39	19.77	$ 246.06	$ 14,555.23	$ 17,046.60	$ 48,615.98	$ 43,750.16
Haul-Cover	North Overburden Stockpile	LGWRF-1	Komatsu 730E	3,202.54	2,668.78	2,135.03	1,601.27	1,067.51	16.84	25.26	5.61	6.31	7.22	8.42	10.10	12.63	16.84	25.26	25.04	$ 246.06	$ 24,590.12	$ 18,591.68	$ 61,555.51	$ 55,394.61
Haul-Cover	North Overburden Stockpile	LGWRF-2	Komatsu 730E	3,202.54	2,668.78	2,135.03	1,601.27	1,067.51	67.28	100.92	22.43	25.23	28.83	33.64	40.37	50.46	67.28	100.92	100.04	$ 246.06	$ 98,248.04	$ 74,281.70	$ 245,940.58	$ 221,325.16
Haul-Cover	North Overburden Stockpile	MTI-1	Komatsu 730E	2,530.27	2,108.56	1,686.85	1,265.14	843.42	413.94	620.91	137.98	155.23	177.40	206.97	248.36	310.45	413.94	620.91	486.28	$ 246.06	$ 477,581.36	$ 457,017.25	$ 1,195,511.22	$ 1,075,856.24
Haul-Cover	North Overburden Stockpile	MTI-2	Komatsu 730E	2,530.27	2,108.56	1,686.85	1,265.14	843.42	138.99	208.48	46.33	52.12	59.57	69.49	83.39	104.24	138.99	208.48	163.28	$ 246.06	$ 160,356.11	$ 153,451.36	$ 401,413.33	$ 361,237.13
Haul-Cover	North Overburden Stockpile	MTI-3	Komatsu 730E	2,530.27	2,108.56	1,686.85	1,265.14	843.42	126.25	189.37	42.08	47.34	54.11	63.12	75.75	94.69	126.25	189.37	148.31	$ 246.06	$ 145,657.90	$ 139,386.04	$ 364,619.87	$ 328,126.21
Haul-Cover	North Overburden Stockpile	MGTI-1	Komatsu 730E	2,858.94	2,382.45	1,905.96	1,429.47	952.98	193.51	290.26	64.50	72.57	82.93	96.75	116.11	145.13	193.51	290.26	256.86	$ 246.06	$ 252,261.83	$ 213,648.21	$ 631,477.42	$ 568,274.82
Haul-Cover	North Overburden Stockpile	MGTI-2	Komatsu 730E	2,858.94	2,382.45	1,905.96	1,429.47	952.98	18.01	27.01	6.00	6.75	7.72	9.00	10.80	13.50	18.01	27.01	23.90	$ 246.06	$ 23,472.99	$ 19,879.99	$ 58,759.04	$ 52,878.04
Haul-Cover	North Overburden Stockpile	PB-1	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	41.12	54.83	18.28	20.56	23.50	27.42	32.90	41.12	54.83	82.25	53.48	$ 246.06	$ 65,684.96	$ 53,849.10	$ 131,484.14	$ 118,324.30
Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Komatsu 730E	2,613.93	2,178.28	1,742.62	1,306.97	871.31	345.51	518.27	115.17	129.57	148.08	172.76	207.31	259.13	345.51	518.27	419.32	$ 246.06	$ 411,814.61	$ 381,469.52	$ 1,030,879.82	$ 927,702.29
Haul-Cover	North Overburden Stockpile	Cntmnt-02	Komatsu 730E	3,166.57	2,638.81	2,111.05	1,583.29	1,055.52	0.03	0.05	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.05	0.04	$ 246.06	$ 44.14	$ 33.75	$ 110.49	$ 99.43
Haul-Cover	North Overburden Stockpile	Cntmnt-03	Komatsu 730E	3,304.40	2,753.67	2,202.93	1,652.20	1,101.47	2.72	5.45	0.61	0.68	0.78	0.91	1.09	1.36	1.82	2.72	2.79	$ 246.06	$ 2,050.96	$ 2,669.81	$ 6,850.43	$ 6,164.80
Haul-Cover	North Overburden Stockpile	Cntmnt-04	Komatsu 730E	3,304.40	2,753.67	2,202.93	1,652.20	1,101.47	2.20	4.39	0.49	0.55	0.63	0.73	0.88	1.10	1.46	2.20	2.25	$ 246.06	$ 1,654.00	$ 2,153.07	$ 5,524.54	$ 4,971.61
Haul-Cover	North Overburden Stockpile	Cntmnt-05	Komatsu 730E	3,166.57	2,638.81	2,111.05	1,583.29	1,055.52	1.16	1.74	0.39	0.44	0.50	0.58	0.70	0.87	1.16	1.74	1.71	$ 246.06	$ 1,677.27	$ 1,282.53	$ 4,198.65	$ 3,778.42
Haul-Cover	North Overburden Stockpile	Cntmnt-06	Komatsu 730E	2,812.87	2,344.06	1,875.25	1,406.44	937.62	0.69	1.03	0.23	0.26	0.29	0.34	0.41	0.52	0.69	1.03	0.90	$ 246.06	$ 882.78	$ 759.89	$ 2,209.82	$ 1,988.64
Haul-Cover	North Overburden Stockpile	Cntmnt-07	Komatsu 730E	3,304.40	2,753.67	2,202.93	1,652.20	1,101.47	2.02	4.04	0.45	0.51	0.58	0.67	0.81	1.01	1.35	2.02	2.07	$ 246.06	$ 1,521.68	$ 1,980.82	$ 5,082.58	$ 4,573.88
Haul-Cover	North Overburden Stockpile	Cntmnt-08	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	1.80	2.40	0.80	0.90	1.03	1.20	1.44	1.80	2.40	3.59	2.34	$ 246.06	$ 2,870.27	$ 2,353.07	$ 5,745.53	$ 5,170.47
Haul-Cover	North Overburden Stockpile	Cntmnt-09	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	1.17	1.57	0.52	0.59	0.67	0.78	0.94	1.17	1.57	2.35	1.53	$ 246.06	$ 1,876.71	$ 1,538.55	$ 3,756.69	$ 3,380.69
Haul-Cover	North Overburden Stockpile	Cntmnt-10	Komatsu 730E	2,100.89	1,750.74	1,400.59	1,050.44	700.30	2.90	3.87	1.29	1.45	1.66	1.94	2.32	2.90	3.87	5.81	3.78	$ 246.06	$ 4,636.59	$ 3,801.11	$ 9,281.23	$ 8,352.30
Haul-Cover	North Overburden Stockpile	Cntmnt-11	Komatsu 730E	3,166.14	2,638.45	2,110.76	1,583.07	1,055.38	4.68	7.02	1.56	1.75	2.00	2.34	2.81	3.51	4.68	7.02	6.88	$ 246.06	$ 6,753.23	$ 5,164.56	$ 16,905.10	$ 15,213.12
Haul-Cover	North Overburden Stockpile	Misc-1	Komatsu 730E	2,614.91	2,179.09	1,743.27	1,307.45	871.64	185.09	277.64	61.70	69.41	79.33	92.55	111.06	138.82	185.09	277.64	224.71	$ 246.06	$ 220,693.79	$ 204,355.43	$ 552,454.35	$ 497,160.92
Haul-Cover	North Overburden Stockpile	Misc-4	Komatsu 730E	2,579.57	2,149.64	1,719.71	1,289.78	859.86	5.43	8.14	1.81	2.03	2.33	2.71	3.26	4.07	5.43	8.14	6.50	$ 246.06	$ 6,382.46	$ 5,990.92	$ 15,976.98	$ 14,377.89

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ates the most efficient number of trucks (up to 10) per loader or shovel for loading cover material at
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Task Description	Source Location 1	Destination Location 2	Equipment	Cost of Using X Trucks per Loader ($) 7	6	5	4	3	2	Lowest Cost ($)	Optimum Number of Trucks Per Loader/Shovel/Excavator	Optimum Number of Trucks Per Loader/Shovel/Excavator Within Max
Haul-Reclaim Ponc	Main Tailings Impoundment MTI-4	-	Komatsu 730E	$ 130,661.13	$ 114,310.75	$ 97,960.37	$ 81,609.99	$ 65,259.61	$ 48,909.23	$ 46,424.88	1	1.00
Haul-Outslope-pulll	Cobre Haul Road CHR-4	-	Cat 725	$ 50,830.87	$ 53,063.44	$ 56,189.04	$ 60,877.43	$ 68,691.42	$ 84,319.40	$ 46,812.25	10	10.00
Haul-Outslope-pulll	Cobre Haul Road CHR-5	-	Cat 725	$ 95,278.58	$ 99,463.35	$ 105,322.05	$ 114,110.08	$ 128,756.81	$ 158,050.26	$ 87,745.97	10	10.00
Haul-Crossings - ei	Cobre Haul Road CHR-6	-	Cat 725	$ 15,300.67	$ 13,344.64	$ 11,388.61	$ 11,171.30	$ 11,806.29	$ 13,076.27	$ 11,171.30	4	4.00
Haul-Crossings - ci	Cobre Haul Road CHR-7	-	Cat 725	$ 2,496.15	$ 2,177.05	$ 1,857.94	$ 1,822.49	$ 1,926.08	$ 2,133.27	$ 1,822.49	4	4.00
Haul-Cover	North Overburden Stockpile	SWRDF-1	Komatsu 730E	$ 971,224.76	$ 849,689.81	$ 728,154.85	$ 606,619.90	$ 497,312.28	$ 559,070.77	$ 497,312.28	3	3.00
Haul-Cover	North Overburden Stockpile	SWRDF-2	Komatsu 730E	$ 2,258,826.65	$ 1,976,166.65	$ 1,693,506.65	$ 1,410,846.65	$ 1,156,624.37	$ 1,300,259.22	$ 1,156,624.37	3	3.00
Haul-Cover	North Overburden Stockpile	SWRDF-3	Komatsu 730E	$ 738,253.66	$ 645,871.73	$ 553,489.79	$ 461,107.85	$ 378,020.23	$ 424,964.50	$ 378,020.23	3	3.00
Haul-Cover	North Overburden Stockpile	SWRDF-4	Komatsu 730E	$ 184,700.61	$ 161,587.96	$ 138,475.31	$ 115,362.66	$ 94,575.31	$ 106,320.10	$ 94,575.31	3	3.00
Haul-Cover	North Overburden Stockpile	N3SS-1	Komatsu 730E	$ 11,488.55	$ 10,050.93	$ 8,613.30	$ 7,175.67	$ 5,738.04	$ 4,300.41	$ 4,300.41	2	2.00
Haul-Cover	North Overburden Stockpile	N3SS-2	Komatsu 730E	$ 38,884.34	$ 34,018.52	$ 29,152.70	$ 24,286.88	$ 19,421.05	$ 14,555.23	$ 14,555.23	2	2.00
Haul-Cover	North Overburden Stockpile	LGWRF-1	Komatsu 730E	$ 49,233.72	$ 43,072.82	$ 36,911.92	$ 30,751.02	$ 24,590.12	$ 18,591.68	$ 18,591.68	2	2.00
Haul-Cover	North Overburden Stockpile	LGWRF-2	Komatsu 730E	$ 196,709.73	$ 172,094.31	$ 147,478.89	$ 122,863.47	$ 98,248.04	$ 74,281.70	$ 74,281.70	2	2.00
Haul-Cover	North Overburden Stockpile	MTI-1	Komatsu 730E	$ 956,201.26	$ 836,546.29	$ 716,891.31	$ 597,236.34	$ 477,581.36	$ 457,017.25	$ 457,017.25	2	2.00
Haul-Cover	North Overburden Stockpile	MTI-2	Komatsu 730E	$ 321,060.92	$ 280,884.72	$ 240,708.52	$ 200,532.31	$ 160,356.11	$ 153,451.36	$ 153,451.36	2	2.00
Haul-Cover	North Overburden Stockpile	MTI-3	Komatsu 730E	$ 291,632.55	$ 255,138.89	$ 218,645.22	$ 182,151.56	$ 145,657.90	$ 139,386.04	$ 139,386.04	2	2.00
Haul-Cover	North Overburden Stockpile	MGTI-1	Komatsu 730E	$ 505,072.22	$ 441,869.63	$ 378,667.03	$ 315,464.43	$ 252,261.83	$ 213,648.21	$ 213,648.21	2	2.00
Haul-Cover	North Overburden Stockpile	MGTI-2	Komatsu 730E	$ 46,997.03	$ 41,116.02	$ 35,235.01	$ 29,354.00	$ 23,472.99	$ 19,879.99	$ 19,879.99	2	2.00
Haul-Cover	North Overburden Stockpile	PB-1	Komatsu 730E	$ 105,164.46	$ 92,004.63	$ 78,844.79	$ 65,684.96	$ 53,849.10	$ 60,536.33	$ 53,849.10	3	3.00
Haul-Cover	North Overburden Stockpile	Hanover Mountain Deposit	Komatsu 730E	$ 824,524.75	$ 721,347.22	$ 618,169.68	$ 514,992.15	$ 411,814.61	$ 381,469.52	$ 381,469.52	2	2.00
Haul-Cover	North Overburden Stockpile	Cntmnt-02	Komatsu 730E	$ 88.37	$ 77.31	$ 66.26	$ 55.20	$ 44.14	$ 33.75	$ 33.75	2	2.00
Haul-Cover	North Overburden Stockpile	Cntmnt-03	Komatsu 730E	$ 5,479.16	$ 4,793.52	$ 4,107.88	$ 3,422.24	$ 2,736.60	$ 2,050.96	$ 2,050.96	2	2.00
Haul-Cover	North Overburden Stockpile	Cntmnt-04	Komatsu 730E	$ 4,418.67	$ 3,865.74	$ 3,312.81	$ 2,759.87	$ 2,206.94	$ 1,654.00	$ 1,654.00	2	2.00
Haul-Cover	North Overburden Stockpile	Cntmnt-05	Komatsu 730E	$ 3,358.19	$ 2,937.96	$ 2,517.73	$ 2,097.50	$ 1,677.27	$ 1,282.53	$ 1,282.53	2	2.00
Haul-Cover	North Overburden Stockpile	Cntmnt-06	Komatsu 730E	$ 1,767.47	$ 1,546.30	$ 1,325.12	$ 1,103.95	$ 882.78	$ 759.89	$ 759.89	2	2.00
Haul-Cover	North Overburden Stockpile	Cntmnt-07	Komatsu 730E	$ 4,065.18	$ 3,556.48	$ 3,047.78	$ 2,539.08	$ 2,030.38	$ 1,521.68	$ 1,521.68	2	2.00
Haul-Cover	North Overburden Stockpile	Cntmnt-08	Komatsu 730E	$ 4,595.42	$ 4,020.37	$ 3,445.32	$ 2,870.27	$ 2,353.07	$ 2,645.28	$ 2,353.07	3	3.00
Haul-Cover	North Overburden Stockpile	Cntmnt-09	Komatsu 730E	$ 3,004.70	$ 2,628.70	$ 2,252.71	$ 1,876.71	$ 1,538.55	$ 1,729.61	$ 1,538.55	3	3.00
Haul-Cover	North Overburden Stockpile	Cntmnt-10	Komatsu 730E	$ 7,423.37	$ 6,494.44	$ 5,565.51	$ 4,636.59	$ 3,801.11	$ 4,273.15	$ 3,801.11	3	3.00
Haul-Cover	North Overburden Stockpile	Cntmnt-11	Komatsu 730E	$ 13,521.15	$ 11,829.17	$ 10,137.19	$ 8,445.21	$ 6,753.23	$ 5,164.56	$ 5,164.56	2	2.00
Haul-Cover	North Overburden Stockpile	Misc-1	Komatsu 730E	$ 441,867.50	$ 386,574.07	$ 331,280.64	$ 275,987.22	$ 220,693.79	$ 204,355.43	$ 204,355.43	2	2.00
Haul-Cover	North Overburden Stockpile	Misc-4	Komatsu 730E	$ 12,778.81	$ 11,179.72	$ 9,580.64	$ 7,981.55	$ 6,382.46	$ 5,990.92	$ 5,990.92	2	2.00

Vegetation Maintenance Costs - Full site

Based on observations of previously reclaimed areas, the annual vegetation failure is conservatively estimated to be 2% failure every year for a total of 12 years, starting the year reclamation is completed.
Vegetation maintenance begins at each facility sub-area/location the year that reclamation is completed for that facility sub-area/location.
May filter on equipement (D14) to show pertinent rows
Assumptions/Inputs:

Year 0 = 2023
Year 99 = 2123
No. Years Veg Maint = 12
% loss per year = 2%

ID	Description	Source Location 1	Destination Location 2	Total Area (ac)	Approx. Year Reclamation Start	Approx. Year Veg Maintenance Start	Approx. Year Veg Maintenance Complete	Number of Years of Veg Maintenance	% Loss Per Year	Veg Maint Area (ac)	Fuel Unit Cost ($/ac)	Veg Maint Unit Cost ($/ac)	Fuel Cost ($)	Veg Maint Cost ($)	Maint. Description
1001-M-e-U24	Post-Closure O&M-Top-Final Grade	South Waste Rock Disposal Facility SWRDF-1	-	109.9	2024	2027	2038	12	2%	26.4	$3.85	$820.12	$101	$21,631	2% of veg fails every year for 12 years
1002-M-e-U24	Post-Closure O&M-3:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-2	-	255.6	2025	2028	2039	12	2%	61.3	$3.85	$820.12	$236	$50,309	2% of veg fails every year for 12 years
1003-M-e-U24	Post-Closure O&M-2.5:1 Interbench Outslope-Final Grade	South Waste Rock Disposal Facility SWRDF-3	-	83.5	2024	2027	2038	12	2%	20.0	$3.85	$820.12	$77	$16,443	2% of veg fails every year for 12 years
1004-M-e-U24	Post-Closure O&M-Laydown Yard N of SWRDF-Final Grade	South Waste Rock Disposal Facility SWRDF-4	-	20.9	2024	2027	2038	12	2%	5.0	$3.85	$820.12	$19	$4,114	2% of veg fails every year for 12 years
1101-M-e-U24	Post-Closure O&M-Top-Final Grade	No. 3 Shaft Stockpile N3SS-1	-	1.3	2026	2029	2040	12	2%	0.3	$3.85	$820.12	$1	$256	2% of veg fails every year for 12 years
1102-M-e-U24	Post-Closure O&M-Outslope-Final Grade	No. 3 Shaft Stockpile N3SS-2	-	4.4	2026	2029	2040	12	2%	1.1	$3.85	$820.12	$4	$866	2% of veg fails every year for 12 years
1201-M-e-U24	Post-Closure O&M-Top-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-1	-	5.6	2026	2029	2040	12	2%	1.3	$3.85	$820.12	$5	$1,097	2% of veg fails every year for 12 years
1202-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Low Grade Ore Waste Rock Facility LGWRF-2	-	22.3	2026	2029	2040	12	2%	5.3	$3.85	$820.12	$21	$4,381	2% of veg fails every year for 12 years
1301-M-e-U24	Post-Closure O&M-Top-Final Grade	Main Tailings Impoundment MTI-1	-	108.2	2026	2029	2040	12	2%	26.0	$3.85	$820.12	$100	$21,297	2% of veg fails every year for 12 years
1302-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Main Tailings Impoundment MTI-2	-	36.3	2026	2029	2040	12	2%	8.7	$3.85	$820.12	$34	$7,151	2% of veg fails every year for 12 years
1303-M-e-U24	Post-Closure O&M-Reclaim Pond-Final Grade	Main Tailings Impoundment MTI-3	-	33.0	2026	2029	2040	12	2%	7.9	$3.85	$820.12	$30	$6,495	2% of veg fails every year for 12 years
1401-M-e-U24	Post-Closure O&M-Top-Final Grade	Magnetite Tailings Impoundment MGTI-1	-	57.2	2027	2030	2041	12	2%	13.7	$3.85	$820.12	$53	$11,249	2% of veg fails every year for 12 years
1402-M-e-U24	Post-Closure O&M-Outslope-Final Grade	Magnetite Tailings Impoundment MGTI-2	-	5.3	2027	2030	2041	12	2%	1.3	$3.85	$820.12	$5	$1,047	2% of veg fails every year for 12 years
1501-M-e-U24	Post-Closure O&M-Top-Final Grade	Cobre Haul Road CHR-1	-	100.0	2027	2030	2041	12	2%	24.0	$3.85	$820.12	$92	$19,683	2% of veg fails every year for 12 years
1502-M-e-U24	Post-Closure O&M-Outslope-pushdown-Final Grade	Cobre Haul Road CHR-2	-	-	2027	2030	2041	12	2%	-	$3.85	$820.12	$0	$0	2% of veg fails every year for 12 years
1503-M-e-U24	Post-Closure O&M-Outslope-pullback Ex Only 2.5:1-Final Grade	Cobre Haul Road CHR-3	-	-	2027	2030	2041	12	2%	-	$3.85	$820.12	$0	$0	2% of veg fails every year for 12 years
1505-M-e-U24	Post-Closure O&M-Outslope-pullback LdTk 2:1-Final Grade	Cobre Haul Road CHR-5	-	-	2027	2030	2041	12	2%	-	$3.85	$820.12	$0	$0	2% of veg fails every year for 12 years
1506-M-e-U24	Post-Closure O&M-Crossings - earth-Final Grade	Cobre Haul Road CHR-6	-	-	2027	2030	2041	12	2%	-	$3.85	$820.12	$0	$0	2% of veg fails every year for 12 years
1507-M-e-U24	Post-Closure O&M-Crossings - concrete-Final Grade	Cobre Haul Road CHR-7	-	-	2027	2030	2041	12	2%	-	$3.85	$820.12	$0	$0	2% of veg fails every year for 12 years
1601-M-e-U24	Post-Closure O&M-Top-Final Grade	Pearson Barnes Mine Area PB-1	-	11.9	2027	2030	2041	12	2%	2.9	$3.85	$820.12	$11	$2,342	2% of veg fails every year for 12 years
2001-M-e-U24	Post-Closure O&M-Blackman's Seep (Pond #2) -Final Grade	Containments Cntmnt-02	-	0.0	2027	2030	2041	12	2%	0.0	$3.85	$820.12	$0	$2	2% of veg fails every year for 12 years
2002-M-e-U24	Post-Closure O&M-Decant Pond #4-Final Grade	Containments Cntmnt-03	-	0.6	2027	2030	2041	12	2%	0.1	$3.85	$820.12	$1	$122	2% of veg fails every year for 12 years
2003-M-e-U24	Post-Closure O&M-East WRF Containment-Final Grade	Containments Cntmnt-04	-	0.5	2027	2030	2041	12	2%	0.1	$3.85	$820.12	$0	$98	2% of veg fails every year for 12 years
2004-M-e-U24	Post-Closure O&M-Grape Gulch Pond #3-Final Grade	Containments Cntmnt-05	-	0.4	2027	2030	2041	12	2%	0.1	$3.85	$820.12	$0	$75	2% of veg fails every year for 12 years
2005-M-e-U24	Post-Closure O&M-Magnetite Seepage Pond-Final Grade	Containments Cntmnt-06	-	0.2	2027	2030	2041	12	2%	0.0	$3.85	$820.12	$0	$39	2% of veg fails every year for 12 years
2006-M-e-U24	Post-Closure O&M-North Tailings Decant Pond-Final Grade	Containments Cntmnt-07	-	0.5	2027	2030	2041	12	2%	0.1	$3.85	$820.12	$0	$91	2% of veg fails every year for 12 years
2007-M-e-U24	Post-Closure O&M-SWRF Dam 1-Final Grade	Containments Cntmnt-08	-	0.5	2027	2030	2041	12	2%	0.1	$3.85	$820.12	$0	$102	2% of veg fails every year for 12 years
2008-M-e-U24	Post-Closure O&M-SWRF Dam 2-Final Grade	Containments Cntmnt-09	-	0.3	2027	2030	2041	12	2%	0.1	$3.85	$820.12	$0	$67	2% of veg fails every year for 12 years
2009-M-e-U24	Post-Closure O&M-SWRF Dam 3-Final Grade	Containments Cntmnt-10	-	0.8	2027	2030	2041	12	2%	0.2	$3.85	$820.12	$1	$165	2% of veg fails every year for 12 years
2010-M-e-U24	Post-Closure O&M-Upper Creek Containment Pond 1 -Final Grade	Containments Cntmnt-11	-	1.5	2027	2030	2041	12	2%	0.4	$3.85	$820.12	$1	$301	2% of veg fails every year for 12 years
3001-M-e-U24	Post-Closure O&M-Unplanned Future Disturbance Areas-Final Grade	Miscellaneous Misc-1	-	50.0	2027	2030	2041	12	2%	12.0	$3.85	$820.12	$46	$9,841	2% of veg fails every year for 12 years
3004-M-e-U24	Post-Closure O&M-Tailings Pipeline Corridor-Final Grade	Miscellaneous Misc-4	-	1.4	2027	2030	2041	12	2%	0.3	$3.85	$820.12	$1	$285	2% of veg fails every year for 12 years
			TOTAL O&M AREA	912 **AC**					**TOTAL VEG MAINT AREA**	219 **AC**		**TOTAL**	$842	$179,550	

Operations & Maintenance -Full Site Reclamation begins 2023 (Year 0)

EROSION CONTROL [1]

	Years 0-12	Years 13-39	Years 40-99
Equipment Base:	$2,923	$2,923	$2,923 $/day
Fuel Base	$382	$382	$382
Time:	12	4	1 day/yr
Equiment Annual:	$35,080	$11,693	$2,923 $/yr
Fuel Annual:	$4,587	$1,529	$382 $/yr

Year	Annual Current Equipment Cost ($)	Annual Current Fuel. Cost ($)	Notes
0	$0	$0	Weighted based on total reclaimed area
1	$8,243	$1,078	Weighted based on total reclaimed area
2	$18,072	$2,363	Weighted based on total reclaimed area
3	$26,189	$3,424	Weighted based on total reclaimed area
4	$35,080	$4,587	Weighted based on total reclaimed area
5	$35,080	$4,587	
6	$35,080	$4,587	
7	$35,080	$4,587	
8	$35,080	$4,587	
9	$35,080	$4,587	
10	$35,080	$4,587	
11	$35,080	$4,587	
12	$35,080	$4,587	
13	$35,080	$1,529	
14	$35,080	$1,529	
15	$35,080	$1,529	
16	$35,080	$1,529	
17	$35,080	$1,529	
18	$35,080	$1,529	
19	$35,080	$1,529	
20	$11,693	$1,529	
21	$11,693	$1,529	
22	$11,693	$1,529	
23	$11,693	$1,529	
24	$11,693	$1,529	
25	$11,693	$1,529	
26	$11,693	$1,529	
27	$11,693	$1,529	
28	$11,693	$1,529	
29	$11,693	$1,529	
30	$11,693	$1,529	
31	$11,693	$1,529	
32	$11,693	$1,529	
33	$11,693	$1,529	
34	$11,693	$1,529	
35	$11,693	$1,529	
36	$11,693	$1,529	
37	$11,693	$1,529	
38	$11,693	$1,529	
39	$11,693	$1,529	
40	$2,923	$382	
41	$2,923	$382	
42	$2,923	$382	
43	$2,923	$382	
44	$2,923	$382	
45	$2,923	$382	
46	$2,923	$382	
47	$2,923	$382	
48	$2,923	$382	
49	$2,923	$382	
50	$2,923	$382	
51	$2,923	$382	
52	$2,923	$382	
53	$2,923	$382	
54	$2,923	$382	
55	$2,923	$382	
56	$2,923	$382	
57	$2,923	$382	
58	$2,923	$382	
59	$2,923	$382	
60	$2,923	$382	
61	$2,923	$382	
62	$2,923	$382	
63	$2,923	$382	
64	$2,923	$382	
65	$2,923	$382	
66	$2,923	$382	
67	$2,923	$382	
68	$2,923	$382	
69	$2,923	$382	
70	$2,923	$382	
71	$2,923	$382	
72	$2,923	$382	
73	$2,923	$382	
74	$2,923	$382	
75	$2,923	$382	
76	$2,923	$382	
77	$2,923	$382	
78	$2,923	$382	
79	$2,923	$382	
80	$2,923	$382	
81	$2,923	$382	
82	$2,923	$382	
83	$2,923	$382	
84	$2,923	$382	
85	$2,923	$382	
86	$2,923	$382	
87	$2,923	$382	
88	$2,923	$382	
89	$2,923	$382	
90	$2,923	$382	
91	$2,923	$382	
92	$2,923	$382	
93	$2,923	$382	
94	$2,923	$382	
95	$2,923	$382	
96	$2,923	$382	
97	$2,923	$382	
98	$2,923	$382	
99	$2,923	$382	
Capital Cost	$1,023,060	$112,370	

ROAD MAINTENANCE [2]

	Years 0-19	Years 20-39	Years 40-99
Equipment Base:	$4,946	$4,946	$4,946 $/month
Fuel Base	$1,240	$1,240	$1,240
Time:	4	2	1 month/yr
Equipment Annual:	$19,784	$9,892	$4,946 $/yr
Fuel Annual:	$4,961	$2,481	$1,240 $/yr

Year	Annual Current Euipment Cost ($)	Annual Current Fuel. Cost ($)	Notes
0	$0	$0	Weighted based on total reclaimed area
1	$4,649	$1,166	Weighted based on total reclaimed area
2	$10,192	$2,556	Weighted based on total reclaimed area
3	$14,769	$3,704	Weighted based on total reclaimed area
4	$19,784	$4,961	Weighted based on total reclaimed area
5	$19,784	$4,961	
6	$19,784	$4,961	
7	$19,784	$4,961	
8	$19,784	$4,961	
9	$19,784	$4,961	
10	$19,784	$4,961	
11	$19,784	$4,961	
12	$19,784	$4,961	
13	$19,784	$4,961	
14	$19,784	$4,961	
15	$19,784	$4,961	
16	$19,784	$4,961	
17	$19,784	$4,961	
18	$19,784	$4,961	
19	$19,784	$4,961	
20	$9,892	$2,481	
21	$9,892	$2,481	
22	$9,892	$2,481	
23	$9,892	$2,481	
24	$9,892	$2,481	
25	$9,892	$2,481	
26	$9,892	$2,481	
27	$9,892	$2,481	
28	$9,892	$2,481	
29	$9,892	$2,481	
30	$9,892	$2,481	
31	$9,892	$2,481	
32	$9,892	$2,481	
33	$9,892	$2,481	
34	$9,892	$2,481	
35	$9,892	$2,481	
36	$9,892	$2,481	
37	$9,892	$2,481	
38	$9,892	$2,481	
39	$9,892	$2,481	
40	$4,946	$1,240	
41	$4,946	$1,240	
42	$4,946	$1,240	
43	$4,946	$1,240	
44	$4,946	$1,240	
45	$4,946	$1,240	
46	$4,946	$1,240	
47	$4,946	$1,240	
48	$4,946	$1,240	
49	$4,946	$1,240	
50	$4,946	$1,240	
51	$4,946	$1,240	
52	$4,946	$1,240	
53	$4,946	$1,240	
54	$4,946	$1,240	
55	$4,946	$1,240	
56	$4,946	$1,240	
57	$4,946	$1,240	
58	$4,946	$1,240	
59	$4,946	$1,240	
60	$4,946	$1,240	
61	$4,946	$1,240	
62	$4,946	$1,240	
63	$4,946	$1,240	
64	$4,946	$1,240	
65	$4,946	$1,240	
66	$4,946	$1,240	
67	$4,946	$1,240	
68	$4,946	$1,240	
69	$4,946	$1,240	
70	$4,946	$1,240	
71	$4,946	$1,240	
72	$4,946	$1,240	
73	$4,946	$1,240	
74	$4,946	$1,240	
75	$4,946	$1,240	
76	$4,946	$1,240	
77	$4,946	$1,240	
78	$4,946	$1,240	
79	$4,946	$1,240	
80	$4,946	$1,240	
81	$4,946	$1,240	
82	$4,946	$1,240	
83	$4,946	$1,240	
84	$4,946	$1,240	
85	$4,946	$1,240	
86	$4,946	$1,240	
87	$4,946	$1,240	
88	$4,946	$1,240	
89	$4,946	$1,240	
90	$4,946	$1,240	
91	$4,946	$1,240	
92	$4,946	$1,240	
93	$4,946	$1,240	
94	$4,946	$1,240	
95	$4,946	$1,240	
96	$4,946	$1,240	
97	$4,946	$1,240	
98	$4,946	$1,240	
99	$4,946	$1,240	
Capital Cost	$840,747	$210,838	

GROUNDWATER MONITORING [3]

	Years 0-19	Years 20-39	Years 40-99
Equipment Base:	$2,625	$2,625	$2,625 $/day
Aqueous Chemistry Base:	$963	$963	$963 $/day
Time:	4	2	1 day/yr
Equipment Annual:	$10,501.76	$5,251	$2,625 $/yr
Aqueous Chemistry Annual:	$3,850	$1,925	$963 $/yr

Year	Annual Current Cost ($)	Notes	Total Cumulative Reclaimed Area (acres)	Percent Reclaimed
0	$10,502	Weighted based on total reclaimed area	0	0%
1	$11,406	Weighted based on total reclaimed area	214	23%
2	$12,485	Weighted based on total reclaimed area	470	52%
3	$13,376	Weighted based on total reclaimed area	681	75%
4	$14,352	Weighted based on total reclaimed area	912	100%
5	$14,352		912	100%
6	$14,352		912	100%
7	$14,352		912	100%
8	$14,352		912	100%
9	$14,352		912	100%
10	$14,352		912	100%
11	$14,352		912	100%
12	$14,352		912	100%
13	$14,352		912	100%
14	$14,352		912	100%
15	$14,352			
16	$14,352			
17	$14,352			
18	$14,352			
19	$14,352			
20	$7,176			
21	$7,176			
22	$7,176			
23	$7,176			
24	$7,176			
25	$7,176			
26	$7,176			
27	$7,176			
28	$7,176			
29	$7,176			
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31	$7,176			
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33	$7,176			
34	$7,176			
35	$7,176			
36	$7,176			
37	$7,176			
38	$7,176			
39	$7,176			
40	$3,588			
41	$3,588			
42	$3,588			
43	$3,588			
44	$3,588			
45	$3,588			
46	$3,588			
47	$3,588			
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89	$3,588			
90	$3,588			
91	$3,588			
92	$3,588			
93	$3,588			
94	$3,588			
95	$3,588			
96	$3,588			
97	$3,588			
98	$3,588			
99	$3,588			
Capital Cost	$636,191			

Total Capital Cost Erosion Control, Road Maintenance, and Groundwater Monitoring	**$2,499,998**	**$323,208**

[1] Erosion Control
Equipment - EquipmentWatch
Labor -2019 NM Department of Labor Type H (Heavy Engineering) labor rates.

	#	$/hour	$/day
Labor Foreman (outside)	1	$23.84	$190.72
Laborers	2	$23.09	$369.44
Equipment Operators (med)	1	$27.52	$220.16
Truck Drivers (heavy)	2	$24.27	$388.32

		equipment $/hr	fuel $/hr	equipment $/day	fuel $/day
Cat 966H	1	$73.11	$19.61	$584.90	$156.87
Cat 725	2	$73.11	$14.09	$1,169.82	$225.39
				Equipment Cost	**Fuel Cost**
			Total Direct Cost	**$2,923**	**$382 $/day**

[2] Road Maintenance Crew
Equipment - EquipmentWatch
Labor -2019 NM Department of Labor Type H (Heavy Engineering) labor rates.

	Equipment Cost ($/hr)	Fuel Cost ($/hr)	Labor Rate ($/hr)	Equipment Subtotal 24 hrs/month ($/month)	Fuel Subtotal 24 hrs/month ($/month)
Cat 14M Motor Grader	$86.71	$19.40	$27.41	$2,739	$658
6,000-gal Water Truck	$67.69	$26.33	$24.27	$2,207	$582
				Equipment Cost	**Fuel Cost**
			Total Direct Cost	**$4,946**	**$1,240 $/month**

[3] Groundwater Monitoring
Equipment - EquipmentWatch
Labor -2019 NM Department of Labor Type H (Heavy Engineering) labor rates.
Aqueous Chemistry Sample Numbers - From the CCP in consultation with NMED and the DP-1340 requirements

	#	$/hour	$/day
Labor Foreman (outside)	1	$23.84	$190.72
Laborers	1	$23.09	$184.72
		$/year	**$/day**
Rental Equipment	1	$5,000.00	$2,000.00
Misc. Field Equipment	1	$1,000.00	$250.00
Aqueous Chemistry Years 0-19	7	$3,850.00	$962.50
Aqueous Chemistry Years 20-39	4	$1,925.00	$962.50
Aqueous Chemistry Years 40-99	2	$962.50	$962.50

	Equipment & Fuel Cost	Aqueous Chemistry Cost
Total Direct Cost Years 0-19	**$2,625**	**$963 $/day**
Total Direct Cost Years 20-39	**$2,625**	**$963 $/day**
Total Direct Cost Years 40-99	**$2,625**	**$963 $/day**

Continental Mine

Operations and Maintenance Summary

			Current Value
DIRECT COSTS	Facility and Structure Removal		$0
	Earthmoving		$0
	Vegetation		$180,392
	Other		$2,823,206
	Subtotal, Direct Costs		**$3,003,598**
INDIRECT COSTS	**Subtotal, Indirect Costs**	**17.5%**	**$525,630**
TOTAL COST			**$3,529,228**

Notes:

Indirect costs are based on 2019 agreement between FMI and agencies.

Indirect costs include but are not limited to mobilization and demobilization, engineering redesign fee, contingencies, contractor profit and overhead, project management fee, and state procurement cost.

Building Demolition

Continental Name	Description	Dimensions L	W	H[2]	Diameter	Building Demolition Demo Quantity	Unit	Unit Cost ($/unit)	Item Cost ($)
Building Name									
Mill Building #2[3]	Wash Shop	197	140	70		2,316,720.00	cf	$0.25	$579,180
Thickener MCC		18	18	12		3,888.00	cf	$0.25	$972
Thickener MCC		12	22	15		3,960.00	cf	$0.25	$990
No. 2 Mill Stacker		820	20	15		246,000.00	cf	$0.25	$61,500
Stacker Hoist		28	23	18		11,592.00	cf	$0.25	$2,898
No. 2 Mill Secondary Crusher Building		36	38	50		68,400.00	cf	$0.25	$17,100
Concentrate Storage Tank				50	30	35,342.92	cf	$0.25	$8,836
Mill Building #1 and Concentrator		160	140	70		1,568,000.00	cf	$0.25	$392,000
Ore Bin (large)				90	30	63,617.25	cf	$0.25	$15,904
Ore Bin (large)				90	30	63,617.25	cf	$0.25	$15,904
Ore Bin (small)				70	30	49,480.08	cf	$0.25	$12,370
Primary Crusher[3]		70	50	60		252,000.00	cf	$0.25	$63,000
Scale House (Guard Shack)		10	10	10		1,000.00	cf	$0.25	$250
Small Truck Shop		102	40	20		81,600.00	cf	$0.25	$20,400
Substation No. 2		66	50	30		99,000.00	cf	$0.25	$24,750
Thickener Tank (100-ft diam.)				14	100	109,955.74	cf	$0.25	$27,489
Thickener Tank (60-ft diam.)				20	60	56,548.67	cf	$0.25	$14,137
Water Tank (on Hanover Mountain)				30	25	14,726.22	cf	$0.25	$3,682
Water Tank (on Hanover Mountain)				50	35	48,105.64	cf	$0.25	$12,026
Magnetic Separator		15	20	14		4,200.00	cf	$0.25	$1,050
Pump House and Shed for Thickener		10	10	14		1,400.00	cf	$0.25	$350

Demolition Total Direct Cost $1,274,788

ID	Unit Cost ($/unit)[1]	Units	RS Means Line Item	Description
Structure Demolition	$0.25	$/cf	024116.13 0100	Building demolition, large urban projects, mixture of types, excludes foundation demolition, dump fees

1. RS Means Online 2019
2. 24' eave height assumed
3. Increased volume by 20% for large equipment

Building Demolition - Cover

Soil Cover Depth ft: 3

Description	Dimensions L	W	H	Diameter	Quantity (cy)	Unit Cost ($/cy)	Item Cost ($)
Continental Name							
Mill Building #2	197	140	70	0	3064	$1.88	$5,767
Thickener MCC	18	18	12	0	36	$1.88	$68
Thickener MCC	12	22	15	0	29	$1.88	$55
No. 2 Mill Stacker	820	20	15	0	1822	$1.88	$3,429
Stacker Hoist	28	23	18	0	72	$1.88	$135
No. 2 Mill Secondary Crusher Building	36	38	50	0	152	$1.88	$286
Concentrate Storage Tank	0	0	50	30	94	$1.88	$177
Mill Building #1 and Concentrator	160	140	70	0	2489	$1.88	$4,684
Ore Bin (large)	0	0	90	30	94	$1.88	$177
Ore Bin (large)	0	0	90	30	94	$1.88	$177
Ore Bin (small)	0	0	70	30	94	$1.88	$177
Primary Crusher	70	50	60	0	389	$1.88	$732
Scale House (Guard Shack)	10	10	10	0	11	$1.88	$21
Small Truck Shop	102	40	20	0	453	$1.88	$853
Substation No. 2	66	50	30	0	367	$1.88	$690
Thickener Tank (100-ft diam.)	0	0	14	100	314	$1.88	$591
Thickener Tank (60-ft diam.)	0	0	20	60	188	$1.88	$355
Water Tank (on Hanover Mountain)	0	0	30	25	79	$1.88	$148
Water Tank (on Hanover Mountain)	0	0	50	35	110	$1.88	$207
Magnetic Separator	15	20	14	0	33	$1.88	$63
Pump House and Shed for Thickener	10	10	14	0	11	$1.88	$21
					Cover Total Direct Cost:		**$18,813**

Item	Unit Cost $/cy	Description
Load and Haul cover material	$1.88	Cost to excavate, haul, and grade cover material per cubic yard of cover material at the existing No. 3 Waste Stockpile

Building Demolition - Vegetation

Chino Tag Number	Dimensions					
	L	W	H	Diameter	Area	Unit
Building Name						
Mill Building #23	197	140	70	0	0.63	acre
Thickener MCC	18	18	12	0	0.01	acre
Thickener MCC	12	22	15	0	0.01	acre
No. 2 Mill Stacker	820	20	15	0	0.38	acre
Stacker Hoist	28	23	18	0	0.01	acre
No. 2 Mill Secondary Crusher Building	36	38	50	0	0.03	acre
Concentrate Storage Tank	0	0	50	30	0.02	acre
Mill Building #1 and Concentrator	160	140	70	0	0.51	acre
Ore Bin (large)	0	0	90	30	0.02	acre
Ore Bin (large)	0	0	90	30	0.02	acre
Ore Bin (small)	0	0	70	30	0.02	acre
Primary Crusher3	70	50	60	0	0.08	acre
Scale House (Guard Shack)	10	10	10	0	0.00	acre
Small Truck Shop	102	40	20	0	0.09	acre
Substation No. 2	66	50	30	0	0.08	acre
Thickener Tank (100-ft diam.)	0	0	14	100	0.18	acre
Thickener Tank (60-ft diam.)	0	0	20	60	0.06	acre
Water Tank (on Hanover Mountain)	0	0	30	25	0.01	acre
Water Tank (on Hanover Mountain)	0	0	50	35	0.02	acre
Magnetic Separator	15	20	14	0	0.01	acre
Pump House and Shed for Thickener	10	10	14	0	0.00	acre

Revegetation Area:		2.19	acres
Revegetation unit cost:	$	823.97	$/acre
Revegetation Total Direct Cost:	**$**	**1,803**	

Data Sources:
See "Revegetation_UC"

Continental Mine
Demolition Worksheet #4
3/29/2019

Building Demolition - Removal of Waste Requiring Special Handling

Amount							Solid Pickup			Transportation (Per Mile Per Load)			
CY	**Drums**	**Tons**	**Loads**	**Origin**	**Disposal Site**	**Miles**	**Min cost**	**Max cost**	**Ave cost**	**Min cost**	**Max cost**	**Ave cost**	**Total Cost**
750	2400	540	30	Fierro, NM	Phoenix, AZ	337	$87,620	$274,390	$181,005	$1,135.69	$2,086.03	$1,610.86	$229,331

Total Cost	$229,331

Item	Min. Base Cost	Max. Base Cost	Ave. Base Cost	Units	Means Line Item
	$/unit	$/unit	$/unit		
Cleanup & Disposal of Wastes Requiring Special Handling	$162.26	$508.13	$335.20	$/ton	02 81 20.10
Transport of Wastes Requiring Special Handling (Truckload = 80 drums or 25 cy or 18 tons)	$3.37	$6.19	$4.78	$/mile	02 81 20.10

R.S. Means Online Heavy Construction Cost Data, 2019 (cost includes location adjustment)

Continental Mine

Facility Demolition Summary

			Current Value
DIRECT COSTS	Facility and Structure Removal		$1,274,788
	Cover		$18,813
	Ripping & Revegetation		$1,803
	Special Waste Removal		$229,331
	Subtotal, Direct Costs		**$1,524,735**
INDIRECT COSTS	**Subtotal, Indirect Costs**	**30.0%**	**$457,421**
TOTAL COST			**$1,982,156**

Notes:

Indirect costs are based on 2019 agreement between FMI and agencies.

Indirect costs include but are not limited to mobilization and demobilization, engineering redesign fee, contingencies, contractor profit and overhead, project management fee, and state procurement cost.

Continental Mine
Earthwork Cash Flow
March 29, 2019

Component	Current Cost
Earthwork & Demo	$19,291,935
Other O&M	$3,317,267
Veg O&M	$211,961
Total	**$22,821,163**

	Earthwork			
Year	Earthwork Current Cost	Vegetation Maint. Current Cost	O&M Current Cost	Total Earthwork Current Cost
1	300,000	-	12,340	312,340
2	4,391,941	-	31,186	4,423,127
3	5,237,432	-	53,660	5,291,092
4	4,324,775	-	72,218	4,396,993
5	4,737,786	17,663	92,548	4,847,998
6	300,000	17,663	92,548	410,212
7	-	17,663	92,548	110,212
8	-	17,663	92,548	110,212
9	-	17,663	92,548	110,212
10	-	17,663	92,548	110,212
11	-	17,663	92,548	110,212
12	-	17,663	92,548	110,212
13	-	17,663	92,548	110,212
14	-	17,663	88,955	106,618
15	-	17,663	88,955	106,618
16	-	17,663	88,955	106,618
17	-	-	88,955	88,955
18	-	-	88,955	88,955
19	-	-	88,955	88,955
20	-	-	88,955	88,955
21	-	-	38,506	38,506
22	-	-	38,506	38,506
23	-	-	38,506	38,506
24	-	-	38,506	38,506
25	-	-	38,506	38,506
26	-	-	38,506	38,506
27	-	-	38,506	38,506
28	-	-	38,506	38,506
29	-	-	38,506	38,506
30	-	-	38,506	38,506
31	-	-	38,506	38,506
32	-	-	38,506	38,506
33	-	-	38,506	38,506
34	-	-	38,506	38,506
35	-	-	38,506	38,506
36	-	-	38,506	38,506
37	-	-	38,506	38,506
38	-	-	38,506	38,506
39	-	-	38,506	38,506
40	-	-	38,506	38,506
41	-	-	15,369	15,369
42	-	-	15,369	15,369
43	-	-	15,369	15,369
44	-	-	15,369	15,369
45	-	-	15,369	15,369
46	-	-	15,369	15,369
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72	-	-	15,369	15,369
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76	-	-	15,369	15,369
77	-	-	15,369	15,369
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87	-	-	15,369	15,369
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91	-	-	15,369	15,369
92	-	-	15,369	15,369
93	-	-	15,369	15,369
94	-	-	15,369	15,369
95	-	-	15,369	15,369
96	-	-	15,369	15,369
97	-	-	15,369	15,369
98	-	-	15,369	15,369
99	-	-	15,369	15,369
100	-	-	15,369	15,369
Total	19,291,935	211,961	3,317,267	22,821,163

Bench Channel Unit Cost

Earthwork

Loading per cy

Task Description	Equipment	Load, Dump, Maneuver Time (min)	Work Time[2] (min)	Loads/ hr	Net Bucket (cy/load)	Production Rate (cy/hr)	Fuel Use Gal per Hour	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost ($/hr)	Loader+Oper Cost ($/hr)	Load+Op Cost ($/cy)	Fuel Cost ($/cy)	Total Cost ($/cy)
Load riprap	Cat 992K	0.65	50	76.92	14.00	1076.92	25.63	59.97	216.23	27.70	243.93	0.23	0.06	0.28
Load filter	Cat 992K	0.65	50	76.92	14.00	1076.92	25.63	59.97	216.23	27.70	243.93	0.23	0.06	0.28
Transfer riprap for placing	Cat 992K	0.65	50	76.92	14.00	1076.92	25.63	59.97	216.23	27.70	243.93	0.23	0.06	0.28
Transfer filter for placing	Cat 992K	0.65	50	76.92	14.00	1076.92	25.63	59.97	216.23	27.70	243.93	0.23	0.06	0.28

Hauling

Task Description	Equipment	Exchange Time (min)	Delivery Travel Time (min)	Unload and Maneuver Time (min)	Return Travel Time (min)	Load Time (min)	Total Time (min)	Work Time[2] (min)	Loads/ hr	Heaped Capacity (cy/load)	Production Rate (cy/hr)	Fuel Use Gal per Hour	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost ($/hr)	Truck+Op Cost ($/hr)	Truck + Op Cost ($/cy)	Fuel Cost ($/cy)	Total Cost ($/cy)
Haul riprap from Source to Site	Komatsu 730E	0.70	3.64	1.10	3.01	6.73	15.19	50	3.29	145	477	33.48	78.34	221.79	24.27	246.06	0.52	0.16	0.68
Haul filter from source to site	Komatsu 730E	0.70	3.64	1.10	3.01	6.73	15.19	50	3.29	145	477	33.48	78.34	221.79	24.27	246.06	0.52	0.16	0.68

Placing

Task Description	Equipment	Distance	Grade	Exchange Time (min)	Delivery Travel Time (min)	Unload and Maneuver Time (min)	Return Travel Time (min)	Load Time (min)	Total Time (min)	Work Time[2] (min)	Loads/ hr	Heaped Capacity (cy/load)	Production Rate (cy/hr)	Fuel Use Gal per Hour	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost ($/hr)	Truck + Op Cost ($/hr)	Truck+Op Cost ($/cy)	Fuel Cost ($/cy)	Total Cost ($/cy)
Place riprap	Cat 725	400	-30%	0.70	3.25	1.10	1.59	0.87	7.52	50	6.65	19	125.05	6.02	14.09	73.11	24.27	97.38	0.78	0.11	0.89
Place filter	Cat 725	400	-30%	0.70	3.25	1.10	1.59	0.87	7.52	50	6.65	19	125.05	6.02	14.09	73.11	24.27	97.38	0.78	0.11	0.89

Grading

Task Description	Equipment	Productivity (cy/hr)	Material Factor2	Grade Factor2	Soil Weight2 (lb/cy)	Production Method/Blade Factor2	Centroid to Centroid Push Distance3 (ft)	Normal Production (cy/hr)	Operator Factor2	Work Hour2 (min/hr)	Visiblity Factor2	Elevation Factor2	Transmission Factor2	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer +Op Cost ($/hr)	Dozer +Op Cost ($/cy)	Fuel Cost ($/cy)	Total Cost ($/cy)
Finish grade -filter	Cat D6T, SU Blade	304.38	1.0	1.02	3500.0	1.0	50.00	727	1	50.00	1	1.00	1.00	16.8948	63.65	27.41	91.06	0.30	0.06	0.35
Finish grade - Riprap	Cat D6T, SU Blade	230.34	0.8	1.02	3700.0	1.0	50.00	727	1	50.00	1	1.00	1.00	16.8948	63.65	27.41	91.06	0.40	0.07	0.47

Continental Riprap & Filter Production Rates

Equipment	Equipment Cost ($/hr)	Fuel Cost ($/hr)	# Equipment	Operator ($/hr)	# Operator	Total Equipment Cost ($/hr)	Total Fuel Cost ($/hr)
Cat 988H	$ 128.76	$ 35.57	1	$ 27.70	1	$ 156.46	$ 35.57
Cat 769D	$ 108.01	$ 22.79	3	$ 24.27	3	$ 396.83	$ 68.37
1 Deck Screening Plant (5X16, 48X60)	$ 40.59	$ 11.35	1	$ 23.09	1	$ 63.68	$ 11.35
3 Deck Screening Plant (5X16, 42X60)	$ 41.16	$ 11.35	1	$ 23.09	1	$ 64.25	$ 11.35
Cat 980H	$ 77.56	$ 25.27	2	$ 27.70	2	$ 210.53	$ 50.54
Cat 992K	$ 216.23	$ 59.97	0	$ 27.70	0	$ -	$ -
Cat 966H	$ 73.11	$ 19.61	1	$ 27.70	1	$ 100.81	$ 19.61
Off-Hwy Water Tanker Truck,6,000-gal.	$ 67.69	$ 26.33	1	$ 24.27	1	$ 91.96	$ 26.33
Supervisor	$ -	-	0	$ 23.84	1	$ 23.84	$ -

Direct Costs

Equipment	Fuel	
$ 1,108	$ 223	$/hr
8	8	hr/work day
$ 8,867	$ 1,785	$/day

Production

400	tons input/hr (total)
0.30	% waste
0.70	% rip rap and gravel/filter
280	tons produced/hr (net)
560,000	lb/hr
3,650	lb/cy
153	cy/hr
8	hr/day (net (60 min/hr))
1,227	cy/day net production

Production	$ 7.22	$ 1.45	$/cy
Filter Delivery and placement	2.05	0.44	$/cy
Rip Rap Delivery and placement	2.14	0.46	$/cy

ASSUMPTIONS

Work Day

8 hrs

50 min hour

Equipment Rates

Source: 2019 EquipmentWatch

Corrected for 50 min work hour

Includes overhaul labor, parts & time

Production

Primary plant fed directly by two 769D haul trucks, 300 to 400 yd haul

400 tons input/hr (per Rusty McCauley, equipment peak production is 900 tons/hr)

30% - 60% waste depending on smallest rip rap size used. (per Rusty McCauley, consistent w/ Mc+C63Cain Springs waste rate of 43% - 1" minus)

3650 lb/cy (Caterpillar Performance Handbook p. 27-4, consistent with 1.8 tons/cy riprap unit weight)

Equipment & Labor	**Rate ($/hr)**	**Comment**
One 988H Loader with Operator (bucket = 8.3 cy)	$ 156.46	Used to load stockpiled material to 769D trucks and 777 haul trucks
Three 769D haul trucks with drivers (22 cy, 36 ton payload e	$ 396.83	Option: Two used to directly feed primary screening plant, one used to move material from end of conveyor
One 1 Deck Portable Screening Plant w/ 5x16 screen & 48"x + 1 Operator	$ 63.68	Primary screening plant, grizzly used to split oversized, 6" - 12" and 6" minus (2 conveyers) One operator required in tower to run screening plant
One 3 Deck Portable Screening Plant w/ 5x16 screen & 42"x + 1 Operator	$ 64.25	One operator required in tower to run screening plant Fed with 6" minus, Produce 6" - 6", 1.5" - 3", 3/8" - 1.5", 3/8 minus One operator required in tower to run screening plant
Two Cat 980H Loaders with Operator (bucket = 7.5 cy)	$ 210.53	Used move material to conveyors or load trucks
Zero Cat 992K Loaders with Operator (bucket = 16 cy)	$ -	Unused loader option
One Cat 966H Loader with Operator (bucket = 5.5 cy)	$ 100.81	Used to move material from end of conveyors & load trucks
One Water Truck with Driver (10,000 gal)	$ 91.96	Dust suppression
One Foreman	$ 23.84	

	Equipment	Fuel	Total	
Total Unit Cost	$ 11.41	$ 2.36	$ 13.77	$/cy

1. Provided from Golder Take off spreadsheet 2018
2. See Equipment Tab
3. Material factor for riprap from CPH Ed. 47 pg. 19-55 (rock)
4. Tram distance is assumed
5. Finish grade volume assumed to be 40% of excavation volume
6. Riprap and filter haul assumed to be similar to cover source haul distances
7. Haul route uphill with 7.5% effective grade
8. Riprap/filter placement distance calculation assumes an average of 7 bench channels and 2 downdrains per stockpile; riprap/filter material is hauled 1/4 length of downdrain and then 1/4 length of bench channel distance for an average placement distance
9. Filter and riprap is placed going uphill

Bench Grading Unit Cost

Bench Grading - 3:1 Stockpiles

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/ft)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Centroid to Centroid Push Distance [1] (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Transmission Factor	# Passes	Speed (miles/hr)	Volume (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	
Excavate	Cat D11T, U Blade	1693	-	1.2	1.1	2900	1.0	100	2588	0.75	50	1.0	1.0	1.0	-	-	9.26	0.0055	$69.62	$254.44	$27.41	$281.85	$1.54	$0.38	
Finish Grade	Cat D9T, SU Blade	-	0.0009	1.2	1.1	2900	1.0	-	-	0.75	50	1.0	1.0	1.0	3	1.0	-	0.0009	$33.58	$198.37	$27.41	$225.78	$0.20	$0.03	
																							$1.74	$0.41	**$2.15 Total**

Bench Grading - 2.5:1 Stockpiles

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/ft)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Centroid to Centroid Push Distance [1] (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Transmission Factor	# Passes	Speed (miles/hr)	Volume (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	
Excavate	Cat D11T, U Blade	1907	-	1.2	1.1	2900	1.0	88	2914	0.75	50	1.0	1.0	1.0	-	-	9.52	0.0050	$69.62	$254.44	$27.41	$281.85	$1.41	$0.35	
Finish Grade	Cat D9T, SU Blade	-	0.0009	1.2	1.1	2900	1.0	-	-	0.75	50	1.0	1.0	1.0	3	1.0	-	0.0009	$33.58	$198.37	$27.41	$225.78	$0.20	$0.03	
																							$1.60	$0.38	**$1.98 Total**

Bench Grading -Tailings

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/ft)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/ Blade Factor	Centroid to Centroid Push Distance [1] (feet)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Transmission Factor	# Passes	Speed (miles/hr)	Volume (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	
Excavate	Cat D11T, U Blade	1693	-	1.2	1.1	2900	1.0	100	2588	0.75	50	1.0	1.0	1.0	-	-	9.26	0.0055	$69.62	$254.44	$27.41	$281.85	$1.54	$0.38	
Finish Grade	Cat D6T XL, SU Blade	-	0.0009	1.2	1.1	2900	1.0	-	-	0.75	50	1.0	1.0	1.0	3	1.0	-	0.0009	$18.25	$65.52	$27.41	$92.93	$0.08	$0.02	
																							$1.62	$0.40	**$2.02 Total**

1. Push distance is assumed to be site average

Bench Channel Unit Cost

Type

		Equip+ Operator ($/ft)	Fuel ($/ft)
3:1 Bench Channel Excavation		$ 3.86	$ 0.95
Filter	11.6 cf/ft	$ 3.98	$ 0.82
Rip Rap	11.6 cf/ft	$ 4.02	$ 0.82
	Total	$8.01	$1.64
			$9.65

Bench Grading - 3:1 Stockpiles

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/ft)	Material Factor[2]	Grade Factor	Soil Weight[2] (lb/cy)	Production Method/ Blade Factor[4]	Centroid to Centroid Push Distance[3] (feet)	Normal Production (cy/hr)	Operator Factor[2]	Work Hour[2] (min/hr)	Visibility Factor[2]	Elevation Factor[2]	Transmission Factor[2]	# Passes[2]	Speed[2] (miles/hr)	Volume[2] (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	
Excavate	Cat D11T, U Blade	1693	-	1.2	1.1	2900	1.0	100	2588	0.75	50	1.0	1.0	1.0	-	-	23.20	0.0137	$69.62	$254.44	$27.41	$281.85	$3.86	$0.95	
																							$3.86	$0.95	**$4.82 Total**

2.5:1 Bench Channel

3:1 Bench Channel Excavation		$ 3.67	$ 0.91
Filter	11.02 cf/ft	$ 3.78	$ 0.77
Rip Rap	11.02 cf/ft	$ 3.82	$ 0.78
	Total	$11.28	$2.46
			$13.74

Bench Grading - 2.5:1 Stockpiles

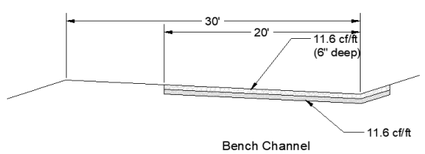
Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/ft)	Material Factor[2]	Grade Factor	Soil Weight[2] (lb/cy)	Production Method/ Blade Factor[4]	Centroid to Centroid Push Distance[3] (feet)	Normal Production (cy/hr)	Operator Factor[2]	Work Hour[2] (min/hr)	Visibility Factor[2]	Elevation Factor[2]	Transmission Factor[2]	# Passes[2]	Speed[2] (miles/hr)	Volume[2] (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	
Excavate	Cat D11T, U Blade	1693	-	1.2	1.1	2900	1.0	100	2588	0.75	50	1.0	1.0	1.0	-	-	22.04	0.0130	$69.62	$254.44	$27.41	$281.85	$3.67	$0.91	
																							$3.67	$0.91	**$4.58 Total**

Tailings Bench Channel

Tailings Bench Channel Excavation		$ 3.86	$ 0.95
Filter	11.6 cf/ft	$ 3.98	$ 0.82
Rip Rap	11.6 cf/ft	$ 4.02	$ 0.82
	Total	$8.01	$1.64
			$9.65

Bench Grading - 3:1 Stockpiles

Task Description	Equipment	Productivity (cy/hr)	Productivity (hrs/ft)	Material Factor[2]	Grade Factor	Soil Weight[2] (lb/cy)	Production Method/ Blade Factor[4]	Centroid to Centroid Push Distance[3] (feet)	Normal Production (cy/hr)	Operator Factor[2]	Work Hour[2] (min/hr)	Visibility Factor[2]	Elevation Factor[2]	Transmission Factor[2]	# Passes[2]	Speed[2] (miles/hr)	Volume[2] (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	
Excavate	Cat D11T, U Blade	1693	-	1.2	1.1	2900	1.0	100	2588	0.75	50	1.0	1.0	1.0	-	-	23.20	0.0137	$69.62	$254.44	$27.41	$281.85	$3.86	$0.95	
																							$3.86	$0.95	**$4.82 Total**



Bench Channel

4. Tram distance is assumed
5. Finish grade volume assumed to be 40% of excavation volume
6. Riprap and filter haul assumed to be similar to cover source haul distances
7. Haul route uphill with 7.5% effective grade
8. Riprap/filter placement distance calculation assumes an average of 7 bench channels and 2 downdrains per stockpile; riprap/filter material is hauled 1/4 length of downdrain and then 1/4 length of bench channel distance for an average placement distance
9. Filter and riprap is placed going uphill

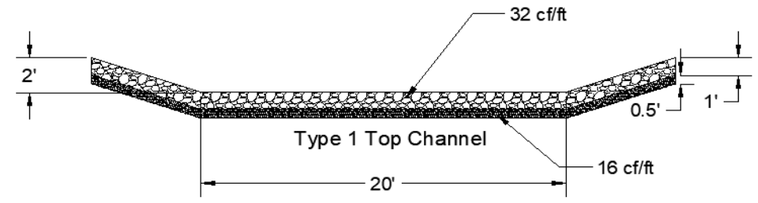
Top Channel Unit Cost

Task Description	Equipment	Productivity (cy/hr)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/Blade Factor	Centroid to Centroid Push Distance (ft)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Transmission Factor	Volume[1] (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)
Excavate	Cat D11T, U Blade	838	1.2	1.0	3300	1.0	175	1573	0.75	50	1.0	1.0	1.0	2.4	0.0029	$69.62	$254.44	$27.41	$281.85	$0.81	$0.20
Waste	Cat D11T, U Blade	744	1.2	1.0	3300	1.0	200	1396	0.75	50	1.0	1.0	1.0	2.4	0.0032	$69.62	$254.44	$27.41	$281.85	$0.91	$0.22
Finish Grade	Cat D9T, SU Blade	353	1.2	1.0	3300	1.0	175	662	0.75	50	1.0	1.0	1.0	0.2	0.0005	$33.58	$198.37	$27.41	$225.78	$0.12	$0.02
																				$1.83	$0.44

Filter	16 cf/ft	$	5.49	$ 1.12	
Rip Rap	32 cf/ft	$	11.10	$ 2.27	
	Total		$18.43	$3.84	$22.26

1. Volumes based on cross-section area for excavation and waste, unit volume/linear foot of downdrain (73 ft^2 * 1 ft/27); Finish grade is 40% of excavation volume

3H:1V side slopes
3.5 ft depth



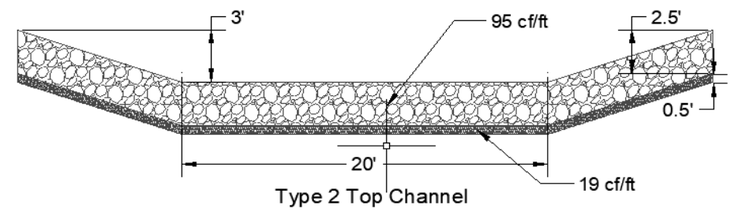
Top Channel Unit Cost

Task Description	Equipment	Productivity (cy/hr)	Material Factor[2]	Grade Factor[2]	Soil Weight[2] (lb/cy)	Production Method/Blade Factor[2]	Centroid to Centroid Push Distance[3] (ft)	Normal Production (cy/hr)	Operator Factor[2]	Work Hour[2] (min/hr)	Visibility Factor[2]	Elevation Factor[2]	Transmission Factor[2]	Volume[1] (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Bench Equipment Cost ($/ft)	Bench Fuel Cost ($/ft)	
Excavate	Cat D11T, U Blade	822	1.2	1.0	3300	1.0	179	1541	0.75	50	1.0	1.0	1.0	7.6	0.0092	$69.62	$254.44	$27.41	$281.85	$2.61	$0.64	
Waste	Cat D11T, U Blade	744	1.2	1.0	3300	1.0	200	1396	0.75	50	1.0	1.0	1.0	7.6	0.0102	$69.62	$254.44	$27.41	$281.85	$2.88	$0.71	
Finish Grade	Cat D9T, SU Blade	346	1.2	1.0	3300	1.0	179	649	0.75	50	1.0	1.0	1.0	0.6	0.0016	$33.58	$198.37	$27.41	$225.78	$0.37	$0.06	
																				$5.86	$1.41	**$7.27 Total**

Filter	19 cf/ft	$	6.52	$	1.34
Rip Rap	95 cf/ft	$	32.96	$	6.74
	Total		$45.34		$9.49

$54.82

1. Finish grade volume based on past calculations where productivity is approximately 1/10th waste productivity



Type 2 Top Channel

Downdrain Unit Cost

Rough Grade

Task Description	Equipment	Productivity (cy/hr)	Material Factor	Grade Factor	Soil Weight (lb/cy)	Production Method/Blade Factor	Centroid to Centroid Push Distance (ft)	Normal Production (cy/hr)	Operator Factor	Work Hour (min/hr)	Visibility Factor	Elevation Factor	Transmission Factor	Volume (cy/ft)	Productivity (hrs/ft)	Fuel Cost ($/hr)	Equipment Cost ($/hr)	Operator Cost (IV) ($/hr)	Dozer Cost ($/hr)	Equipment w/o Fuel Cost ($/ft)	Fuel Cost ($/ft)	Total Excavation Cost ($/ft)
Excavate	Cat D11T, U Blade	1470	1.2	1.6	2900	1.0	175	1573	0.75	50	1.0	1.0	1.0	1.9	0.0013	$69.62	$254.44	$27.41	$281.85	$0.37	0.09121327	$0.46
Waste	Cat D11T, U Blade	1305	1.2	1.6	2900	1.0	200	1396	0.75	50	1.0	1.0	1.0	1.9	0.0015	$69.62	$254.44	$27.41	$281.85	0.41589805	0.10272309	$0.52
								.												$0.79	$0.19	$0.98

Finish Grade & Place ACB

	Area (sf/ft)	Unit Cost ($/sf)	$/ft
Downdrain ACBs			
40T	31	$7.42	$230.02
Installation	31	$4.63	$143.53
		ACB Cost/ft	**$373.55**

Total Downdrain Cost ($/ft)	**$374.53**

Place ACB

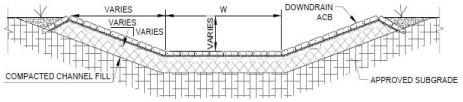
Dissipater ACBs	Area (sf)	Unit Cost ($/sf)	$/sf
70T	320	$10.65	$3,408.00
Installation	320	$4.63	$1,481.60
40T	506	$7.42	$3,754.52
Installation	506	$4.63	$2,342.78
		ACB Cost per Dissipater	**$10,986.90**

Install Cutoff Wall

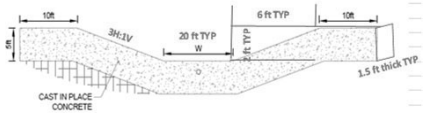
Cutoff Wall (cast in place concrete)	cubic yard	$/cubic yard	**$/dissipater^2**
RSMeans (2019)	14	$ 254.97	**$3,569.58**

Total Dissipator Cost ($/each)	**$14,556.48**

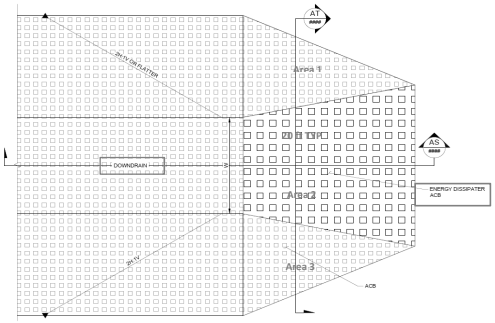
DOWNDRAIN Dimensions:		
Left Side Slope:	3	H:1V
Left Side Slope:	3	H:1V
Depth:	2	ft
Perimeter:	31	ft
Excavation Area	52	sf
ACB Area	31	sf



N.T.S AU 022A TYPICAL DOWNDRAIN SECTION



N.T.S. AX 022A TYPICAL CUTTOFF WALL SECTION



N.T.S B 022A TYPICAL TOE ENERGY DISSIPATOR PLAN DETAIL

1. Quote from Contech ES 2018; Downdrain ACB installation includes fine grade base/subgrade soils (assuming subgrade at + 0.5 ft); equipment is D6 LGP dozer with Power Angle Tilt Blade (PAT) and GPS Blade Control
2. One cutoff wall per dissipator
3. Typical flow depth is 2'; concrete depth is 5' (diagram is not drawn to scale); concrete thickness is 1.5'
4. Excavation volume is smaller than SOW because ACB's require less excavation than riprap

Chino RCE Revegetation Unit Cost

Revegetation consists of 5 operations - scarifying, discing, drill seeding, mulching, and crimping.
Cost information is obtained from EquipmentWatch (EQW), if available, or RS Means 2019 rates.

Tractor used for each operation is Deere 7430		**Cost**	**Unit**	**Information or Calculation**
EQW base rate for tractor rental	$	5,210.05	$ per month	EQW for Deere 7430
EQW base rate for tractor rental	$	29.60	$ per hour	= ($/month)/176
EQW field labor rate per hour of operation	$	2.53	$ per hour	EQW for Deere 7430, which includes mechanic's wage of $23.09 (NMDOL, 2019)
EQW lube material cost	$	2.84	$ per hour	EQW for Deere 7430
EQW field parts cost	$	0.61	$ per hour	EQW for Deere 7430
EQW tire material cost	$	2.42	$ per hour	EQW for Deere 7430
EQW fuel burn rate		5.98	gallons per hour	EQW for Deere 7430
Local fuel cost	$	2.34	$ per gallon	Local quote
Fuel cost	$	13.99	$ per hour	= (EQW fuel burn rate) x (local fuel cost)
NM Department of labor equipment operator rate	$	24.27	$ per hour	NM Department of Labor (NMDOL)
Total tractor cost	**$**	**76.27**	**$ per hour**	**Sum of $ per hour costs shown in boxes**

Tractor coverage/rate of operation, fuel cost per acre				
Tractor/equipment net width		12	feet	Assigned as a typical net width of coverage for each pass
Tractor/equipment travel speed		2.5	miles per hour	Assigned as approximate average speed of equipment (3 mph for 50 min/hr)
For 1 acre, total traveling distance		3630	feet per acre	= (43560 sf/ac)/(net width)
Time of travel over 1 acre		0.275	hour per acre	= [(traveling distance feet/acre)/(5280 ft/mile)]/(travel speed)
Fuel cost per acre	**$**	**3.85**	**$ per acre**	**Already included in total tractor cost… Fuel cost/acre = (fuel cost/hour) x (travel time hour/acre)**

Operation				
Scarifying				
Base rate for ripper rental	$	898.90	per month	EQW Ripper, Miscellaneous MSR-189H, to 260 HP
Base rate for ripper rental	$	5.11	$ per hour	= ($/month)/176
Field labor rate per hour of operation	$	0.57	$ per hour	EQW for ripper, incl mechanic's wage $23.09 (NMDOL, 2019)
Lube material cost	$	0.15	$ per hour	EQW for ripper
Field parts cost	$	0.16	$ per hour	EQW for ripper
Ground Engaging Component cost	$	0.78	$ per hour	EQW for ripper
Total cost with tractor+operator included	**$**	**83.03**	**per hour**	**= total tractor cost + (rake without tractor, with ratio)**
Discing				
Disc harrow attachment, for tractor	$	616.33	per month	RS Means 01 54 33 20 1500
Disc harrow attachment, for tractor	$	3.50	per hour	= ($/month)/176
Ground Engaging Component (GEC) cost	$	0.78	$ per hour	Assume similar to GEC cost for ripper (EQW)
Total cost with tractor included	**$**	**80.55**	**per hour**	**= total tractor cost + (disc harrow, with ratio)**
Drill seeding (assume similar to discing)				
Disc harrow attachment, for tractor	$	616.33	per month	RS Means 01 54 33 20 1500
Disc harrow attachment, for tractor	$	3.50	per hour	= ($/month)/176
Ground Engaging Component cost	$	0.78	$ per hour	Assume similar to GEC cost for ripper (EQW)
Total cost with tractor+operator included	**$**	**80.55**	**per hour**	
Mulching				
Mulcher, diesel powered, trailer mounted	$	2,167.95	per month	EQW for trailer mounted mulcher (Finn B260)
Mulcher, diesel powered, trailer mounted	$	12.32	per hour	= ($/month)/176
Field labor rate per hour of operation	$	1.25	$ per hour	EQW for trailer mounted mulcher (Finn B260), incl mechanic's wage $23.09 (NMDOL, 2019)
Lube material cost	$	1.60	$ per hour	EQW for trailer mounted mulcher (Finn B260)
Field parts cost	$	0.15	$ per hour	EQW for trailer mounted mulcher (Finn B260)
Tire material cost	$	0.60	$ per hour	EQW for trailer mounted mulcher (Finn B260)
Fuel burn rate		4.13	gallons per hour	EQW for trailer mounted mulcher (Finn B260)
Local fuel cost	$	2.34	$ per gallon	Local quote
Fuel cost	$	9.66	$ per hour	= (EQW fuel burn rate) x (local fuel cost)
NM Department of labor equipment operator rate	$	24.27	$ per hour	NM Department of Labor (NMDOL)
Total cost with tractor+operator included	**$**	**126.12**	**per hour**	
Crimping (assume similar to discing)				
Disc harrow attachment, for tractor	$	616.33	per month	RS Means 01 54 33 20 1500
Disc harrow attachment, for tractor	$	3.50	per hour	= ($/month)/176
Ground Engaging Component cost	$	0.78	$ per hour	Assume similar to GEC cost for ripper (EQW)
Total cost with tractor+operator included	**$**	**80.55**	**per hour**	
Summary for operations				
Total cost for all operations combined (hour)	$	450.79	per hour	Each of the 5 operations is done individually as part of revegetation (includes fuel cost)
Total cost for all operations combined w/o fuel(acre)	$	120.12	per acre	---
Total cost for all operations combined w/ fuel(acre)	$	123.97	per acre	Total is based on "tractor coverage/rate of operation" = (total cost of operations/hour) x (hours of travel time/acre)

Materials (from sources used at Chino, by Rocky Mountain Reclamation)				
Seed	$	210.00	per acre	From supplier (Rocky Mountain Reclamation)
Hay mulch	$	490.00	per acre	From supplier (Rocky Mountain Reclamation): Mulch is applied at a rate of 2 tons per acre

Summary for operations + materials				
Total revegetation unit cost	$	823.97	per acre	Total is for all operations (combined) + seed material + hay mulch material + fuel

Specific inputs in EquipmentWatch that are adjusted

EquipmentWatch Line Item	**Description of EquipmentWatch Changes to Eliminate Duplicate Costs**
Mechanics Wages	Per New Mexico law, the $23.09/hour Mechanics labor rate is based on the most current New Mexico Department of Labor (DOL) Type H (Heavy Engineering) labor rates. FICA, Medicare, Social Security, Unemployment Taxes, and Workmans' Comp are accounted for in Overhead.
Sales Tax	The Sales Tax is set at $0/hour because New Mexico does not charge sales tax on state contracts. Sales Tax adjusted from 5.1% to 0%
Maximum work hours per month	Per EquipmentWatch BlueBlook Rental calculations, a standard value of 176 hr/ month is assumed to be the maximum working hours per month. This value is used to determine the hourly cost of equipment use based on the monthly rental rate. This value is adjusted outside of EquipmentWatch in the Equipment worksheet.
Annual Field Repair Parts Cost	The Annual Field Repair costs are set to $0/yr because Chino will be renting equipment. This is input as a value <$1 because EquipmentWatch doesn't accept $0 as an input.
Annual Use Hours	The Annual Use Hours are adjusted in EquipmentWatch to eliminate the EquipmentWatch 50 minute work hour.
Fuel Rate	The Fuel Rate is set to $1/gal as the starting point to calculate fuel consumption and then fuel cost. Example Calculation for CAT 14M: First, the Fuel Rate is set to $1/gal. Then, Equipment Watch calculates fuel cost to be $8.29/hr. Fuel consumption is calculated as ($8.29/hr)/($1.00/gal) = 8.29 gal/hr. Fuel consumption is then multiplied by the Fuel Quote value ($2.34/gal) to yield a Fuel Cost for 14M of $19.40/hr.

Standard costs are used for other EquipmentWatch components

Definitions

Field Repair	Operating cost includes field repair defined as routine, daily servicing of the equipment and would include repairing, replacing or adjusting small components such as pumps, carburetors, injectors, batteries, filters, belts, gaskets, and hoses.The cost of extraordinary operating expendables is not included. Certain ground engaging components, such as hammer and drill bits, drill steel, augers, saw blades, and tooth-bits, are normally excluded from the "Estimated Operating Cost/Hr." because of their highly variable wear patterns. It is recommended that these costs be recovered separately
Field Repair - Labor	Field repair labor costs are accrued on a machine working-hour basis to offset charges incurred to perform normal field repair and maintenance. Costs listed under this heading represent an annual average over the economic life of the equipment.For adjustments and comparisons, the average labor cost per hour can be related to the average mechanic's wage (including fringe benefits) published.
Field Repair - Parts	Field repair parts costs are accrued on a machine working-hour basis to offset the costs for supplying parts necessary to keep the equipment operating in good condition. These parts consist of anything short of a major component overhaul or replacement. This annual cost includes “miscellaneous supply parts” referred to in the cost adjustment section. Costs listed under this heading represent an annual average over the economic life of the equipment.
Miscellaneous Supply Parts	Miscellaneous Supply Parts are parts normally stocked in bulk for an entire fleet, rather than for individual machines, this cost includes cables, hoses, steel etc.
Ground Engaging Components (GEC)	These costs include repair and/or replacement, either in whole or part, of ground engaging components such as pads, drums, teeth and cutting edges.
Tires	Tire costs include the repair and/or replacement of tires. Listed tire costs are based on the current price of tires, typical contractor discounts, and the tire life listed which reflects average working conditions.
Fuel	Fuel costs are calculated using average load factors, equipment horsepower, and the price of fuel per gallon. Actual fuel consumption will depend on variations in load factors, elevation, engine performance, operator efficiency, and terrain.
Lube	Lubrication includes the costs of oils, grease, coolants and filters. Labor and ancillary equipment involved in servicing is also included. (e.g. The cost of a lube truck and operator is included in this cost). For dual engine models, costs for both equipment and carrier are included.

References

Caterpillar, Inc. 1998. Caterpillar Performance Handbook, Edition 29. Peoria, Illinois: Caterpillar, Inc.
Caterpillar, Inc. 2011. Caterpillar Performance Handbook, Edition 41. Peoria, Illinois: Caterpillar, Inc.
Caterpillar, Inc. 2014. Caterpillar Performance Handbook, Edition 44. Peoria, Illinois: Caterpillar Inc.
Caterpillar, Inc. 2017. Caterpillar Performance Handbook, Edition 47. Peoria, Illinois: Caterpillar Inc.
Caterpillar, Inc. 2018. Caterpillar Performance Handbook, Edition 48. Peoria, Illinois: Caterpillar, Inc.
Freeport-McMoRan Copper & Gold. 2012. Reclamation Cost Estimate Update, GR010RE, DP-1341 Operator Factor and Swell Factor. Letter to MMD and NMED dated September 5, 2012.
Golder Associates (Golder). 2006. Supplemental Borrow Materials Investigation, Continental Mine, Grant County, New Mexico. Prepared for Cobre Mining Company, Hurley, New Mexico by Golder Associates Inc., Albuquerque, New Mexico. February 1, 2006.
NMDOL. 2019. Prevailing Wage Poster H 2019. Retrieved January 16, 2019, from New Mexico Department of Labor: https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2019_final.pdf
R.S. Means. 2019. Heavy Construction Cost Data, Version 8.7. Retrieved from R.S. Means Data Online: https://www.rsmeansonline.com
Penton Media. 2019. EquipmentWatch Construction Estimator. Retrieved January and February 2019, from EquipmentWatch: https://equipmentwatch.com
Telesto Solutions, Inc. (Telesto). 2014. Continental Mine Closure/Closeout Plan. Prepared for Freeport-McMoRan Chino Mining Company, Vanadium, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. December 2014.
Telesto Solutions, Inc. (Telesto). 2018. Continental Mine Closure/Closeout Plan Update. Prepared for Freeport-McMoRan Chino Mining Company, Vanadium, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. May 2018.
See Appendix D for January 2019 agreement between FA Work Group and Freeport-McMoRan. The FA Work Group involved representatives of Freeport-McMoRan New Mexico Operations (FNMO), MMD, NMED, and Gila Resources Information Project

Abbreviation	Name
ac	acre
ACB	Articulated Concrete Blocks
bcy	bulk cubic yards
cy	cubic yards
cf	cubic feet
ea	each
EQW	EquipmentWatch
ft	feet (or linear feet)
gal	gallon
hr	hour
lb	pound
lcy	loose cubic yards
misc	miscellaneous
MMD	Mining and Minerals Division
NMA	North Mine Area
NM	New Mexico
NMDOL	New Mexico Department of Labor
O&M	Operation and Maintenance
Reveg	Revegetate
sf	square feet
SMA	South Mine Area
SOW	Scope of Work (see references)
UC	Unit Cost
yr	year

Appendix B.2

Supporting Documentation

Appendix B.2.1

2019 Labor Rates (NMDOL)

Labor Rates

NMDOL Type A Operator Group	Base rate	Fringe rate	Apprenticeship		Total 2019 Rate ($/hr)
Equipment Operator IV	20.87	5.94	0.6	$	27.41
Equipment Operator V	20.98	5.94	0.6	$	27.52
Equipment Operator VI	21.16	5.94	0.6	$	27.70
Laborer I	16.86	5.63	0.6	$	23.09
Laborer II	17.61	5.63	0.6	$	23.84
Truck Driver III	16.15	7.52	0.60	$	24.27

Labor rates based on NM Department of Labor Type H (Heavy Engineering) 2019 labor rates. Rates include base hourly wage, fringe benefit, and apprenticeship contribution rates.

https://www.dws.state.nm.us/Portals/0/DM/LaborRelations/Prevailing_Wage_Poster_H_2019_final.pdf

Appendix B.2.2

Equipment Watch Data

EquipmentWatch

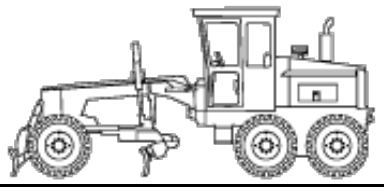
www.equipmentwatch.com

All prices shown in US$

Adjustments for MANDYLILLA11 in All Saved Models

January 17, 2019

Caterpillar 14M (disc. 2015)
Articulated Frame Graders



Size Class:
250 HP & Over
Weight:
46,796 lbs.

Configuration for 14M (disc. 2015)

Power Mode	**Diesel**	Net Horsepower	**259 hp**
Operator Protection	**EROPS**	Moldboard Size	**14 ft**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$30.16/hr	$28.25/hr	-6.3%
Cost of Facilities Capital (CFC)	$9.87/hr	$8.14/hr	-17.5%
Overhead	$15.01/hr	$12.24/hr	-18.5%
Overhaul Labor	$7.57/hr	$2.42/hr	-68%
Overhaul Parts	$17.21/hr	$14.02/hr	-18.5%
Total Hourly Ownership Cost:	**$79.82/hr**	**$65.07/hr**	**-18.5%**

User Defined Adjustments: Annual Use Hours (1,400hrs -> 1,718hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$6.30/hr	$2.02/hr	-67.9%
Field Parts	$16.69/hr	$2.27/hr	-86.4%
Ground Engaging Component (GEC)	$1.38/hr	$1.16/hr	-15.9%
Tire	$7.04/hr	-	-
Electrical/Fuel	$27.10/hr	$8.29/hr	-69.4%
Lube	$6.57/hr	-	-
Total Operating Ownership Cost:	**$65.08/hr**	**$27.35/hr**	**-58%**

User Defined Adjustments: Annual Field Repair Parts Cost ($19,471.51 -> $0.42) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$79.82/hr	$65.07/hr	-18.5%
Hourly Operating Costs	$65.08/hr	$27.35/hr	-58%
Total Hourly Cost	**$144.90**	**$92.42/hr**	**-36.2%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$55.04/hr	$48.63/hr	-11.6%
Idle	$106.92/hr	$73.36/hr	-31.4%

Revised Date: 1st Half 2019

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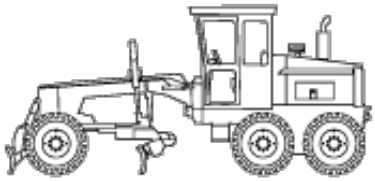
All prices shown in US$

Adjustments for MANDYLILLA11 in All Saved Models

January 17, 2019

Caterpillar 14M (disc. 2015)
Articulated Frame Graders



Size Class:
250 HP & Over
Weight:
46,796 lbs.

Configuration for 14M (disc. 2015)

Net Horsepower	**259 hp**	Moldboard Size	**14 ft**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$13,845.00	$4,709.00	$1,577.00
Adjustments			
Region (New Mexico: 86%)	($1,938.30)	($659.26)	($220.78)
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$11,906.70**	**$4,049.74**	**$1,356.22**

Date Last Updated: Oct 01, 2018

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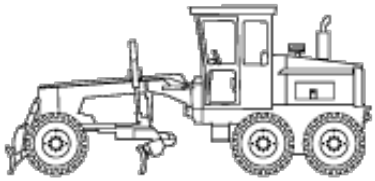
All prices shown in US$

Adjustments for Grader 16M 3A in All Saved Models

January 17, 2019

Caterpillar 16M
Articulated Frame Graders

Size Class:
250 HP & Over
Weight:
59,435 lbs.



Configuration for 16M

Power Mode	**Diesel**	Net Horsepower	**297 hp**
Operator Protection	**EROPS**	Moldboard Size	**16 ft**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$43.66/hr	$40.89/hr	-6.3%
Cost of Facilities Capital (CFC)	$14.28/hr	$11.78/hr	-17.5%
Overhead	$10.94/hr	$8.92/hr	-18.5%
Overhaul Labor	$7.57/hr	$2.42/hr	-68%
Overhaul Parts	$24.76/hr	$20.18/hr	-18.5%
Total Hourly Ownership Cost:	**$101.21/hr**	**$84.19/hr**	**-16.8%**

User Defined Adjustments: Annual Use Hours (1,400hrs -> 1,718hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$6.30/hr	$2.02/hr	-67.9%
Field Parts	$24.01/hr	$3.26/hr	-86.4%
Ground Engaging Component (GEC)	$2.00/hr	$1.76/hr	-12%
Tire	$10.13/hr	-	-
Electrical/Fuel	$31.08/hr	$9.50/hr	-69.4%
Lube	$8.69/hr	-	-
Total Operating Ownership Cost:	**$82.21/hr**	**$35.36/hr**	**-57%**

User Defined Adjustments: Annual Field Repair Parts Cost ($28,017.41 -> $0.41) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$101.21/hr	$84.19/hr	-16.8%
Hourly Operating Costs	$82.21/hr	$35.36/hr	-57%
Total Hourly Cost	**$183.42**	**$119.55/hr**	**-34.8%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$68.88/hr	$61.59/hr	-10.6%
Idle	$132.29/hr	$93.69/hr	-29.2%

Revised Date: 1st Half 2019

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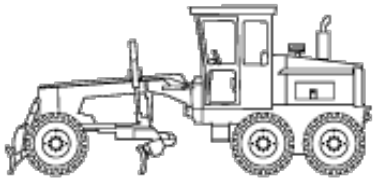
All prices shown in US$

Adjustments for Grader 16M 3A in All Saved Models

January 16, 2019

Caterpillar 16M
Articulated Frame Graders

Size Class:
250 HP & Over
Weight:
59,435 lbs.



Configuration for 16M

Net Horsepower	**297 hp**	Moldboard Size	**16 ft**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$13,845.00	$4,709.00	$1,577.00
Adjustments			
Region (New Mexico: 86%)	($1,938.30)	($659.26)	($220.78)
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$11,906.70**	**$4,049.74**	**$1,356.22**

Date Last Updated: Oct 01, 2018

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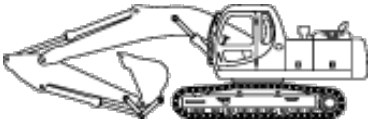
Custom Cost Evaluator

February 15, 2019

Caterpillar 319D L (disc. 2012)
Crawler Mounted Hydraulic Excavators



Size Class:
19.1 - 21.0 MTons
Weight:
43,872 lbs.

Configuration for 319D L (disc. 2012)

Power Mode	**Diesel**	Net Horsepower	**125 hp**
Bucket Capacity - Heaped	**1 cu yd**	Operating Weight	**19.9 mt**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$16.20/hr	$15.16/hr	-6.4%
Cost of Facilities Capital (CFC)	$3.99/hr	$3.29/hr	-17.5%
Overhead	$3.75/hr	$3.04/hr	-18.9%
Overhaul Labor	$11.81/hr	$3.75/hr	-68.2%
Overhaul Parts	$7.21/hr	$5.84/hr	-19%
Total Hourly Ownership Cost:	**$42.96/hr**	**$31.08/hr**	**-27.7%**

User Defined Adjustments: Annual Use Hours (1,295hrs -> 1,599hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$14.31/hr	$4.55/hr	-68.2%
Field Parts	$7.37/hr	$1.19/hr	-83.9%
Ground Engaging Component (GEC)	$1.15/hr	$0.94/hr	-18.3%
Tire	$0.00/hr	-	-
Electrical/Fuel	$17.17/hr	$5.25/hr	-69.4%
Lube	$3.47/hr	-	-
Total Operating Ownership Cost:	**$43.47/hr**	**$15.40/hr**	**-64.6%**

User Defined Adjustments: Annual Field Repair Parts Cost ($7,630.58 -> $0.58) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$42.96/hr	$31.08/hr	-27.7%
Hourly Operating Costs	$43.47/hr	$15.40/hr	-64.6%
Total Hourly Cost	**$86.43**	**$46.48/hr**	**-46.2%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$23.94/hr	$21.49/hr	-10.2%
Idle	$60.13/hr	$36.33/hr	-39.6%

Revised Date: 1st Half 2019

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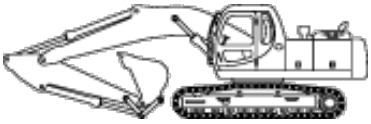
Adjustments for MANDYLILLA9 in All Saved Models

January 16, 2019

Caterpillar 319D L (disc. 2012)
Crawler Mounted Hydraulic Excavators



Size Class:
19.1 - 21.0 MTons
Weight:
43,872 lbs.

Configuration for 319D L (disc. 2012)

Bucket Capacity - Heaped	**1 cu yd**	Net Horsepower	**125 hp**
Operating Weight	**19.9 mt**		

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$6,835.00	$2,573.00	$956.00
Adjustments			
Region (New Mexico: 109%)	$615.15	$231.57	$86.04
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$7,450.15**	**$2,804.57**	**$1,042.04**

Date Last Updated: Oct 01, 2018

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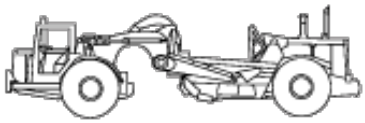
Adjustments for MANDYLILLA14 in All Saved Models

January 16, 2019

Caterpillar 657G
Dual Engine Conventional Scrapers

Size Class:
18CY & Over
Weight:
149,417 lbs.



Configuration for 657G

Scraper Capacity	**32 cu yd - 44 cu yd**	Power Mode	**Diesel**
Net Horsepower	**564 hp**	Operator Protection	**EROPS**
Scraper Horsepower	**410**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$77.61/hr	$73.09/hr	-5.8%
Cost of Facilities Capital (CFC)	$25.79/hr	$22.08/hr	-14.4%
Overhead	$46.91/hr	$39.74/hr	-15.3%
Overhaul Labor	$25.68/hr	$8.54/hr	-66.7%
Overhaul Parts	$60.80/hr	$51.51/hr	-15.3%
Total Hourly Ownership Cost:	**$236.79/hr**	**$194.96/hr**	**-17.7%**

User Defined Adjustments: Annual Use Hours (1,375hrs -> 1,623hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$38.51/hr	$12.80/hr	-66.8%
Field Parts	$61.28/hr	$7.73/hr	-87.4%
Ground Engaging Component (GEC)	$2.61/hr	$2.31/hr	-11.5%
Tire	$9.34/hr	-	-
Electrical/Fuel	$70.08/hr	$42.86/hr	-38.8%
Lube	$20.41/hr	-	-
Total Operating Ownership Cost:	**$202.23/hr**	**$95.45/hr**	**-52.8%**

User Defined Adjustments: Annual Field Repair Parts Cost ($71,708.32 -> $0.32) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$236.79/hr	$194.96/hr	-17.7%
Hourly Operating Costs	$202.23/hr	$95.45/hr	-52.8%
Total Hourly Cost	**$439.02**	**$290.41/hr**	**-33.9%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$150.31/hr	$134.91/hr	-10.2%
Idle	$306.87/hr	$237.82/hr	-22.5%

Revised Date: 1st Half 2019

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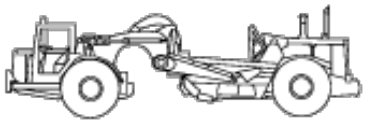
All prices shown in US$

Adjustments for MANDYLILLA14 in All Saved Models

January 16, 2019

Caterpillar 657G
Dual Engine Conventional Scrapers

Size Class:
18CY & Over
Weight:
149,417 lbs.



Configuration for 657G

Scraper Horsepower	**410**	Net Horsepower	**564 hp**
Scraper Capacity	**32 cu yd - 44 cu yd**		

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$27,250.00	$6,813.00	$1,363.00
Adjustments			
Region (New Mexico: 92%)	($2,180.00)	($545.04)	($109.04)
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$25,070.00**	**$6,267.96**	**$1,253.96**

Date Last Updated: Oct 01, 2018

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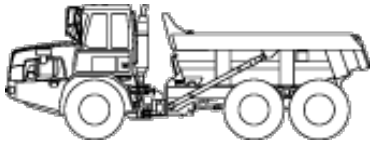
All prices shown in US$

Adjustments for MANDYLILLA17 in All Saved Models

January 17, 2019

Caterpillar 725 (disc. 2014)
Articulated Rear Dumps



Size Class:
20 - 25 MTons
Weight:
49,075 lbs.

Configuration for 725 (disc. 2014)

Net Horsepower	**301 hp**	Power Mode	**Diesel**
Rated Payload	**23.6 mt**	Body Capacity (Struck--Heaped)	**14.3 cu yd - 18.8 cu yd**
Axle Configuration	**6 X 6**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$27.02/hr	$25.45/hr	-5.8%
Cost of Facilities Capital (CFC)	$5.58/hr	$4.92/hr	-11.8%
Overhead	$6.58/hr	$5.71/hr	-13.2%
Overhaul Labor	$12.72/hr	$4.33/hr	-66%
Overhaul Parts	$10.37/hr	$9.01/hr	-13.1%
Total Hourly Ownership Cost:	**$62.27/hr**	**$49.42/hr**	**-20.6%**

User Defined Adjustments: Annual Use Hours (1,850hrs -> 2,131hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$9.86/hr	$3.36/hr	-65.9%
Field Parts	$6.50/hr	$0.94/hr	-85.5%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$7.11/hr	-	-
Electrical/Fuel	$19.69/hr	$6.02/hr	-69.4%
Lube	$5.74/hr	-	-
Total Operating Ownership Cost:	**$48.90/hr**	**$23.17/hr**	**-52.6%**

User Defined Adjustments: Annual Field Repair Parts Cost ($10,027.26 -> $0.26) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$62.27/hr	$49.42/hr	-20.6%
Hourly Operating Costs	$48.90/hr	$23.17/hr	-52.6%
Total Hourly Cost	**$111.17**	**$72.59/hr**	**-34.7%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$39.18/hr	$36.08/hr	-7.9%
Idle	$81.96/hr	$55.44/hr	-32.4%

Revised Date: 1st Half 2019

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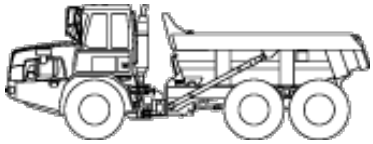
Adjustments for MANDYLILLA17 in All Saved Models

January 16, 2019

Caterpillar 725 (disc. 2014)
Articulated Rear Dumps



Size Class:
20 - 25 MTons
Weight:
49,075 lbs.

Configuration for 725 (disc. 2014)

Axle Configuration	**6 X 6**	Body Capacity (Struck--Heaped)	**14.3 cu yd - 18.8 cu yd**
Net Horsepower	**301 hp**	Rated Payload	**23.6 mt**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$9,120.00	$3,277.00	$1,093.00
Adjustments			
Region (New Mexico: 108%)	$729.60	$262.16	$87.44
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$9,849.60**	**$3,539.16**	**$1,180.44**

Date Last Updated: Oct 01, 2018

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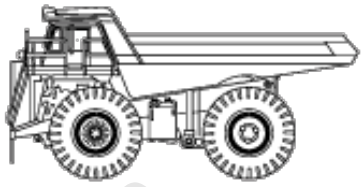
Adjustments for 3A 769D Truck in All Saved Models

January 17, 2019

Caterpillar 769D (disc. 2007)
Mechanical Drive Rear Dumps

Size Class:
30 - 39 MTons
Weight:
66,800 lbs.



Configuration for 769D (disc. 2007)

Body Capacity (Struck–Heaped)	**22.2 cu yd - 31.7 cu yd**	Power Mode	**Diesel**
Net Horsepower	**487 hp**	Rated Payload	**36.4 mt**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$33.52/hr	$31.57/hr	-5.8%
Cost of Facilities Capital (CFC)	$8.12/hr	$7.19/hr	-11.5%
Overhead	$5.20/hr	$4.55/hr	-12.5%
Overhaul Labor	$15.90/hr	$5.46/hr	-65.7%
Overhaul Parts	$16.64/hr	$14.56/hr	-12.5%
Total Hourly Ownership Cost:	**$79.38/hr**	**$63.33/hr**	**-20.2%**

User Defined Adjustments: Annual Use Hours (1,850hrs -> 2,114hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.56/hr	$4.31/hr	-65.7%
Field Parts	$10.14/hr	$1.48/hr	-85.4%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$13.72/hr	-	-
Electrical/Fuel	$31.85/hr	$9.74/hr	-69.4%
Lube	$8.77/hr	-	-
Total Operating Ownership Cost:	**$77.04/hr**	**$38.02/hr**	**-50.6%**

User Defined Adjustments: Annual Field Repair Parts Cost ($15,635.76 -> $0.76) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$79.38/hr	$63.33/hr	-20.2%
Hourly Operating Costs	$77.04/hr	$38.02/hr	-50.6%
Total Hourly Cost	**$156.42**	**$101.35/hr**	**-35.2%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$46.84/hr	$43.31/hr	-7.5%
Idle	$111.23/hr	$73.07/hr	-34.3%

Revised Date: 1st Half 2019

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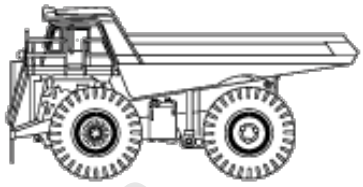
Adjustments for 3A 769D Truck in All Saved Models

January 16, 2019

Caterpillar 769D (disc. 2007)
Mechanical Drive Rear Dumps

Size Class:
30 - 39 MTons
Weight:
66,800 lbs.



Configuration for 769D (disc. 2007)

Body Capacity (Struck–Heaped)	**22.2 cu yd - 31.7 cu yd**	Net Horsepower	**487 hp**
Rated Payload	**36.4 mt**		

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$13,700.00	$4,600.00	$1,150.00
Adjustments			
Region (New Mexico: 102%)	$342.50	$115.00	$28.75
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$14,042.50**	**$4,715.00**	**$1,178.75**

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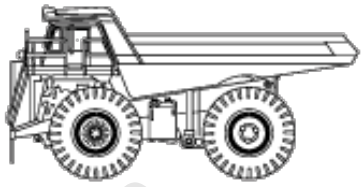
Adjustments for MANDYLILLA18 in All Saved Models

January 17, 2019

Komatsu 730E
Electric Drive Rear Dumps

Size Class:
170 - 199 MTons
Weight:
309,950 lbs.



Configuration for 730E

Net Horsepower	**1860 hp**	Power Mode	**Diesel**
Body Capacity (Struck–Heaped)	**101 cu yd - 145 cu yd**	Wheel Motor Model	**GE788**
Rated Payload	**183.7 mt**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$57.76/hr	$54.40/hr	-5.8%
Cost of Facilities Capital (CFC)	$18.12/hr	$17.55/hr	-3.1%
Overhead	$29.49/hr	$28.51/hr	-3.3%
Overhaul Labor	$54.07/hr	$20.51/hr	-62.1%
Overhaul Parts	$23.65/hr	$22.86/hr	-3.3%
Total Hourly Ownership Cost:	**$183.09/hr**	**$143.83/hr**	**-21.4%**

User Defined Adjustments: Annual Use Hours (1,850hrs -> 1,914hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$31.49/hr	$11.94/hr	-62.1%
Field Parts	$11.14/hr	$1.80/hr	-83.8%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$21.21/hr	-	-
Electrical/Fuel	$109.48/hr	$33.48/hr	-69.4%
Lube	$20.49/hr	-	-
Total Operating Ownership Cost:	**$193.81/hr**	**$88.92/hr**	**-54.1%**

User Defined Adjustments: Annual Field Repair Parts Cost ($17,180.45 -> $0.45) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$183.09/hr	$143.83/hr	-21.4%
Hourly Operating Costs	$193.81/hr	$88.92/hr	-54.1%
Total Hourly Cost	**$376.90**	**$232.75/hr**	**-38.2%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$105.37/hr	$100.46/hr	-4.7%
Idle	$292.57/hr	$177.31/hr	-39.4%

Revised Date: 1st Half 2019

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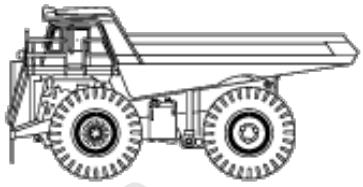
All prices shown in US$

Adjustments for MANDYLILLA18 in All Saved Models

January 16, 2019

Komatsu 730E
Electric Drive Rear Dumps

Size Class:
170 - 199 MTons
Weight:
309,950 lbs.



Configuration for 730E

Net Horsepower	**1860 hp**	Power Mode	**Diesel**
Body Capacity (Struck–Heaped)	**101 cu yd - 145 cu yd**	Wheel Motor Model	**GE788**
Rated Payload	**183.7 mt**		

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$32,225.00	$9,025.00	$2,255.00	$340.00	$193.80	$376.90
Adjustments						
Region (Las Cruces, New Mexico: 91.1%)	($2,868.02)	($803.22)	($200.69)	($30.26)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$29,356.98**	**$8,221.78**	**$2,054.31**	**$309.74**	**$193.80**	**$360.60**

Non-Active Use Rates

	Hourly
Standby Rate	$88.40
Idling Rate	$276.28

Rate Element Allocation

Element	**Percentage**	**Value**
Depreciation (ownership)	31%	$9,989.75/mo
Overhaul (ownership)	47%	$15,145.75/mo
CFC (ownership)	9%	$2,900.25/mo
Indirect (ownership)	13%	$4,189.25/mo
Fuel (operating) @ 3.27	56%	$109.48/hr

Revised Date: 1st Half 2019

These are the most accurate rates for the selected Revision Date(s). However, due to more frequent online updates, these rates may not match Rental Rate Blue Book Print. Visit the Cost Recovery Product Guide on our Help page for more information.

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Adjustments for 3A 966H Loader in All Saved Models

January 16, 2019

Caterpillar 966H (disc. 2015)
4-Wd Articulated Wheel Loaders

Size Class:
250 - 274 HP
Weight:
52,254 lbs.

Configuration for 966H (disc. 2015)

Power Mode	**Diesel**	Net Horsepower	**262 hp**
Operator Protection	**EROPS**	Bucket Capacity - Heaped	**5.5 cu yd**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$20.82/hr	$19.42/hr	-6.7%
Cost of Facilities Capital (CFC)	$6.60/hr	$5.53/hr	-16.2%
Overhead	$5.17/hr	$4.27/hr	-17.4%
Overhaul Labor	$10.18/hr	$3.30/hr	-67.6%
Overhaul Parts	$6.20/hr	$5.12/hr	-17.4%
Total Hourly Ownership Cost:	**$48.97/hr**	**$37.64/hr**	**-23.1%**

User Defined Adjustments: Annual Use Hours (1,445hrs -> 1,751hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.42/hr	$4.02/hr	-67.6%
Field Parts	$6.84/hr	$0.84/hr	-87.7%
Ground Engaging Component (GEC)	$0.91/hr	$0.75/hr	-17.6%
Tire	$5.71/hr	-	-
Electrical/Fuel	$27.42/hr	$8.38/hr	-69.4%
Lube	$5.33/hr	-	-
Total Operating Ownership Cost:	**$58.63/hr**	**$25.03/hr**	**-57.3%**

User Defined Adjustments: Annual Field Repair Parts Cost ($8,409.97 -> $0.97) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$48.97/hr	$37.64/hr	-23.1%
Hourly Operating Costs	$58.63/hr	$25.03/hr	-57.3%
Total Hourly Cost	**$107.60**	**$62.67/hr**	**-41.8%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$32.59/hr	$29.22/hr	-10.3%
Idle	$76.39/hr	$46.02/hr	-39.8%

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Adjustments for 3A 966H Loader in All Saved Models

January 16, 2019

Caterpillar 966H (disc. 2015)
4-Wd Articulated Wheel Loaders

Size Class:
250 - 274 HP
Weight:
52,254 lbs.

Configuration for 966H (disc. 2015)

Bucket Capacity - Heaped	**5.5 cu yd**	Net Horsepower	**262 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$9,375.00	$3,179.00	$1,050.00
Adjustments			
Region (New Mexico: 106%)	$562.50	$190.74	$63.00
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$9,937.50**	**$3,369.74**	**$1,113.00**

Date Last Updated: Oct 01, 2018

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All prices shown in US$

Adjustments for 3A 980H Loader in All Saved Models

January 16, 2019

Caterpillar 980H (disc. 2013)
4-Wd Articulated Wheel Loaders

Size Class:
275 - 349 HP
Weight:
67,294 lbs.

Configuration for 980H (disc. 2013)

Power Mode	**Diesel**	Net Horsepower	**315 hp**
Operator Protection	**EROPS**	Bucket Capacity - Heaped	**7.5 cu yd**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$27.41/hr	$25.55/hr	-6.8%
Cost of Facilities Capital (CFC)	$8.69/hr	$7.27/hr	-16.3%
Overhead	$6.72/hr	$5.55/hr	-17.4%
Overhaul Labor	$10.18/hr	$3.30/hr	-67.6%
Overhaul Parts	$8.35/hr	$6.89/hr	-17.5%
Total Hourly Ownership Cost:	**$61.35/hr**	**$48.56/hr**	**-20.8%**

User Defined Adjustments: Annual Use Hours (1,445hrs -> 1,751hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.42/hr	$4.02/hr	-67.6%
Field Parts	$9.21/hr	$1.13/hr	-87.7%
Ground Engaging Component (GEC)	$1.20/hr	$1.03/hr	-14.2%
Tire	$7.69/hr	-	-
Electrical/Fuel	$32.96/hr	$10.08/hr	-69.4%
Lube	$6.70/hr	-	-
Total Operating Ownership Cost:	**$70.18/hr**	**$30.65/hr**	**-56.3%**

User Defined Adjustments: Annual Field Repair Parts Cost ($11,328.38 -> $0.38) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$61.35/hr	$48.56/hr	-20.8%
Hourly Operating Costs	$70.18/hr	$30.65/hr	-56.3%
Total Hourly Cost	**$131.53**	**$79.21/hr**	**-39.8%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$42.82/hr	$38.37/hr	-10.4%
Idle	$94.31/hr	$58.64/hr	-37.8%

Revised Date: 1st Half 2019

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Adjustments for 3A 980H Loader in All Saved Models

January 16, 2019

Caterpillar 980H (disc. 2013)
4-Wd Articulated Wheel Loaders

Size Class:
275 - 349 HP
Weight:
67,294 lbs.

Configuration for 980H (disc. 2013)

Bucket Capacity - Heaped	**7.5 cu yd**	Net Horsepower	**315 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$9,463.00	$3,721.00	$1,141.00
Adjustments			
Region (New Mexico: 106%)	$567.78	$223.26	$68.46
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$10,030.78**	**$3,944.26**	**$1,209.46**

Date Last Updated: Oct 01, 2018

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Adjustments for 3A 988H Loader in All Saved Models

January 16, 2019

Caterpillar 988H (disc. 2014)
4-Wd Articulated Wheel Loaders

Size Class:
350 - 499 HP
Weight:
109,230 lbs.

Configuration for 988H (disc. 2014)

Power Mode	**Diesel**	Net Horsepower	**475 hp**
Operator Protection	**EROPS**	Bucket Capacity - Heaped	**8.33 cu yd**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$51.99/hr	$48.49/hr	-6.7%
Cost of Facilities Capital (CFC)	$16.42/hr	$13.74/hr	-16.3%
Overhead	$14.96/hr	$12.35/hr	-17.4%
Overhaul Labor	$10.18/hr	$3.30/hr	-67.6%
Overhaul Parts	$15.56/hr	$12.84/hr	-17.5%
Total Hourly Ownership Cost:	**$109.11/hr**	**$90.72/hr**	**-16.9%**

User Defined Adjustments: Annual Use Hours (1,445hrs -> 1,751hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.42/hr	$4.02/hr	-67.6%
Field Parts	$17.17/hr	$2.11/hr	-87.7%
Ground Engaging Component (GEC)	$2.26/hr	$1.93/hr	-14.6%
Tire	$16.85/hr	-	-
Electrical/Fuel	$49.70/hr	$15.20/hr	-69.4%
Lube	$11.40/hr	-	-
Total Operating Ownership Cost:	**$109.80/hr**	**$51.51/hr**	**-53.1%**

User Defined Adjustments: Annual Field Repair Parts Cost ($21,117.92 -> $0.92) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$109.11/hr	$90.72/hr	-16.9%
Hourly Operating Costs	$109.80/hr	$51.51/hr	-53.1%
Total Hourly Cost	**$218.91**	**$142.23/hr**	**-35%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$83.37/hr	$74.58/hr	-10.5%
Idle	$158.81/hr	$105.92/hr	-33.3%

Revised Date: 1st Half 2019

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All prices shown in US$

Adjustments for 3A 988H Loader in All Saved Models

January 16, 2019

Caterpillar 988H (disc. 2014)
4-Wd Articulated Wheel Loaders

Size Class:
350 - 499 HP
Weight:
109,230 lbs.

Configuration for 988H (disc. 2014)

Bucket Capacity - Heaped	**8.33 cu yd**	Net Horsepower	**475 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$15,351.00	$5,261.00	$1,790.00
Adjustments			
Region (New Mexico: 106%)	$921.06	$315.66	$107.40
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$16,272.06**	**$5,576.66**	**$1,897.40**

Date Last Updated: Oct 01, 2018

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All prices shown in US$

Adjustments for Loader 992K 3A in All Saved Models

January 16, 2019

Caterpillar 992K
4-Wd Articulated Wheel Loaders

Size Class:
500 - 999 HP
Weight:
214,948 lbs.

Configuration for 992K

Power Mode	**Diesel**	Net Horsepower	**801 hp**
Operator Protection	**EROPS**	Bucket Capacity - Heaped	**14 cu yd**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$120.33/hr	$112.37/hr	-6.6%
Cost of Facilities Capital (CFC)	$35.65/hr	$29.84/hr	-16.3%
Overhead	$62.12/hr	$51.27/hr	-17.5%
Overhaul Labor	$10.18/hr	$3.30/hr	-67.6%
Overhaul Parts	$32.68/hr	$26.97/hr	-17.5%
Total Hourly Ownership Cost:	**$260.96/hr**	**$223.75/hr**	**-14.3%**

User Defined Adjustments: Annual Use Hours (1,445hrs -> 1,751hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.42/hr	$4.02/hr	-67.6%
Field Parts	$36.06/hr	$4.43/hr	-87.7%
Ground Engaging Component (GEC)	$4.91/hr	$4.99/hr	+1.6%
Tire	$35.39/hr	-	-
Electrical/Fuel	$83.82/hr	$25.63/hr	-69.4%
Lube	$22.35/hr	-	-
Total Operating Ownership Cost:	**$194.95/hr**	**$96.81/hr**	**-50.3%**

User Defined Adjustments: Annual Field Repair Parts Cost ($44,343.18 -> $0.18) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$260.96/hr	$223.75/hr	-14.3%
Hourly Operating Costs	$194.95/hr	$96.81/hr	-50.3%
Total Hourly Cost	**$455.91**	**$320.56/hr**	**-29.7%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$218.10/hr	$193.48/hr	-11.3%
Idle	$344.78/hr	$249.38/hr	-27.7%

Revised Date: 1st Half 2019

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Adjustments for Loader 992K 3A in All Saved Models

January 16, 2019

Caterpillar 992K
4-Wd Articulated Wheel Loaders

Size Class:
500 - 999 HP
Weight:
214,948 lbs.

Configuration for 992K

Bucket Capacity - Heaped	**14 cu yd**	Net Horsepower	**801 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$24,083.00	$7,750.00	$2,506.00
Adjustments			
Region (New Mexico: 106%)	$1,444.98	$465.00	$150.36
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$25,527.98**	**$8,215.00**	**$2,656.36**

Date Last Updated: Oct 01, 2018

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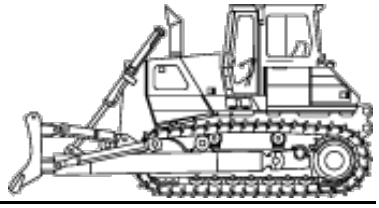
All prices shown in US$

Custom Cost Evaluator

January 16, 2019

Caterpillar D11T
Standard Crawler Dozers

Size Class:
520 HP & Over
Weight:
208,885 lbs.



Configuration for D11T

Dozer Type	**U Blade**	Power Mode	**Diesel**
Net Horsepower	**850 hp**	Operator Protection	**EROPS**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$116.51/hr	$109.64/hr	-5.9%
Cost of Facilities Capital (CFC)	$34.88/hr	$29.42/hr	-15.7%
Overhead	$66.43/hr	$55.39/hr	-16.6%
Overhaul Labor	$17.23/hr	$5.64/hr	-67.3%
Overhaul Parts	$102.61/hr	$85.56/hr	-16.6%
Total Hourly Ownership Cost:	**$337.66/hr**	**$285.65/hr**	**-15.4%**

User Defined Adjustments: Annual Use Hours (1,400hrs -> 1,679hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$20.17/hr	$6.60/hr	-67.3%
Field Parts	$99.94/hr	$13.89/hr	-86.1%
Ground Engaging Component (GEC)	$16.66/hr	$12.22/hr	-26.7%
Tire	$0.00/hr	-	-
Electrical/Fuel	$97.28/hr	$29.75/hr	-69.4%
Lube	$26.23/hr	-	-
Total Operating Ownership Cost:	**$260.28/hr**	**$88.69/hr**	**-65.9%**

User Defined Adjustments: Annual Field Repair Parts Cost ($116,600.00 -> $0.50) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$337.66/hr	$285.65/hr	-15.4%
Hourly Operating Costs	$260.28/hr	$88.69/hr	-65.9%
Total Hourly Cost	**$597.94**	**$374.34/hr**	**-37.4%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$217.82/hr	$194.45/hr	-10.7%
Idle	$434.94/hr	$315.40/hr	-27.5%

Revised Date: 1st Half 2019

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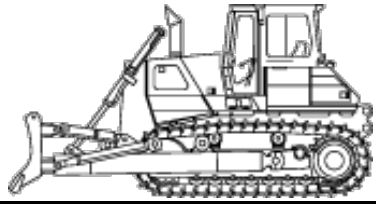
All prices shown in US$

Adjustments for MANDYLILLA5 in All Saved Models

January 16, 2019

Caterpillar D11T
Standard Crawler Dozers



Size Class:
520 HP & Over
Weight:
208,885 lbs.

Configuration for D11T

Dozer Type	**U Blade**	Net Horsepower	**850 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$30,423.00	$10,403.00	$3,509.00
Adjustments			
Region (New Mexico: 113%)	$3,985.41	$1,362.79	$459.68
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$34,408.41**	**$11,765.79**	**$3,968.68**

Date Last Updated: Oct 01, 2018

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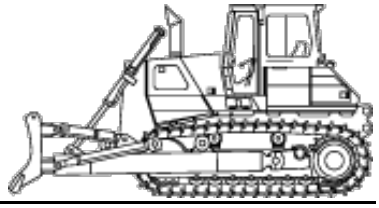
All prices shown in US$

AED Green Book®

January 29, 2019

Caterpillar D11T CD
Standard Crawler Dozers

Size Class:
520 HP & Over
Weight:
220,524 lbs.



Configuration for D11T CD

Dozer Type	**U Blade**	Net Horsepower	**850 hp**

AED Rental Rates

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	Monthly	Weekly	Daily
Published Rates	$30,423.00	$10,403.00	$3,509.00
Adjustments			
Region (New Mexico: 113%)	$3,985.41	$1,362.79	$459.68
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$34,408.41**	**$11,765.79**	**$3,968.68**

Date Last Updated: Oct 01, 2018

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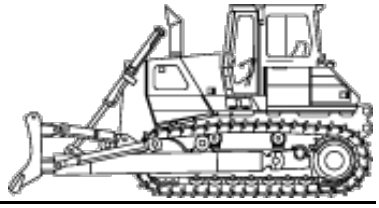
All prices shown in US$

Adjustments for MANDYLILLA6 in All Saved Models

January 16, 2019

Caterpillar D6T
Standard Crawler Dozers

Size Class:
160 - 189 HP
Weight:
40,550 lbs.



Configuration for D6T

Dozer Type	**Semi-U**	Power Mode	**Diesel**
Net Horsepower	**185 hp**	Operator Protection	**EROPS**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$21.97/hr	$20.45/hr	-6.9%
Cost of Facilities Capital (CFC)	$7.33/hr	$5.97/hr	-18.6%
Overhead	$15.71/hr	$12.64/hr	-19.5%
Overhaul Labor	$9.84/hr	$3.11/hr	-68.4%
Overhaul Parts	$16.15/hr	$12.99/hr	-19.6%
Total Hourly Ownership Cost:	**$71.00/hr**	**$55.16/hr**	**-22.3%**

User Defined Adjustments: Annual Use Hours (1,285hrs -> 1,597hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.13/hr	$3.83/hr	-68.4%
Field Parts	$15.65/hr	$2.10/hr	-86.6%
Ground Engaging Component (GEC)	$2.61/hr	$2.10/hr	-19.5%
Tire	$0.00/hr	-	-
Electrical/Fuel	$23.59/hr	$7.22/hr	-69.4%
Lube	$4.83/hr	-	-
Total Operating Ownership Cost:	**$58.81/hr**	**$20.08/hr**	**-65.9%**

User Defined Adjustments: Annual Field Repair Parts Cost ($16,758.98 -> $0.98) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$71.00/hr	$55.16/hr	-22.3%
Hourly Operating Costs	$58.81/hr	$20.08/hr	-65.9%
Total Hourly Cost	**$129.81**	**$75.24/hr**	**-42%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$45.01/hr	$39.06/hr	-13.2%
Idle	$94.59/hr	$62.38/hr	-34.1%

Revised Date: 1st Half 2019

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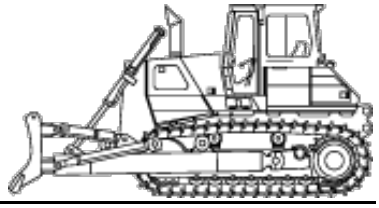
All prices shown in US$

Adjustments for MANDYLILLA6 in All Saved Models

January 16, 2019

Caterpillar D6T
Standard Crawler Dozers

Size Class:
160 - 189 HP
Weight:
40,550 lbs.



Configuration for D6T

Dozer Type	**Semi-U**	Net Horsepower	**185 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$7,904.00	$2,778.00	$925.00
Adjustments			
Region (New Mexico: 113%)	$1,035.42	$363.92	$121.18
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$8,939.42**	**$3,141.92**	**$1,046.18**

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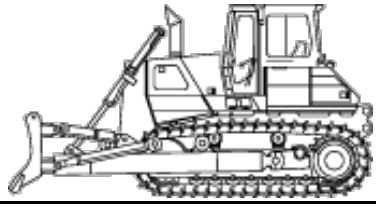
Adjustments for 3A D6TXL in All Saved Models

January 16, 2019

Caterpillar D6T XL
Standard Crawler Dozers

Size Class:
190 - 259 HP
Weight:
44,420 lbs.



Configuration for D6T XL

Dozer Type	**Semi-U**	Power Mode	**Diesel**
Net Horsepower	**200 hp**	Operator Protection	**EROPS**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$26.11/hr	$24.43/hr	-6.4%
Cost of Facilities Capital (CFC)	$7.85/hr	$6.41/hr	-18.3%
Overhead	$15.49/hr	$12.47/hr	-19.5%
Overhaul Labor	$9.84/hr	$3.11/hr	-68.4%
Overhaul Parts	$17.88/hr	$14.39/hr	-19.5%
Total Hourly Ownership Cost:	**$77.17/hr**	**$60.81/hr**	**-21.2%**

User Defined Adjustments: Annual Use Hours (1,285hrs -> 1,597hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$12.13/hr	$3.83/hr	-68.4%
Field Parts	$17.33/hr	$2.32/hr	-86.6%
Ground Engaging Component (GEC)	$2.89/hr	$2.36/hr	-18.3%
Tire	$0.00/hr	-	-
Electrical/Fuel	$25.51/hr	$7.80/hr	-69.4%
Lube	$5.28/hr	-	-
Total Operating Ownership Cost:	**$63.14/hr**	**$21.59/hr**	**-65.8%**

User Defined Adjustments: Annual Field Repair Parts Cost ($18,555.77 -> $0.77) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$77.17/hr	$60.81/hr	-21.2%
Hourly Operating Costs	$63.14/hr	$21.59/hr	-65.8%
Total Hourly Cost	**$140.31**	**$82.40/hr**	**-41.3%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$49.45/hr	$43.31/hr	-12.4%
Idle	$102.68/hr	$68.61/hr	-33.2%

Revised Date: 1st Half 2019

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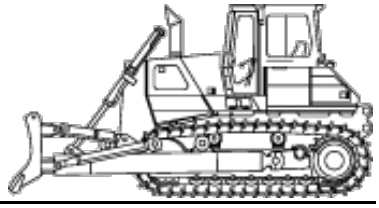
All prices shown in US$

Adjustments for 3A D6TXL in All Saved Models

January 16, 2019

Caterpillar D6T XL
Standard Crawler Dozers

Size Class:
190 - 259 HP
Weight:
44,420 lbs.



Configuration for D6T XL

Dozer Type	**Semi-U**	Net Horsepower	**200 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$8,050.00	$3,554.00	$1,196.00
Adjustments			
Region (New Mexico: 113%)	$1,054.55	$465.57	$156.68
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$9,104.55**	**$4,019.57**	**$1,352.68**

Date Last Updated: Oct 01, 2018

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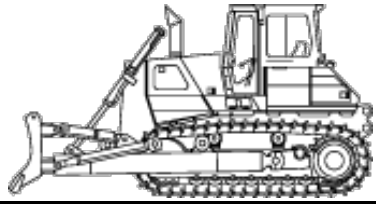
Adjustments for MANDYLILLA4 in All Saved Models

January 16, 2019

Caterpillar D9T
Standard Crawler Dozers

Size Class:
360 - 519 HP
Weight:
105,600 lbs.



Configuration for D9T

Dozer Type	**Semi-U**	Power Mode	**Diesel**
Net Horsepower	**410 hp**	Operator Protection	**ROPS/FOPS**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$45.49/hr	$42.80/hr	-5.9%
Cost of Facilities Capital (CFC)	$13.80/hr	$11.64/hr	-15.7%
Overhead	$37.97/hr	$31.66/hr	-16.6%
Overhaul Labor	$17.23/hr	$5.64/hr	-67.3%
Overhaul Parts	$40.59/hr	$33.84/hr	-16.6%
Total Hourly Ownership Cost:	**$155.08/hr**	**$125.58/hr**	**-19%**

User Defined Adjustments: Annual Use Hours (1,400hrs -> 1,679hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$20.17/hr	$6.60/hr	-67.3%
Field Parts	$39.53/hr	$5.49/hr	-86.1%
Ground Engaging Component (GEC)	$6.59/hr	$3.98/hr	-39.6%
Tire	$0.00/hr	-	-
Electrical/Fuel	$46.92/hr	$14.35/hr	-69.4%
Lube	$11.22/hr	-	-
Total Operating Ownership Cost:	**$124.43/hr**	**$41.64/hr**	**-66.5%**

User Defined Adjustments: Annual Field Repair Parts Cost ($46,119.12 -> $0.12) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$155.08/hr	$125.58/hr	-19%
Hourly Operating Costs	$124.43/hr	$41.64/hr	-66.5%
Total Hourly Cost	**$279.51**	**$167.22/hr**	**-40.2%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$97.26/hr	$86.10/hr	-11.5%
Idle	$202.00/hr	$139.93/hr	-30.7%

Revised Date: 1st Half 2019

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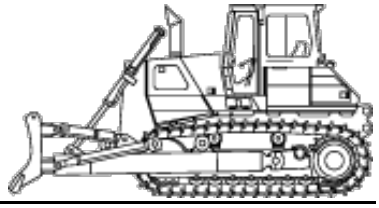
All prices shown in US$

Adjustments for MANDYLILLA4 in All Saved Models

January 16, 2019

Caterpillar D9T
Standard Crawler Dozers

Size Class:
360 - 519 HP
Weight:
105,600 lbs.



Configuration for D9T

Dozer Type	**Semi-U**	Net Horsepower	**410 hp**

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$26,622.00	$9,141.00	$3,118.00
Adjustments			
Region (New Mexico: 113%)	$3,487.48	$1,197.47	$408.46
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$30,109.48**	**$10,338.47**	**$3,526.46**

Date Last Updated: Oct 01, 2018

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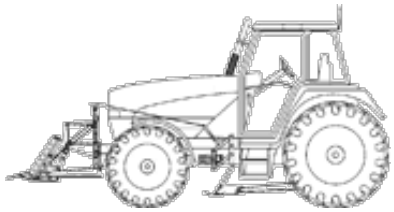
All prices shown in US$

Adjustments for MANDYLILLA27 in All Saved Models

January 17, 2019

Deere 7430 (disc. 2011)
Wheel Tractors

Size Class:
125 to 174 hp
Weight:
N/A



Configuration for 7430 (disc. 2011)

Power Mode **Diesel**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$12.48/hr	$11.70/hr	-6.3%
Cost of Facilities Capital (CFC)	$3.12/hr	$2.43/hr	-22.1%
Overhead	$4.42/hr	$3.35/hr	-24.2%
Overhaul Labor	$6.46/hr	$1.92/hr	-70.3%
Overhaul Parts	$5.55/hr	$4.20/hr	-24.3%
Total Hourly Ownership Cost:	**$32.03/hr**	**$23.60/hr**	**-26.3%**

User Defined Adjustments: Annual Use Hours (1,030hrs -> 1,359hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$8.51/hr	$2.53/hr	-70.3%
Field Parts	$4.86/hr	$0.61/hr	-87.4%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$2.42/hr	-	-
Electrical/Fuel	$19.54/hr	$5.98/hr	-69.4%
Lube	$2.84/hr	-	-
Total Operating Ownership Cost:	**$38.17/hr**	**$14.38/hr**	**-62.3%**

User Defined Adjustments: Annual Field Repair Parts Cost ($4,174.20 -> $0.20) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$32.03/hr	$23.60/hr	-26.3%
Hourly Operating Costs	$38.17/hr	$14.38/hr	-62.3%
Total Hourly Cost	**$70.20**	**$37.98/hr**	**-45.9%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$20.02/hr	$17.48/hr	-12.7%
Idle	$51.57/hr	$29.58/hr	-42.6%

Revised Date: 1st Half 2019

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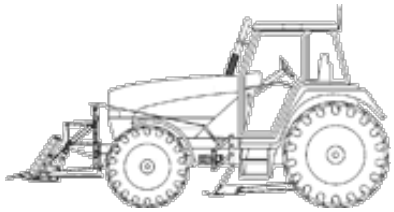
Adjustments for MANDYLILLA27 in All Saved Models

January 17, 2019

Deere 7430 (disc. 2011)
Wheel Tractors

Size Class:
125 to 174 hp
Weight:
N/A



Configuration for 7430 (disc. 2011)

AED Rental Rates

These rental rates reflect an average for equipment of this type and size. Rates shown for specific brands or models are provided for convenience only. Rates charged by rental companies for specific brands or models will vary depending on many factors

	Monthly	Weekly	Daily
Published Rates	$3,891.00	$1,303.00	$463.00
Adjustments			
Region (New Mexico: 134%)	$1,319.05	$441.72	$156.96
User Defined			
Rental Rates (100%)	-	-	-
Total:	**$5,210.05**	**$1,744.72**	**$619.96**

Date Last Updated: Oct 01, 2018

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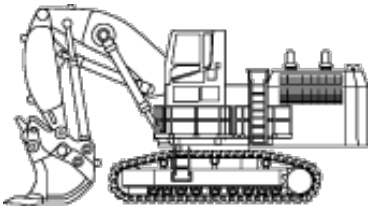
Adjustments for MANDYLILLA15 in All Saved Models

January 17, 2019

Hitachi EX3600-5 (disc. 2009)
Hydraulic Shovels

Size Class:
150.1 MTons & Over
Weight:
772,000 lbs.



Configuration for EX3600-5 (disc. 2009)

Operating Weight	**350 mt**	Bucket Capacity - Heaped	**27.4 cu yd**
Net Horsepower	**1880 hp**	Power Mode	**Diesel**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$157.54/hr	$148.69/hr	-5.6%
Cost of Facilities Capital (CFC)	$46.64/hr	$42.62/hr	-8.6%
Overhead	$72.89/hr	$66.17/hr	-9.2%
Overhaul Labor	$30.53/hr	$10.88/hr	-64.4%
Overhaul Parts	$121.97/hr	$110.72/hr	-9.2%
Total Hourly Ownership Cost:	**$429.57/hr**	**$379.08/hr**	**-11.8%**

User Defined Adjustments: Annual Use Hours (1,850hrs -> 2,038hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$40.55/hr	$14.45/hr	-64.4%
Field Parts	$133.55/hr	$24.25/hr	-81.8%
Ground Engaging Component (GEC)	$19.91/hr	$16.56/hr	-16.8%
Tire	$0.00/hr	-	-
Electrical/Fuel	$270.49/hr	$82.72/hr	-69.4%
Lube	$59.15/hr	-	-
Total Operating Ownership Cost:	**$523.65/hr**	**$197.13/hr**	**-62.4%**

User Defined Adjustments: Annual Field Repair Parts Cost ($197,654.88 -> $0.47) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$429.57/hr	$379.08/hr	-11.8%
Hourly Operating Costs	$523.65/hr	$197.13/hr	-62.4%
Total Hourly Cost	**$953.22**	**$576.21/hr**	**-39.6%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$277.07/hr	$257.48/hr	-7.1%
Idle	$700.06/hr	$461.80/hr	-34%

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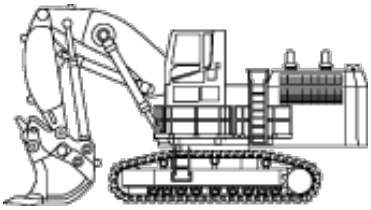
Adjustments for MANDYLILLA15 in All Saved Models

January 16, 2019

Hitachi EX3600-5 (disc. 2009)
Hydraulic Shovels

Size Class:
150.1 MTons & Over
Weight:
772,000 lbs.



Configuration for EX3600-5 (disc. 2009)

Operating Weight	**350 mt**	Bucket Capacity - Heaped	**27.4 cu yd**
Net Horsepower	**1880 hp**	Power Mode	**Diesel**

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$76,625.00	$21,455.00	$5,365.00	$805.00	$530.00	$965.37
Adjustments						
Region (Las Cruces, New Mexico: 90.4%)	($7,356.00)	($2,059.68)	($515.04)	($77.28)		
Model Year (2009: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$69,269.00**	**$19,395.32**	**$4,849.96**	**$727.72**	**$530.00**	**$923.57**

Non-Active Use Rates

	Hourly
Standby Rate	$196.79
Idling Rate	$664.06

Rate Element Allocation

Element	**Percentage**	**Value**
Depreciation (ownership)	32%	$24,520.00/mo
Overhaul (ownership)	50%	$38,312.50/mo
CFC (ownership)	9%	$6,896.25/mo
Indirect (ownership)	9%	$6,896.25/mo
Fuel (operating) @ 3.27	51%	$270.49/hr

Revised Date: 1st Half 2019

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Adjustments for MANDYLILLA12 in All Saved Models

January 16, 2019

Miscellaneous MSR-359H
Crawler Tractor Multi-Shank Rippers

Size Class:
260 HP & Over
Weight:
N/A

Model Image

Configuration for MSR-359H

Engine Horsepower	**260 - 359**	Number of Shanks	**3**
Ripper Type	**Parallelogram**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$7.23/hr	$6.86/hr	-5.1%
Cost of Facilities Capital (CFC)	$0.97/hr	$0.79/hr	-18.6%
Overhead	$1.68/hr	$1.33/hr	-20.8%
Overhaul Labor	$2.75/hr	$0.85/hr	-69.1%
Overhaul Parts	$2.35/hr	$1.86/hr	-20.9%
Total Hourly Ownership Cost:	**$14.98/hr**	**$11.69/hr**	**-22%**

User Defined Adjustments: Annual Use Hours (1,285hrs -> 1,623hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$5.04/hr	$1.56/hr	-69%
Field Parts	$2.37/hr	$0.31/hr	-86.9%
Ground Engaging Component (GEC)	$1.97/hr	$1.56/hr	-20.8%
Tire	$0.00/hr	-	-
Electrical/Fuel	$0.00/hr	-	-
Lube	$0.37/hr	-	-
Total Operating Ownership Cost:	**$9.75/hr**	**$3.80/hr**	**-61%**

User Defined Adjustments: Annual Field Repair Parts Cost ($2,534.87 -> $0.87) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$14.98/hr	$11.69/hr	-22%
Hourly Operating Costs	$9.75/hr	$3.80/hr	-61%
Total Hourly Cost	**$24.73**	**$15.49/hr**	**-37.4%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$9.88/hr	$8.98/hr	-9.1%
Idle	$14.98/hr	$11.69/hr	-22%

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Adjustments for MANDYLILLA12 in All Saved Models

January 16, 2019

Miscellaneous MSR-359H
Crawler Tractor Multi-Shank Rippers

Size Class:
260 HP & Over
Weight:
N/A

Model Image

Configuration for MSR-359H

Engine Horsepower	**260 - 359**	Number of Shanks	**3**
Ripper Type	**Parallelogram**		

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$2,635.00	$740.00	$185.00	$28.00	$9.75	$24.72
Adjustments						
Region (Las Cruces, New Mexico: 89%)	($289.85)	($81.40)	($20.35)	($3.08)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$2,345.15**	**$658.60**	**$164.65**	**$24.92**	**$9.75**	**$23.07**

Non-Active Use Rates

	Hourly
Standby Rate	$9.19
Idling Rate	$13.32

Rate Element Allocation

Element	**Percentage**	**Value**
Depreciation (ownership)	50%	$1,317.50/mo
Overhaul (ownership)	31%	$816.85/mo
CFC (ownership)	7%	$184.45/mo
Indirect (ownership)	12%	$316.20/mo

Fuel cost data is not available for these rates.

Revised Date: 1st Half 2019

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Custom Cost Evaluator

February 21, 2019

Miscellaneous MSR-189H
Crawler Tractor Multi-Shank Rippers

Size Class:
To 260 HP
Weight:
3,557 lbs.

Model Image

Configuration for MSR-189H

Engine Horsepower	**130 - 189**	Number of Shanks	**3**
Ripper Type	**Parallelogram**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$2.64/hr	$2.50/hr	-5.3%
Cost of Facilities Capital (CFC)	$0.38/hr	$0.31/hr	-18.4%
Overhead	$0.66/hr	$0.52/hr	-21.2%
Overhaul Labor	$1.10/hr	$0.34/hr	-69.1%
Overhaul Parts	$0.95/hr	$0.75/hr	-21.1%
Total Hourly Ownership Cost:	**$5.73/hr**	**$4.42/hr**	**-22.9%**

User Defined Adjustments: Annual Use Hours (1,285hrs -> 1,629hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$1.83/hr	$0.57/hr	-68.9%
Field Parts	$1.18/hr	$0.16/hr	-86.4%
Ground Engaging Component (GEC)	$0.99/hr	$0.78/hr	-21.2%
Tire	$0.00/hr	-	-
Electrical/Fuel	$0.00/hr	-	-
Lube	$0.15/hr	-	-
Total Operating Ownership Cost:	**$4.15/hr**	**$1.66/hr**	**-60%**

User Defined Adjustments: Annual Field Repair Parts Cost ($1,268.18 -> $0.18) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$5.73/hr	$4.42/hr	-22.9%
Hourly Operating Costs	$4.15/hr	$1.66/hr	-60%
Total Hourly Cost	**$9.88**	**$6.08/hr**	**-38.5%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$3.68/hr	$3.33/hr	-9.5%
Idle	$5.73/hr	$4.42/hr	-22.9%

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Rental Rate Blue Book®

February 21, 2019

Miscellaneous MSR-189H
Crawler Tractor Multi-Shank Rippers

Size Class:
To 260 HP
Weight:
3,557 lbs.

Model Image

Configuration for MSR-189H

Engine Horsepower	**130 - 189**	Number of Shanks	**3**
Ripper Type	**Parallelogram**		

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$1,010.00	$285.00	$71.00	$11.00	$4.15	$9.89
Adjustments						
Region (Las Cruces, New Mexico: 89%)	($111.10)	($31.35)	($7.81)	($1.21)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$898.90**	**$253.65**	**$63.19**	**$9.79**	**$4.15**	**$9.26**

Non-Active Use Rates

	Hourly
Standby Rate	$3.52
Idling Rate	$5.11

Rate Element Allocation

Element	Percentage	Value
Depreciation (ownership)	50%	$505.00/mo
Overhaul (ownership)	31%	$313.10/mo
CFC (ownership)	7%	$70.70/mo
Indirect (ownership)	12%	$121.20/mo

Fuel cost data is not available for these rates.

Revised Date: 1st Half 2019

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Custom Cost Evaluator

February 21, 2019

Finn B260
Trailer Mounted Mulchers

Size Class:
51 HP & Over
Weight:
4,880 lbs.

Model Image

Configuration for B260

Power Mode **Diesel** Horsepower **115**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$5.80/hr	$5.45/hr	-6%
Cost of Facilities Capital (CFC)	$0.88/hr	$0.69/hr	-21.6%
Overhead	$1.18/hr	$0.90/hr	-23.7%
Overhaul Labor	$3.36/hr	$1.00/hr	-70.2%
Overhaul Parts	$2.54/hr	$1.92/hr	-24.4%
Total Hourly Ownership Cost:	**$13.76/hr**	**$9.96/hr**	**-27.6%**

User Defined Adjustments: Annual Use Hours (1,050hrs -> 1,388hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$4.20/hr	$1.25/hr	-70.2%
Field Parts	$1.47/hr	$0.15/hr	-89.8%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$0.60/hr	-	-
Electrical/Fuel	$13.50/hr	$4.13/hr	-69.4%
Lube	$1.60/hr	-	-
Total Operating Ownership Cost:	**$21.37/hr**	**$7.73/hr**	**-63.8%**

User Defined Adjustments: Annual Field Repair Parts Cost ($1,342.66 -> $0.66) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$13.76/hr	$9.96/hr	-27.6%
Hourly Operating Costs	$21.37/hr	$7.73/hr	-63.8%
Total Hourly Cost	**$35.13**	**$17.69/hr**	**-49.6%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$7.86/hr	$7.04/hr	-10.4%
Idle	$27.26/hr	$14.09/hr	-48.3%

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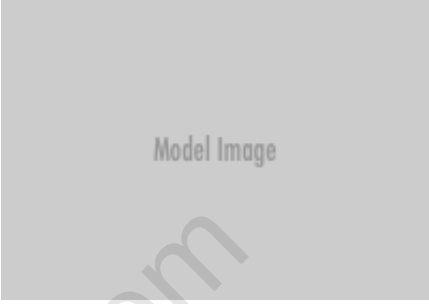
Rental Rate Blue Book®

February 21, 2019

Finn B260

Trailer Mounted Mulchers

Size Class:
51 HP & Over
Weight:
4,880 lbs.



Configuration for B260

Power Mode	**Diesel**	Horsepower	**115**

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$2,425.00	$680.00	$170.00	$26.00	$21.35	$35.13
Adjustments						
Region (Las Cruces, New Mexico: 89.4%)	($257.05)	($72.08)	($18.02)	($2.76)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$2,167.95**	**$607.92**	**$151.98**	**$23.24**	**$21.35**	**$33.67**

Non-Active Use Rates

	Hourly
Standby Rate	$6.16
Idling Rate	$25.82

Rate Element Allocation

Element	**Percentage**	**Value**
Depreciation (ownership)	37%	$897.25/mo
Overhaul (ownership)	50%	$1,212.50/mo
CFC (ownership)	6%	$145.50/mo
Indirect (ownership)	7%	$169.75/mo
Fuel (operating) @ 3.27	63%	$13.50/hr

Revised Date: 1st Half 2019

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Adjustments for MANDYLILLA21 in All Saved Models

January 17, 2019

Miscellaneous 6000 330
Off-Highway Water Tanker Trucks

Size Class:
300 - 399 HP
Weight:
54,400 lbs.

Model Image

Configuration for 6000 330

Power Mode	**Diesel**	Horsepower	**330**
Tank Capacity	**6000 gal**		

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$22.90/hr	$21.43/hr	-6.4%
Cost of Facilities Capital (CFC)	$5.88/hr	$4.96/hr	-15.6%
Overhead	$7.31/hr	$6.06/hr	-17.1%
Overhaul Labor	$9.02/hr	$2.94/hr	-67.4%
Overhaul Parts	$5.85/hr	$4.85/hr	-17.1%
Total Hourly Ownership Cost:	**$50.96/hr**	**$40.24/hr**	**-21%**

User Defined Adjustments: Annual Use Hours (1,500hrs -> 1,809hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$22.16/hr	$7.21/hr	-67.5%
Field Parts	$10.69/hr	$1.48/hr	-86.2%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$6.42/hr	-	-
Electrical/Fuel	$36.80/hr	$11.25/hr	-69.4%
Lube	$6.15/hr	-	-
Total Operating Ownership Cost:	**$82.22/hr**	**$32.51/hr**	**-60.5%**

User Defined Adjustments: Annual Field Repair Parts Cost ($13,358.68 -> $0.68) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$50.96/hr	$40.24/hr	-21%
Hourly Operating Costs	$82.22/hr	$32.51/hr	-60.5%
Total Hourly Cost	**$133.18**	**$72.75/hr**	**-45.4%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$36.09/hr	$32.45/hr	-10.1%
Idle	$87.76/hr	$51.49/hr	-41.3%

Revised Date: 1st Half 2019

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All prices shown in US$

Adjustments for MANDYLILLA21 in All Saved Models

January 16, 2019

Miscellaneous 6000 330
Off-Highway Water Tanker Trucks

Size Class:
300 - 399 HP
Weight:
54,400 lbs.

Model Image

Configuration for 6000 330

Power Mode	**Diesel**	Horsepower	**330**
Tank Capacity	**6000 gal**		

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$8,970.00	$2,510.00	$630.00	$95.00	$82.20	$133.17
Adjustments						
Region (Las Cruces, New Mexico: 91.1%)	($798.33)	($223.39)	($56.07)	($8.45)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$8,171.67**	**$2,286.61**	**$573.93**	**$86.55**	**$82.20**	**$128.63**

Non-Active Use Rates

	Hourly
Standby Rate	$32.50
Idling Rate	$83.23

Rate Element Allocation

Element	**Percentage**	**Value**
Depreciation (ownership)	45%	$4,036.50/mo
Overhaul (ownership)	30%	$2,691.00/mo
CFC (ownership)	11%	$986.70/mo
Indirect (ownership)	14%	$1,255.80/mo
Fuel (operating) @ 3.27	45%	$36.80/hr

Revised Date: 1st Half 2019

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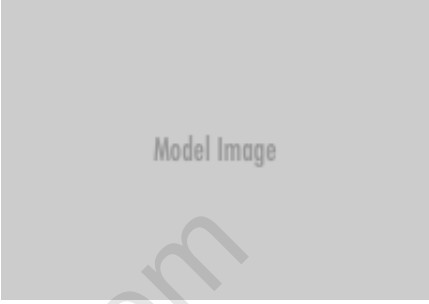
Adjustments for MANDYLILLA25 in All Saved Models

January 17, 2019

Miscellaneous 48" X 60' - 516
Single Deck Portable Screening Plants

Size Class:
37" & Over
Weight:
23,300 lbs.



Configuration for 48" X 60' - 516

Screen Size	**5' X 16'**	Power Mode	**Diesel**
Horsepower	**110**	Conveyor Size	**48" X 60'**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$10.30/hr	$9.74/hr	-5.4%
Cost of Facilities Capital (CFC)	$2.11/hr	$1.74/hr	-17.5%
Overhead	$3.48/hr	$2.80/hr	-19.5%
Overhaul Labor	$12.47/hr	$3.94/hr	-68.4%
Overhaul Parts	$7.59/hr	$6.11/hr	-19.5%
Total Hourly Ownership Cost:	**$35.95/hr**	**$24.33/hr**	**-32.3%**

User Defined Adjustments: Annual Use Hours (1,250hrs -> 1,553hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$14.12/hr	$4.46/hr	-68.4%
Field Parts	$7.05/hr	$1.14/hr	-83.8%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$0.39/hr	-	-
Electrical/Fuel	$15.86/hr	$4.85/hr	-69.4%
Lube	$2.37/hr	-	-
Total Operating Ownership Cost:	**$39.79/hr**	**$13.21/hr**	**-66.8%**

User Defined Adjustments: Annual Field Repair Parts Cost ($7,054.61 -> $0.61) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$35.95/hr	$24.33/hr	-32.3%
Hourly Operating Costs	$39.79/hr	$13.21/hr	-66.8%
Total Hourly Cost	**$75.74**	**$37.54/hr**	**-50.4%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$15.89/hr	$14.28/hr	-10.1%
Idle	$51.81/hr	$29.18/hr	-43.7%

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Adjustments for MANDYLILLA25 in All Saved Models

January 17, 2019

Miscellaneous 48" X 60' - 516
Single Deck Portable Screening Plants

Size Class:
37" & Over
Weight:
23,300 lbs.

Model Image

Configuration for 48" X 60' - 516

Screen Size	**5' X 16'**	Power Mode	**Diesel**
Horsepower	**110**	Conveyor Size	**48" X 60'**

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$6,330.00	$1,770.00	$445.00	$67.00	$39.80	$75.77
Adjustments						
Region (Las Cruces, New Mexico: 89.6%)	($658.32)	($184.08)	($46.28)	($6.97)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$5,671.68**	**$1,585.92**	**$398.72**	**$60.03**	**$39.80**	**$72.03**

Non-Active Use Rates

	Hourly
Standby Rate	$13.21
Idling Rate	$48.09

Rate Element Allocation

Element	Percentage	Value
Depreciation (ownership)	27%	$1,709.10/mo
Overhaul (ownership)	59%	$3,734.70/mo
CFC (ownership)	5%	$316.50/mo
Indirect (ownership)	9%	$569.70/mo
Fuel (operating) @ 3.27	40%	$15.86/hr

Revised Date: 1st Half 2019

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All prices shown in US$

Adjustments for MANDYLILLA24 in All Saved Models

January 17, 2019

Miscellaneous 42" X 60' - 516
Triple Deck Portable Screening Plants

Size Class:
37" & Over
Weight:
26,300 lbs.

Model Image

Configuration for 42" X 60' - 516

Screen Size	**5' X 16'**	Power Mode	**Diesel**
Horsepower	**110**	Conveyor Size	**42" X 60'**

Hourly Ownership Costs

	Standard Value	User Adjusted Value	Variance
Depreciation	$10.18/hr	$9.62/hr	-5.5%
Cost of Facilities Capital (CFC)	$2.13/hr	$1.75/hr	-17.8%
Overhead	$3.52/hr	$2.84/hr	-19.3%
Overhaul Labor	$13.04/hr	$4.12/hr	-68.4%
Overhaul Parts	$7.56/hr	$6.09/hr	-19.4%
Total Hourly Ownership Cost:	**$36.43/hr**	**$24.42/hr**	**-33%**

User Defined Adjustments: Annual Use Hours (1,250hrs -> 1,551hrs) Sales Tax (5.1% -> 0%)

Hourly Operating Costs

	Standard Value	User Adjusted Value	Variance
Field Labor	$14.59/hr	$4.62/hr	-68.3%
Field Parts	$7.23/hr	$1.16/hr	-84%
Ground Engaging Component (GEC)	$0.00/hr	-	-
Tire	$0.37/hr	-	-
Electrical/Fuel	$15.86/hr	$4.85/hr	-69.4%
Lube	$2.38/hr	-	-
Total Operating Ownership Cost:	**$40.43/hr**	**$13.38/hr**	**-66.9%**

User Defined Adjustments: Annual Field Repair Parts Cost ($7,225.13 -> $0.45) Diesel Cost (3.27 -> 1) Mechanics Wage ($58.84 -> $23.09)

Total

	Standard Value	User Adjusted Value	Variance
Hourly Ownership Costs	$36.43/hr	$24.42/hr	-33%
Hourly Operating Costs	$40.43/hr	$13.38/hr	-66.9%
Total Hourly Cost	**$76.86**	**$37.80/hr**	**-50.8%**

Non-active use rates

	Standard Value	User Adjusted Value	Variance
Standby	$15.83/hr	$14.21/hr	-10.2%
Idle	$52.29/hr	$29.27/hr	-44%

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Adjustments for MANDYLILLA24 in All Saved Models

January 17, 2019

Miscellaneous 42" X 60' - 516
Triple Deck Portable Screening Plants

Size Class:
37" & Over
Weight:
26,300 lbs.

Model Image

Configuration for 42" X 60' - 516

Screen Size	**5' X 16'**	Power Mode	**Diesel**
Horsepower	**110**	Conveyor Size	**42" X 60'**

Blue Book Rates

** FHWA Rate is equal to the monthly ownership cost divided by 176 plus the hourly estimated operating cost.

	Ownership Costs				Estimated Operating Costs	FHWA Rate**
	Monthly	**Weekly**	**Daily**	**Hourly**	**Hourly**	**Hourly**
Published Rates	$6,410.00	$1,795.00	$450.00	$68.00	$40.45	$76.87
Adjustments						
Region (Las Cruces, New Mexico: 89.6%)	($666.64)	($186.68)	($46.80)	($7.07)		
Model Year (2019: 100%)	-	-	-	-		
Adjusted Hourly Ownership Cost (100%)	-	-	-	-		
Hourly Operating Cost (100%)					-	
Total:	**$5,743.36**	**$1,608.32**	**$403.20**	**$60.93**	**$40.45**	**$73.08**

Non-Active Use Rates

	Hourly
Standby Rate	$13.38
Idling Rate	$48.49

Rate Element Allocation

Element	Percentage	Value
Depreciation (ownership)	26%	$1,666.60/mo
Overhaul (ownership)	59%	$3,781.90/mo
CFC (ownership)	6%	$384.60/mo
Indirect (ownership)	9%	$576.90/mo
Fuel (operating) @ 3.27	39%	$15.86/hr

Revised Date: 1st Half 2019

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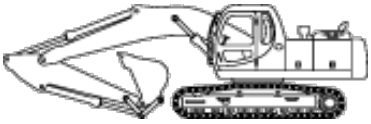
Spec Finder

December 8, 2018

Caterpillar 319D L (disc. 2012)
Crawler Mounted Hydraulic Excavators



Size Class:
19.1 - 21.0 MTons
Weight:
43,872 lbs.

Specifications

BOOM, STICK & BUCKET	
Stick Length	126 in
Bucket Capacity Range	.59 cu yd - 1.4 cu yd
Boom Type	1-Piece
Boom Length	209 in
Bucket Capacity - Heaped	1 cu yd
Bucket Type	Heavy Duty
Bucket Digging Force-Standard	18142 lbs
Bucket Width	36 in
ENGINE	
Engine	C4.2
Engine Manufacturer	Caterpillar
Power Mode	Diesel
Net Horsepower	125 hp
Displacement (cu. in)	259
Gross Horsepower	131 hp
FLUID CAPACITIES	
Hydraulic Tank Capacity	28 gal
Fuel Tank Capacity	79.3 gal
HYDRAULICS	
Standard Relief Pressure	5076 psi
Main Pump - Maximum Flow	100.1 gal/min
PERFORMANCE	
Side Lift Capy @ 20' G.L.	6700 lbs
Maximum Drawbar Pull	46466 lbs
Travel Speed - High	3 mph
Maximum Swing Speed	11.1 rpm
Stick Digging Force - Standard	18142 lbs
Front Lift Capy @ 20' G.L.	13000 lbs
UNDERCARRIAGE	
Ground Pressure	5.1 psi
No. of Upper/Carrier Rollers	2
Track Gauge	87 in
Track Shoe Width	28 in
Track Length	175 in
No. of Lower/Track Rollers	7
WEIGHTS & DIMENSIONS	
Undercarriage Ground Clearance	17 in
Tail Swing Radius	98 in
Overall Track Width--Retracted	114 in
Maximum Digging Depth	271 in
Maximum Dumping Height	269 in
Overall Length	345 in
Overall Height	139 in
Overall Width	114 in
Digging Depth (8' Flat Bottom)	265 in
Maximum Reach at Ground Level	380 in
Operating Weight	19.9 mt

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Vertical Straight Wall Depth	225 in

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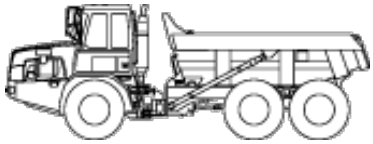
Spec Finder

February 17, 2019

Caterpillar 725 (disc. 2014)
Articulated Rear Dumps



Size Class:
20 - 25 MTons
Weight:
49,075 lbs.

Specifications

AXLES & TIRES	
Axle Configuration	6 X 6
Front Tire_Size	23.5 R25
Rear Tire Size	23.5 R25
DUMP BODY	
Body Capacity (Struck--Heaped)	14.3 cu yd - 18.8 cu yd
Dump Cycle (Hoist/Raise)	10 "
Dump Cycle (Power Down)	8 "
Dump Angle	70 °
Body Sidewall Thickness	.47 in
Body Front-Plate Thickness	.31 in
Body Floor-Plate Thickness	.55 in
ENGINE	
Engine	C11 ACERT
Engine Manufacturer	Caterpillar
Power Mode	Diesel
Emissions Tier	Tier 3
Net Horsepower	301 hp
Cylinders	6
Displacement (cu. in)	680
FLUID CAPACITIES	
Fuel Tank Capacity	94 gal
Hydraulic System Capacity	49 gal
STEERING	
Steering Angle	45 °
TRANSMISSION	
Maximum Speed	35 mph
Transmission Manufacturer	Caterpillar
Number of Speeds	6F/1R
Transmission Type	Autoshift
WEIGHTS & DIMENSIONS	
Overall Machine Length	389 in
Overall Machine Width	109 in
Ground Clearance	18 in
Wheelbase	215 in
Rated Payload	23.6 mt
Rear Axle Weight (GVW)	33510 lbs
Front Axle Weight (GVW)	33135 lbs
Center Axle Weight (GVW)	34440 lbs
Inside Turning Radius	146 in
Load Over Height	108 in
Net Weight	49075 lbs
Overall Machine Height	135 in
Gross Weight	101085 lbs
Outside Turning Radius	286 in

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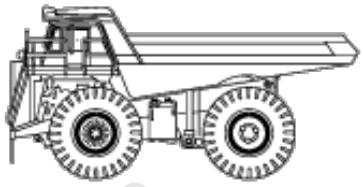
Spec Finder

January 31, 2019

Komatsu 730E
Electric Drive Rear Dumps

Size Class:
170 - 199 MTons
Weight:
309,950 lbs.



Specifications

AXLES & TIRES	
Front Tire_Size	37.00R57
Rear Tire Size	37.00R57
BRAKES	
Elec. Dynamic Retarding (Max.)	3700 hp
Parking Brake	SAHR
Service Brakes - Front	Wheel Spd Disc
Service Brakes - Rear	Dual Disc
DUMP BODY	
Body Capacity (Struck--Heaped)	101 cu yd - 145 cu yd
Dump Cycle (Power Down)	15 "
Body Sidewall Thickness	.35 in
Body Front-Plate Thickness	.47 in
Body Floor-Plate Thickness	.75 in
Dump Angle	45 °
Dump Cycle (Hoist/Raise)	21 "
ELECTRIC DRIVE	
Wheel Motor Planetary Ratio	26.825:1
Alternator/Generator Model	GTA-22
Alternator/Generator Mfr	General Electric
System Current	AC/DC
Maximum Travel Speed	34.6
Wheel Motor Model	GE788
Wheel Motor Manufacturer	General Electric
ENGINE	
Rated RPM	1900
Engine	SSA16V159
Engine Manufacturer	Komatsu
Power Mode	Diesel
Net Horsepower	1860 hp
Gross Horsepower	2000 hp
Cylinders	16
FLUID CAPACITIES	
Fuel Tank Capacity	850 gal
Hydraulic System Capacity	193 gal
WEIGHTS & DIMENSIONS	
Gross Weight	715000 lbs
Height of Rear Body (Empty)	221 in
Net Weight	309950 lbs
Rated Payload	183.7 mt
Maximum Payload	186 mt
Height to Cab Guard - Loading	246 in
Clearance Circle	1104 in
Overall Machine Length	505 in
Overall Machine Width	297 in

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Ground Clearance	45 in
Wheelbase	232 in

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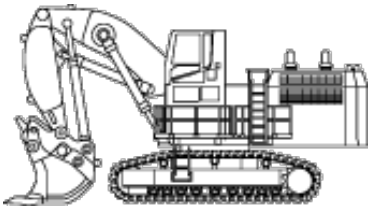
Spec Finder

January 31, 2019

Hitachi EX3600-5 (disc. 2009)
Hydraulic Shovels



Size Class:
150.1 MTons & Over
Weight:
772,000 lbs.

Specifications

BOOM & BUCKET	
Bucket Type	Bottom Dump
Bucket Digging Force-Standard	254000 lbs
Bucket Width	155 in
Bucket Capacity - Heaped	27.4 cu yd
Boom Length	311 in
ENGINE	
Cylinders	16
Displacement (cu. in)	3990
Rated RPM	1600
Gross Horsepower	1880 hp
Engine	S16R-TAA
Engine Manufacturer	Hitachi
Power Mode	Diesel
Net Horsepower	1880 hp
FLUID CAPACITIES	
Fuel Tank Capacity	1900 gal
HYDRAULICS	
Hydraulic Pumps - Type	Piston
Main Pump - Maximum Flow	1056 gal/min
Standard Relief Pressure	4270 psi
PERFORMANCE	
Stick Digging Force - Standard	269000 lbs
Travel Speed - High	1.4 mph
Maximum Drawbar Pull	395700 lbs
Maximum Swing Speed	3.2 rpm
UNDERCARRIAGE	
Track Gauge	217 in
Track Shoe Width	50 in
Ground Pressure	26.3 psi
WEIGHTS & DIMENSIONS	
Upperstructure Width	355 in
Tail Swing Radius	262 in
Operating Weight	350 mt
Overall Track Width--Retracted	267 in
Component Weight-Counterweight	88600 lbs
Maximum Dumping Height	433 in
Length of Track on Ground	262 in
Track Length	342 in
Height to Top of Cab	305 in
Maximum Reach at Ground Level	599 in
Undercarriage Ground Clearance	36 in
Maximum Digging Depth	154 in

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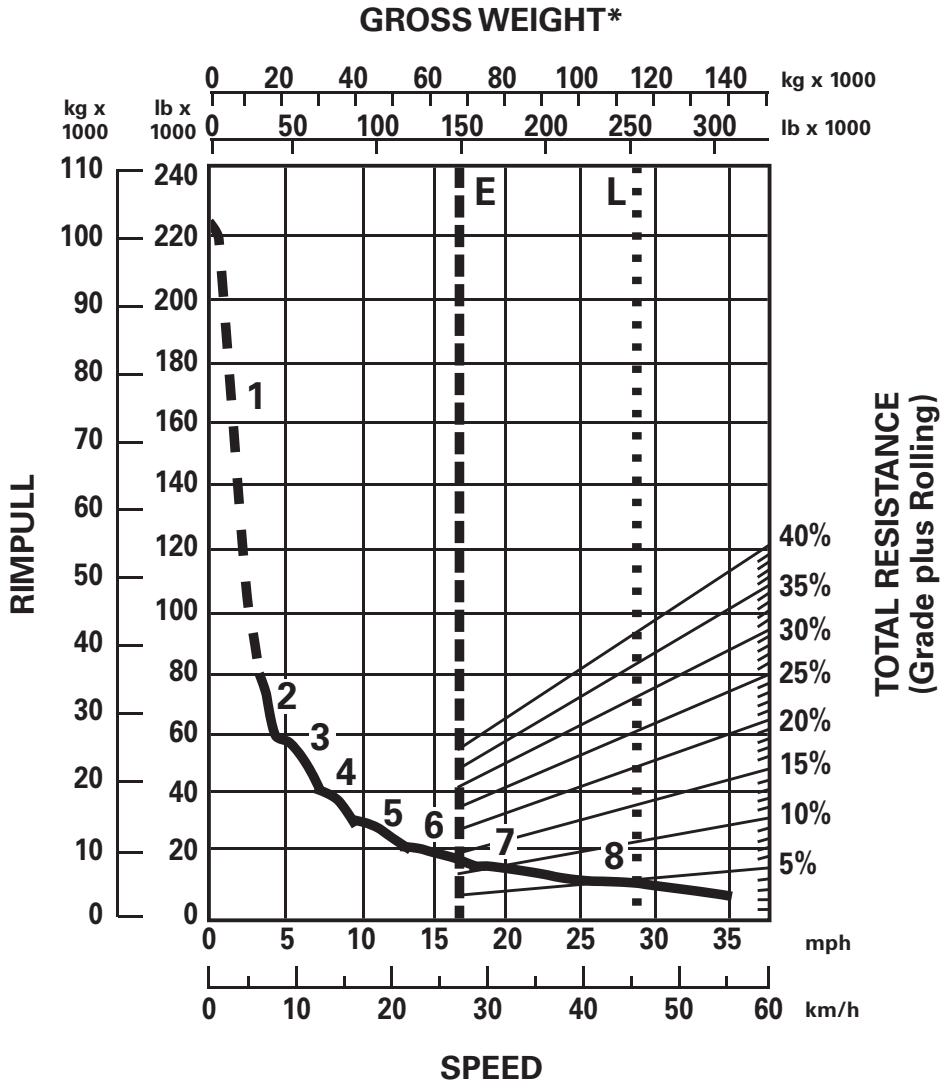
Appendix B.2.3

Equipment Productivity Curve Fits



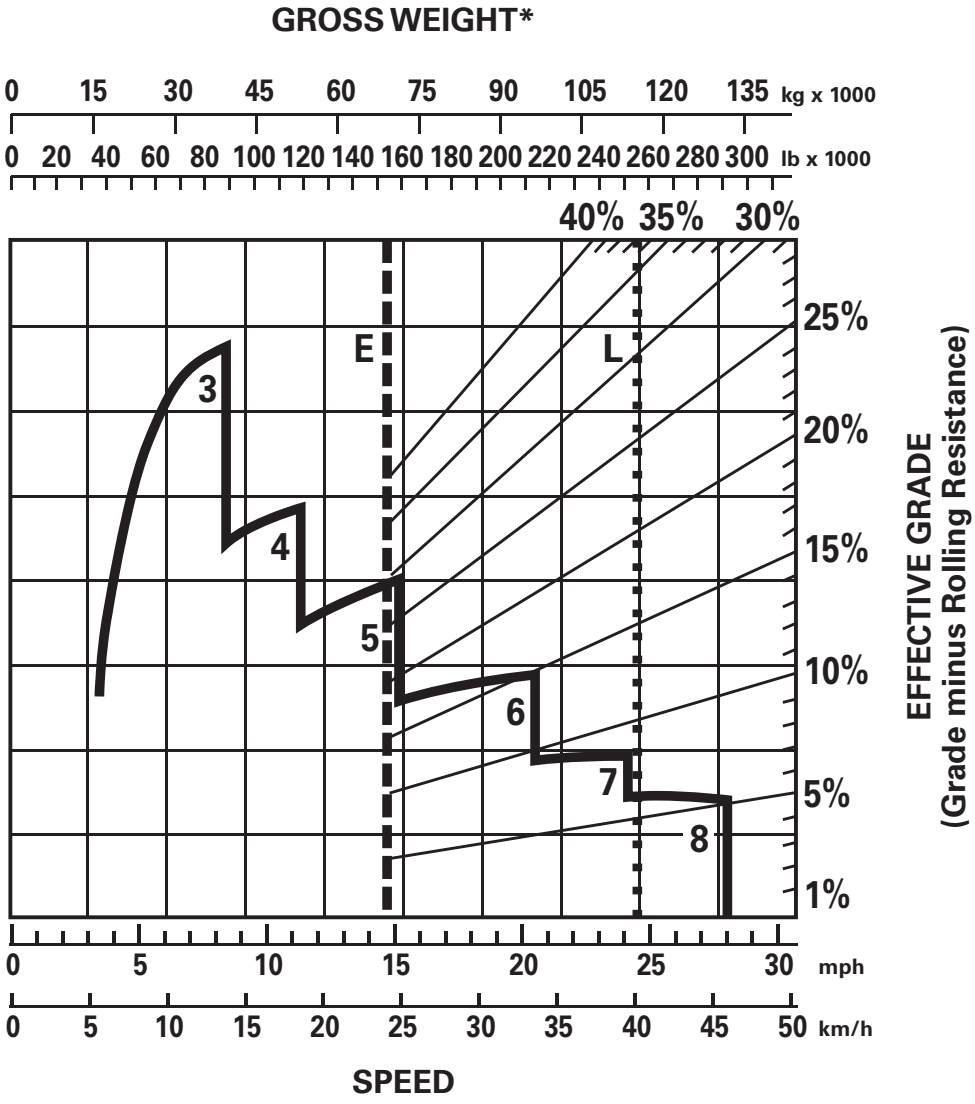
*at sea level

KEY

1 — 1st Gear Torque Converter Drive
2 — 2nd Gear Torque Converter Drive
3 — 3rd Gear Direct Drive
4 — 4th Gear Direct Drive
5 — 5th Gear Direct Drive
6 — 6th Gear Direct Drive
7 — 7th Gear Direct Drive
8 — 8th Gear Direct Drive

KEY

E — Empty 72 804 kg (160,505 lb)
L — Loaded 119 978 kg (264,505 lb)



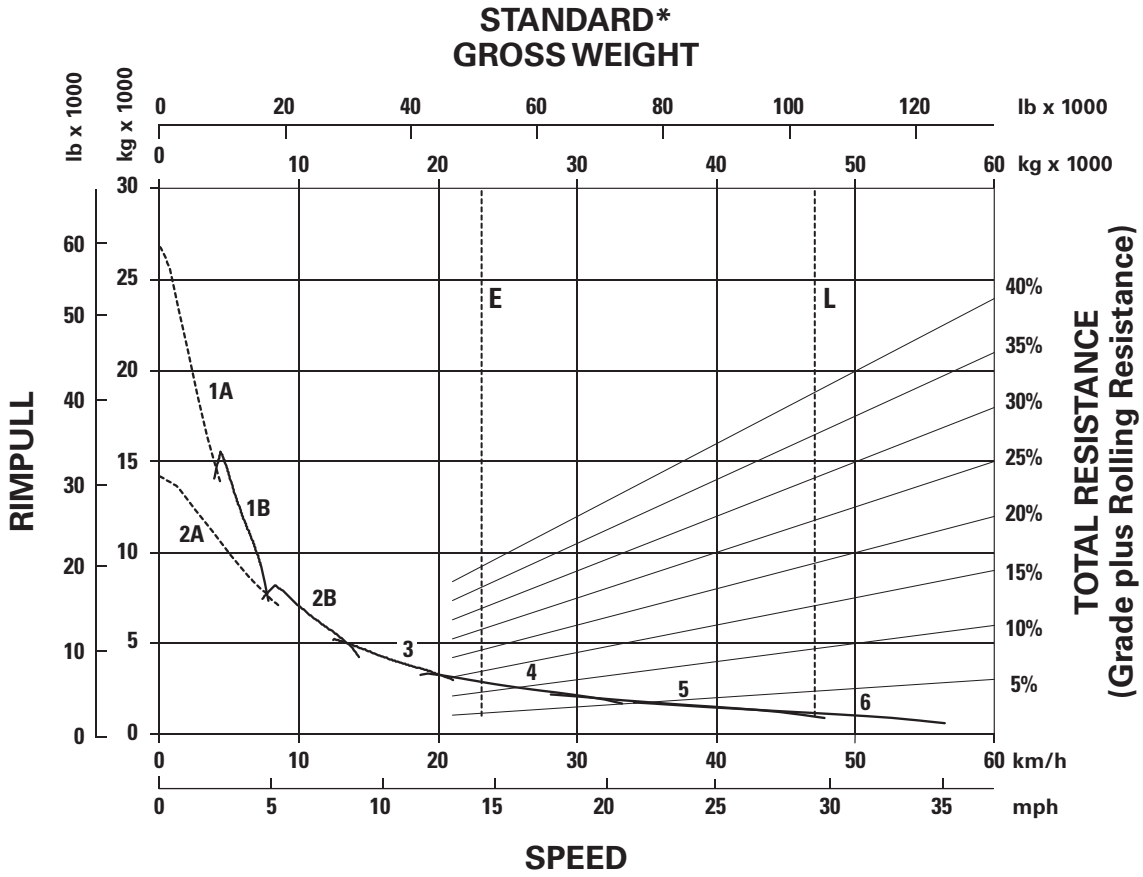
*at sea level

KEY

3 — 3rd Gear Direct Drive
4 — 4th Gear Direct Drive
5 — 5th Gear Direct Drive
6 — 6th Gear Direct Drive
7 — 7th Gear Direct Drive
8 — 8th Gear Direct Drive

KEY

E — Empty 72 804 kg (160,505 lb)
L — Loaded 119 978 kg (264,505 lb)



KEY

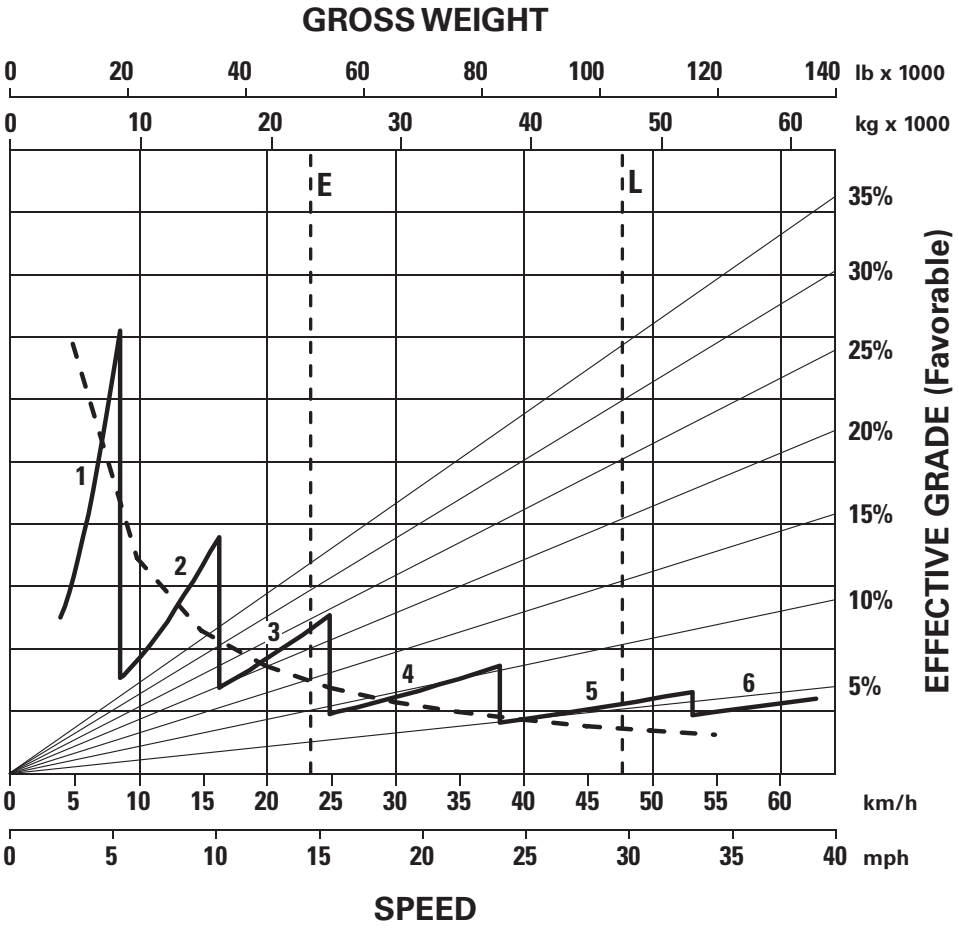
1A — 1st Gear (Converter Drive)
1B — 1st Gear (Direct Drive)
2A — 2nd Gear (Converter Drive
2B — 2nd Gear (Direct Drive)
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY

E — Empty 23 040 kg (50,795 lb)
L — Loaded 47 040 kg (103,707 lb)

*At sea level.

725C2 Brake/Retarder Performance Curve
- 23.5R25 Tires
- Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final)

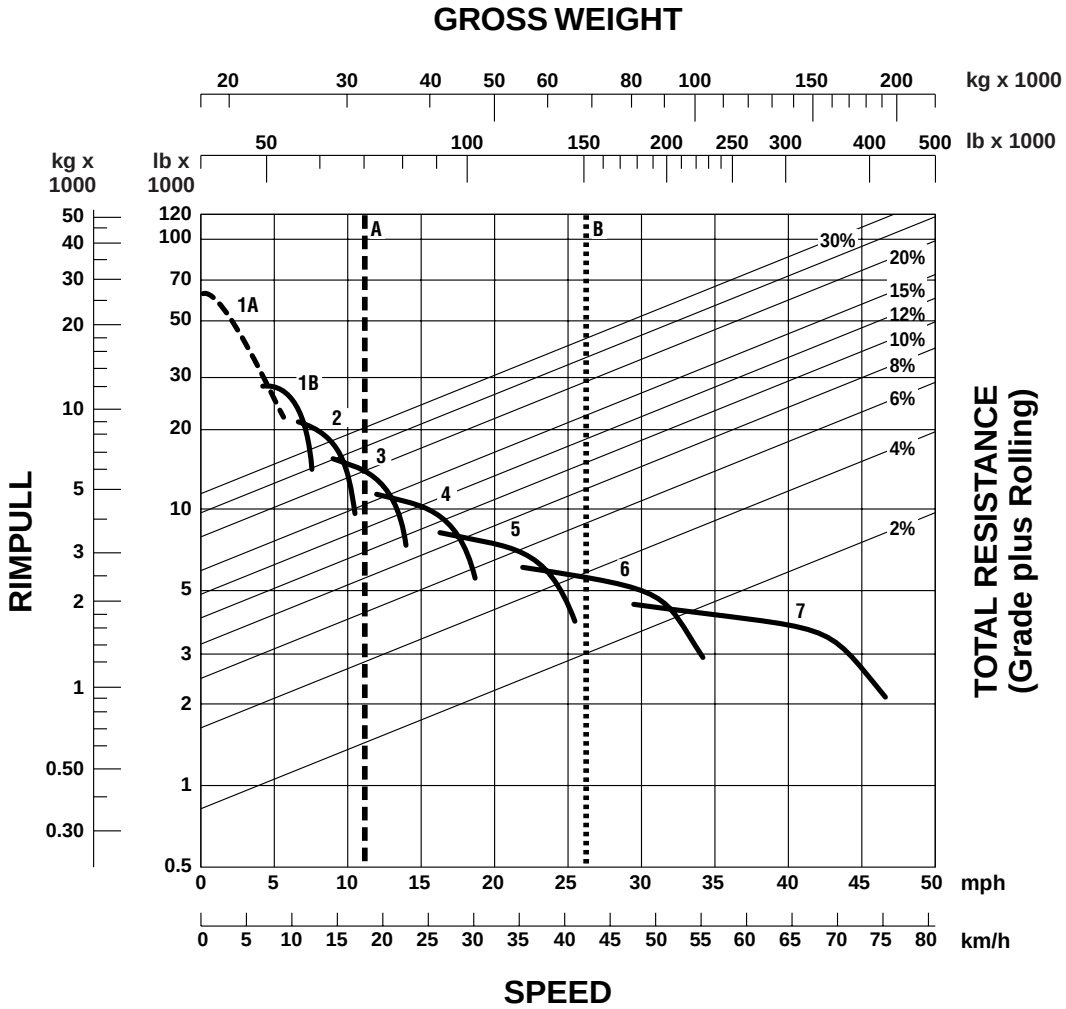


KEY

1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY

E — Empty 23 040 kg (50,795 lb)
L — Loaded 47 040 kg (103,707 lb)



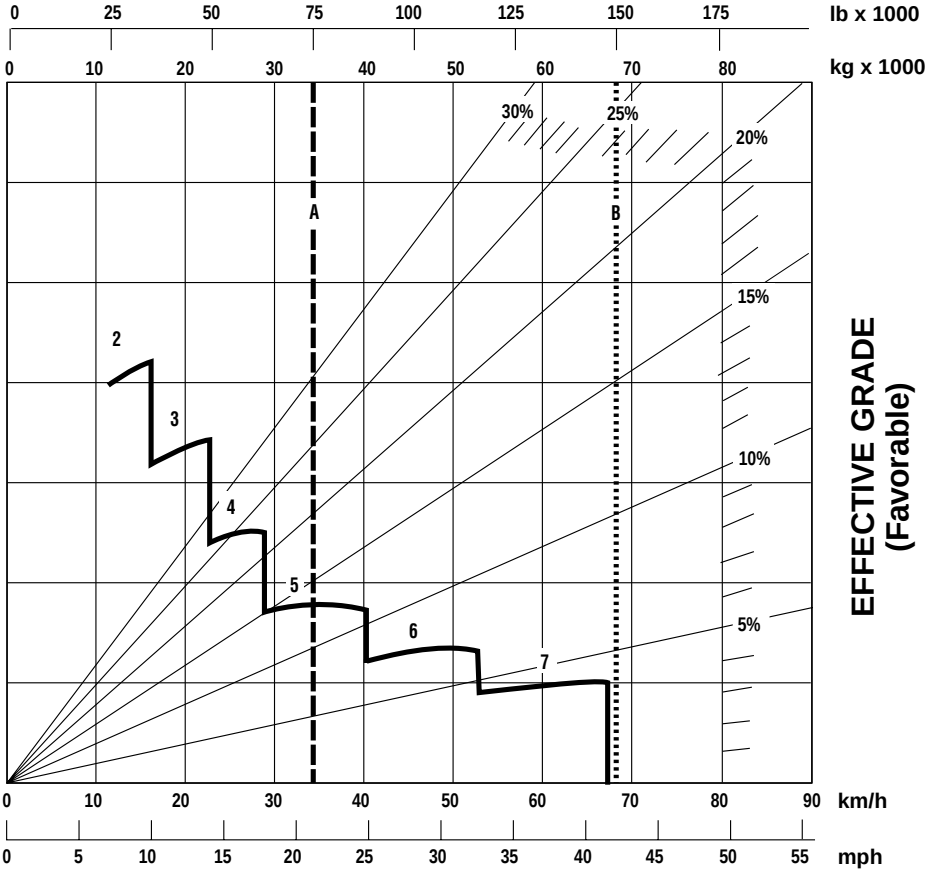
KEY

1A — 1st Gear (Torque Converter)
1B — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear
7 — 7th Gear

KEY

A — Empty 31 250 kg (68,900 lb)
B — Max GMW 68 182 kg (150,000 lb)

GROSS WEIGHT



SPEED

CONTINUOUS GRADE LENGTH

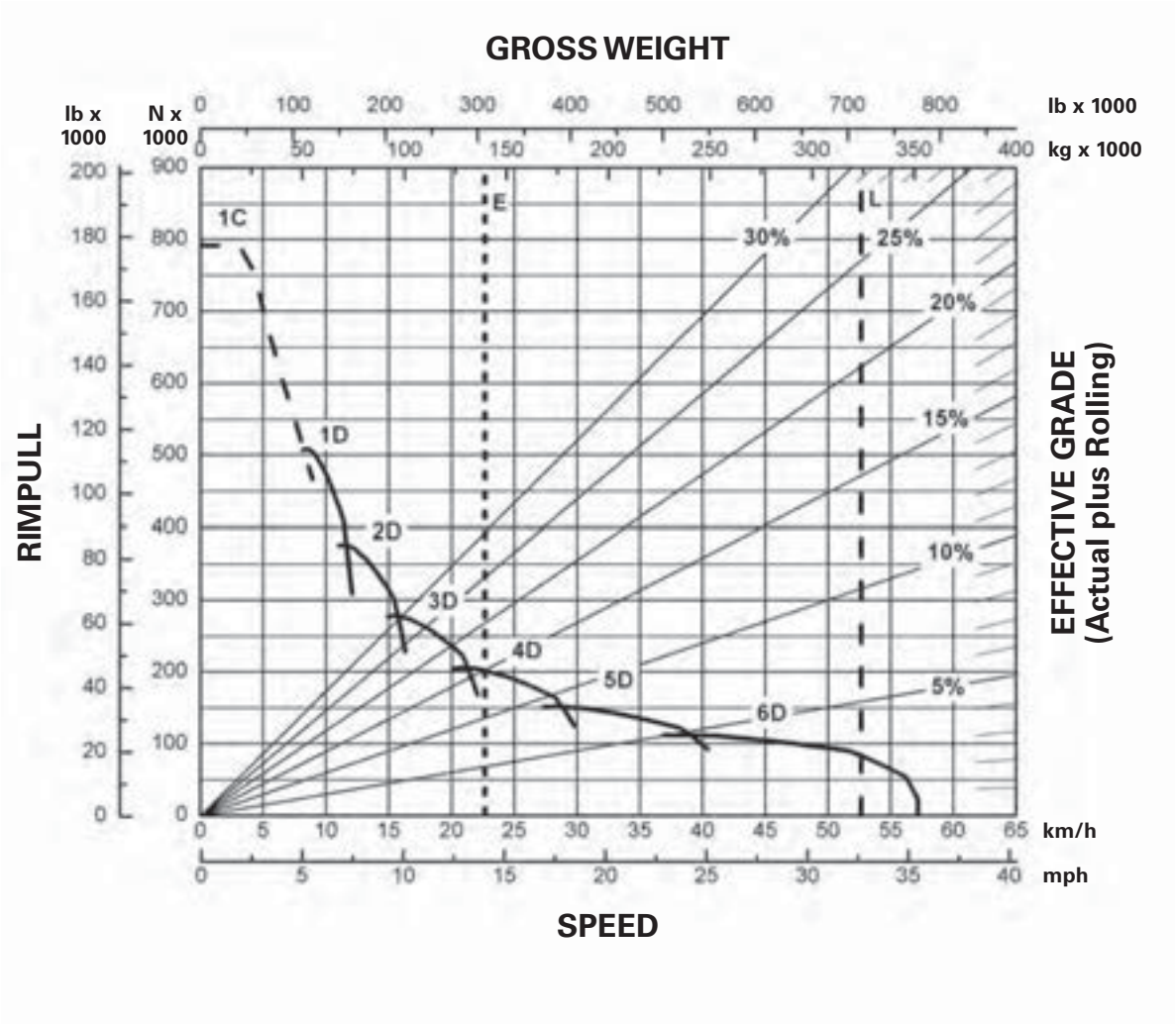
KEY

2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear
7 — 7th Gear

KEY

A — Empty 31 250 kg (68,900 lb)
B — Max GMW 68 182 kg (150,000 lb)

789D 2100 HP Rimpull-Speed-Gradeability
- 37.00R57 Tires**
- 1593 mm **(5'2.7")** Tire Radius



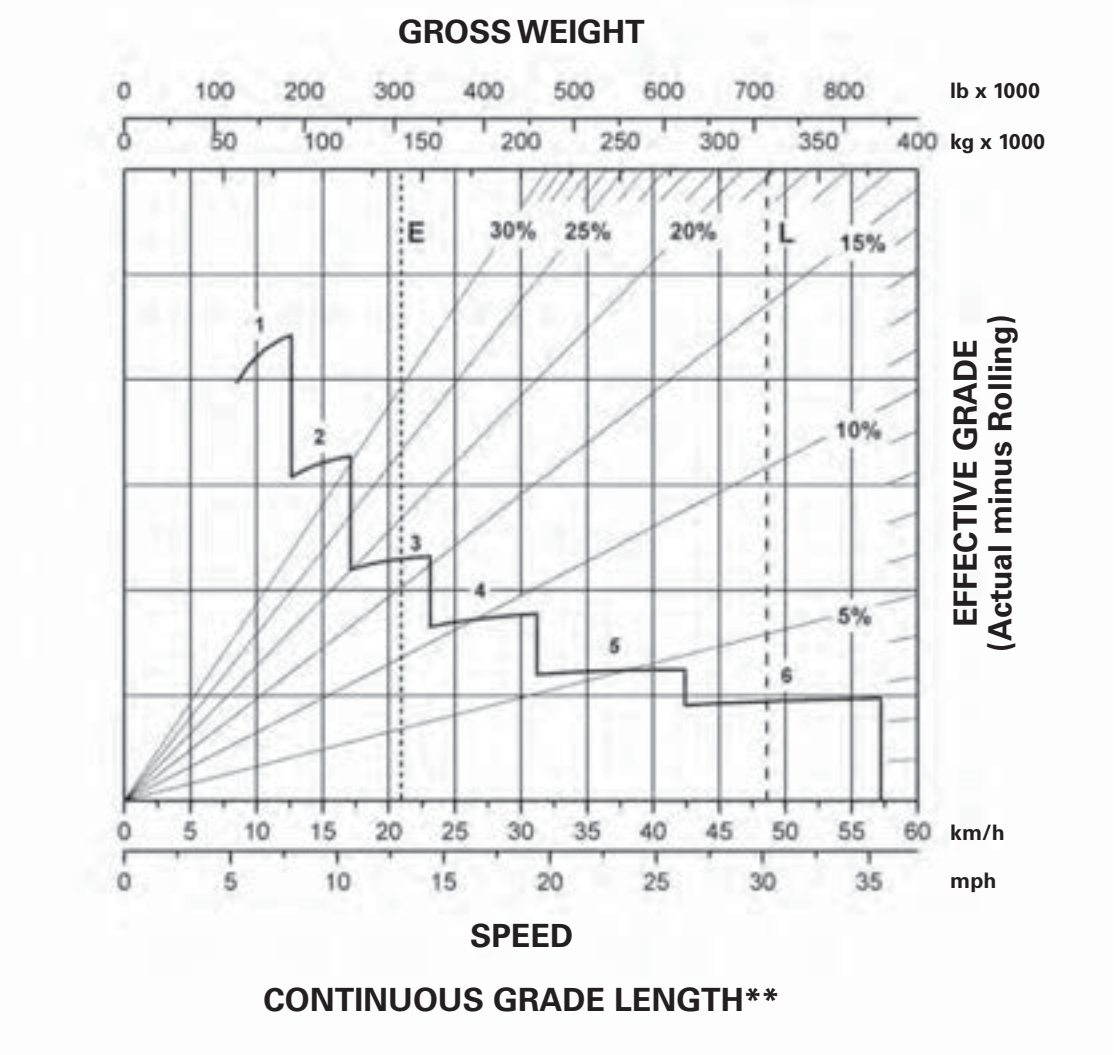
KEY

1C — 1st Gear (Torque Converter)
1D — 1st Gear
2D — 2nd Gear
3D — 3rd Gear
4D — 4th Gear
5D — 5th Gear
6D — 6th Gear

KEY

E — Empty Operating Weight 141 214 kg (311,324 lb)*
L — Target GMW 324 319 kg (715,000 lb)

*Truck equipped with sideboards and liners.
**At Sea Level.



KEY

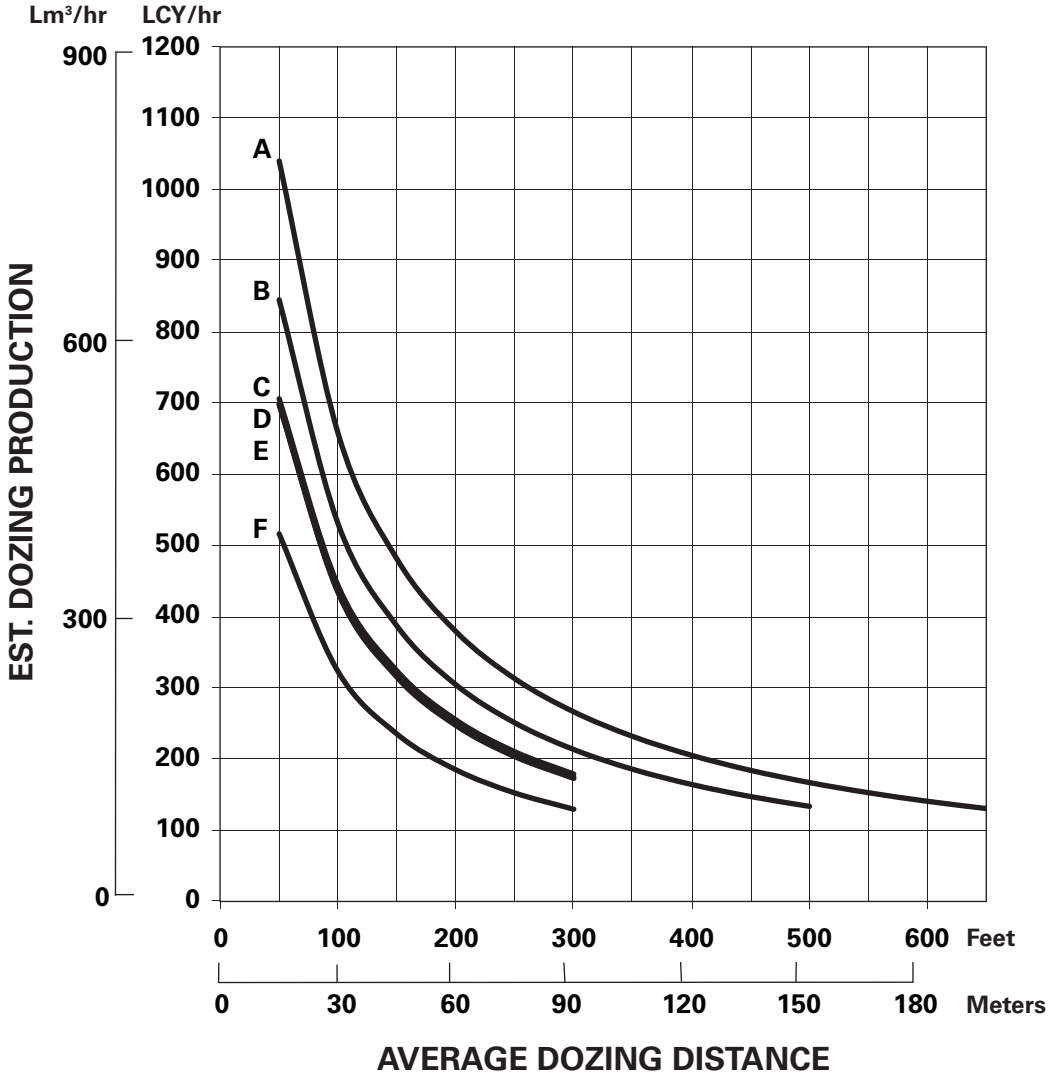
1 — 1st Gear
2 — 2nd Gear
3 — 3rd Gear
4 — 4th Gear
5 — 5th Gear
6 — 6th Gear

KEY

E — Empty Operating Weight 141 214 kg (311,324 lb)*
L — Target GMW 324 319 kg (715,000 lb)

*Truck equipped with sideboards and liners.
**At Sea Level.

ESTIMATED DOZING PRODUCTION ● Semi-Universal Blades ● D6N through D8R

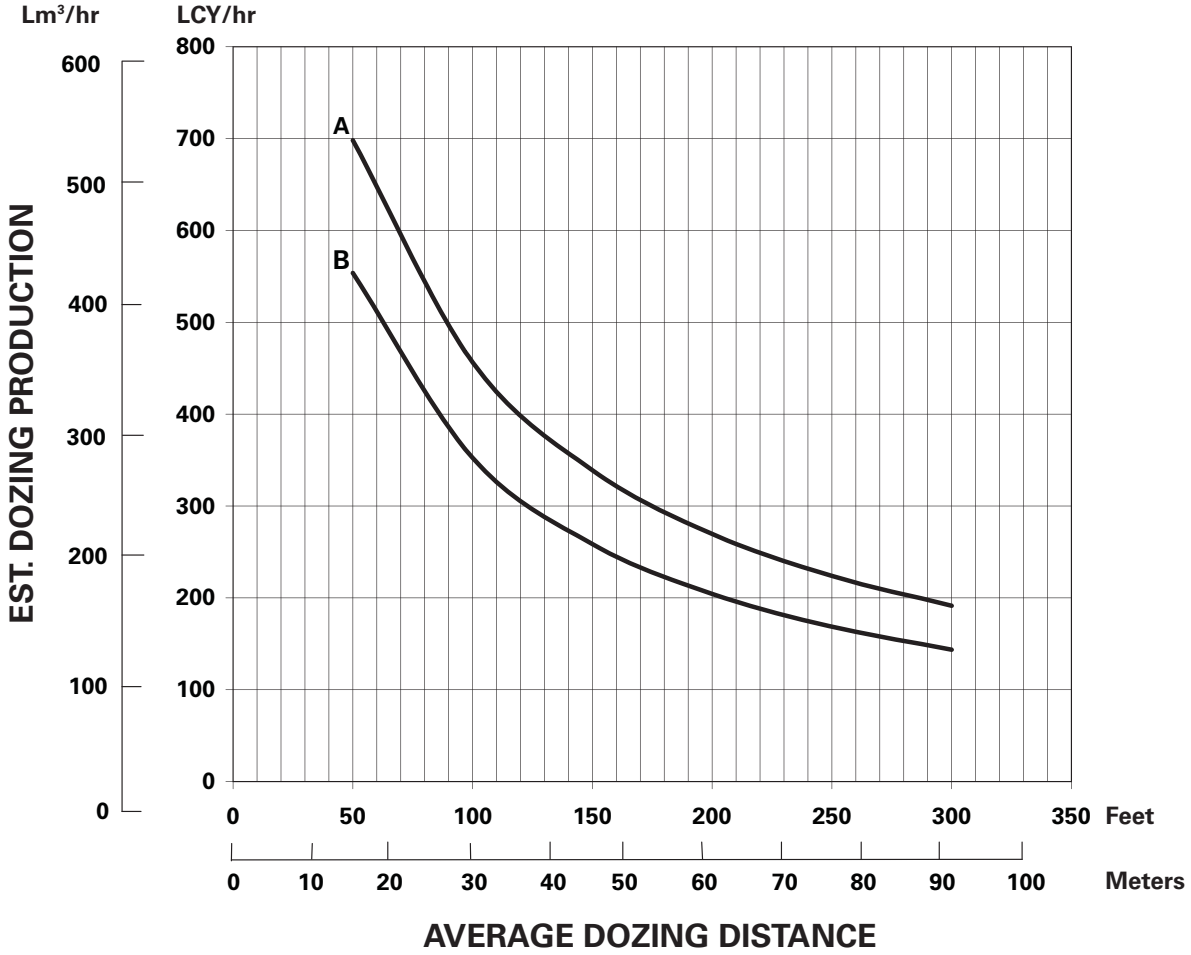


KEY

A — D8R
B — D7R
C — D6T Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim)
D — D6T
E — D6R
F — D6N

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

ESTIMATED DOZING PRODUCTION ● Straight Blades ● D6T through D7E

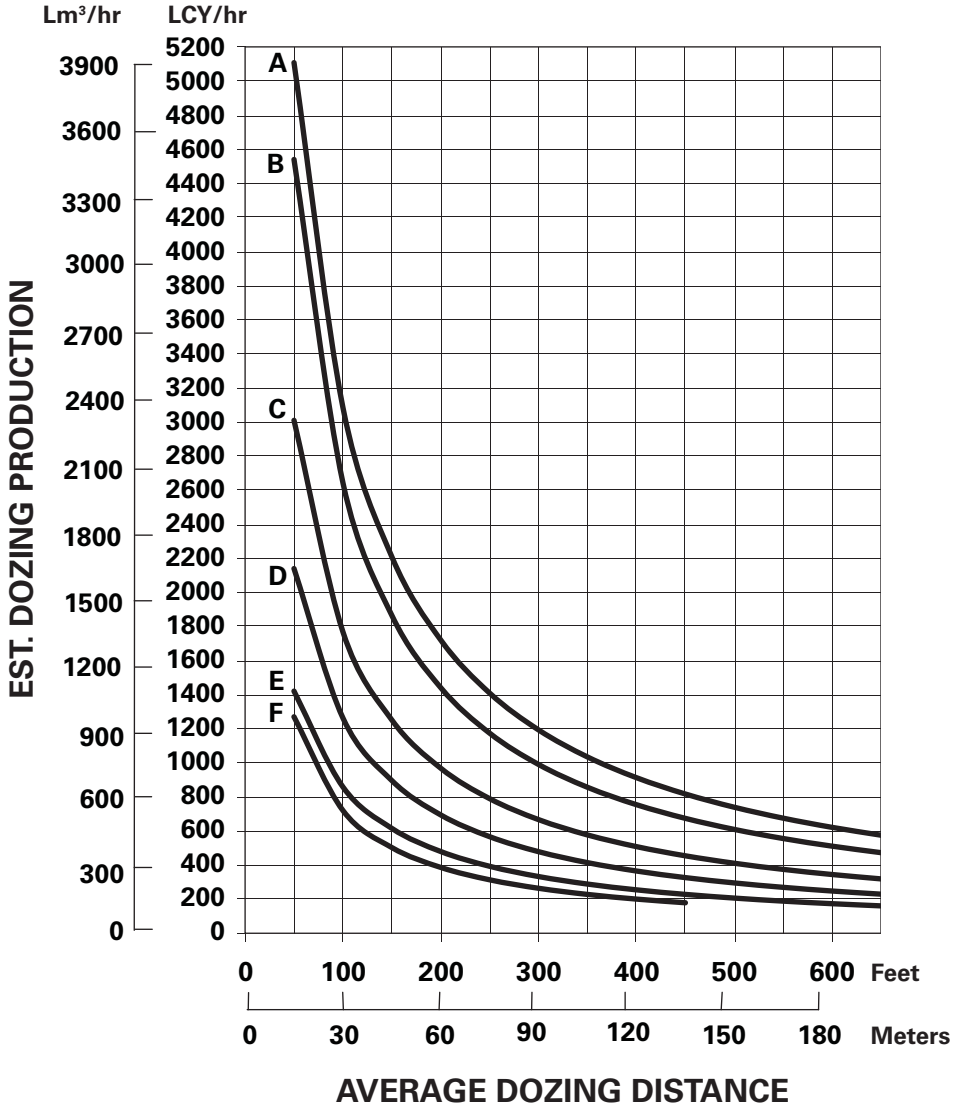


KEY

A — D7E
B — D6T

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

ESTIMATED DOZING PRODUCTION ● Universal Blades ● D7E through D11T CD

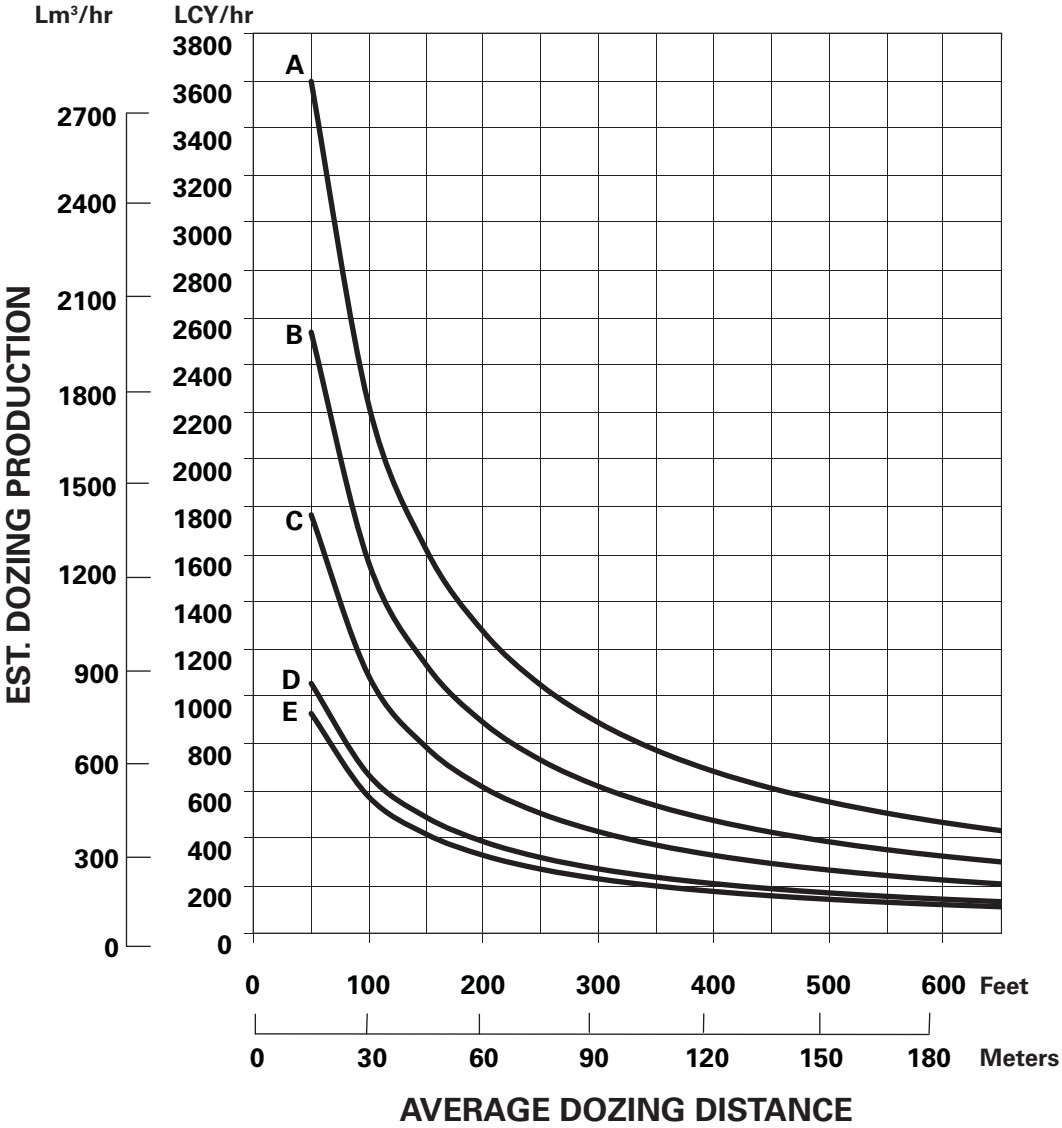


KEY

A — D11T CD
B — D11T
C — D10T2
D — D9T
E — D8T
F — D7E

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

ESTIMATED DOZING PRODUCTION ● Semi-Universal Blades ● D7E through D11T

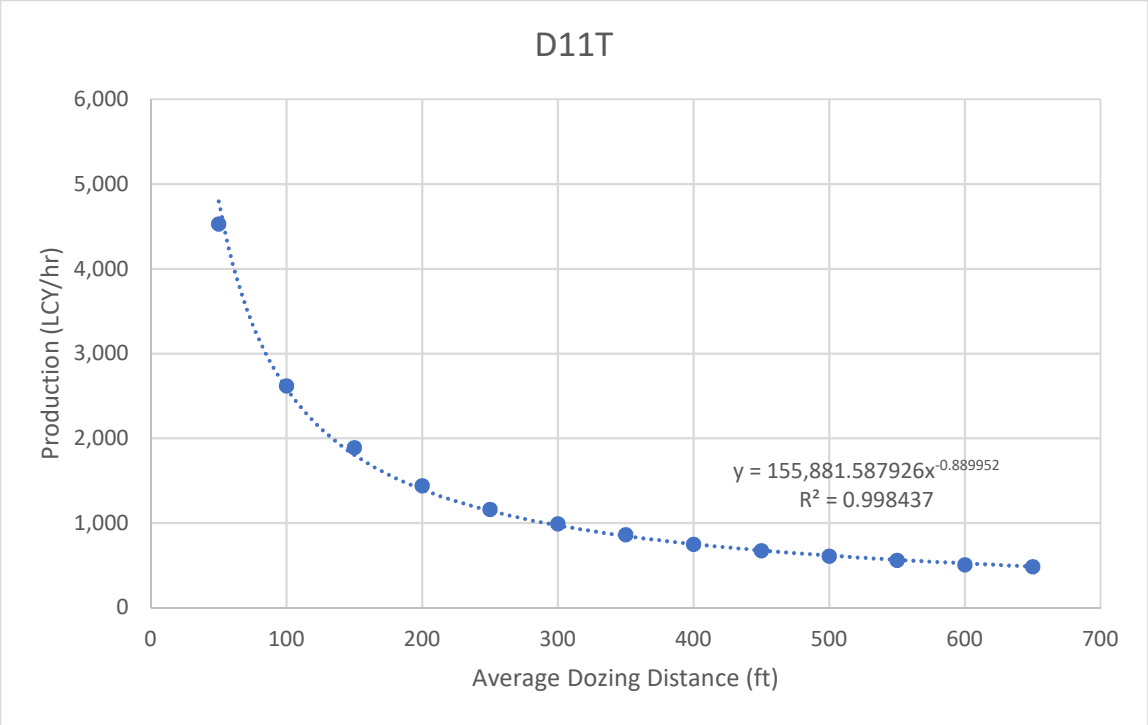


KEY

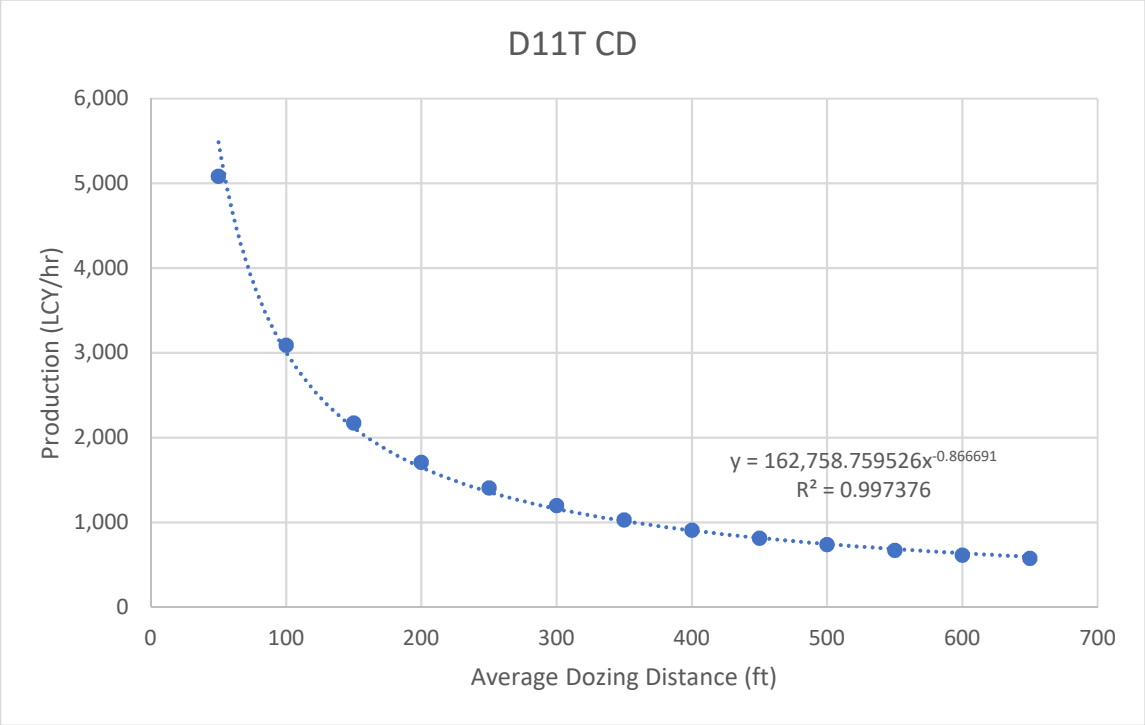
A — D11T
B — D10T2
C — D9T
D — D8T
E — D7E

NOTE: This chart is based on numerous field studies made under varying job conditions. Refer to correction factors following these charts.

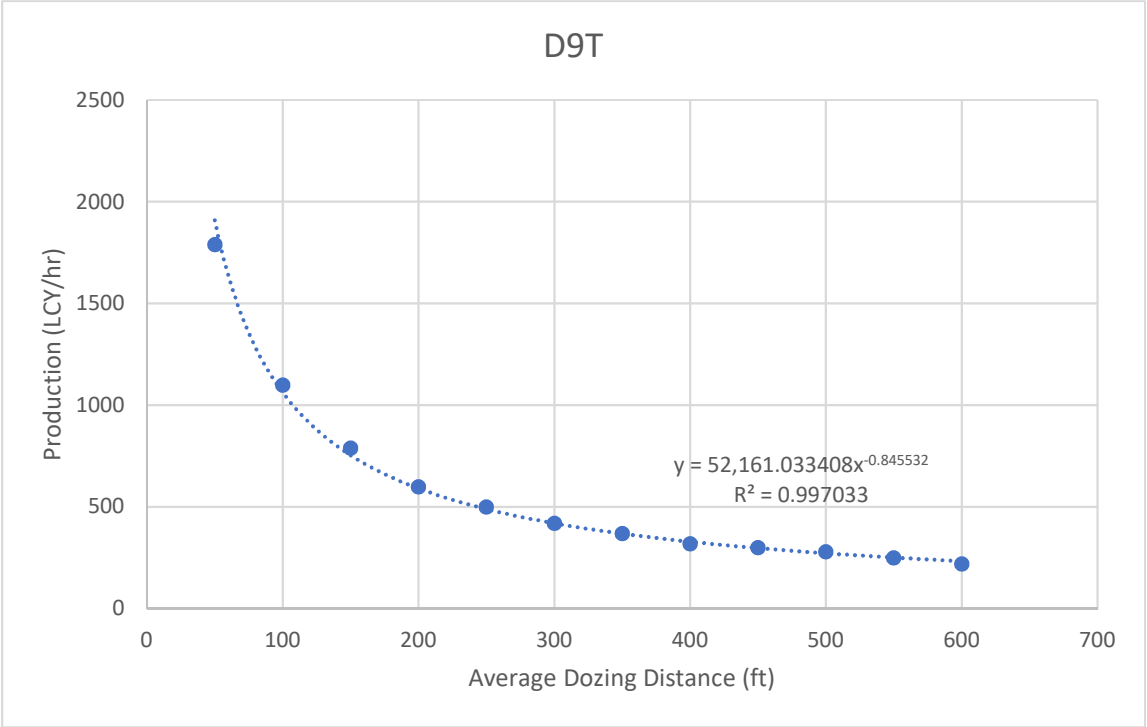
Dozing Production



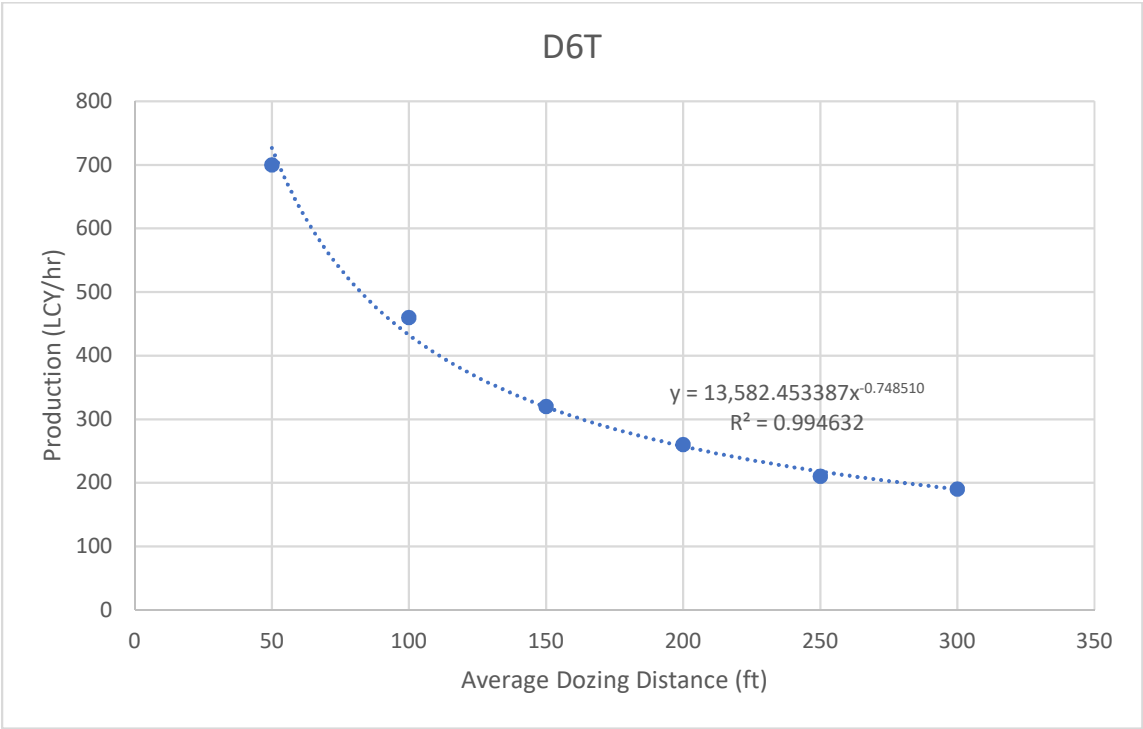
Caterpillar Performance Handbook Edition 47, 19-51



Caterpillar Performance Handbook Edition 47, 19-51

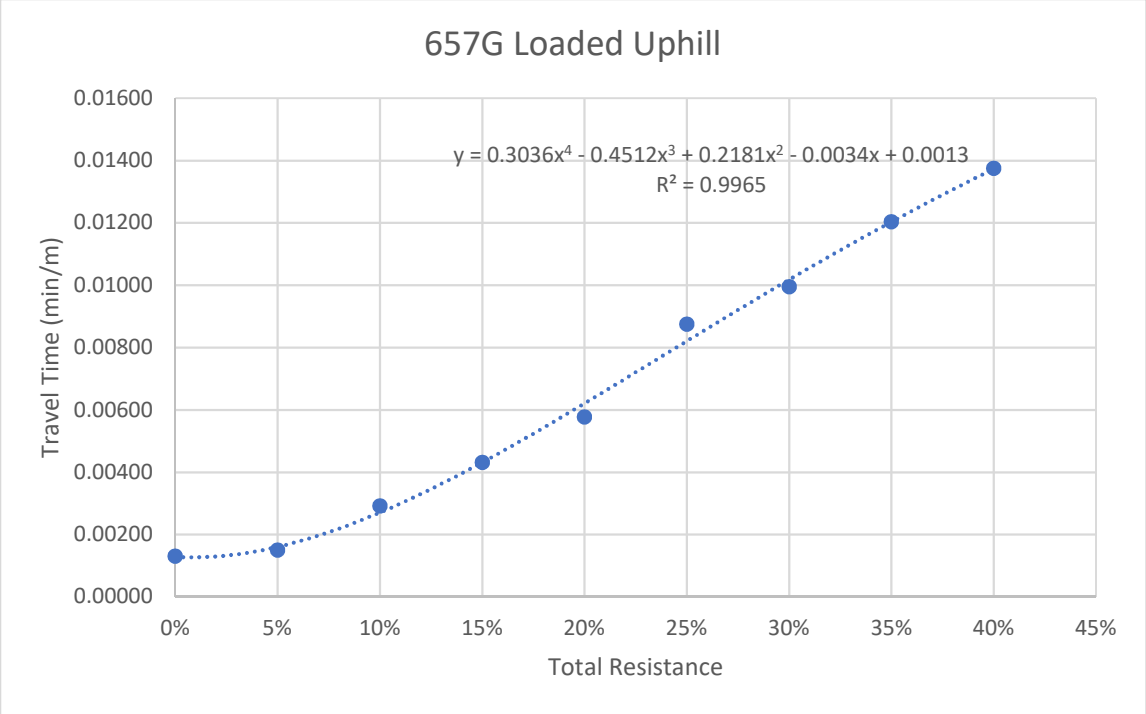


Caterpillar Performance Handbook Edition 47, 19-52

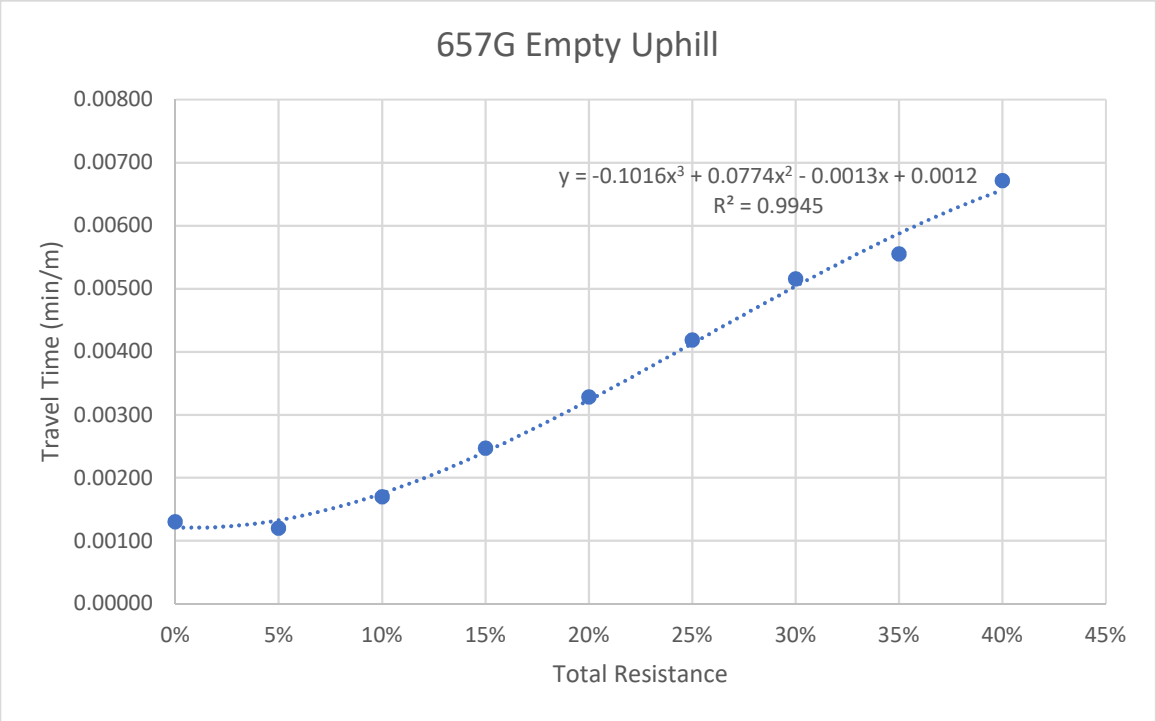


Caterpillar Performance Handbook Edition 47, 19-53

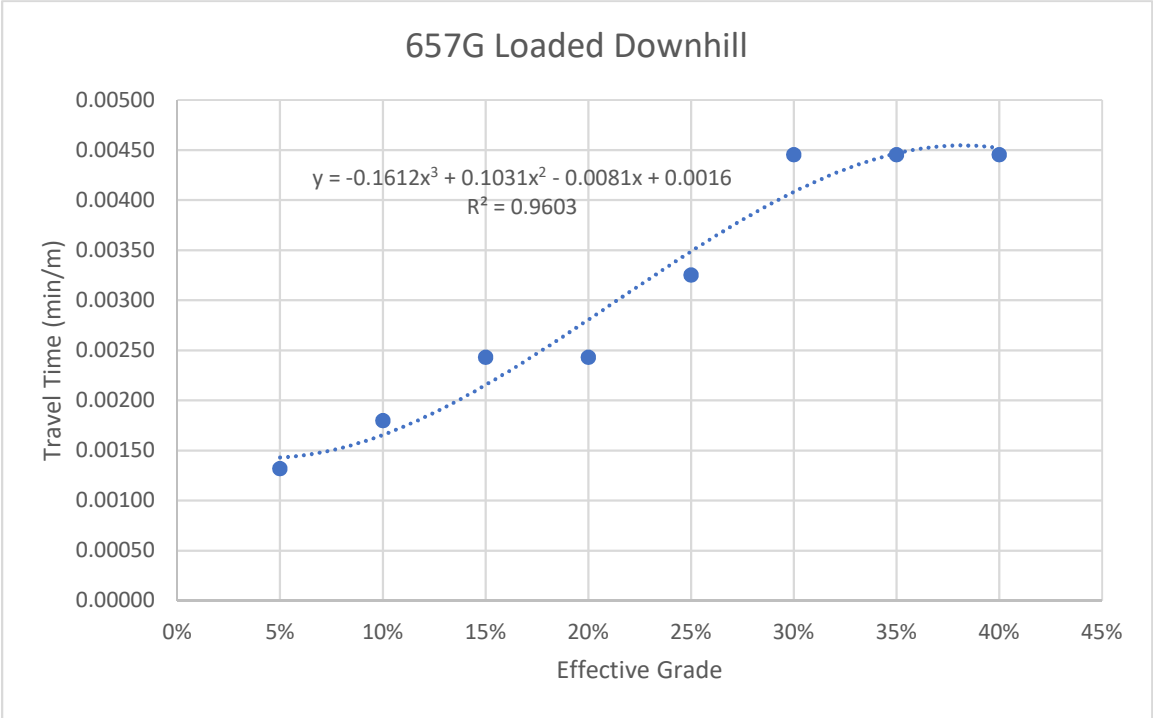
Scraper Haul Travel Time



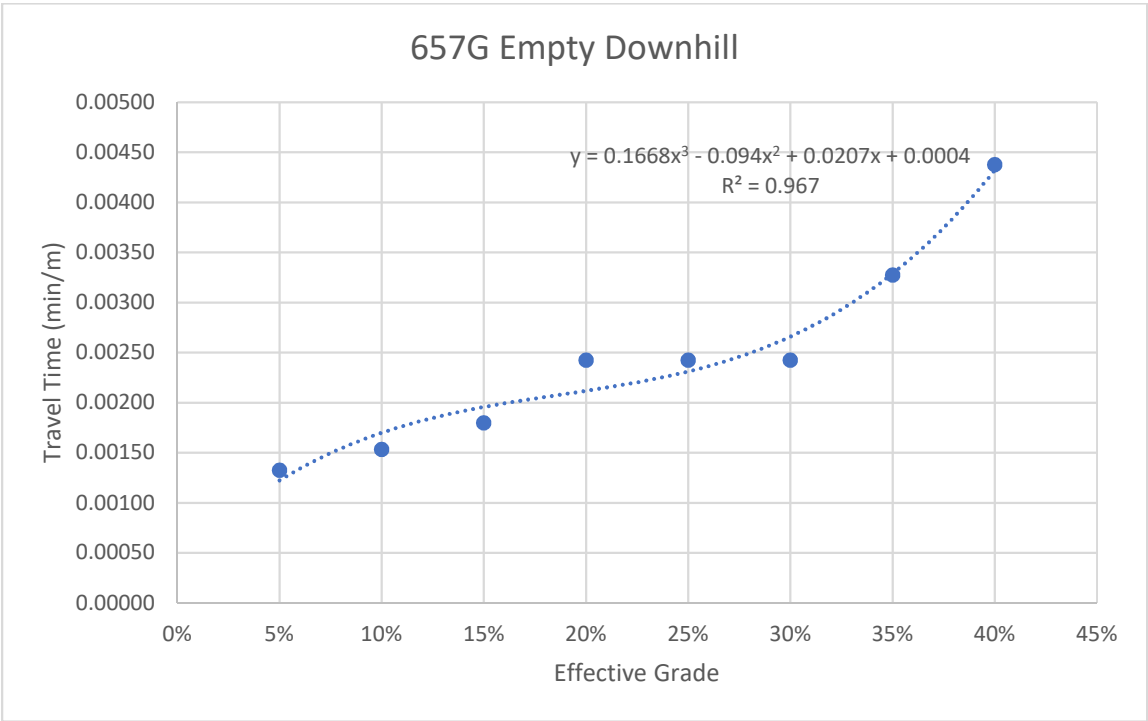
Caterpillar Performance Handbook Edition 47, 24-29



Caterpillar Performance Handbook Edition 47, 24-29

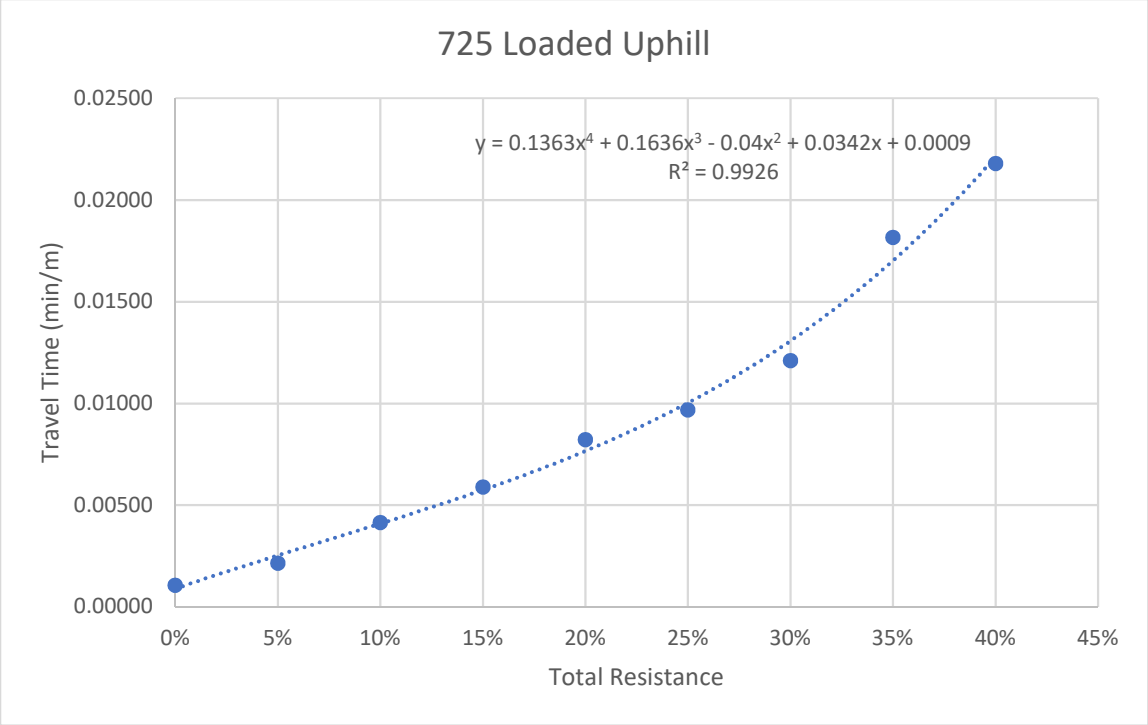


Caterpillar Performance Handbook Edition 47, 24-30

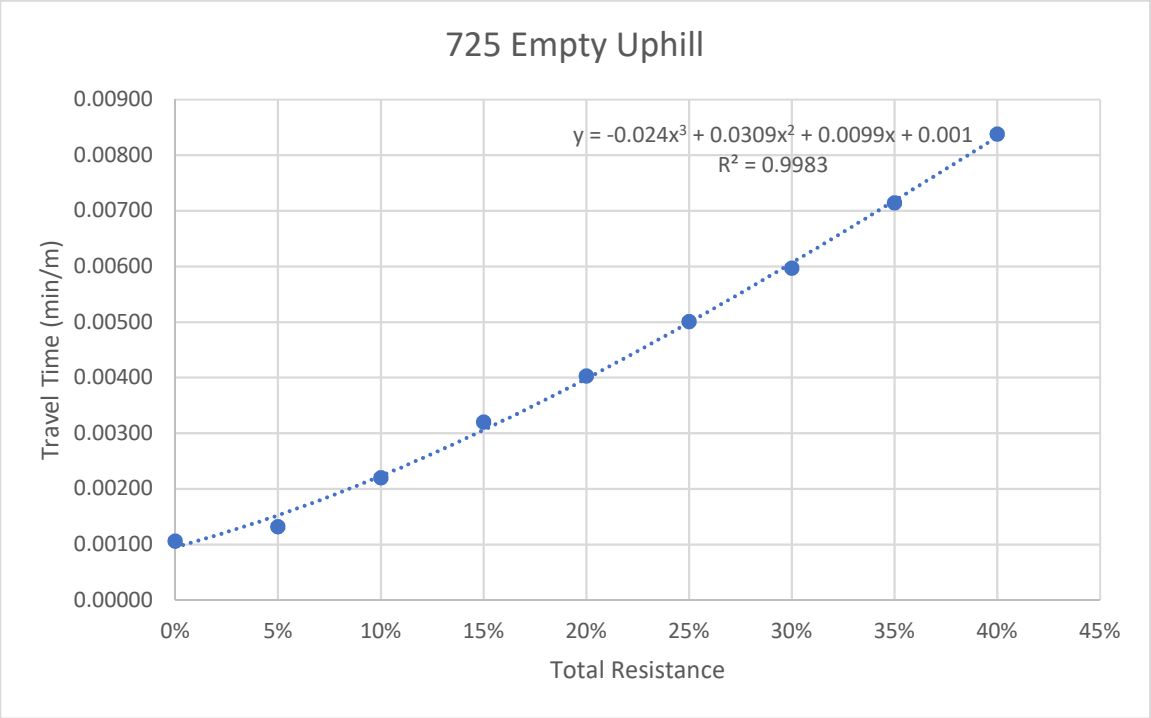


Caterpillar Performance Handbook Edition 47, 24-30

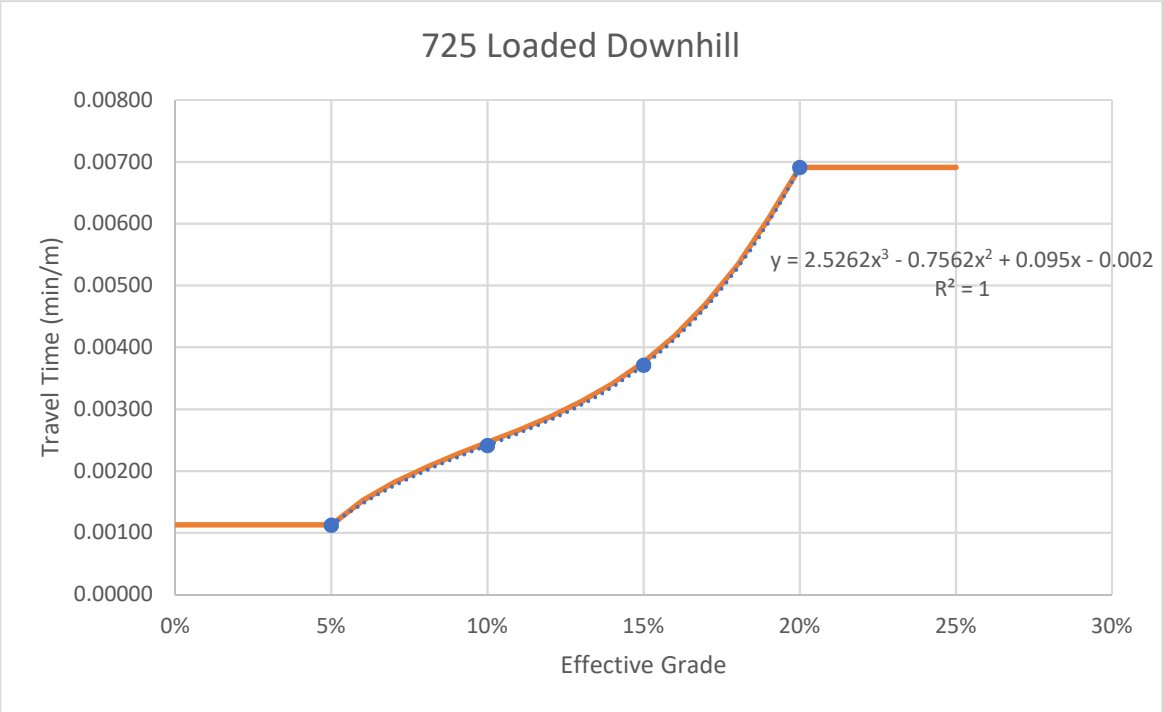
Truck Haul Travel Time



Caterpillar Performance Handbook Edition 47, 1-9



Caterpillar Performance Handbook Edition 47, 1-9



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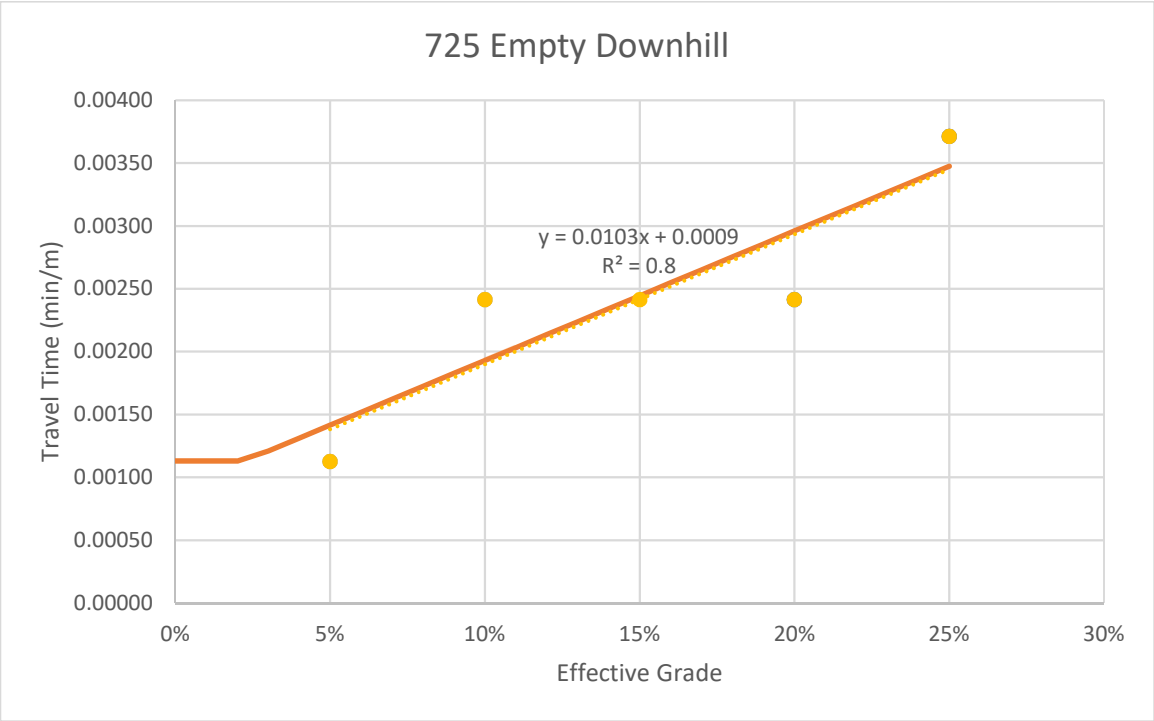
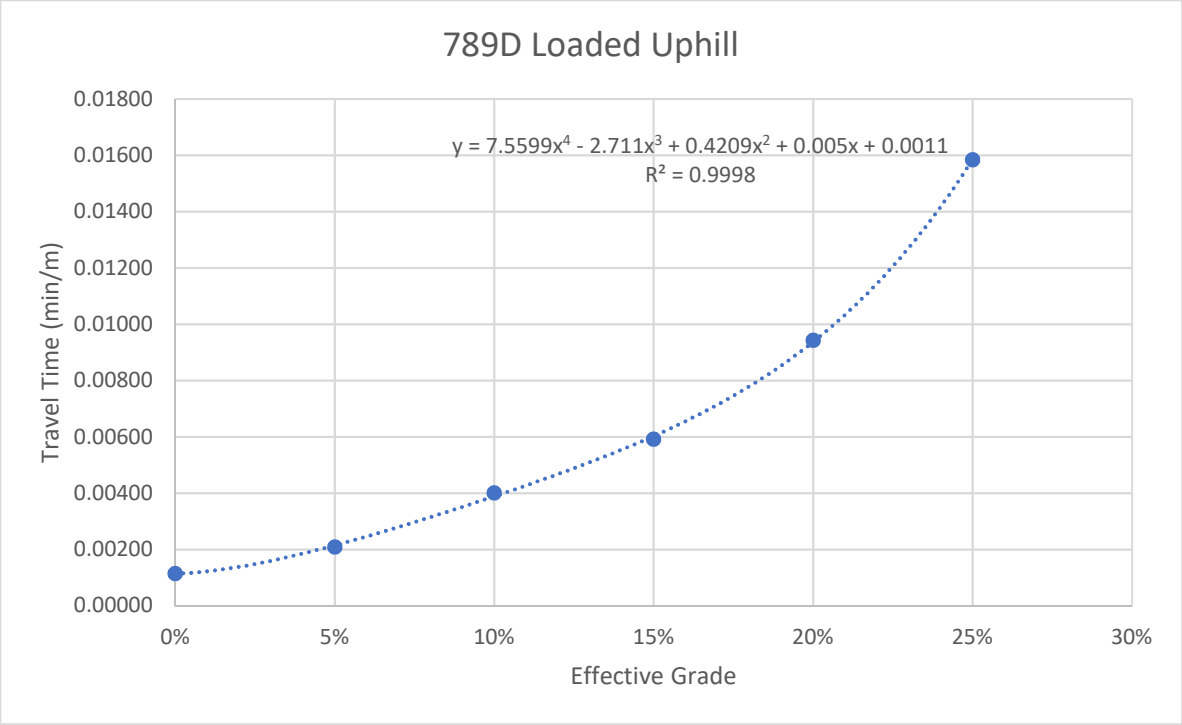
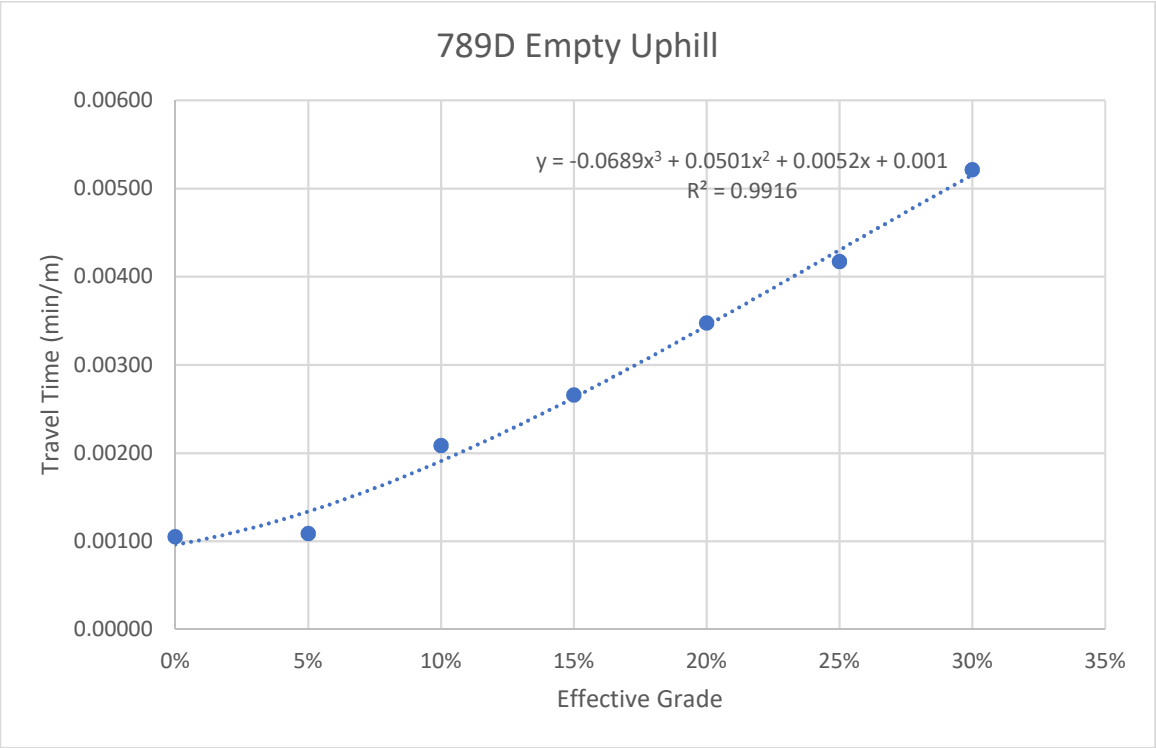


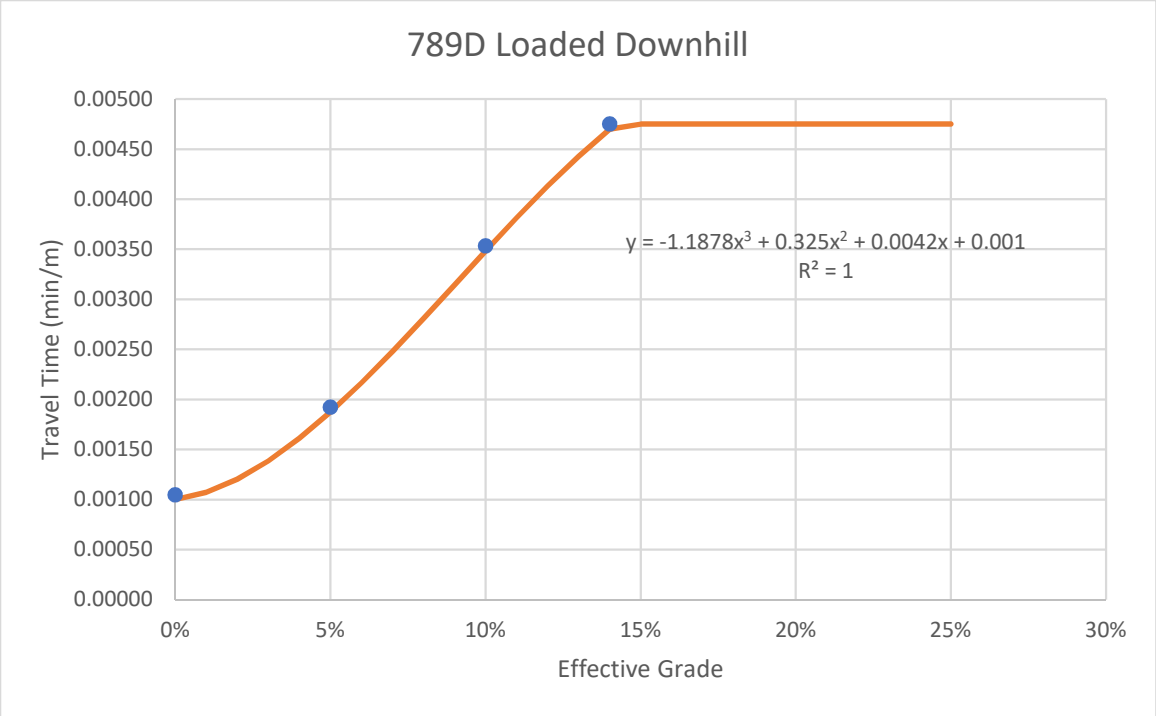
Caterpillar Performance Handbook Edition 47, 1-10



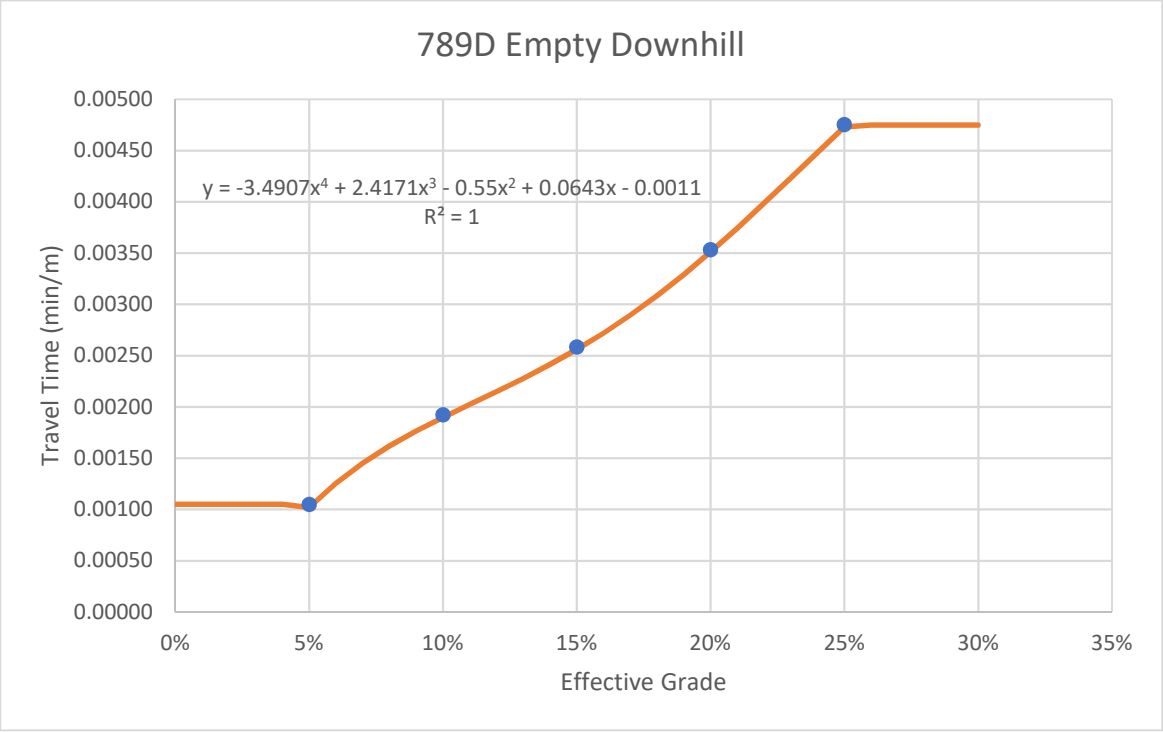
Caterpillar Performance Handbook Edition 47, 10-64



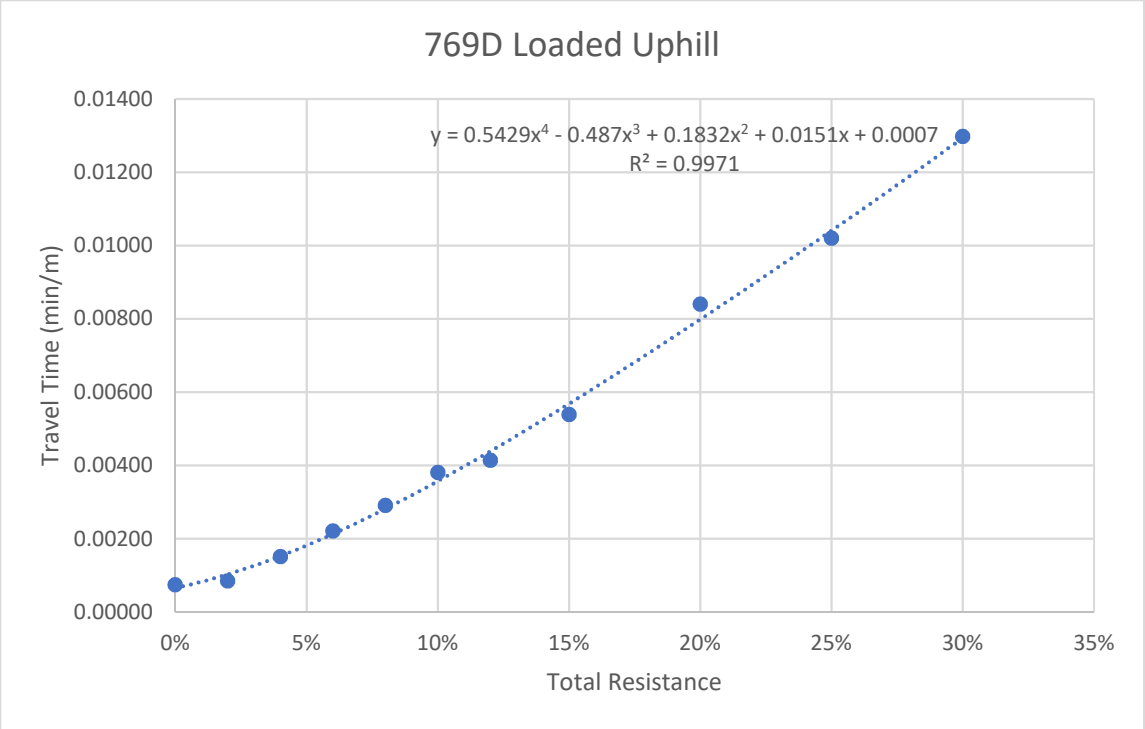
Caterpillar Performance Handbook Edition 47, 10-64



Caterpillar Performance Handbook Edition 47, 10-65



Caterpillar Performance Handbook Edition 47, 10-65



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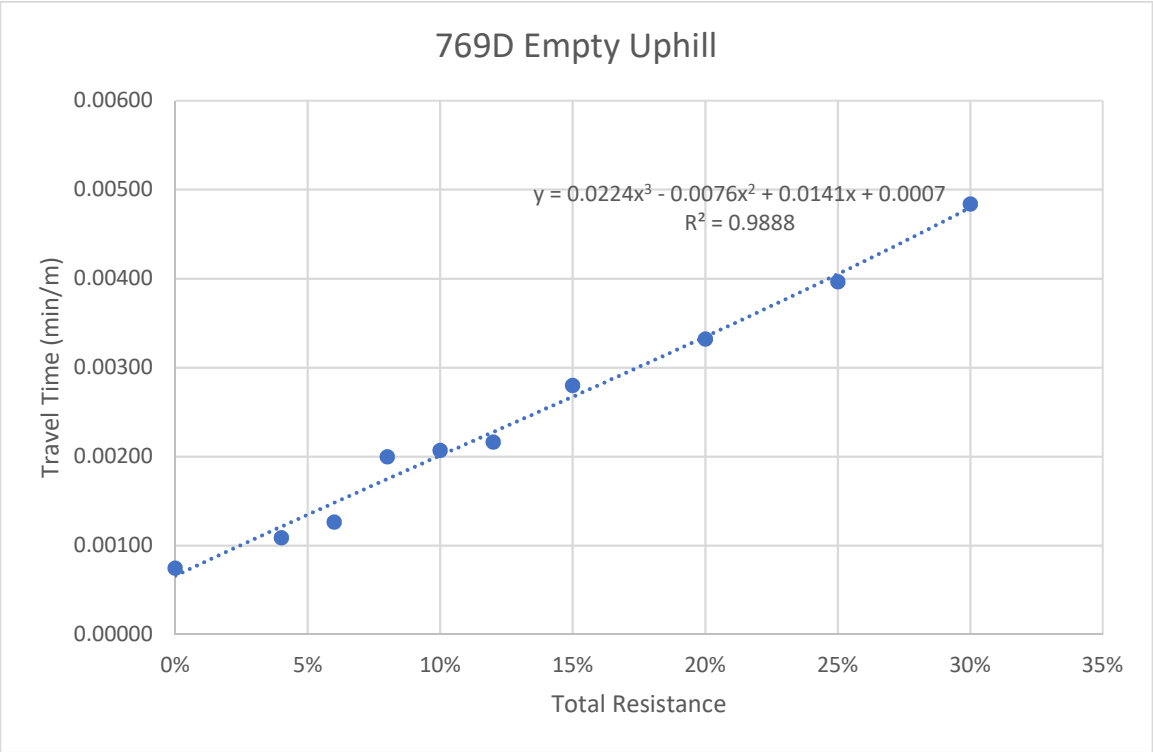

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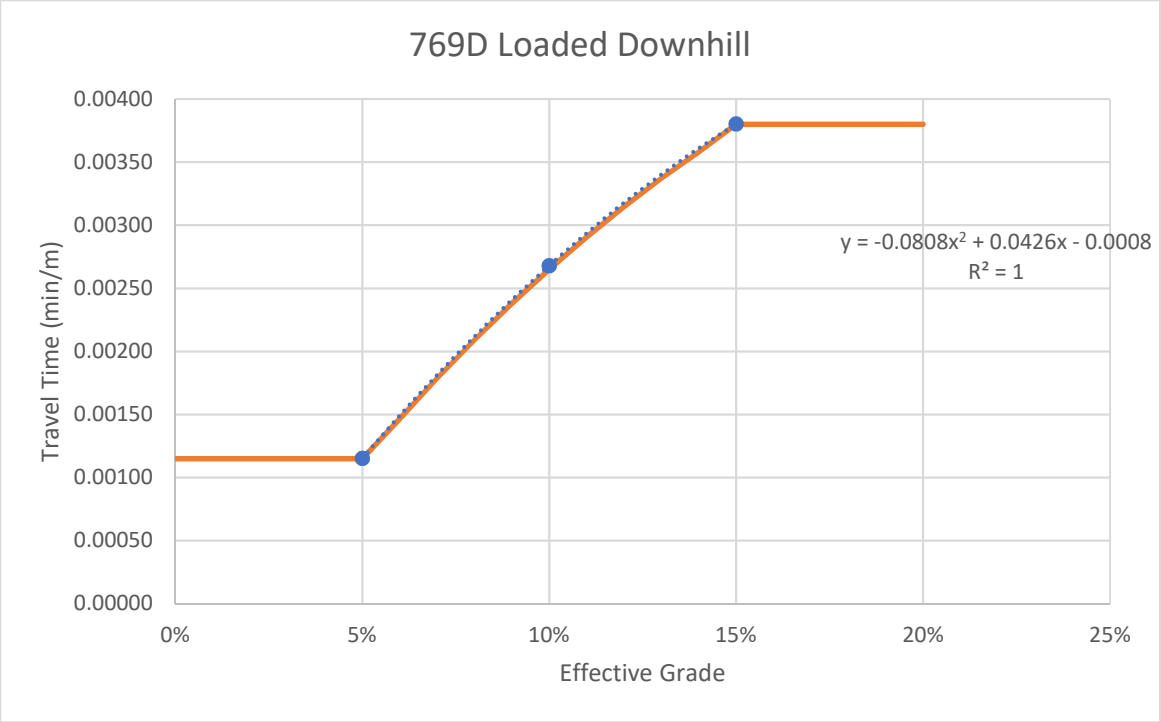
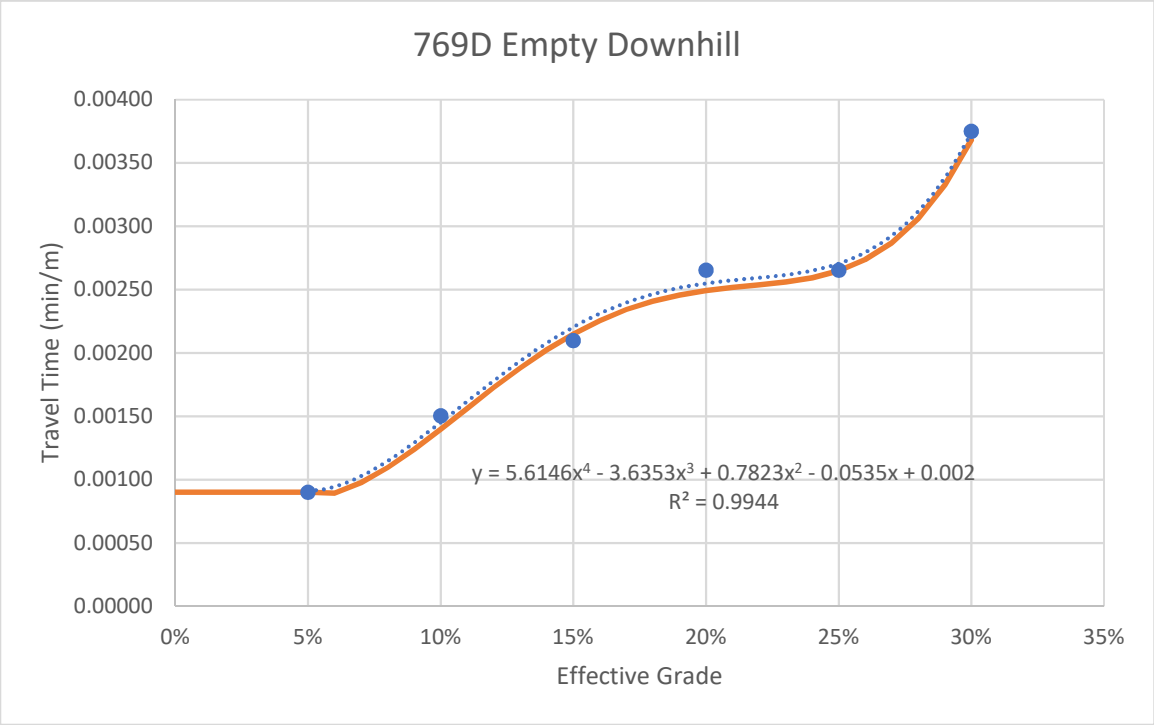


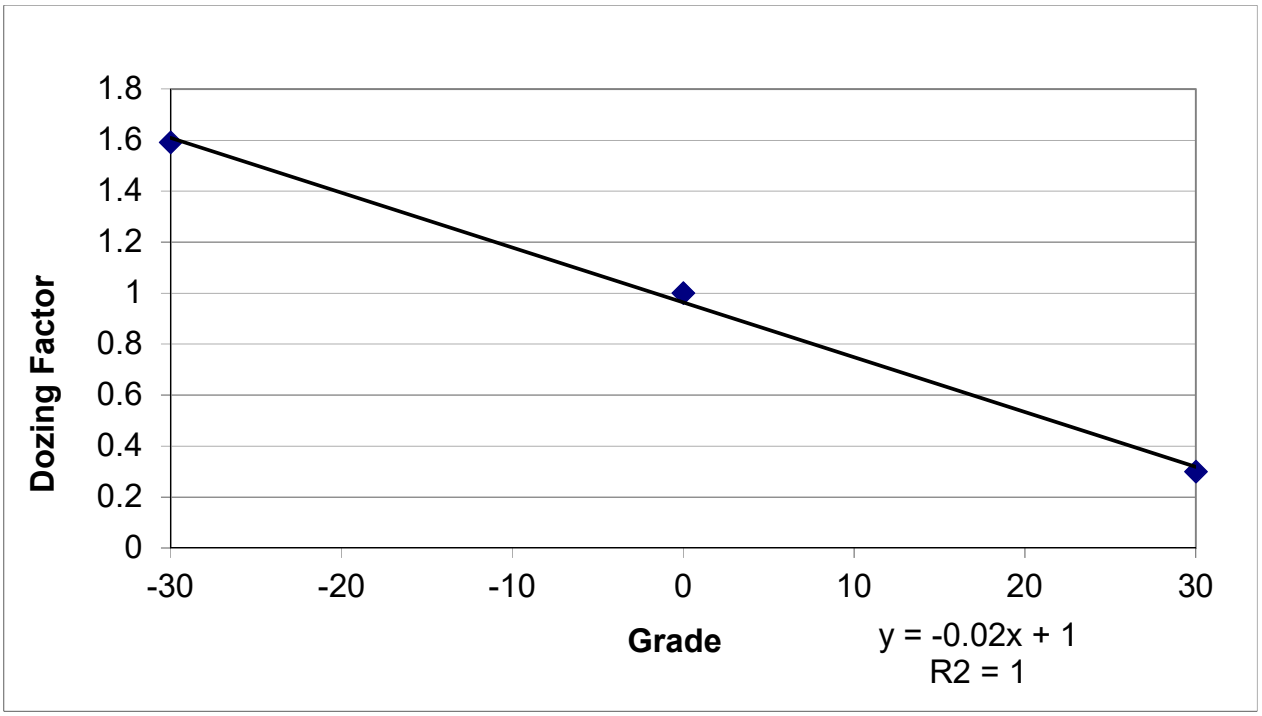
Caterpillar Performance Handbook Edition 29, 9-11



Caterpillar Performance Handbook Edition 29, 9-11

Grade vs. Dozing Factor

Grade %	Dozing Factor
0	1
-30	1.59
30	0.3



Appendix B.2.4

R.S. Means Data

RS Means Online Data

Demolition - accessed February 13, 2019

Line Number	Description	Unit	Material	Labor	Equipment	Total	Data Release	CCI Location
024116130100	Building demolition, large urban projects, mixture of types, excludes foundation demolition, dump fees	C.F.	$ -	$ 0.12	$ 0.13	$ 0.25	Year 2019	NEW MEXICO / LAS CRUCES (880)
024116170400	Buillding footings and foundations demolition, floors, concrete slab on grade, plain concrete, 6" thick, excludes disposal costs and dump fees	S.F.	$ -	$ 0.19	$ 0.43	$ 0.62	Year 2019	NEW MEXICO / LAS CRUCES (880)
260505100370	Non metallic sheathed cable, (Romex), #14, 3 wire, electrical demolition, remove	L.F.	$ -	$ 0.63	$ -	$ 0.63	Year 2019	NEW MEXICO / LAS CRUCES (880)
024113800200	Selective demolition, utility poles & cross arms, utility poles, wood, 35'-45' high	Ea.	$ -	$ 193.83	$ 22.41	$ 216.24	Year 2019	NEW MEXICO / LAS CRUCES (880)
130505750530	Steel tank, single wall, above ground, 5,000 thru 10,000 gallon, selective demolition, excluding foundation, pumps or piping	Ea.	$ -	$ 553.42	$ 452.55	$ 1,005.97	Year 2019	NEW MEXICO / LAS CRUCES (880)

Revegetation - accessed February 13, 2019

Line Number	Description	Unit	Material	Labor	Equipment	Total	Data Release	CCI Location
015433201500	Rent disc harrow attchment for tractor, Excl. Hourly Oper. Cost.	Month	$ -	$ -	$ 616.33	$ 616.33	Year 2019	NEW MEXICO / LAS CRUCES (880)

Fence - accessed March 18, 2019

Line Number	Description	Unit	Material	Labor	Equipment	Total	Data Release	CCI Location
323113200800	Fence, chain link industrial, galvanized steel, 6 ga. wire, 2" posts @ 10' OC, 6' high, includes excavation, & concrete, excludes barbed wire	L.F.	$ 19.07	$ 3.28	$ 0.70	$ 23.05	Year 2019	NEW MEXICO / LAS CRUCES (880)

Wastes requiring special handling (cleanup, transportation, and disposal) - accessed February 13, 2019

Line Number	Description	Unit	Material	Labor	Equipment	Total	Data Release	CCI Location
028120101120	Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, minimum	Ton	$ -	$ -	$ -	$ 162.26	Year 2019	NEW MEXICO / LAS CRUCES (880)
028120101130	Hazardous waste cleanup/pickup/disposal, solid pickup, bulk material, maximum	Ton	$ -	$ -	$ -	$ 508.13	Year 2019	NEW MEXICO / LAS CRUCES (880)
028120101260	Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, minimum	Mile	$ -	$ -	$ -	$ 3.37	Year 2019	NEW MEXICO / LAS CRUCES (880)
028120101270	Hazardous waste cleanup/pickup/disposal, transportation to disposal site, truckload = 80 drums or 25 C.Y. or 18 tons, maximum	Mile	$ -	$ -	$ -	$ 6.19	Year 2019	NEW MEXICO / LAS CRUCES (880)

Crew No.	Bare Costs		Incl. Subs O&P		Cost Per Labor-Hour	
Crew B-12B	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Hyd. Excavator, 1.5 C.Y.		908.70		999.57	56.79	62.47
16 L.H., Daily Totals		$1696.70		$2186.37	$106.04	$136.65
Crew B-12C	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Hyd. Excavator, 2 C.Y.		1078.00		1185.80	67.38	74.11
16 L.H., Daily Totals		$1866.00		$2372.60	$116.63	$148.29
Crew B-12D	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Hyd. Excavator, 3.5 C.Y.		2256.00		2481.60	141.00	155.10
16 L.H., Daily Totals		$3044.00		$3668.40	$190.25	$229.28
Crew B-12E	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Hyd. Excavator, .5 C.Y.		443.75		488.13	27.73	30.51
16 L.H., Daily Totals		$1231.75		$1674.93	$76.98	$104.68
Crew B-12F	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Hyd. Excavator, .75 C.Y.		681.25		749.38	42.58	46.84
16 L.H., Daily Totals		$1469.25		$1936.18	$91.83	$121.01
Crew B-12G	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 15 Ton		866.60		953.26		
1 Clamshell Bucket, .5 C.Y.		42.55		46.81	56.82	62.50
16 L.H., Daily Totals		$1697.15		$2186.86	$106.07	$136.68
Crew B-12H	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 25 Ton		1386.00		1524.60		
1 Clamshell Bucket, 1 C.Y.		51.20		56.32	89.83	98.81
16 L.H., Daily Totals		$2225.20		$2767.72	$139.07	$172.98
Crew B-12I	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 20 Ton		1130.00		1243.00		
1 Dragline Bucket, .75 C.Y.		21.85		24.04	71.99	79.19
16 L.H., Daily Totals		$1939.85		$2453.84	$121.24	$153.36
Crew B-12J	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Gradall, 5/8 C.Y.		862.55		948.80	53.91	59.30
16 L.H., Daily Totals		$1650.55		$2135.61	$103.16	$133.48

Crew No.	Bare Costs		Incl. Subs O&P		Cost Per Labor-Hour	
Crew B-12K	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Gradall, 3 Ton, 1 C.Y.		1185.00		1303.50	74.06	81.47
16 L.H., Daily Totals		$1973.00		$2490.30	$123.31	$155.64
Crew B-12L	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 15 Ton		866.60		953.26		
1 F.E. Attachment, .5 C.Y.		63.95		70.34	58.16	63.98
16 L.H., Daily Totals		$1718.55		$2210.41	$107.41	$138.15
Crew B-12M	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 20 Ton		1130.00		1243.00		
1 F.E. Attachment, .75 C.Y.		68.90		75.79	74.93	82.42
16 L.H., Daily Totals		$1986.90		$2505.59	$124.18	$156.60
Crew B-12N	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 25 Ton		1386.00		1524.60		
1 F.E. Attachment, 1 C.Y.		74.85		82.33	91.30	100.43
16 L.H., Daily Totals		$2248.85		$2793.74	$140.55	$174.61
Crew B-12O	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 40 Ton		1392.00		1531.20		
1 F.E. Attachment, 1.5 C.Y.		85.65		94.22	92.35	101.59
16 L.H., Daily Totals		$2265.65		$2812.22	$141.60	$175.76
Crew B-12P	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 40 Ton		1392.00		1531.20		
1 Dragline Bucket, 1.5 C.Y.		35.10		38.61	89.19	98.11
16 L.H., Daily Totals		$2215.10		$2756.61	$138.44	$172.29
Crew B-12Q	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Hyd. Excavator, 5/8 C.Y.		587.30		646.03	36.71	40.38
16 L.H., Daily Totals		$1375.30		$1832.83	$85.96	$114.55
Crew B-12S	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Hyd. Excavator, 2.5 C.Y.		1441.00		1585.10	90.06	99.07
16 L.H., Daily Totals		$2229.00		$2771.90	$139.31	$173.24
Crew B-12T	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 75 Ton		1734.00		1907.40		
1 F.E. Attachment, 3 C.Y.		111.50		122.65	115.34	126.88
16 L.H., Daily Totals		$2633.50		$3216.85	$164.59	$201.05

Crew No.	Bare Costs		Incl. Subs O&P		Cost Per Labor-Hour	
Crew B-12V	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$49.25	$74.17
1 Laborer	41.05	328.40	62.10	496.80		
1 Crawler Crane, 75 Ton		1734.00		1907.40		
1 Dragline Bucket, 3 C.Y.		56.25		61.88	111.89	123.08
16 L.H., Daily Totals		$2578.25		$3156.07	$161.14	$197.25
Crew B-12Y	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$46.52	$70.15
2 Laborers	41.05	656.80	62.10	993.60		
1 Hyd. Excavator, 3.5 C.Y.		2256.00		2481.60	94.00	103.40
24 L.H., Daily Totals		$3372.40		$4165.20	$140.52	$173.55
Crew B-12Z	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Equip. Oper. (crane)	$57.45	$459.60	$86.25	$690.00	$46.52	$70.15
2 Laborers	41.05	656.80	62.10	993.60		
1 Hyd. Excavator, 2.5 C.Y.		1441.00		1585.10	60.04	66.05
24 L.H., Daily Totals		$2557.40		$3268.70	$106.56	$136.20
Crew B-13	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Labor Foreman (outside)	$43.05	$344.40	$65.10	$520.80	$44.84	$67.66
4 Laborers	41.05	1313.60	62.10	1987.20		
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Equip. Oper. (oiler)	49.20	393.60	73.85	590.80		
1 Hyd. Crane, 25 Ton		581.70		639.87	10.39	11.43
56 L.H., Daily Totals		$3092.90		$4428.67	$55.23	$79.08
Crew B-13A	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Labor Foreman (outside)	$43.05	$344.40	$65.10	$520.80	$47.05	$70.89
2 Laborers	41.05	656.80	62.10	993.60		
2 Equipment Operators (med.)	55.10	881.60	82.70	1323.20		
2 Truck Drivers (heavy)	47.00	752.00	70.75	1132.00		
1 Crawler Crane, 75 Ton		1734.00		1907.40		
1 Crawler Loader, 4 C.Y.		1461.00		1607.10		
2 Dump Trucks, 8 C.Y., 220 H.P.		679.20		747.12	69.18	76.10
56 L.H., Daily Totals		$6509.00		$8231.22	$116.23	$146.99
Crew B-13B	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Labor Foreman (outside)	$43.05	$344.40	$65.10	$520.80	$44.84	$67.66
4 Laborers	41.05	1313.60	62.10	1987.20		
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Equip. Oper. (oiler)	49.20	393.60	73.85	590.80		
1 Hyd. Crane, 55 Ton		981.50		1079.65	17.53	19.28
56 L.H., Daily Totals		$3492.70		$4868.45	$62.37	$86.94
Crew B-13C	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Labor Foreman (outside)	$43.05	$344.40	$65.10	$520.80	$44.84	$67.66
4 Laborers	41.05	1313.60	62.10	1987.20		
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Equip. Oper. (oiler)	49.20	393.60	73.85	590.80		
1 Crawler Crane, 100 Ton		1879.00		2066.90	33.55	36.91
56 L.H., Daily Totals		$4390.20		$5855.70	$78.40	$104.57
Crew B-13D	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Laborer	$41.05	$328.40	$62.10	$496.80	$49.25	$74.17
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Hyd. Excavator, 1 C.Y.		749.70		824.67		
1 Trench Box		77.75		85.53	51.72	56.89
16 L.H., Daily Totals		$1615.45		$2096.99	$100.97	$131.06

Crew No.	Bare Costs		Incl. Subs O&P		Cost Per Labor-Hour	
Crew B-13E	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Laborer	$41.05	$328.40	$62.10	$496.80	$49.25	$74.17
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Hyd. Excavator, 1.5 C.Y.		908.70		999.57		
1 Trench Box		77.75		85.53	61.65	67.82
16 L.H., Daily Totals		$1774.45		$2271.90	$110.90	$141.99
Crew B-13F	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Laborer	$41.05	$328.40	$62.10	$496.80	$49.25	$74.17
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Hyd. Excavator, 3.5 C.Y.		2256.00		2481.60		
1 Trench Box		77.75		85.53	145.86	160.45
16 L.H., Daily Totals		$3121.75		$3753.93	$195.11	$234.62
Crew B-13G	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Laborer	$41.05	$328.40	$62.10	$496.80	$49.25	$74.17
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Hyd. Excavator, .75 C.Y.		681.25		749.38		
1 Trench Box		77.75		85.53	47.44	52.18
16 L.H., Daily Totals		$1547.00		$2021.70	$96.69	$126.36
Crew B-13H	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Laborer	$41.05	$328.40	$62.10	$496.80	$49.25	$74.17
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Gradall, 5/8 C.Y.		862.55		948.80		
1 Trench Box		77.75		85.53	58.77	64.65
16 L.H., Daily Totals		$1728.30		$2221.13	$108.02	$138.82
Crew B-13I	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Laborer	$41.05	$328.40	$62.10	$496.80	$49.25	$74.17
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Gradall, 3 Ton, 1 C.Y.		1185.00		1303.50		
1 Trench Box		77.75		85.53	78.92	86.81
16 L.H., Daily Totals		$2050.75		$2575.82	$128.17	$160.99
Crew B-13J	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
1 Laborer	$41.05	$328.40	$62.10	$496.80	$49.25	$74.17
1 Equip. Oper. (crane)	57.45	459.60	86.25	690.00		
1 Hyd. Excavator, 2.5 C.Y.		1441.00		1585.10		
1 Trench Box		77.75		85.53	94.92	104.41
16 L.H., Daily Totals		$2306.75		$2857.43	$144.17	$178.59
Crew B-13K	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
2 Equip. Opers. (crane)	$57.45	$919.20	$86.25	$1380.00	$57.45	$86.25
1 Hyd. Excavator, .75 C.Y.		681.25		749.38		
1 Hyd. Hammer, 4000 ft-lb		332.85		366.13		
1 Hyd. Excavator, .75 C.Y.		681.25		749.38	105.96	116.56
16 L.H., Daily Totals		$2614.55		$3244.89	$163.41	$202.81
Crew B-13L	**Hr.**	**Daily**	**Hr.**	**Daily**	**Bare Costs**	**Incl. O&P**
2 Equip. Opers. (crane)	$57.45	$919.20	$86.25	$1380.00	$57.45	$86.25
1 Hyd. Excavator, 1.5 C.Y.		908.70		999.57		
1 Hyd. Hammer, 5000 ft-lb		407.60		448.36		
1 Hyd. Excavator, .75 C.Y.		681.25		749.38	124.85	137.33
16 L.H., Daily Totals		$2916.75		$3577.30	$182.30	$223.58

Appendix B.2.4 (continued)

Caterpillar Handbook Pages

Caterpillar Performance Handbook

Edition 29

CATERPILLAR®

CONSTRUCTION & MINING TRUCKS
CONSTRUCTION & MINING TRACTORS

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Features:

- **Caterpillar four-stroke-cycle diesels** … turbocharged, aftercooled, adjustment-free fuel system (direct injection).
- **Electronically-controlled automatic transmission** … speed sensing device automatically shifts transmission between 1st and gear selected by operator.
- **Truck Production Management System (TPMS)** utilizes strut pressure sensors and an on-board microprocessor to determine payload weight, cycle segment times, delay times, actual clock time and date of each cycle.
- **Vital Information Management System (VIMS)** Monitors all vital machine functions. Keeps operator informed of current machine operating conditions, helps reduce downtime and allows service personnel easy access to data for fast accurate diagnosis. VIMS includes Production Management System.
- **Electronic Unit Injection (EUI)** in the 776D-793C and **Hydraulic Electronic Unit Injection (HEUI)** on 769D-775D electronically maintains fuel settings, provides automatic altitude and air filter restriction compensation, automatic variable timing, improved diagnostics and increased fuel efficiency.
- **Oil cooled disc brakes** provide retarding, service, parking, and secondary braking in one sealed, fade-resistant, maintenance-free unit. 769D-777D front brakes are caliper disc, can be switched out of the service system when not needed but activate as part of the secondary system. (Front oil-cooled brakes optional on 777D.) 784C-793C front brakes are oil-cooled disc.
- **Automatic Retarder Control (ARC)** electronically controls braking on grade to maintain faster downhill speeds and consistently higher engine speed.
- **Full hydraulic steering,** with front suspension cylinders serving as kingpins.
- **Four independent,** self-contained, oil-pneumatic suspension cylinders absorb loading and road shocks. Wide spacing for stability.
- **Dual slope body** has V-bottom for load balance and retention. Low loading height and center of gravity.
- **Quarry trucks** have single-slope flat floor for smooth, metered dumping into crushers or hoppers. Optional flat floor body available for 769D, 773D.
- **Integral Roll Over Protective Structure (ROPS)** cab standard on all models.
- **Separate hydraulic systems** prevents cross contamination.

Tractor Features:

- **Yoke type hitch** oscillates four ways to reduce frame stresses. Rugged turn stops prevent excessive wagon rotation either direction.
- **Rear platform** functions as a power train guard and provides safe, stable work area. Fenders and mud flaps protect from material thrown by tires.

NOTE: Listed features may be standard on some models. Optional on others. Contact your Caterpillar Dealer for specific information.

MODEL	769D		769D		771D	
Body Type	**Flat Floor**		**Dual Slope**		**Quarry**	
Gross Vehicle Weight	68 180 kg	**150,000 lb**	68 180 kg	**150,000 lb**	73 970 kg	**163,100 lb**
Chassis Weight*	22 950 kg	**50,600 lb**	22 950 kg	**50,600 lb**	22 950 kg	**50,600 lb**
Body Weight	7800 kg	**17,200 lb**	7330 kg	**16,170 lb**	10 350 kg	**22,820 lb**
Maximum Payload**	37 430 kg	**82,533 lb**	37 900 kg	**83,570 lb**	40 670 kg	**89,680 lb**
Standard Liner Weight	3300 kg	**7280 lb**	3160 kg	**6970 lb**	**—**	
Payload with Standard Liner	34 130 kg	**75,250 lb**	34 740 kg	**76,600 lb**	**—**	
Capacity:						
Struck (SAE)	16.5 m^3	**21.6 yd^3**	17 m^3	**22.2 yd^3**	20.2 m^3	**26.4 yd^3**
Heaped (2:1) (SAE)	24.2 m^3	**31.7 yd^3**	24.2 m^3	**31.7 yd^3**	27.5 m^3	**36 yd^3**
Distribution Empty:						
Front	**49.7%**		**49.8%**		**46.3%**	
Rear	**50.3%**		**50.2%**		**53.7%**	
Distribution Loaded:						
Front	**33.2%**		**33.3%**		**32.9%**	
Rear	**66.8%**		**66.7%**		**67.1%**	
Engine Model	**3408E**		**3408E**		**3408E**	
Number of Cylinders	**8**		**8**		**8**	
Bore	137 mm	**5.4"**	137 mm	**5.4"**	137 mm	**5.4"**
Stroke	152 mm	**6"**	152 mm	**6"**	152 mm	**6"**
Displacement	18 L	**1099 in^3**	18 L	**1099 in^3**	18 L	**1099 in^3**
Flywheel Power	362 kW	**485 hp**	362 kW	**485 hp**	362 kW	**485 hp**
Gross Power	380 kW	**510 hp**	380 kW	**510 hp**	380 kW	**510 hp**
Standard Tires	**18.00R33(E-4)**		**18.00R33(E-4)**		**18.00R33(E-4)**	
Machine Clearance Turning Circle	19.8 m	**65'0"**	19.8 m	**65'0"**	19.8 m	**65'0"**
Fuel Tank Refill Capacity	530 L	**140 U.S. gal**	530 L	**140 U.S. gal**	530 L	**140 U.S. gal**
Top Speed (Loaded)	75 km/h	**47 mph**	75 km/h	**47 mph**	56 km/h	**35 mph**
GENERAL DIMENSIONS (Empty):						
Height to Canopy Rock Guard Rail	4.07 m	**13'4"**	4.03 m	**13'3"**	4.02 m	**13'2"**
Wheelbase	3.71 m	**12'2"**	3.71 m	**12'2"**	3.71 m	**12'2"**
Overall Length	8.73 m	**28'7"**	8.57 m	**28'1"**	8.73 m	**28'7"**
Loading Height (Empty)	3.19 m	**10'6"**	3.14 m	**10'4"**	3.40 m	**11'2"**
Height at Full Dump	7.75 m	**25'5"**	7.71 m	**25'3"**	7.74 m	**25'5"**
Body Length (Target Length)	5.43 m	**17'10"**	5.28 m	**17'4"**	5.52 m	**18'1"**
Width (Operating)	5.01 m	**16'5"**	5.01 m	**16'5"**	5.01 m	**16'5"**
Width (Shipping)***	3.95 m	**12'11"**	3.95 m	**12'11"**	3.95 m	**12'11"**
Front Tire Tread	3.10 m	**10'2"**	3.10 m	**10'2"**	3.10 m	**10'2"**

*Weights include lubricants, coolants, and 10% fuel.
**Maximum rating requires selection of proper tires and is dependent on selection of optional equipment. Gross vehicle weight should not be exceeded.
***Disassembled.

Caterpillar Performance Handbook

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CAT®

CATERPILLAR PERFORMANCE HANDBOOK

a publication by Caterpillar Inc., Peoria, Illinois, U.S.A.

JANUARY 2011

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NOTE: Always refer to the appropriate Operation and Maintenance Manual for specific product information.

Materials and specifications are subject to change without notice.

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TOWED SCRAPERS

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- Tandem Powered
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MODEL	627G		637G		657G	
Flywheel Power: Tractor	246/272 kW	**330/365 hp**	345/373 kW	**462/500 hp**	421/447 kW	**564/600 hp**
Scraper	178/198 kW	**239/266 hp**	198/211 kW	**266/283 hp**	306/337 kW	**410/451 hp**
Approx. Operating Weight (Empty)◀	37 922 kg	**83,604 lb**	51 963 kg	**114,559 lb**	68 384 kg	**150,760 lb**
Scraper Capacity: Struck	12 m^3	**15.7 yd^3**	18.3 m^3	**24 yd^3**	24.5 m^3	**32 yd^3**
Heaped	17 m^3	**22 yd^3**	26 m^3	**34 yd^3**	33.6 m^3	**44 yd^3**
Rated Load	23 950 kg	**52,800 lb**	37 013 kg	**81,600 lb**	47 174 kg	**104,000 lb**
Weight Distribution — Empty: Front	**59%**		**59%**		**58%**	
Rear	**41%**		**41%**		**42%**	
Weight Distribution — Loaded: Front	**50%**		**50%**		**50%**	
Rear	**50%**		**50%**		**50%**	
Engine Model: Tractor	**C15 ACERT**		**C18 ACERT**		**C18 ACERT**	
Scraper	**C9 ACERT**		**C9 ACERT**		**C15 ACERT**	
Rated Engine RPM: Tractor	**1800**		**1800**		**1800**	
Scraper	**2000**		**2000**		**1800**	
Displacement: Tractor	15.2 L	**928 in^3**	18.1 L	**1105 in^3**	18.1 L	**1105 in^3**
Scraper	8.8 L	**538 in^3**	8.8 L	**538 in^3**	15.2 L	**928 in^3**
Top Speed (Loaded)	51 km/h	**32 mph**	53 km/h	**33 mph**	53 km/h	**33 mph**
180° Curb-to-Curb Turning Width	11.7 m	**38'5"**	12.2 m	**40'1"**	14.2 m	**46'7"**
Tires — Tractor Drive	**33.25R29★★E3**		**37.25R35★★E3**		**40.5/75R39★★E3**	
Scraper	**33.25R29★★E3**		**37.25R35★★E3**		**40.5/75R39★★E3**	
Width of Cut	3.02 m	**9'11"**	3.51 m	**11'6"**	3.85 m	**12'8"**
Maximum Depth of Cut	333 mm	**13.1"**	437 mm	**17"**	440 mm	**17.3"**
Maximum Depth of Spread	522 mm	**20.6"**	480 mm	**18.9"**	660 mm	**26"**
Fuel Tank Refill Capacity: Tractor	**—**		**—**		**—**	
Scraper	1105 L	**292 U.S. gal**	1268 L	**335 U.S. gal**	1597 L	**424 U.S. gal**
GENERAL DIMENSIONS:						
Height to Top of Scraper	3.81 m	**12'6"**	4.18 m	**13'9"**	4.62 m	**15'2"**
Wheelbase	7.72 m	**25'4"**	8.77 m	**28'9"**	9.96 m	**32'8"**
Overall Length	12.88 m	**42'3"**	14.71 m	**48'3"**	16.2 m	**53'1"**
Overall Width	3.58 m	**11'9"**	3.94 m **	**12'11"**	4.35 m	**14'4"**
Shipping Width (Draft Arm on Inside of Bowl)	**—**		3.63 m *	**11'11"**	3.91 m **	**12'10"**
Scraper Tread	2.23 m	**7'4"**	2.46 m	**8'1"**	2.81 m	**9'3"**
Tractor Tread	2.20 m	**7'3"**	2.46 m	**8'1"**	2.63 m	**8'8"**
PUSH-PULL GENERAL DIMENSIONS:						
Operating Weight (Empty)◀	39 443 kg	**86,957 lb**	54 057 kg	**119,175 lb**	72 804 kg	**160,505 lb**
Overall Length	15.2 m	**49'7"**	16.64 m	**54'7"**	18.01 m	**59'1"**
Weight Distribution — Empty: Front	**59%**		**60%**		**58%**	
Rear	**41%**		**40%**		**42%**	
Weight Distribution — Loaded: Front	**51%**		**51%**		**51%**	
Rear	**49%**		**49%**		**49%**	

*Optional Shipping Configuration.
**Standard Shipping Configuration.
◀Operating weight includes standard machine, coolant, lubricants, full fuel tank, and operator.

MODEL	637G			657G		
Flywheel Power: Tractor	345/373 kW		**462/500 hp**	421/447 kW		**564/600 hp**
Scraper	198/211 kW		**266/283 hp**	306/337 kW		**410/451 hp**
Approx. Operating Weight (Empty)	54 050 kg		**118,909 lb**	72 190 kg		**158,817 lb**
Scraper Capacity: Struck	31 m^3		**41 yd^3**	45 m^3		**59 yd^3**
Heaped	38 m^3		**50 yd^3**	56 m^3		**73 yd^3**
Rated Load	34 473 kg		**76,000 lb**	49 895 kg		**110,000 lb**
Approx. Operating Weight (Loaded)	88 409 kg		**194,909 lb**	121 933 kg		**268,817 lb**
Top Speed (Loaded)	53 km/h		**33 mph**	53 km/h		**33 mph**
180° Curb-to-Curb Turning Width	13.7 m		**44'10"**	15.6 m		**51'3"**
GENERAL DIMENSIONS:						
Height to Top of Scraper	4.18 m		**13'9"**	4.62 m		**15'2"**
Wheelbase	9.53 m		**31'3"**	11.01 m		**36'1"**
Overall Length	15.47 m		**50'9"**	17.21 m		**56'5"**
Overall Width	3.94 m	**	**12'11"**	4.35 m		**14'4"**
Shipping Width (Draft Arm on Inside of Bowl)	3.63 m	*	**11'11"**	3.91 m	**	**12'10"**
Scraper Tread	2.46 m		**8'1"**	2.81 m		**9'3"**
Tractor Tread	2.46 m		**8'1"**	2.63 m		**8'8"**

*Optional Shipping Configuration.
**Standard Shipping Configuration.

Coal Bowl

Coal Bowl Wheel Tractor-Scrapers are typically used for building and maintaining coal stockpiles and hauling coal to the supply system at coal power plants. The self-loading capability, large capacity, coal pile compaction, and high speed of Coal Bowl Wheel Tractor-Scrapers make them the tool of choice for moving coal both short and long distances. Coal Bowl Wheel Tractor-Scrapers are available in the 637G and 657G tandem engine models.

Coal Bowl Advantages:

- Load hoppers
- Manage coal stockpiles
- Compaction reduces risk of spontaneous combustion in coal stockpile
- Exclusively designed large capacity coal bowls

Notes:

- The 637G Coal Scraper is 736 mm **(29.0")** longer, the bowl sides are 476 mm **(18.7")** taller, and the apron is 499 mm **(19.6")** taller than its earthmoving counterpart.
- The 657G Coal Scraper is 1072 mm **(42.2")** longer, the bowl sides are 1010 mm **(39.8")** taller, the apron is 677 mm **(26.7")** taller, and the ejector is 944 mm **(37.2")** taller than its earthmoving counterpart.

WHEEL LOADERS
INTEGRATED TOOLCARRIERS

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WHEEL LOADERS

Features:

- **Cat heavy duty diesel engine.**
- **Productive operator environment. Excellent visibility.**
- **Automatic lift and bucket controls.**
- **Adjustable suspension seat and steering column.**
- **Four wheel enclosed wet disc brakes.**
- **Automatic power shift transmissions.** Allows operator to select automatic or manual mode.
- **Hydrostatic drive on 906H, 908H and 914G.**
- **Transmission neutralizer switch (924H, 924Hz, 928Hz, 930H, 938H-980H).**
- **Computerized machine function monitoring.**
- **Command control steering** with integrated transmission controls and electro-hydraulic controls … 950H-980H.
- **Lock up clutch on 990H and 994F (optional on 988H).**
- **Impeller clutch on 988H, 990H, 992K, 993K and 994F.**
- **Tilting hood … 938H-980H.**
- **Brake wear indicator.**
- **Limited slip differentials.**
- **Differential locks … 938H.**
- **Automatic Ride Control suspension system.** Operator select “on”, “off” or “automatic”.
- **Payload control system.**
- **Optional Fusion™ coupler system** for work tool interchangeability with pin-on performance. Work tools can interchange across the entire SWL/MWL/IT line.

Listed features may be standard on some models, optional or unavailable on others. Contact your Cat dealer for specific information.

MODEL	972H		980H		988H		990H	
Flywheel Power: Net	214 kW	**287 hp**	260 kW	**349 hp**	373 kW	**501 hp**	468 kW	**627 hp**
Gross	229 kW	**307 hp**	293 kW	**392 hp**	414 kW	**555 hp**	512 kW	**687 hp**
Rated Payload*	**—**		**—**		11.4 t	**12.5 T**	15 t	**16.5 T**
Gross Rated Bucket Payload*	**—**		**—**		16 300 kg	**36,000 lb**	22 700 kg	**50,000 lb**
Engine Model	**C13 ATAAC**		**C15 ATAAC**		**C18 ACERT**		**C27 ACERT**	
Rated Engine RPM	**1800**		**1800**		**1800**		**2000**	
Bore	130 mm	**5.1"**	137 mm	**5.4"**	145 mm	**5.7"**	137 mm	**5.4"**
Stroke	157 mm	**6.2"**	171 mm	**6.75"**	183 mm	**7.2"**	152 mm	**6"**
No. Cylinders	**6**		**6**		**6**		**12**	
Displacement	12.5 L	**763 in³**	15.2 L	**928 in³**	18.1 L	**1104.5 in³**	27.1 L	**1666 in³**
Speeds Forward	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**
1st	7.2	**4.5**	6.6	**4.1**	6.7	**4.2**	7.0	**4.3**
2nd	12.6	**7.8**	11.8	**7.3**	11.8	**7.3**	12.1	**7.5**
3rd	21.4	**13.3**	20.7	**12.9**	20.8	**12.9**	20.8	**13.0**
4th	36.9	**22.9**	36.3	**22.6**	36.0	**22.3**	**—**	
Speeds Reverse								
1st	8.2	**5.1**	7.6	**4.7**	7.6	**4.7**	7.7	**4.8**
2nd	14.2	**8.8**	13.5	**8.4**	13.5	**8.4**	13.4	**8.3**
3rd	24.3	**15.1**	23.6	**14.7**	23.7	**14.7**	22.9	**14.2**
4th	38.8	**24.0**	41.5	**25.8**	**—**		**—**	
Hydraulic Cycle Time, Rated Load in Bucket:	**Seconds**		**Seconds**		**Seconds**		**Seconds**	
Raise	**5.9**		**6.0**		**9.4**		**9.2**	
Dump	**2.1**		**2.1**		**2.4**		**2.9**	
Lower (Empty, Float Down)	**2.4**		**3.4**		**3.8**		**3.8**	
Total	**10.4**		**11.5**		**15.6**		**15.9**	
Tread Width	2.23 m	**7'4"**	2.44 m	**8'0"**	2.59 m	**8'6"**	3.1 m	**10'2"**
Width Over Tires	3.00 m	**9'10"**	3.23 m	**10'7"**	3.54 m	**11'7"**	4.1 m	**13'5"**
Ground Clearance	494 mm	**20"**	442 mm	**17.4"**	549 mm	**22"**	478 mm	**18.8"**
Fuel Tank Capacity	380 L	**100 U.S. gal**	479 L	**127 U.S. gal**	712 L	**188 U.S. gal**	1074 L	**284 U.S. gal**
Hydraulic Tank Capacity	110 L	**29 U.S. gal**	125 L	**33 U.S. gal**	267 L	**70 U.S. gal**	174 L†	**46 U.S. gal**
Hydraulic System Capacity (includes tank)	200 L	**52 U.S. gal**	250 L	**66 U.S. gal**	470 L	**124 U.S. gal**	435 L†	**115 U.S. gal**

*Changes in bucket weight, including field installed wear iron, can impact rated payload. Consult your Cat dealer for assistance in selecting and configuring the proper bucket for the application. The Cat Large Wheel Loader Payload Policy is a guideline intended to maximize wheel loader structural and component life. The Cat Payload Policy is that the "Gross Bucket plus Payload Capacity" is the MAXIMUM weight that should be carried on the end of the Lift Arm/Boom.

†990H has a separate hydraulic system for steering and engine cooling fan. System (including tank) 194 L **(51 U.S. gal)**, tank only 132 L **(35 U.S. gal)**.

Wheel Loaders (cont'd)

Model	Product Ident. No. Prefix	Years Built	Flywheel Horse-power	Approx. Shipping Wt. kg (lb)	Rated Capacity m³ (yd³)	Breakout Force kg (lb)	Width Over Tires m (ft)	Ground Clearance mm (in)	Max. Reach at max. height mm (ft)	Dump Clearance at max. height m (ft)	Maximum Speeds km/h (mph) Fwd.	Rev.	Remarks
988	87A	63-76	325	35 800 **(79,000)**	4.6-5.4 **(6.0-7.0)**	21 380 **(47,130)**	3.20 **(10'7")**	570 **(22.5")**	1450 **(4'9")**	3.33 **(10'11")**	30.6 **(19.0)**	30.6 **(19.0)**	
988B	50W	76-93	375	43 365 **(95,600)**	5.4-6.3 **(7.0-8.25)**	36 330 **(80,100)**	3.52 **(11'7")**	474 **(18")**	2150 **(7'1")**	3.19 **(10'5")**	36.2 **(22.5)**	41.4 **(25.7)**	3408 Engine Z Bar Linkage
988F	8YG	93-95	400	43 540 **(95,900)**	5.4-6.1 **(7.0-8.0)**	37 363 **(82,371)**	3.52 **(11'7")**	496 **(19")**	1830 **(6'0")**	3.21 **(10'6")**	35.1 **(21.8)**	23.5 **(14.6)**	Bucket/HP increase STIC Steer
988F Series II	2ZR	95-00	475	45 678 **(100,492)**	6.1-6.9 **(8.0-9.0)**	37 400 **(82,282)**	3.52 **(11'7")**	496 **(1'7")**	1611 **(5'3")**	3.22 **(10'7")**	35.1 **(21.8)**	23.5 **(14.6)**	3048E HEUI Engine Axle Shaft Brakes
988G	2TW	01	475	50 040 **(110,320)**	6.3-7.0 **(8.2-9.2)**	46 950 **(103,500)**	3.47 **(11'5")**	549 **(21.6")**	2113 **(6'11")**	4.0 **(13'1")**	38.7 **(24.0)**	22.3 **(13.8)**	6 Bar Linkage "G" Series
988G	BNH	01-05	475	50 040 **(110,320)**	6.3-7.0 **(8.2-9.2)**	46 950 **(103,500)**	3.47 **(11'5")**	549 **(21.6")**	2113 **(6'11")**	4.0 **(13'11")**	38.6 **(24.0)**	25.1 **(15.6)**	6 Bar Linkage "G" Series
988H	BXY	05	501	49 546 **(109,249)**	6.4-7.0 **(8.33-9.2)**	378.4 **(85,068)**	3.47 **(11'5")**	549 **(22")**	5.85 **(19'2")**	3466 **(11'37")**	36 **(22.3)**	23.7 **(14.7)**	3.88 Meter Linkage
990	7HK	93-95	610	72 910 **(160,600)**	8.6 **(11.2)**	59 776 **(131,784)**	4.13 **(13'6")**	552 **(21.7")**	2070 **(6'10")**	3.99 **(13'1")**	22.5 **(14.0)**	25.0 **(15.5)**	ICTC & New Model
990 Series II	4FR	96-05	625	72 200 **(159,170)**	8.4-9.2 **(11-12)**	63 100 **(138,800)**	4.0 **(13'1")**	490 **(19.3")**	1990 **(6'6")**	4.05 **(13'3")**	22.5 **(14.0)**	25.0 **(15.5)**	HEUI Engine
990H	BWX	05	627	77 842 **(171,642)**	8.6-9.2 **(11.25-12)**	602 **(135,429)**	4.16 **(13'3")**	478 **(18'8")**	8.07 **(26'6")**	4220 **(13'10")**	22.4 **(13.92)**	24.8 **(15.41)**	Standard Lift 8.6 m³/**11.2 yd³** Bucket
992	25K	68-73	550	47 670 **(105,100)**	7.65 **(10.0)**	36 900 **(81,360)**	3.93 **(12'11")**	530 **(21")**	2820 **(8'3")**	4.52 **(14'10")**	35.6 **(22.1)**	38.5 **(23.8)**	
992B	25K	73-77	550	64 320 **(141,800)**	7.65 **(10.0)**	29 330 **(84,660)**	— **—**	— **—**	1930 **(6'4")**	4.34 **(14'3")**	40.2 **(25.0)**	43.6 **(27.1)**	
992C	42X	77-81	690	85 640 **(188,800)**	9.6 **(12.5)**	66 240 **(146,030)**	4.55 **(14'11")**	533 **(21")**	2310 **(7'7")**	4.17 **(13'8")**	21.1 **(13.1)**	23.3 **(14.5)**	3412 PCT Engine Z Bar Linkage
992C	49Z	81-92	690	88 430 **(194,950)**	10.4 **(13.5)**	66 285 **(146,132)**	4.50 **(14'9")**	544 **(21")**	2310 **(7'7")**	4.17 **(13'8")**	21.0 **(13.0)**	22.9 **(14.2)**	3412 DIT Engine
992D	7MJ	92-97	710	88 690 **(195,125)**	10.7 **(14.0)**	62 670 **(137,870)**	4.50 **(14'9")**	544 **(21")**	2300 **(7'7")**	4.17 **(13'8")**	21.0 **(13.0)**	22.9 **(14.2)**	
992G	7HR	98-00	800	91 540 **(201,810)**	11.5-12.3 **(15-16)**	62 650 **(137,840)**	4.5 **(14'9")**	691 **(27.2")**	2300 **(7'7")**	4.6 **(15'3")**	20.2 **(12.5)**	22.7 **(14.1)**	6 Bar Linkage "G" Series
992K	H4C	07	801	97 294 **(214,535)**	10.7-12.3 **(14-16)**	584.66 **(128,917)**	— **—**	682 **(2'2")**	9313 **(30'6")**	4480 **(14'8")**	20.6 **(12.8)**	22.4 **(13.9)**	10.7 m³/**14 yd³** Bucket
993K	Z9K	07	945	133 637 **(294,800)**	12.8-14.5 **(16.7-19)**	709 **(159,500)**	4.93 **(16'2")**	783 **(30'8")**	9313 **(30'7")**	4849 **(15'11")**	20.1 **(22.1)**	12.5 **(13.7)**	12.8 m³/**16.7 yd³** Bucket
994	9YF	90-98	1250	177 000 **(390,300)**	10.3 **(13.4)**	103 420 **(228,000)**	5.20 **(17'1")**	662 **(26")**	2692 **(8'10")**	6.20 **(20'4")**	24.7 **(15.0)**	26.6 **(16.5)**	

CATERPILLAR PERFORMANCE HANDBOOK

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Performance information in this booklet is intended for estimating purposes only. Because of the many variables peculiar to individual jobs (including material characteristics, operator efficiency, underfoot conditions, altitude, etc.), neither Caterpillar nor its dealers warrant that the machines described will perform as estimated.

NOTE: Always refer to the appropriate Operation and Maintenance Manual for specific product information.

Materials and specifications are subject to change without notice.

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ARTICULATED TRUCKS

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Features:

- **Cat® engines with ACERT™ Technology** meet U.S. EPA Tier 4 Final/EU Stage IV/Japan 2014 (Tier 4 Final), or Tier 2/Stage II/Japan 2001 (Tier 2) equivalent emission standards. The four core elements of meeting these standards are:

  I) Common Rail;

  II) Electronics, ADEM™ A4;

  III) Fuel delivery, Mechanical-activated Electronic Unit Injection (MEUI™ A-C);

  IV) Air Management, Wastegate Turbocharging, Air to Air Aftercooling (ATAAC) with the proven technology of a crossflow cylinder head.

- **Cat electronically controlled transmissions** … Transmissions purpose built and designed for articulated trucks and their applications. Advanced Productivity Electronic Control Strategy (APECS) delivering smooth shifting transmissions with improved acceleration and high productivity. Providing complete integration with the engines for efficient power delivery as well as offering advanced diagnostic and troubleshooting capabilities.

- **Articulating and fully oscillating hitch** … Links front and rear frames for exceptional maneuverability and traction on uneven terrain while eliminating damaging twisting of the frames. Bolted hitch design allows optimum material choices for the cast hitch head and the hard-wearing tube. Bolted design allows easier rebuild and repair.

- **Three-point front suspension** … Three-point front suspension with long-stroke, low-pressure suspension cylinders provide unparalleled ride quality for operator comfort and higher average haul speeds. Front and rear suspension together with the hitch provide for excellent traction in all conditions.

- **Wide, long and low dump body design** … For excellent loadability and high fill factors, excellent machine stability and load retention as well as a good match for other Cat loading systems. Diverging flow design also gives excellent material ejection.

- **Standard ROPS/FOPS, low sound level cab** … Two man cab common across the range. Large cab with excellent visibility, ergonomic control layout and plentiful storage.

- **High capacity low pressure tires in single formation** … For superior traction and flotation in poor underfoot conditions.

- **Bare Chassis offerings** … For certain applications the Caterpillar OEM Solutions Group offers non-dumper/Bare Chassis arrangements.

  Bare Chassis arrangements applications could include: water, service (fuel and lube), high capacity body (waste, coal, etc.), open body (log, pipe, etc.), container carrier, hook lift, tow, cable reel, etc. Please refer to specific OEM for additional information.

MODEL	725C2		730C2		730C2 EJ	
Gross Power — SAE J1995	239 kW	**320 hp**	280 kW	**375 hp**	280 kW	**375 hp**
Net Power — SAE J1349	234 kW	**314 hp**	274 kW	**367 hp**	274 kW	**367 hp**
Net Power — ISO 14396	236 kW	**316 hp**	276 kW	**370 hp**	276 kW	**370 hp**
Operating Weight (Empty)*	23 040 kg	**50,795 lb**	23 725 kg	**52,305 lb**	26 395 kg	**57,277 lb**
Top Speed (Loaded)	55 km/h	**34 mph**	55 km/h	**34 mph**	55 km/h	**34 mph**
Gross Machine Weight	47 040 kg	**103,707 lb**	51 725 kg	**114,034 lb**	54 515 kg	**119,270 lb**
Distribution Empty:						
Front	**63%**		**62%**		**59%**	
Center	**19%**		**19%**		**21%**	
Rear	**18%**		**19%**		**20%**	
Distribution Loaded:						
Front	**36%**		**34%**		**30%**	
Center	**32%**		**33%**		**35%**	
Rear	**32%**		**33%**		**35%**	
Max. Capacity**	24.0 t	**26.5 T**	28 t	**31 T**	28 t	**31 T**
Struck (SAE)	11 m^3	**14.4 yd^3**	13.3 m^3	**17.4 yd^3**	13.5 m^3	**17.7 yd^3**
Heaped (2:1) (SAE)	15 m^3	**19.6 yd^3**	17.5 m^3	**23 yd^3**	16.9 m^3	**22.1 yd^3**
Tailgate Heaped SAE 2:1	15.6 m^3	**20.4 yd^3**	18.8 m^3	**24.6 yd^3**	—	
Tailgate Struck	11.1 m^3	**14.5 yd^3**	13.9 m^3	**18.2 yd^3**	—	
Engine Model	**C9.3 ACERT**		**C13 ACERT**		**C13 ACERT**	
No. Cylinders	**6**		**6**		**6**	
Bore	115 mm	**4.53"**	130 mm	**5.12"**	130 mm	**5.12"**
Stroke	149 mm	**5.87"**	157 mm	**6.18"**	157 mm	**6.18"**
Displacement	9.3 L	**567 in^3**	12.5 L	**763 in^3**	12.5 L	**763 in^3**
Tires	**23.5R25**		**23.5R25**		**750/65/R26**	
Clearance Radius	8075 mm	**317.9"**	8075 mm	**317.9"**	8075 mm	**317.9"**
Fuel Tank Refill Capacity	412 L	**108.8 U.S. gal**	412 L	**108.8 U.S. gal**	412 L	**108.8 U.S. gal**
DEF Tank Capacity	20 L	**5.3 U.S. gal**	20 L	**5.3 U.S. gal**	20 L	**5.3 U.S. gal**
General Dimensions (Empty):						
Height to Cab Top	3482 mm	**137.1"**	3482 mm	**137.1"**	3461 mm	**136"**
Overall Length	10 547 mm	**415.2"**	10 555 mm	**415.6"**	10 376 mm	**408.5"**
Loading Height (Empty)	2725 mm	**107.3"**	2911 mm	**114.6"**	3025 mm	**119.1"**
Height at Full Dump	6306 mm	**248.3"**	6464 mm	**254.5"**	—	
Body Length	5696 mm	**224.3"**	5783 mm	**227.7"**	5340 mm	**210.2"**
Width (Operating — Over Mirrors)	3704 mm	**145.8"**	3704 mm	**145.8"**	3704 mm	**145.8"**

*Includes coolant, lubricant and full fuel tank.
**Rating dependent on optional equipment. Maximum gross weight (empty weight plus payload) should not be exceeded.

MODEL	725C2		730C2		730C2 EJ	
Gross Power — SAE J1995	239 kW	**320 hp**	280 kW	**375 hp**	280 kW	**375 hp**
Net Power — SAE J1349	234 kW	**314 hp**	274 kW	**367 hp**	274 kW	**367 hp**
Net Power — ISO 14396	236 kW	**316 hp**	276 kW	**370 hp**	276 kW	**370 hp**
Operating Weight (Empty)*	22 775 kg	**50,211 lb**	23 305 kg	**51,378 lb**	25 980 kg	**57,277 lb**
Top Speed (Loaded)	55 km/h	**34 mph**	55 km/h	**34 mph**	55 km/h	**34 mph**
Gross Machine Weight	46 775 kg	**103,121 lb**	51 305 kg	**113,107 lb**	54 100 kg	**119,270 lb**
Distribution Empty:						
Front	**62%**		**62%**		**58%**	
Center	**19%**		**19%**		**21%**	
Rear	**19%**		**19%**		**21%**	
Distribution Loaded:						
Front	**35%**		**34%**		**29%**	
Center	**33%**		**33%**		**36%**	
Rear	**32%**		**33%**		**35%**	
Max. Capacity**	24.0 t	**26.5 T**	28 t	**31 T**	28 t	**31 T**
Struck (SAE)	11 m^3	**14.4 yd^3**	13.3 m^3	**17.4 yd^3**	13.5 m^3	**17.7 yd^3**
Heaped (2:1) (SAE)	15 m^3	**19.6 yd^3**	17.5 m^3	**23 yd^3**	16.9 m^3	**22.1 yd^3**
Tailgate Heaped SAE 2:1	15.6 m^3	**20.4 yd^3**	18.8 m^3	**24.6 yd^3**	—	
Tailgate Struck	11.1 m^3	**14.5 yd^3**	13.9 m^3	**18.2 yd^3**	—	
Engine Model	**C9.3 ACERT**		**C13 ACERT**		**C13 ACERT**	
No. Cylinders	**6**		**6**		**6**	
Bore	115 mm	**4.53"**	130 mm	**5.12"**	130 mm	**5.12"**
Stroke	149 mm	**5.87"**	157 mm	**6.18"**	157 mm	**6.18"**
Displacement	9.3 L	**567 in^3**	12.5 L	**763 in^3**	12.5 L	**763 in^3**
Tires	**23.5R25**		**23.5R25**		**750/65/R26**	
Clearance Radius	8075 mm	**317.9"**	8075 mm	**317.9"**	8075 mm	**317.9"**
Fuel Tank Refill Capacity	412 L	**108.8 U.S. gal**	412 L	**108.8 U.S. gal**	412 L	**108.8 U.S. gal**
General Dimensions (Empty):						
Height to Cab Top	3482 mm	**137.1"**	3482 mm	**137.1"**	3461 mm	**136"**
Overall Length	10 547 mm	**415.2"**	10 555 mm	**415.6"**	10 376 mm	**408.5"**
Loading Height (Empty)	2725 mm	**107.3"**	2911 mm	**114.6"**	3025 mm	**119.1"**
Height at Full Dump	6306 mm	**248.3"**	6464 mm	**254.5"**	—	
Body Length	5696 mm	**224.3"**	5783 mm	**227.7"**	5340 mm	**210.2"**
Width (Operating — Over Mirrors)	3704 mm	**145.8"**	3704 mm	**145.8"**	3704 mm	**145.8"**

*Includes coolant, lubricant and full fuel tank.
**Rating dependent on optional equipment. Maximum gross weight (empty weight plus payload) should not be exceeded.

HYDRAULIC EXCAVATORS

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Cycle Time Estimating Chart

Model		308E2 CR SB	311D LRR	312D, 312D L	315D L	319D L, 319D LN	M314F, M315D2	M316F, M317D2, M318F	M320F, M320D2	M322F, M322D2
Bucket Size	**L**	220	450	520	520	800	610	750	900	1050
	yd³	**0.30**	**0.59**	**0.68**	**0.68**	**1.05**	**0.80**	**0.98**	**1.18**	**1.37**
Soil Type		← Packed Earth →					← Sand/Gravel →			
Digging Depth	**m**	1.8	1.5	1.8	3.0	3.0	3.0	3.0	3.0	3.0
	ft	**6'0"**	**5'0"**	**6'0"**	**10'0"**	**10'0"**	**10'0"**	**10'0"**	**10'0"**	**10'0"**
Load Bucket	**min**	0.08	0.07	0.07	0.07	0.09	0.05	0.06	0.06	0.08
Swing Loaded	**min**	0.03	0.06	0.06	0.08	0.09	0.05	0.05	0.06	0.06
Dump Bucket	**min**	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.04
Swing Empty	**min**	0.08	0.05	0.05	0.06	0.07	0.04	0.04	0.05	0.05
Total Cycle Time	**min**	0.22	0.21	0.21	0.24	0.28	0.17	0.18	0.20	0.23

Cycle Time Estimating Chart

Model		320D2	320D RR, 321D CR, 323D2	324D	328D LCR	329D	336D	349D2, 349E, 349F	365C L	385C
Bucket Size	**L**	800	800	1000	N/A	1100	1400	2400	1900	3760
	yd³	**1.05**	**1.05**	**1.31**		**1.44**	**1.83**	**3.0**	**2.5**	**5.0**
Soil Type		← Hard Clay →								
Digging Depth	**m**	2.3	2.3	3.2	N/A	3.2	3.4	4.0	4.2	5.6
	ft	**8**	**8**	**10**		**10**	**11**	**13**	**14**	**18**
Load Bucket	**min**	0.09	0.09	0.09	N/A	0.09	0.09	0.13	0.10	0.19
Swing Loaded	**min**	0.06	0.06	0.06	N/A	0.06	0.07	0.07	0.09	0.06
Dump Bucket	**min**	0.03	0.03	0.04	N/A	0.04	0.04	0.02	0.04	0.03
Swing Empty	**min**	0.05	0.05	0.06	N/A	0.06	0.07	0.06	0.07	0.07
Total Cycle Time	**min**	0.23	0.23	0.25	N/A	0.25	0.27	0.28	0.30	0.35

N/A = Not Applicable

MINING & OFF-HIGHWAY TRUCKS

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MODEL	785C		785D		789D	
Body Type	**Dual Slope**		**Dual Slope**		**Dual Slope**	
Target Gross Machine Weight §	249 476 kg	**550,000 lb**	249 476 kg	**550,000 lb**	324 319 kg	**715,000 lb**
Basic Machine Weight*	59 385 kg	**130,922 lb**	46 240 kg	**101,942 lb**	48 554 kg	**107,043 lb**
Attachments**	21 602 kg	**47,624 lb**	35 781 kg	**78,885 lb**	52 249 kg	**115,190 lb**
Body Weight without Liners***	22 997 kg	**50,700 lb**	22 997 kg	**50,700 lb**	26 606 kg	**58,656 lb**
Full Liner	8113 kg	**17,886 lb**	8113 kg	**17,886 lb**	9692 kg	**21,367 lb**
Operating Machine Weight	112 097 kg	**247,132 lb**	113 131 kg	**249,412 lb**	137 101 kg	**302,256 lb**
Debris (3% of Operating Machine Weight)	3363 kg	**7414 lb**	3394 kg	**7482 lb**	4113 kg	**9068 lb**
Empty Operating Weight	115 460 kg	**254,546 lb**	116 525 kg	**256,894 lb**	141 214 kg	**311,324 lb**
Target Payload §	134.0 m tons	**147.7 tons**	133.0 m tons	**146.6 tons**	183.1 m tons	**201.8 tons**
Capacity:						
Heaped (2:1) (SAE) Base Body	78 m^3	**102 yd^3**	78 m^3	**102 yd^3**	108 m^3	**141 yd^3**
Heaped (2:1) (SAE) with Std. Sideboards	91 m^3	**119 yd^3**	91 m^3	**119 yd^3**	125 m^3	**161 yd^3**
Distribution Empty:						
Front	**45%**		**45.5%**		**46%**	
Rear	**55%**		**54.5%**		**54%**	
Distribution Loaded:						
Front	**33.3%**		**33.3%**		**33%**	
Rear	**66.7%**		**66.7%**		**66%**	
Engine Model	**3512B EUI**		**3512C HD-EUI**		**3516C HD**	
Number of Cylinders	**12**		**12**		**16**	
Bore	170 mm	**6.7"**	170 mm	**6.7"**	170 mm	**6.7 in**
Stroke	190 mm	**7.5"**	215 mm	**8.46"**	210 mm	**8.3 in**
Displacement	51.8 L	**3158 in^3**	58.56 L	**3574 in^3**	78.1 L	**4766 in^3**
Net Power	979 kW	**1313 hp**	979 kW	**1313 hp**	1468 kW	**1969 hp**
Gross Power	1082 kW	**1450 hp**	1082 kW	**1450 hp**	1566 kW	**2100 hp**
Standard Tires	**33.00R51**		**33.00R51**		**37.00R57**	
Machine Clearance Turning Circle	30.6 m	**100'5"**	33.2 m	**108'11"**	30.23 m	**99'2"**
Fuel Tank Refill Capacity	1893 L	**500 U.S. gal**	1893 L	**500 U.S. gal**	2082 L	**550 U.S. gal**
Top Speed (Loaded)	56.5 km/h	**35.1 mph**	56.5 km/h	**35.1 mph**	57.2 km/h	**35.5 mph**
GENERAL DIMENSIONS (Empty):						
Height to Canopy Rock Guard Rail	5.77 m	**19'0"**	5.68 m	**18'7"**	6.50 m	**21'4"**
Wheelbase	5.18 m	**17'0"**	5.18 m	**17'0"**	5.70 m	**18'8"**
Overall Length (Base Body)	11.02 m	**36'3"**	11.55 m	**37'9"**	12.72 m	**41'9"**
Loading Height (Base Body)	4.97 m	**16'4"**	4.97 m	**16'4"**	5.60 m	**18'4"**
Height at Full Dump	11.21 m	**36'10"**	11.81 m	**38'9"**	13.20 m	**43'4"**
Body Length (Target Length)	7.65 m	**25'2"**	7.65 m	**25'2"**	8.29 m	**27'3"**
Width (Operating)	6.64 m	**21'10"**	7.06 m	**23'2"**	7.65 m	**25'1"**
Width (Shipping)****	3.91 m	**12'10"**	3.91 m	**12'10"**	3.84 m	**12'7"**
Front Tire Tread	4.85 m	**15'11"**	4.85 m	**15'11"**	5.37 m	**17'8"**

*See Weight Definitions and Relations on page 18 of this section. Note: No mandatory or optional attachments or fuel.
**Typical selection of mandatory and optional attachments.
***Data provided is for a representative body and liner package. Several dual slope, flat floor, and mine specific design (MSD) bodies and liner packages are available. All weights, capacities, and dimensions are dependent on the machine configuration (body type, attachments, tires, and optional equipment selected).
****Disassembled.
§Reference Caterpillar's latest 10/10/20 Payload Policy for information on gross machine operating weight and target payload.
NOTE: Contact Mining Representative to use Caterpillar Weight Configurator for application specific weights.

USE OF BRAKE PERFORMANCE CURVES

The speed that can be maintained when the machine is descending a grade with retarder applied can be determined from the retarder curves in this section when gross machine weight and total effective grade are known.

Select appropriate grade distance chart that covers total downhill haul; don't break haul into individual segments.

To determine brake performance: Read from gross weight down to the percent effective grade. (Effective grade equals actual % grade *minus* 1% for each 10 kg/metric ton (20 lb/U.S. ton) of rolling resistance.) From this weight-effective grade point, read horizontally to the curve with the highest obtainable speed range, then down to maximum descent speed brakes can safely handle without exceeding cooling capacity. When braking, engine RPM should be maintained at the highest possible level without overspeeding. If cooling oil overheats, reduce ground speed to allow transmission to shift to next lower speed range.

Brake Performance Curves are made in compliance with ISO 10268 and applicable to Sea Level and 32° C (90° F) temperature. Contact Factory for Application Specific Performance.

USE OF RIMPULL-SPEED-GRADEABILITY CURVES

For best results, use Caterpillar Fleet Production and Cost Analysis (FPC) to simulate cycle time, fuel burn, and production for Application Specific Performance inquiries. Contact Factory Representative or visit catminer.cat.com/stb for more information.

(See Wheel Tractor Scraper Section)

Total Effective Grade (or Total Resistance) is grade assistance *minus* rolling resistance.

10 kg/metric ton (20 lb/U.S. ton) = 1% adverse grade.

Example —

With a favorable grade of 20% and rolling resistance of 50 kg/metric ton (100 lb/U.S. ton), find Total Effective Grade.

(50 kg/metric ton) = 50 ÷ 10 = 5% Effective Grade
(from Rolling Resistance)
100 lb/ton = 100 ÷ 20 = 5% Effective Grade
20% (grade) – 5% (resistance) =
15% Total Effective Grade

TYPICAL FIXED TIMES FOR HAULING UNITS

Wait time, delays and operator efficiency all impact cycle time. Minimizing truck exchange time can have a significant effect on productivity.

Fixed time for hauling units include:
1. Truck load time (various with loading tool)
2. Truck maneuver in load area (Truck exchange) (Typically 0.6-0.8 min.)
3. Maneuver and dump time at dump point (Typically 1.0-1.2 min.)

Total cycle time is the combination of:
1. The above fixed time
2. Hauling time (Loaded)
3. Return time (Empty)

Example — assume load tool spots hauler with full bucket

		988F	5130B
cycle times		.60	.45
First pass	(dump time)	.10 min.	.05 min.
2 passes	(full cycle)	.70	.50
3 passes	"	1.30	.95
4 passes	"	1.90	1.40
5 passes	"	2.50	1.85
6 passes	"	3.10	2.30
7 passes	"	3.70	2.75
8 passes	"	4.30	3.20
9 passes	"	4.90	3.65
10 passes	"	5.40	4.10

NOTE: Other sizes of loading tools will have different cycle times. See Wheel Loader section for **average** cycle times for truck loading.

MOTOR GRADERS

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INDUSTRIES SERVED

The motor grader is one of the most versatile work tools in the Cat® product line. The M Series machines are used in numerous applications within a wide range of industries. The major industries using Cat motor graders, along with the typical applications within each, are summarized below.

- **Heavy Construction**
  - Highway Construction
  - Paving/Resurfacing
  - Airport Construction
  - Railroad Construction
  - Dam and Levee Construction
  - Haul Road Maintenance
- **Governmental**
  - Road Maintenance
  - Road Construction
  - Ditch Building/Cleaning
  - Snow Removal
- **Building Construction**
  - Residential Construction
  - Commercial Construction
  - Industrial Construction
  - Sewer and Water Systems
- **Industrial**
  - Waste Disposal
  - Pipeline Construction
- **Mining**
  - Haul Road Maintenance
  - Snow Removal
- **Forestry**
  - Access Road Construction
  - Forest Development
  - Snow Removal
  - Haul Road Maintenance
- **Geographic Versions —** Cat motor graders were specifically designed to meet the needs of different geographic regions and regulations. K/K2 Series for less regulated locations and M/M2/M3 Series are available with an assortment of standard features and optional equipment. All motor graders feature advanced electronically controlled Cat engines, power train components, hydraulics and machine structures.

FEATURES, M Series Motor Graders:

Building on the strong heritage of the H Series, the M Series delivers multiple technological breakthroughs, setting the new standard for motor graders. The H Series has been the industry standard in a variety of heavy construction, mining, road building and governmental applications. The M Series continues this tradition, incorporating revolutionary, customer-driven enhancements by:

- Improving ease of operation and operation training time
- Offering best-in-class operator station and unmatched visibility
- Delivering maximum productivity
- Improving availability and decreasing maintenance time

The M Series line includes eleven models: 120, 120 AWD, 140, 140 AWD, 160, 160 AWD, 12, 12 AWD, 14, 16, 24. The 120 through 14 meet construction, road building, and governmental applications. The All Wheel Drive models improve traction in poor underfoot conditions such as snow, mud, and sand. The 16 and 24 meet the specialized needs of large mining customers.

- **Operation Station:** The 120 through 16 models feature a revolutionary cab design that provides unmatched comfort, visibility, storage and ease of use, which can enhance operator confidence and productivity. The interior noise level is maintained between 70 and 74 dB(A) with the doors and windows closed.

  Ease of Operation. The revolutionary joystick controls and exceptional visibility make operating easier without sacrificing control. The intuitive joystick control pattern allows both new and experienced operators to become productive quickly. Logical grouping of hydraulic functions in the joysticks allow any operator to easily control several functions at the same time. This allows the operator to be more productive and remain comfortable throughout the work shift.

  Advanced Joystick Controls. Two electro-hydraulic joysticks reduce hand and wrist movement as much as 78% compared to conventional lever controls for greatly enhanced operator efficiency. The intuitive pattern is easy to learn and provides the precise implement control to allow both new and experienced operators to become productive quickly. Logical grouping of hydraulic functions in the joysticks allow any operator to control several functions at the same time for more productivity.

  Visibility. The 120 through 16 models boast excellent visibility to the work area, made possible with angled cab doors, a tapered engine enclosure and a patented sloped rear window. Ample glass area and carefully placed components provide excellent visibility to enhance operator confidence and productivity in all motor grader applications. The cab design gives the operator an exceptional view forward to the blade, working surface and front tires. The black glare-reducing paint on the front frame and engine enclosure enhances visibility.

- **Drawbar, Circle and Moldboard:** The 120 through 16 models provide a broad range of extended blade positions particularly beneficial in mid-range bank sloping, ditch cutting and ditch cleaning. A long wheel base allows for an aggressive blade angle permitting material to roll more freely, reducing power requirements. Top-accessible drawbar wear inserts and the shimless moldboard retention system make DCM adjustments fast and simple, delivering more precise material control while lowering operating costs.

  Top-Adjust Drawbar Wear Strips. The patented top-adjust wear strips dramatically reduce drawbar/circle adjustment time. By removing the access plates on top of the drawbar, shims and wear strips can easily be added or replaced. This feature reduces service downtime and lowers overall machine operating costs.

  Shimless Moldboard Retention System. The unique shimless moldboard retention system reduces the potential for blade chatter. Adjusting screws keep the moldboard's wear strips aligned for precise blade control and dramatic reductions in service time.

- **Power Train:** Integrated, electronically controlled systems, deliver smooth reliable performance with reduced operating costs.

  Smooth Shifting Transmission. The transmission design combines several key innovations to ensure smooth, powerful shifts throughout the gear range.

  Advanced Productivity Electronics Control Strategy (APECS). APECS utilizes an electronic control strategy to read the input from sensors to shift the transmission at the optimal point. Event based shifting allows operators to experience faster, smoother and more consistent shifts. Note: M Series 3 Only.

  Electronically Controlled Shifting. The full Electronic Clutch Pressure Control (ECPC) system optimizes inching modulation and smoothes shifting between all gears and directional changes. This provides outstanding control and also extends the life of the transmission by reducing stress on gears.

  Load Compensation. This standard feature ensures consistent shift quality regardless of blade or machine load.

  Hydraulic Brakes. The oil bathed, multi-disc service brakes are hydraulically actuated, providing smooth predictable braking and lower operating costs. With brakes located at each tandem wheel, the Cat motor graders offer the largest total brake surface area in the industry, delivering dependable stopping power and longer brake life.

- **Engine:** The Cat motor grader combines power management with ACERT™ Technology to deliver maximum power and efficiency while reducing the environmental impact.

  ACERT Technology. ACERT Technology allows Cat engines to supply more power per unit of displacement without causing premature wear. This breakthrough technology reduces emissions during the combustion process by using advanced technology in the air and fuel systems, in conjunction with integrated electronics. ACERT Technology enhances overall engine performance while dramatically reducing exhaust emissions.

  Power Management. Power Management utilizes Variable Horse Power (VHP) and Variable Horse Power Plus (VHP Plus) to optimize motor grader performance. VHP delivers additional power in the working gear while balancing fuel consumption, traction and horsepower. VHP Plus, delivers additional power in each forward gear 5th through 8th for increased speed on grade and performance.

  Exhaust Emission Standards. The Cat ACERT Technology engines in the M Series Motor Graders meet U.S. EPA Tier 3/EU Stage IIIA equivalent/Japan 2006 (Tier 3) emission standards. The M Series 2 machines meet U.S. EPA Tier 4 Interim/EU Stage IIIB/Japan 2011 (Tier 4 Interim) equivalent emission standards. The M Series 3 machines meet U.S. EPA Tier 4 Final/EU Stage IV/Japan 2014 (Tier 4 Final) emission standards.

- **Hydraulics:** Electro-hydraulics enable advanced machine controls with precise and predictable movements.

  Advanced Electro-Hydraulic System. The Cat motor grader product line incorporates a state-of-the-art electro-hydraulic system. This technology is the foundation for revolutionary changes of the machine and implement controls. Advanced joystick controls provide unmatched controllability with precise, predictable hydraulic movements and the reliability you expect from Cat products.

  Load Sensing Hydraulics (PPPC). The time proven load-sensing system and the advanced Proportional Priority Pressure-Compensating (PPPC, or "triple-PC") electro-hydraulic valves are designed to provide superior implement control and enhanced machine performance in all applications. Continuous matching of hydraulic flow and pressure to power demands creates less heat and reduces power consumption.

- **Serviceability:**

  Grouped Service Points. Grouped daily service points in the left side service center help ensure proper maintenance and inspection routines.

  Extended Service Intervals. Extended service intervals, such as 500-hour engine oil changes and 4000-hour hydraulic oil changes, reduce machine service time and increase availability.

  Ecology Drains. Conveniently located ecology drains shorten service times and help keep the environment safe by preventing spills.

  Diagnostics and Monitoring. Cat Messenger and Cat Message are offered as standard equipment to enhance diagnostic capabilities by displaying machine system errors and fault codes. Cat Electronic Technician is a two way communication tool that provides easy access to stored diagnostic data and lets technicians configure machine parameters through the Cat Data Link. Product Link™ provides a communication flow of vital machine data and location. Cat motor graders integrate Cat Messenger, Cat Electronic Technician, and S•O•S℠ analysis for easy monitoring and fast troubleshooting, keeping your machine up and running. Note: Cat Messenger is standard on M Series and M Series 2 only. Cat Message is standard on M Series 3 only.

- **Safety.** Safety is an integral part of all machine and system designs. Cat motor graders provide a safe working environment for both the operator and ground personnel. ROPS and FOPS structures meeting current SAE and ISO requirements are standard on all Global machines. Back-up alarms are a standard feature.

  Operator Presence System. The Operator Presence System keeps the parking brake engaged until the operator is seated for safe operation.

  Secondary Steering System. The standard secondary steering system automatically engages in case of a drop in steering pressure, allowing the operator to steer the machine to a stop.

  Speed Sensitive Steering. The steering software automatically provides an infinitely variable ratio between the joystick and the steer tires, resulting in less sensitive steering as the groundspeed increases.

  Hydraulic Lockout. A simple switch located in the cab disables all implement functions while still providing machine steering control. This safety feature is especially useful while the machine is roading.

  Circle Drive Slip Clutch. This standard feature protects the drawbar, circle and moldboard from shock loads when the end of the blade encounters immovable objects. It also reduces the possibility of abrupt directional changes in poor traction conditions, protecting the machine, operator and surroundings.

  Blade Lift Accumulators. This optional feature uses accumulators to help absorb impact loads to the moldboard by allowing vertical blade travel. Blade lift accumulators reduce unnecessary wear and help to avoid unintended machine movement for increased operator safety.

  Drop-Down Rear Lights. Optional drop-down lights fold out from the rear of the machine. This creates a wider, lower profile, to be better aligned with passenger cars.

  Rearview Camera. Visibility is further enhanced with an optional Work Area Vision System (WAVS) LCD color monitor in the cab.

- **Automatic Differential Lock/Unlock.** The Auto Diff-Lock feature automatically unlocks the differential during a turn, re-locks when straight, for easier operation and improved power train protection.

- **Swing Out Cooling Fan.** This standard feature allows for easy access to the cooling cores reducing time required for clean out. The latched door requires no tools for opening and closing. Note: M Series 2 and M Series 3 Only.

APPLICATIONS, Motor Graders:

The broad line of Cat motor graders allows the customer to choose a motor grader that best fits the intended application. Below is a summary of the typical motor grader applications.

Finish Grading

This application involves preparing a roadway or site surface for future paving or other construction activity. The material being moved is usually a hard, dry base material on a solid underfoot. Finish blading is the motor grader application that requires the highest degree of accuracy. Thus, it is primarily done at low operating speeds — usually less than 5 km/h (3 mph) — in gears 1 and 2. To ensure a smooth, even finished surface, one gear is usually maintained for a given pass. Pass lengths during this application are usually less than 600 m (2000 feet) for road construction and 150 m (500 feet) for site development. Most finish blading is performed by contractors in the Heavy Construction and Building Construction industries.

Heavy Blading

This application involves cutting, moving, and mixing material, usually in the initial stages of surface preparation. A variety of material types are moved in this manner, and the blade tip position varies accordingly. Full blade loads are usually experienced during heavy blading, since moving material is the primary goal. Pass lengths within this application vary, but are usually less than 600 m (2000 feet). Unlike finish blading, the speed of the machine is dependent on the load being moved when heavy blading material. Typical operating speeds are from 0-10 km/h (0 to 6 mph). Therefore, gears 2 through 4 are frequently used in this application. Most heavy blading activity is performed by contractors in the Heavy Construction, Governmental, Industrial, and Forestry industries.

Site Preparation

This application involves any material cutting, moving, and mixing necessary to prepare a residential, commercial, or industrial site for construction. A variety of materials are encountered in this application. Blade loads vary depending on the activity being performed. Both heavy blading and finish blading are performed when preparing a site. Pass lengths are typically in the range of 30-300 m (100 to 1000 feet). Typical operating speeds for site preparation vary depending on whether heavy blading or finish blading activities are being performed. Most site preparation activities are performed by contractors in the Building Construction industry.

Road Maintenance

This application involves reshaping dirt or gravel roads to maintain a crown or superelevation, or restoring the surface itself. This generally involves secondary roads maintained by governmental bodies such as townships and counties. Materials being moved in this application vary from extremely hard dirt bases to moist gravel surfaces. The typical blade load falls between that of finish blading and heavy blading. Pass lengths are frequently longer than 600 m (2000 feet) and can extend for miles. The general speed range for this application is 5-16 km/h (3 to 10 mph), corresponding to gears 2 (heavy dirt) through 5 (soft gravel). As with finish blading, accuracy of the graded surface is the primary concern in this application. Thus, frequent shifts should be avoided whenever possible. A gear should be chosen and maintained unless there is a significant change in the material being moved. Most road maintenance activities are performed by the Governmental industry.

Haul Road Maintenance

This application of the motor grader involves reshaping haul roads at mining, construction, or forestry work sites, usually for the purpose of maintaining smooth travel surfaces for equipment. Materials being moved while maintaining haul roads vary widely. Typical blade loads are about one-third to half of full capacity. Haul roads that experience large hauling units travelling on soft material may require heavy blade loads in order to reshape the road surface. Pass lengths vary depending on the application but can extend for miles on remote forestry or large mine haul roads. The general speed range for haul road maintenance is heavily dependent on the material being moved as well as the grade of the haul road. Many mine sites are in mountainous areas, requiring haul roads with steep grades. Generally, haul-road maintenance is performed at speeds similar to those required for general road maintenance 5-16 km/h (3 to 10 mph).

A travel surface that allows for the safe and efficient movement of machinery is the ultimate goal with this motor grader application. Very precise roadway elevations and slopes are desired but less crucial than when finish blading. Most haul road maintenance activities are performed by the Mining, Heavy Construction, and Forestry industries.

Side/Bank Slope Work

This application involves preparing side slopes or bank slopes along roadways by placing the moldboard on a sloped surface. Slopes of up to a 2:1 angle can be cut using a motor grader. Often the motor grader is operated on the level surface adjacent to the slope, and the moldboard is extended outward to the sloped surface. Fine soils are generally encountered in this application of the motor grader. Blade loads are usually less than half of the full blade capacity, and pass lengths are seldom longer than 600 m (2000 feet). A smooth-graded sloped surface is the primary concern in this application so frequent shifts should be avoided. The typical speed range is 0-6 km/h (0 to 4 mph), corresponding to a gear selection of 1 to 3. The nominal speed is heavily dependent on the type of material being moved and on the slope of the surface. Most side/bank slope work is performed by the Heavy Construction and Governmental industries.

Ditch Building/Cleaning

This application involves cutting "V" and flat-bottom ditches for drainage purposes and rebuilding them when necessary. Due to excessive rain and/or poor material, ditches often need cleaning and reshaping. When building ditches, materials with a wide range of densities are encountered. Blade loads vary accordingly, from half to full-blade capacity. Pass lengths are usually less than 600 m (2000 feet). The primary objective is to move material in a manner that yields a ditch with the desired slope. Ditch building often involves cutting and moving material of high density. Therefore, typical speed ranges vary. Most ditch building work, however, is performed in gears 1 through 3, corresponding to a maximum speed of about 8 km/h (5 mph). Ditch cleaning usually involves blading moist materials underneath a sod cover. Blade loads are usually less than half of full blade capacity when cleaning ditches, and pass lengths are similar to those encountered in ditch building. Typical maximum speeds for this activity are similar to that of ditch building, but less of a blade load is experienced. Ditch building and cleaning activities are usually performed by the Heavy Construction and Governmental industries.

Ripping/Scarifying

This application involves conditioning hard, rough soils before they are bladed. Shanks on the ripper and/or scarifier are pushed into the ground, thus breaking up otherwise hard surfaces. Hard materials such as asphalt can also be loosened in order to make grading operations less damaging to the moldboard. Rippers and scarifiers can also be used to mix aggregates together. The materials being ripped/ scarified are usually hard and dry. Rippers generally penetrate 150-300 mm (6 to 12 inches) into the ground, while scarifiers typically penetrate to a depth of 25-200 mm (1 to 8 inches). Pass lengths are generally less than 600 m (2000 feet) for both activities. Since the material being ripped/scarified is generally hard, the typical maximum speed for this application is about 6 km/h (4 mph) gears 1-2. If the ripper/scarifier is used for mixing aggregates, the typical operating range becomes 6-20 km/h (4 to 12 mph) gears 3-6. Most ripping/scarifying activities are performed by the Heavy Construction and Governmental industries.

Snow Removal

Snow removal is the process of cutting and removing snow or ice from the roadway. In addition to the standard motor grader moldboard, other attachments such as a snow wing, V-plow, one-way plow, or reversible plow can be used to remove the snow. The moldboard itself is the most commonly used attachment for snow plowing. It is used in areas where snow depths are low, the terrain is relatively flat, and where excessive drifting does not occur. A snow wing is a moldboard that attaches to the machine's right side. The wing's curvature lifts the snow and "wings" it off the plowed surface. The snow wing is often used in conjunction with the standard moldboard, where the moldboard cuts the material and feeds it onto the wing. V-plows are mounted in front of the motor grader and are designed to dig into and lift packed snow. The typical speed range for snow removal is 10-30 km/h (6 to 18 mph), corresponding to a gear range of 3 to 7. Snow plowing often involves lower speeds than snow removal. The typical operating range for snow plowing is 8-19 km/h (5 to 12 mph) gears 2 to 4. The majority of Snow Removal/Plowing operations are performed by the Governmental, Mining, and Forestry industries.

TRUCK TO MOTOR GRADER MATCH

	740	770	775	777	785	789	793	797
12/140/160								
14								
16								
18								
24								

NOTE: Calculations based on 30 degree blade angle, standard moldboard width.
May not be applicable in all applications depending on haul road damage.
Rule of thumb 2.5 times the truck width.

MODEL	14M3		16M3	
Base Power — Net	178 kW	**238 hp**	216 kW	**290 hp**
VHP Range — Net	178-213 kW	**238-285 hp**	216-259 kW	**290-348 hp**
VHP Plus Range — Net	180-215 kW	**241-289 hp**	—	
Operating Weight*	25 968 kg	**57,250 lb**	32 411 kg	**71,454 lb**
Engine Model	**C13 ACERT**		**C13 ACERT**	
Rated Engine RPM	**1850**		**2000**	
No. of Cylinders	**6**		**6**	
Displacement	12.5 L	**763 in³**	12.5 L	**763 in³**
Max. Torque:				
Tier 4 Final[1]	1542 N·m	**1137 lb-ft**	1771 N·m	**1306 lb-ft**
Tier 2 and Tier 3 Equivalent[2]	1542 N·m	**1137 lb-ft**	1721 N·m	**1270 lb-ft**
No. of Speeds Forward/Reverse	**8/6**		**8/6**	
Top Speed: Forward	50.5 km/h	**31.4 mph**	51.7 km/h	**32.1 mph**
Reverse	39.9 km/h	**24.8 mph**	40.8 km/h	**25.3 mph**
Std. Tires — Front and Rear	**20.5R25**		**23.5R25**	
Front Axle/Steering:				
Oscillation Angle	**32°**		**35°**	
Wheel Lean Angle — Left/Right	**17.1°/17.1°**		**18°/17°**	
Steering Angle	**50°**		**47.5°**	
Articulation Angle	**20°**		**20°**	
Minimum Turning Radius**	7.9 m	**25'11"**	9.3 m	**30'6"**
No. Circle Support Shoes	**6**		**6**	
Hydraulics:				
Pump Type	**Variable Piston**		**Variable Piston**	
Max. Pump Flow	257 L/min	**68 gpm**	280 L/min	**74 gpm**
Tank Capacity	64 L	**16.9 U.S. gal**	70 L	**18.5 U.S. gal**
Implement Pressure: Max.	24 100 kPa	**3495 psi**	24 750 kPa	**3590 psi**
Min.	3400 kPa	**493 psi**	3400 kPa	**493 psi**
Interior Sound Level/SAE J919:				
Tier 4 Final/EU Certified[1]	**73 dB(A)**		**71 dB(A)**	
Tier 2 and Tier 3 Equivalent[2]	**73 dB(A)**		**72 dB(A)**	
Electrical:				
System Size	**24V**		**24V**	
Std. Battery CCA @ 0° F	**1125**		**1400**	
Std. Alternator	**150**		**150**	
GENERAL DIMENSIONS:				
Height (to top of ROPS)	3566 mm	**140.4"**	3719 mm	**146.4"**
Overall Length	9677 mm	**381"**	10 593 mm	**417"**
With Ripper and Pushplate	10 899 mm	**429.1"**	12 051 mm	**474.4"**
Wheelbase	6616 mm	**260.5"**	7365 mm	**290"**
Blade Base	2880 mm	**113.4"**	3066 mm	**120.7"**
Overall Width (at top of front tires)	3050 mm	**120.1"**	3411 mm	**134.3"**
Standard Blade: Length	4267 mm	**14'0"**	4877 mm	**16'0"**
Height	585 mm	**23.0"**	787 mm	**31.0"**
Thickness	25.4 mm	**1.0"**	25 mm	**1.0"**
Lift Above Ground	438 mm	**17.2"**	400 mm	**15.7"**
Max. Shoulder Reach:***				
Frame Straight — Left	3460 mm	**136.2"**	2311 mm	**91"**
Frame Straight — Right	3350 mm	**131.9"**	2311 mm	**91"**
Fuel Tank Capacity	416 L	**109.9 U.S. gal**	496 L	**131 U.S. gal**

***Operating Weight** — based on standard machine configuration with full fuel tank, coolant, lubricants and operator.
****Minimum Turning Radius** — combining the use of articulated frame steering, front wheel steer and unlocked differential.
***Applicable for the standard blade with hydraulic sideshift and tip control. Maximum shoulder reach is obtainable to the right.
[1] Meets Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) emission standards.
[2] Meets Tier 2/Stage II/Japan 2001 (Tier 2) equivalent and Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.

TRAVEL SPEEDS @ MAXIMUM RPM WITH STD. TIRES (M/M2/M3 SERIES)

Gear		1		2		3		4		5		6		7		8	
		km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph
120M	Forward	4.1	**2.6**	5.6	**3.5**	8.2	**5.1**	11.2	**7.0**	17.5	**10.8**	23.7	**14.8**	32.7	**20.3**	47.5	**29.5**
	Reverse	3.3	**2.0**	6.1	**3.8**	8.9	**5.5**	13.8	**8.6**	25.8	**16.0**	37.5	**23.3**	—	—	—	—
120M2	Forward	4.0	**2.5**	5.4	**3.4**	7.8	**4.8**	10.8	**6.7**	16.8	**10.4**	22.8	**14.2**	31.4	**19.5**	45.7	**28.4**
	Reverse	3.1	**1.9**	5.9	**3.9**	8.5	**5.3**	13.2	**8.2**	24.8	**15.4**	36.1	**22.4**	—	—	—	—
12M	Forward	4.0	**2.5**	5.5	**3.4**	8.0	**5.0**	11.0	**6.8**	17.1	**10.6**	23.3	**14.5**	32.0	**19.9**	46.6	**29.0**
	Reverse	3.2	**2.0**	6.0	**3.7**	8.7	**5.4**	13.5	**8.4**	25.3	**15.7**	36.8	**22.9**	—	—	—	—
12M2	Forward	4.1	**2.5**	5.5	**3.4**	8.0	**5.0**	11.0	**6.9**	17.1	**10.6**	23.3	**14.5**	32.0	**19.9**	46.6	**29.0**
	Reverse	3.2	**2.0**	6.0	**3.7**	8.7	**5.4**	13.5	**8.4**	25.3	**15.7**	36.8	**22.9**	—	—	—	—
12M3	Forward	4.1	**2.5**	5.5	**3.4**	8.0	**5.0**	11.0	**6.9**	17.1	**10.6**	23.3	**14.5**	32.0	**19.9**	46.6	**29.0**
	Reverse	3.2	**2.0**	6.0	**3.7**	8.7	**5.4**	13.5	**8.4**	25.3	**15.7**	36.8	**23.0**	—	—	—	—
140M	Forward	4.0	**2.5**	5.5	**3.4**	8.0	**5.0**	11.0	**6.9**	17.1	**10.6**	23.3	**14.5**	32.0	**19.9**	46.6	**29.0**
	Reverse	3.2	**2.0**	6.0	**3.7**	8.7	**5.4**	13.5	**8.4**	25.3	**15.7**	36.8	**22.9**	—	—	—	—
140M2	Forward	4.1	**2.5**	5.5	**3.4**	8.0	**5.0**	11.0	**6.9**	17.1	**10.6**	23.3	**14.5**	32.0	**19.9**	46.6	**29.0**
	Reverse	3.2	**2.0**	6.0	**3.7**	8.7	**5.4**	13.5	**8.4**	25.3	**15.7**	36.8	**22.9**	—	—	—	—
140M3	Forward	4.1	**2.5**	5.5	**3.4**	8.0	**5.0**	11.0	**6.9**	17.1	**10.6**	23.3	**14.5**	32.0	**19.9**	46.6	**29.0**
	Reverse	3.2	**2.0**	6.0	**3.7**	8.7	**5.4**	13.5	**8.4**	25.3	**15.7**	36.8	**23.0**	—	—	—	—
160M	Forward	4.1	**2.5**	5.6	**3.5**	8.1	**5.0**	11.2	**7.0**	17.4	**10.8**	23.7	**14.7**	32.6	**20.3**	47.4	**29.5**
	Reverse	3.3	**2.0**	6.1	**3.8**	8.8	**5.5**	13.7	**8.5**	25.7	**16.0**	37.4	**23.3**	—	—	—	—
160M2	Forward	4.1	**2.6**	5.6	**3.5**	8.1	**5.1**	11.2	**7.0**	17.4	**10.8**	23.7	**14.7**	32.6	**20.3**	47.4	**29.5**
	Reverse	3.3	**2.0**	6.1	**3.8**	8.9	**5.5**	13.7	**8.5**	25.7	**16.0**	37.4	**23.3**	—	—	—	—
160M3	Forward	4.1	**2.6**	5.6	**3.5**	8.1	**5.1**	11.2	**7.0**	17.4	**10.8**	23.7	**14.7**	32.6	**20.3**	47.4	**29.5**
	Reverse	3.3	**2.0**	6.1	**3.8**	8.8	**5.5**	13.7	**8.5**	25.7	**16.0**	37.4	**23.3**	—	—	—	—
14M3	Forward	4.4	**2.7**	5.9	**3.7**	8.6	**5.3**	11.8	**7.4**	18.4	**11.4**	24.9	**15.5**	34.3	**21.3**	49.9	**31.0**
	Reverse	3.4	**2.1**	6.4	**4.0**	9.4	**5.8**	14.5	**9.0**	27.0	**16.8**	39.4	**24.5**	—	—	—	—
16M3	Forward	4.5	**2.8**	6.1	**3.8**	8.9	**5.5**	12.3	**7.6**	19.0	**11.8**	25.8	**16.0**	35.5	**22.0**	51.7	**32.1**
	Reverse	3.6	**2.2**	6.6	**4.1**	9.7	**6.0**	15.0	**9.3**	28.0	**17.4**	40.8	**25.3**	—	—	—	—
18M3	Forward	4.5	**2.8**	6.1	**3.8**	8.9	**5.5**	12.3	**7.6**	19.0	**11.8**	25.8	**16.0**	35.5	**22.0**	51.7	**32.1**
	Reverse	3.6	**2.2**	6.6	**4.1**	9.7	**6.0**	15.0	**9.3**	28.0	**17.4**	40.8	**25.3**	—	—	—	—
24M	Forward	3.7	**2.3**	5.7	**3.6**	9.7	**6.0**	15.1	**9.4**	28.0	**17.4**	43.4	**27.0**	—	—	—	—
	Reverse	5.5	**3.4**	14.5	**9.0**	41.6	**25.8**	—	—	—	—	—	—	—	—	—	—

NOTE: 120M speeds were calculated with a 628 mm **(24.7")** tire at 2000 rpm rated speed.
120M2 speeds were calculated with a 620 mm **(24.4")** tire at high idle, 2150 rpm.
12M2-160M2 speeds were calculated with a 655 mm **(25.8")** tire at high idle, 2150 rpm.
12M3-160M3 speeds were calculated with a 655 mm **(25.8")** tire at 2000 rpm rated speed.

PRODUCTION

The motor grader is used in a variety of applications in a variety of industries. Therefore, there are many ways to measure its operating capacity, or production. One method expresses a motor grader's production in relation to the area covered by the moldboard.

Formula:

$$A = S \times (L_e - L_o) \times 1000 \times E \quad \text{(Metric)}$$
$$A = S \times (L_e - L_o) \times 5280 \times E \quad \text{(English)}$$

where
- A: Hourly operating area (m^2/h or ft^2/h)
- S: Operating speed (km/h or mph)
- L_e: Effective blade length (m or ft)
- L_o: Width of overlap (m or ft)
- E: Job efficiency

Operating Speeds:

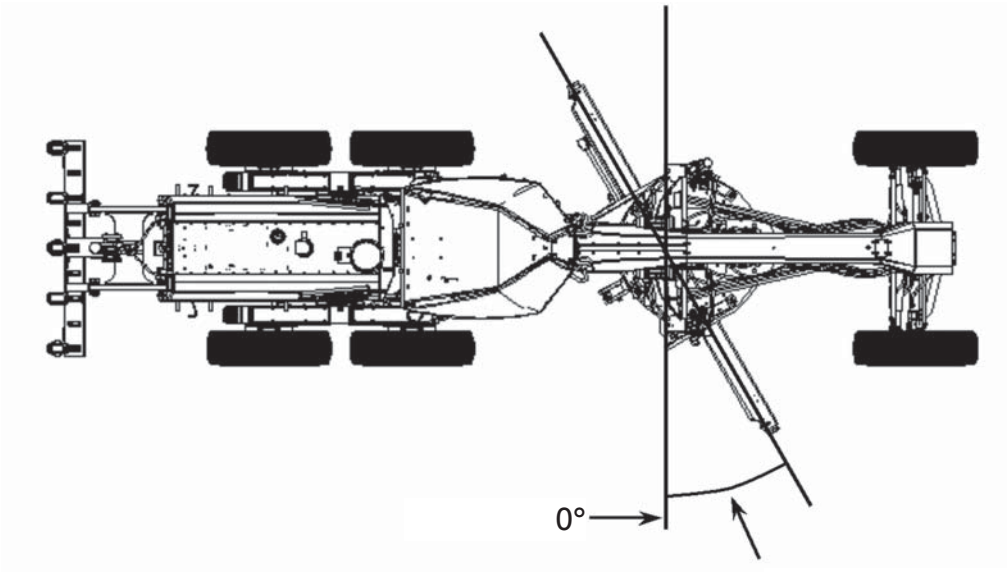
Typical operating speeds by application

Finish Grading:	0-4 km/h	(0-2.5 mph)
Heavy Blading:	0-9 km/h	(0-6 mph)
Ditch Repair:	0-5 km/h	(0-3 mph)
Ripping:	0-5 km/h	(0-3 mph)
Road Maintenance:	5-16 km/h	(3-9.5 mph)
Haul Road Maintenance:	5-16 km/h	(3-9.5 mph)
Snow Plowing:	7-21 km/h	(4-13 mph)
Snow Winging:	15-28 km/h	(9-17 mph)

Effective Blade Length:

Since the moldboard is usually angled when moving material, an effective blade length must be computed to account for this angle. This is the actual width of material swept by the moldboard.

NOTE: Angles are measured as shown below. The effective length becomes shorter as the angle increases.



Moldboard Angle

Moldboard Length, m (ft)	Effective Length, m (ft) 30 degree blade angle	Effective Length, m (ft) 45 degree blade angle
3.658 **(12)**	3.17 **(10.4)**	2.59 **(8.5)**
4.267 **(14)**	3.70 **(12.1)**	3.02 **(9.9)**
4.877 **(16)**	4.22 **(13.9)**	3.45 **(11.3)**
7.315 **(24)**	6.33 **(20.8)**	5.17 **(17.0)**

For other blade lengths and carry angles:
Effective length = COS [Radians (Blade L)] 3 Blade Length

Width of Overlap:

The width of overlap is generally 0.6 m (2.0 ft). This overlap accounts for the need to keep the tires out of the windrow on the return pass.

Job Efficiency:

Job efficiencies vary based on job conditions, operator skill, etc.

A good estimation for efficiency is approximately 0.70 to 0.85, but actual operating conditions should be used to determine the best value.

Example problem:

A Cat motor grader with a 3.66 m (12 ft) moldboard is performing road maintenance on a township road. The machine is working at an average speed of 13 km/h (8 mph) with a moldboard carry angle of 30 degrees. What is the motor grader's production based on coverage area?

Note: Due to the long passes involved in road maintenance — fewer turnarounds — a higher job efficiency of 0.90 is chosen.

Solution:

From the table, the effective blade length is 3.17 m (10.4 ft).

Metric

Production, A = 13 km/h × (3.17 m − 0.6 m) × 1000 × 0.90
= **30 069 m²/hr (3.07 hectares/hr)**

English

Production, A = 8 mph × (10.4 ft − 2.0 ft) × 5280 × 0.90
= **319,334 ft²/hr (7.33 acres/hr)**

To pinpoint the theoretical number of motor graders required to properly maintain your haul roads, based on your specific mining applications, please download the haul road maintenance calculator on *https://catminer.cat.com.*

Haul road maintenance impacts cycle time, tire, frame and drive train components, safety and ultimately your cost per ton. To achieve optimal truck productivity, your haul roads must be properly maintained.

Moderate:
- Road Maintenance
- Pad Cleaning
- Rock Clearing
- Shoulder Sweeping

Difficult:
- Ripping
- Spreading Dump Material
- Road Profiling/Reshaping

BLADE PULL

This specification is also known as drawbar pull. This spec can be calculated as follows:

Variables:

Rear weight of machine = Wr

Tire traction coefficient = T (Look up the table entitled "Coefficient of Traction Factors")

Wr × T = Blade Pull

Example problem:

Calculate the blade pull for a 140M Global Version version machine operating in a quarry pit...

Metric

RW = 10 501 kg

T = 0.65

10 501 × 0.65 = 6825.65

English

RW = 23,151 lb

T = 0.65

23,151 × 0.65 = 15,048.15

BLADE DOWN PRESSURE

This spec can be calculated as follows:

Variables:

Blade to front axle length = BA

Wheel base length = WB

Weight on front wheels = FW

Blade down pressure = BD

$$\frac{\mathbf{WB}}{\mathbf{(WB - BA)}} \times \mathbf{FW = BD}$$

Example problem:

Calculate the blade down pressure for a 140M Global Version version machine...

Metric

BA = 2565 mm FW = 4223 kg

WB = 6086 mm BD = ?

$$\frac{\mathbf{6086}}{\mathbf{(6086 - 2565)}} \times \mathbf{4223 = 7299\ kg}$$

English

BA = 101 in FW = 9310 lb

WB = 240 in BD = ?

$$\frac{\mathbf{240}}{\mathbf{(240 - 101)}} \times \mathbf{9310 = 16{,}075\ lb}$$

This specification is only a minor indicator of a motor grader's productivity. It alone gives no measure of overall machine productivity. When considering motor grader production you need an optimum balance between the machine's front and rear weights. If a machine has too much weight on the front axle, it might have a high blade down pressure spec. It will, however, lack the essential rear weight and traction needed to push through the load. Too much weight in the rear and it will not have the necessary weight in the front during heavy cuts to maintain proper steering control.

Cat machines are built with this optimum balance in mind. A Cat motor grader is engineered with the proper weight distribution necessary for maximum productivity.

Effective Blade Length*

		Moldboard							
		3.66 m (12')		4.27 m (14')		4.88 m (16')		7.32 m (24')	
		m	ft	m	ft	m	ft	m	ft
Angle°	0°	3.66	**12.00**	4.27	**14.00**	4.88	**16.00**	7.32	**24.00**
	5°	3.64	**11.95**	4.25	**13.95**	4.86	**15.94**	7.29	**23.91**
	10°	3.60	**11.82**	4.20	**13.79**	4.80	**15.76**	7.21	**23.64**
	15°	3.53	**11.59**	4.12	**13.52**	4.71	**15.45**	7.07	**23.18**
	20°	3.44	**11.28**	4.01	**13.16**	4.58	**15.04**	6.87	**22.55**
	25°	3.32	**10.88**	3.87	**12.69**	4.42	**14.50**	6.63	**21.75**
	30°	3.17	**10.39**	3.69	**12.12**	4.22	**13.86**	6.33	**20.78**
	35°	3.00	**9.83**	3.50	**11.47**	4.00	**13.11**	5.99	**19.66**
	40°	2.80	**9.19**	3.27	**10.72**	3.74	**12.26**	5.61	**18.39**
	45°	2.59	**8.49**	3.02	**9.90**	3.45	**11.31**	5.17	**16.97**

*Effective blade length is the amount of blade coverage the machine is capable of when the blade is at a given angle.

EXTREME SLOPE OPERATION

There are two ways of defining slope work. The slope perpendicular to the machine's direction of travel is commonly referred to as "Side Sloping." The slope parallel to the machine's direction of travel — the machines ability to travel up or down terrain, is commonly referred to as "Gradeability."

Side Sloping capability for our Cat graders is somewhat subjective, but general agreement among professional operators is that working on a slope ratio of 2.5:1 (21.8 degrees) is the safe limit … an experienced operator may be able to operate on a 2:1 (28 degrees) slope. Many factors influence this limit such as operator experience, machine configuration, tires and soil conditions, but a 2.5:1 is achievable. Further, a 3:1 slope is the approximate maximum side slope a grader can work on in straight frame configuration. The steeper side slopes all require the machine be articulated to safely navigate the slope.

Gradeability is approximately 22 degrees. This is established by the grader's ability to stop without skidding the tires while moving downhill. The motor grader can, however, *climb* grades steeper than 22 degrees. The traction coefficient is the critical factor in determining whether a grader can safely navigate the slope. Caterpillar recommends that you never climb a slope steeper than you can safely descend.

Maximum lubrication angle: We have measured the graders on a tilt table and pump cavitation occurs around 30 degrees (58% or 1.7:1). This is beyond the grade or slope a motor grader can operate on.

When working side hills and slopes, consideration should be given to the following important points.

- **Speed of Travel —** At higher speeds, inertia forces tend to make the grader less stable.
- **Roughness of Terrain or Surface —** Ample allowance should be made where the terrain or surface is uneven.
- **Mounted Equipment —** Mounted attachments such as front plows, snow wings, rippers and other mounted equipment cause the tractor to balance differently.
- **Nature of Surface —** New earthen fills may give way with the weight of the grader. Rocky surfaces may promote side slipping of grader.
- **Excessive Loads or Side Draft —** This may cause wheel slippage, where the downhill tires "dig in," increasing the angle of grader.
- **Tire Selection and Maintenance —** Consideration should be given to proper tire selection and air pressure. For more information, consult Caterpillar publications — Motor Grader Tire Selection Guide and Operation and Maintenance Manual.
- **Drawbar, Circle and Blade Position —** The position of the blade can affect the stability of the machine.
- **Articulation Angle —** Articulation angle can affect the stability of the machine.
- **Wheel Lean Angle —** Wheel lean angle can affect the stability of the machine.

NOTE: Safe operation on steep slopes may require special machine maintenance as well as excellent operator skill and proper equipment setup for the specific application. Consult Caterpillar publications for further operating tips — Operation & Maintenance Manual, Motor Grader Application Guide, and the Grade Comparison Chart in the Tables section of this Performance Handbook.

Work Tool	120M/ 120M2	12M/ 12M2/ 12M3	140M/ 140M2/ 140M3	160M/ 160M2/ 160M3	16M3/ 18M3	14M3	24M
Lift Group	x	x	x	x	x	x	—
V-Plow	x	x	x	x	—	x	—
One Way Plow	x	x	x	x	—	x	—
Manual Reversible Plow	—	—	—	—	—	x	—
Hydraulic Reversible Plow	x	x	x	x	—	x	—
Snow Wing	x	x	x	x	—	x	—
Mid Mount Scarifier	x	x	x	—	—	—	—
Front Scarifier	x	x	x	x	—	x	—
Manual Angle Blade	x	x	x	x	—	x	—
Hydraulic Angle Blade	x	x	x	x	—	x	—
Straight Blade	x	x	x	x	x	x	—

This list is not all-inclusive.

See Price Lists, Cat Work Tools (Cat WT) Price List, and your Cat dealer for special attachment needs.

Attachments for Cat motor graders require additional hydraulics.

Most front-mounted attachments require a Quick Attach-Detach Parallel Lift Group.

TRACK LOADERS

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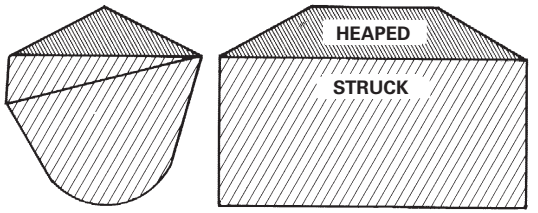
Features common to all D Series models (953D-963D-973D):

- **Improved serviceability.** All D Series Track-Type Loaders are equipped with a tiltable cab that allows complete service of the hydraulic system. Most daily maintenance checks are performed from the machine's right side, facilitating quick start up. Easy access to major components enhances serviceability and increase uptime.
- **Operator station.** Experience a high level of efficiency, comfort and productivity with the new D Series cab. The cab features a new gauge cluster, a fully air-suspension seat, the new seat mounted controls, an automatic air climate control and provides excellent visibility.
- **Messenger.** Messenger is a new electronic monitoring system with real time, visual feedback on engine and machine operating conditions. It provides information on diagnostic data, maintenance, and allows operating settings such as implement reactions.
- **Hydrostatic drive.** The closed loop hydrostatic drive with electronic control provides precise modulation for quick, smooth operation and superior maneuverability. Shorter cycle times, high efficiency, and excellent maneuverability results in increased productivity.

SAE BUCKET RATING



SAE Bucket Capacities

Struck capacity is that volume contained in a bucket after a load is leveled by drawing a straight edge resting on the cutting edge and the back of the bucket.

Heaped capacity is a struck capacity *plus* that additional material that would heap on the struck load at a 2:1 angle of repose with the struck line parallel to the ground.

SAE J742 (Oct. 79) specifies that the addition of any auxiliary spill guard to protect against spillage of material which might injure the operator will not be included in bucket capacity ratings. Buckets with irregular shaped cutting edges (vee edge) the strike plane should be drawn at one-third the distance of the protruding portion of the cutting edge. Cat rock buckets are built with integral see-through rock guards. Cat light material buckets come standard with bolt-on edges. These features which add to actual bucket capacity are included in published ratings.

Dump Height

SAE J732 JUN92 specifies that dump height is the vertical distance from the ground to the lowest point of the cutting edge with the bucket hinge pin at maximum height and the bucket at a 45° dump angle. Dump angle is the angle in degrees that the longest flat section of the inside bottom of the bucket will rotate below horizontal.

Static Tipping Load

The minimum weight at center of gravity of "SAE Rated" load in bucket which will rotate rear of machine to a point where, on track loaders, front rollers are clear of the track under the following conditions:

a. Loader on hard level surface and stationary.
b. Unit at standard operating weight.
c. Bucket at maximum rollback position.
d. Load at maximum forward position during raising cycle.
e. Unit with standard equipment as described in specifications unless otherwise noted under the heading.

Operating Load

In order to comply with SAE standard J818 MAY87, the operating load for track loaders should not exceed 35% of the Static Tipping load rating. See "Performance Data" of each machine in this handbook for increases to static tipping load by adding cab, counterweights, ripper-scarifier, etc.

SELECTING A MACHINE

Steps in selecting the proper size loader:

1. Determine production required or desired.
2. Determine loader cycle time and cycles per hour. A machine size must be assumed to select a basic cycle time.
3. Determine required payload per cycle in loose cubic yards and pounds (meters and kilograms).
4. Determine bucket size needed.
5. Make machine selection using bucket size and payload as criteria to meet production requirements.
6. Compare the loader cycle time used in calculations to the cycle time of the machine selected. If there is a difference, rework the process beginning at step 2.

1. Production Required

The production required of a track loader should be slightly greater than the production capability of the other critical units in the earth or material moving system. For example, if a hopper can handle 300 tons per hour, a loader capable of slightly more than 300 tons should be used. Required production should be carefully calculated so the proper machine and bucket selections are made.

2. Loader Cycle Times

Material type, pile height, and other factors may improve or reduce production, and should be added to or subtracted from the basic cycle time when applicable.

When hauls are involved, obtain haul and return portions of the cycle from the estimated travel chart (this section). Add the haul and return times to the estimated basic cycle time to obtain total cycle time.

CYCLE TIME FACTORS

A basic cycle time (Load, Dump, Maneuver) of 0.25-0.35 minutes is average for a track loader [the basic cycle for large track loaders, 2 m^3 (2.6 yd^3) and up, can be slightly longer], but variations can be authenticated in the field. The following values for many variable elements are based on normal operations. Adding or subtracting any of the variable times will give the total basic cycle time.

Estimating Cycle Time

Cycle time of a track loader needs to be determined to find loads per hour. Total cycle time includes the following segments:

Load Time + Maneuver Time + Travel Time + Dump Time

Load Time —

Material	Minutes
Uniform aggregates	0.03-0.05
Moist mixed aggregates	0.03-0.06
Moist loam	0.03-0.07
Soil, boulders, roots	0.04-0.20
Cemented materials	0.05-0.20

Maneuver Time — includes basic travel, four changes of direction and turning time, and will be about 0.20 minutes with a competent operator.

Travel Time — in a load and carry operation is comprised of haul and return times which can be determined by the travel charts in this section.

Dump Time — is dictated by the size and strength of the dump target and varies from 0.00 to 0.10 minutes. Typical dump times into highway trucks are from 0.04 to 0.07 minutes.

NOTE: When comparing hydrostatic track loaders with former power shift models (using the production estimating method) two factors must be considered: (1) The hydrostatic track loaders on the average outcycle power shift models by up to 10 percent due to faster machine speed and easier operation. (2) Larger, rear engine hydrostatic track loaders incorporate Z-bar linkage, which provides substantially better bucket fill factors. The degree to which each factor affects estimated production should be left to the user's judgment depending on the particular job application and conditions.

Example: Moist loam is being excavated from a bank and loaded into trucks.

	Minutes
Load — moist loam	0.05
Maneuver Time	0.20
Travel — none required	0.00
Dump	0.05
Total Cycle	0.30 min. or 200 cycles per 60 min. hour

	Minutes added (+) or Subtracted (–) From Basic Cycle
Materials	
— Mixed	+0.02
— Up to 3 mm (1/8 in)	+0.02
— 3 mm (1/8 in) to 20 mm (3/4 in)	–0.02
— 20 mm (3/4 in) to 150 mm (6 in)	0.00
— 150 mm (6 in) and over	+0.03 and Up
— Bank or broken	+0.04 and Up
Pile	
— Conveyor or Dozer piled 3 m (10 ft) and up	0.00
— Conveyor or Dozer piled 3 m (10 ft) or less	+0.01
— Dumped by truck	+0.02
Miscellaneous	
— Common ownership of trucks and loaders	Up to –0.04
— Independently owned trucks	Up to +0.04
— Constant operation	Up to –0.04
— Inconsistent operation	Up to +0.04
— Small target	Up to +0.04
— Fragile target	Up to +0.05

Using actual job conditions and the above factors, total cycle time can be estimated. Convert total cycle time to cycles per hour.

$$\textit{Cycles per hour at 100\% Efficiency} = \frac{60\ \textit{Min}}{\textit{Total Cycle Time in Minutes}}$$

Job efficiency is an important factor in machine selection. Efficiency is the actual number of minutes worked during an hour. Job efficiency accounts for operator breaks, and other work interruptions. See "Efficiency Considerations" in this section.

Bucket Fill Factors

The following indicates the approximate amounts of material as a percent of rated bucket capacity which will actually be delivered per bucket per cycle. This is known as "Bucket Fill Factor."

Loose Material	Fill Factor
Mixed Moist Aggregates	95-110%
Uniform Aggregates	
up to 3 mm (1/8 in)	95-110
3 mm-9 mm (1/8 in-3/8 in)	90-110
12 mm-20 mm (1/2 in-3/4 in)	90-110
24 mm and over (1 in)	90-110
Blasted Rock	
Well	80-95%
Average	75-90
Poor	60-75
Other	
Rock Dirt Mixtures	100-120%
Moist Loam	100-120
Soil, Boulders, Roots	80-100
Cemented Materials	85-100

Fill factors on track loaders are affected by bucket penetration, breakout force, rack back angle, bucket profile and ground engaging tools such as bucket teeth and segments or bolt-on replaceable cutting edges.

GENERAL PURPOSE BUCKET W/TEETH & SEGMENTS MAXIMUM OPERATING CAPACITIES

	GENERAL PURPOSE BUCKET SIZE		MAXIMUM OPERATING CAPACITY	
MODEL	m^3	yd^3	kg	lb
953D/953K	1.85	**2.4**	3182	**7015**
963D/963K	2.45	**3.2**	4214	**9290**
973D	3.21	**4.2**	5521	**12,174**

LOADER PRODUCTION

Loader production equals quantity of material the bucket carries per load × number of bucket loads per hour.

Estimating Bucket Load

The quantity of material in a loader bucket is estimated by two methods, depending on whether the material being loaded is in a loose or bank state.

1. When the material is loose, as in stockpile loading, the bucket load is estimated in loose meters (or cubic yards) by a Bucket Fill Factor (see Tables Section or chart following this discussion). The quantity of material is determined as follows:
   Rated Bucket Capacity × Bucket Fill Factor = Bucket Payload in Loose m^3 (yd^3)

   For example, a 973 with a 3.2 m^3 (4.2 yd^3) General Purpose bucket loading moist loam material will carry:
   3.2 m^3 × 1.15 = 3.68 loose cubic meters
   (4.2 yd^3 × 1.15 = 4.83 loose cubic yards)

   Once the potential bucket load has been determined, check the static tipping load ratings on the specific machine to determine if bucket load is in fact a safe operating load. *(Safe operating load as defined by SAE for track loaders should not exceed 35% of static tipping load.)*

   Productivity in many applications is measured in tons. See Tables Section for material densities if conversion to tons is desired.

2. When material is in the bank state, as in excavation, productivity is measured in bank meters (cubic yards). Bucket load in Bm^3 (BCY) is estimated by applying one of the load factors from the Tables section to convert the excavated material in the bucket from Bm^3 (BCY) to Lm^3 (LCY) to allow for the digging and carrying characteristics of the material. The quantity of excavated material a bucket carries is then determined as follows:
   Rated Bucket Capacity × Load Factor × Bucket Fill Factor = Bucket Payload in Bm^3 (BCY)

   Example: a 953D with a 1.85 m^3 (2.4 yd^3) General Purpose bucket loading wet loam earth from bank:
   1.85 m^3 × 0.79 × 1.15 = 1.68 Bm^3
   (2.4 yd^3 × 0.79 × 1.15 = 2.18 BCY)

Estimating Production

Machine and job considerations include:

- Machine model and bucket size
- Material type, particle size, density and load factor (see Tables Section)
- Bucket fill factor
- Haul distance
- Underfoot conditions
- Altitude
- Dump target size, height, and type

Example:

Conditions —

Machine	953D
Bucket size	1.85 m^3 (2.4 yd^3)
Material	Moist Loam
Bucket fill factor	1.15
Haul length	30 m (100 ft)
Dump target	Pile
Travel in forward speed	

Cycle Time	**Minutes**
Load time	0.15
Maneuver time	0.20
Travel time (from curves)	0.40
Dump time	0.05
Total	0.80

Loads Per Hour —

$$\frac{60 \text{ min/hr}}{0.80 \text{ min/cycle}} = \text{75 cycles per hour @ 100\% efficiency}$$

Load Per Cycle —

1.85 m^3 × 1.15 BFF = 2.13 Lm^3 × 0.81 LF = 1.72 Bm^3
(2.4 yd^3 × 1.15 BFF = 2.76 LCY × 0.81 LF = 2.24 BCY)

Hourly Production —

1.72 Bm^3 × 75 cycles/h = 129 Bm^3/h
(2.24 BCY × 75 cycles/hr = 168 BCY/hr)

More accurate production estimates can be made by recording actual machine cycle times in the same or similar application. Then visually verify the approximate bucket fill factor.

Efficiency Considerations

Loader capacity should always be matched to peak production requirements of the job. Actual "on-the-job" loader productivity will be influenced by factors such as operator skill, personal delays, job layout and other delays. Experience and knowledge of local conditions will be the best indicators of actual job efficiency.

Operation	Working Hour	Efficiency Factor
Day	50 min/Hr	0.83

An Alternative Machine Selection Method

Another method of selecting the right Track Loader and bucket to meet production requirements is by use of the nomographs on the following pages. The method is quicker and easier than the proceding example because it does not require as many calculations, yet the accuracy is about the same within the normal limits of input data.

Be careful when entering and reading data from the nomographs because some scales increase from bottom to top, while others are the reverse. Do not be overly concerned with the precision as affected by pencil line width or reading to the hundredth of a m^3 (yd^3). Remember that bucket fill factor, material density, and cycle time are at best close estimates.

Example problem

A track loader must produce 200 Lm^3 (262 LCY) per hour. Estimated cycle time is 0.5 minutes, working 50 minutes per hour. Bucket fill factor is 110% and the material density is 1600 kg/Lm^3 (2700 lb/LCY).

Determine bucket size, machine model and hourly production in tons and yards.

Solution

At full efficiency, it will cycle 120 times per hour. Since only an average 50 minutes are available, only 100 cycles will be completed per hour.

Starting on Scale A at 100 cycles per hour draw a straight line intersecting 200 m^3/hr (262 yd^3/hr) on Scale B and continuing the line on to Scale C giving 2.0 m^3 (2.62 yd^3) required payload.

Follow steps 1 through 7 on the next two pages.

● ● ●

TRACK-TYPE TRACTORS
Hydraulic Controls
Bulldozers
Rippers and Winches

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TRACK-TYPE TRACTORS

Features:

- **Cat® Diesel Engines** provide the power, high torque rise, reliability and performance you can depend on.
- **HEUI™** on D6R and D7R increases fuel efficiency, reduces smoke, improves cold starting and enhances diagnostic capabilities.
- **Mechanical Electronic Unit Injector (MEUI™)** on D8T, D9T, D10T2 and D11T excels in its ability to control injection pressure over the entire engine operating speed range. It combines the technical advancement of an electronic control system with the simplicity of direct mechanically controlled unit fuel injection. These features allow the engine to have complete control over injection timing, duration, and pressure.
- **Common Rail fuel injection system** on D3K2, D4K2, D5K2, D6K2, D5R2, D6N, D6T and D7E machines; optimizes performance and fuel consumption, minimizes heat rejection, and lowers emissions.

- **Oil cooled steering clutches and brakes** standard on D9R, D10T2 and D11T.
- **Finger Tip Controls (FTC)** of transmission, steering clutches and brakes on D10T2 and D11T.
- **Differential steering** allows infinitely variable turning radius. Standard on the D5R2, D6N, D6R2, D6T, D7R, D7E, D8R, D8T and D9T, allows the tractor to make a "power turn" keeping both tracks working for more traction and higher performance.
- **Electronic Hydrostatic Power Train System** on D3K2 through D6K2 allows power turns, stepless speed range, smooth modulation, dynamic hydrostatic braking, superior maneuverability and excellent controllability.
- **Electric Drive Power Train System** on D7E allows stepless speed range, smooth modulation, and excellent efficiency. When coupled with differential steer it provides superior maneuverability with locked-track pivot turn capability and excellent controllability.
- **Combined hand lever steering** located left of operator provides easier operation on D9R.
- **Standard Tractors** designed for heavy dozing and general grading.
- **XL Tractor D6T** offers higher horsepower and longer roller frames for increased finish grading capability, flotation and productivity.
- **Extra Wide (XW) gauge** on D6T length roller frame provides wider shoes for greater flotation and stability for steep slope grading.
- **Sealed and Lubricated Track** reduces pin and bushing wear for lower undercarriage repair costs. Sealed and lubricated track is standard on the D3K2, D4K2, and D5K2 while heavy duty track chain is available on D5R, D6K2, D6N, D6T, and D7E improves wear life and reduces pin/bore stretching and cracking.
- **SystemOne™ Undercarriage** extends undercarriage system life, improves reliability, and reduces owning and operating costs. Optional on D6T (all sources), D5R2, D6K2, D6N, D6R2, optional on D8T and D8R (all sources), D3K2, D4K2, D5K2.
- **Elevated sprockets** (not on D6K2 or D7E) eliminate final drive stress induced by roller frame movement and ground impact loads. Final drives pull chain only. Seals moved up out of dirt, sand and water for longer life. Blade visibility improved because operator sits higher.
- **Resilient mounted bogie undercarriage** on D8R, D8T, D9T, D10T2 and D11T reduces shock transmitted to tractor. Allows track to conform to rough ground for better traction.
- **Solid mounted undercarriage** standard on D3K2 through D5K2 provides stable platform for low impact, and high abrasion applications. Provides optimum finish grading performance.
- **Oscillating undercarriage** on D6K2 through D7E and optional on the D8R and D8T decreases ground shock to the machine and provides a smoother, more comfortable ride for the operator.
- **Accessible modular design** on D6N XL and up greatly reduces drive train removal and installation time resulting in reduced repair costs.
- **Tag link** on D7R, D8R/D8T and up; L-shaped push arms on D6N, D6T and D7E. Both designs allow closer mounting of dozer blades. This reduces total tractor length, improves maneuverability, balance, blade penetration and pryout.
- **Low ground pressure (LGP)** tractors offer greater flotation in soft, swampy conditions. Available on D3K2 through D8T.

MODEL	D6T		D6T XL	
Emission Standards	**Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent**		**Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent**	
Flywheel Power	149 kW	**200 hp**	149 kW	**200 hp**
Operating Weight:[1]				
Power Shift Differential Steer				
SU Blade	20 580 kg	**45,370 lb**	21 600 kg	**47,620 lb**
Engine Model	**C9 ACERT**		**C9 ACERT**	
Rated Engine RPM: Power Shift	**1850**		**1850**	
No. of Cylinders	**6**		**6**	
Bore	112 mm	**4.4"**	112 mm	**4.4"**
Stroke	149 mm	**5.9"**	149 mm	**5.9"**
Displacement	8.8 L	**537 in³**	8.8 L	**537 in³**
Track Rollers (Each Side)	**6**		**7**	
Width of Standard Track Shoe	560 mm	**22"**	560 mm	**22"**
Length of Track on Ground	2.61 m	**8'7"**	2.81 m	**9'3"**
Ground Contact Area (w/Std. Shoe)	2.92 m²	**4531 in²**	3.15 m²	**4878 in²**
Track Gauge	1.88 m	**74"**	1.88 m	**74"**
GENERAL DIMENSIONS:				
Height[2] (Stripped Top)[3]	2.40 m	**7'11"**	2.40 m	**7'11"**
Height[2] (To Top of ROPS Canopy)	3.11 m	**10'2"**	3.11 m	**10'2"**
Height[2] (To Top of ROPS Cab)	3.11 m	**10'2"**	3.11 m	**10'2"**
Overall Length (without Blade)	3.85 m	**12'7"**	3.85 m	**12'7"**
with SU Blade	5.08 m	**16'8"**	5.33 m	**17'6"**
with Angle Blade	5.00 m	**16'5"**	5.21 m	**17'1"**
Width (over Trunnion)	2.64 m	**8'8"**	2.64 m	**8'8"**
Width (w/o Trunnion — Std. Track)	2.44 m	**8'0"**	2.44 m	**8'0"**
Ground Clearance[2]	384 mm	**1'3"**	384 mm	**1'3"**
Blade Types and Widths:				
Angle Straight	4.16 m	**13'8"**	4.16 m	**13'8"**
Full 25° Angle	3.77 m	**12'5"**	3.77 m	**12'5"**
Semi-U	3.26 m	**10'8"**	3.26 m	**10'8"**
Fuel Tank Refill Capacity	425 L	**112 U.S. gal**	425 L	**112 U.S. gal**

[1] Operating weight includes cab, operator, lubricants, coolant, full fuel tank, standard track, hydraulic controls and fluid, SU blade, drawbar and counterweight.
[2] Dimensions measured from ground line. Add grouser height for total dimension on hard surfaces.
[3] Height (Stripped Top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

Track-Type Tractor Sustainability

Well matched engine and power train systems enhance productivity and fuel efficiency.

MODEL	D6T XL		D6T XW		D6T LGP	
Emission Standards	**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**		**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**		**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**	
Flywheel Power	151 kW	**202 hp**	151 kW	**202 hp**	151 kW	**202 hp**
Operating Weight:[1]						
Power Shift Differential Steer	20 985 kg	**46,263 lb**	21 788 kg	**48,034 lb**	22 902 kg	**50,490 lb**
VPAT	23 663 kg	**52,167 lb**	24 118 kg	**53,170 lb**	24 336 kg	**53,651 lb**
Engine Model	**C9.3 ACERT**		**C9.3 ACERT**		**C9.3 ACERT**	
Advertised Engine RPM	**2000**		**2000**		**2000**	
No. of Cylinders	**6**		**6**		**6**	
Bore	115 mm	**4.5"**	115 mm	**4.5"**	115 mm	**4.5"**
Stroke	149 mm	**5.9"**	149 mm	**5.9"**	149 mm	**5.9"**
Displacement	9.3 L	**567 in³**	9.3 L	**567 in³**	9.3 L	**567 in³**
Track Rollers (Each Side)	**7**		**7**		**8**	
VPAT	**7**		**8**		**8**	
Width of Standard Track Shoe	560 mm	**22"**	760 mm	**30"**	915 mm	**36"**
VPAT	560 mm	**22"**	710 mm	**28"**	785 mm	**31"**
Length of Track on Ground	2.84 m	**9'5"**	2.84 m	**9'5"**	3.25 m	**10'9"**
VPAT	2.84 m	**9'5"**	3.25 m	**10'9"**	3.25 m	**10'9"**
Ground Contact Area (w/Std. Shoe)	3.54 m²	**5489 in²**	4.81 m²	**7449 in²**	6.53 m²	**10,122 in²**
VPAT	3.54 m²	**5489 in²**	5.10 m²	**7909 in²**	5.60 m²	**8684 in²**
Track Gauge	1.88 m	**74"**	2.03 m	**80"**	2.29 m	**90"**
VPAT	2.13 m	**84"**	2.29 m	**90"**	2.29 m	**90"**
GENERAL DIMENSIONS:						
Height[2] (Stripped Top[3])	2.46 m	**8'1"**	2.46 m	**8'1"**	2.51 m	**8'3"**
VPAT	2.46 m	**8'1"**	2.51 m	**8'3"**	2.51 m	**8'3"**
Height[2] (To Top of ROPS Canopy)	3.11 m	**10'2"**	3.11 m	**10'2"**	3.16 m	**10'4"**
VPAT	3.11 m	**10'2"**	3.16 m	**10'4"**	3.16 m	**10'4"**
Height[2] (To Top of ROPS Cab)	3.15 m	**10'4"**	3.15 m	**10'4"**	3.20 m	**10'6"**
VPAT	3.15 m	**10'4"**	3.20 m	**10'6"**	3.20 m	**10'6"**
Overall Length (without Blade)	3.89 m	**12'9"**	3.89 m	**12'9"**	4.25 m	**13'11"**
VPAT	3.89 m	**12'9"**	4.25 m	**13'11"**	4.25 m	**13'11"**
with S Blade	—		—		5.50 m	**18'1"**
with SU Blade	5.33 m	**17'6"**	5.33 m	**17'6"**	—	
with VPAT Blade	5.39 m	**17'8"**	5.53 m	**18'2"**	5.53 m	**18'2"**
with Angle Blade	5.21 m	**17'1"**	5.29 m	**17'4"**	5.81 m	**19'1"**
Width (over Trunnion)	2.69 m	**8'10"**	2.94 m	**9'8"**	3.48 m	**11'5"**
Width (w/o Trunnion — Std. Track)	2.59 m	**8'6"**	2.79 m	**9'2"**	3.20 m	**10'6"**
VPAT	2.72 m	**8'11"**	3.00 m	**9'10"**	3.14 m	**10'4"**
Ground Clearance[2]	372 mm	**1'3"**	372 mm	**1'3"**	406 mm	**1'4"**
VPAT	372 mm	**1'3"**	406 mm	**1'4"**	406 mm	**1'4"**
Blade Types and Widths:						
Straight	—		—		4.06 m	**13'4"**
Angle Straight	4.16 m	**13'8"**	4.52 m	**14'10"**	5.07 m	**16'8"**
Full 25° Angle	3.77 m	**12'5"**	4.11 m	**13'6"**	4.63 m	**15'2"**
Semi-U	3.26 m	**12'8"**	3.56 m	**11'8"**	—	
VPAT						
Straight	3.88 m	**12'9"**	4.16 m	**13'8"**	4.16 m	**13'8"**
Full 24° Angle	3.54 m	**11'7"**	3.79 m	**12'5"**	3.79 m	**12'5"**
Fuel Tank Refill Capacity	411 L	**109 U.S. gal**	411 L	**109 U.S. gal**	411 L	**109 U.S. gal**
DEF Tank Refill Capacity	17.1 L	**4.5 U.S. gal**	17.1 L	**4.5 U.S. gal**	17.1 L	**4.5 U.S. gal**

[1] Operating weight includes cab, operator, lubricants, coolant, full fuel tank, standard track, hydraulic controls and fluid, SU blade and drawbar.
[2] Dimensions measured from ground line. Add grouser height for total dimension on hard surfaces.
[3] Height (Stripped Top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.

MODEL	D9R		D9T		D9T	
Emission Standards	—		**Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent[1]**		**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**	
Flywheel Power	302 kW	**405 hp**	306 kW	**410 hp**	325 kW	**436 hp**
Operating Weight:[2]						
Power Shift Clutch Brake	48 784 kg	**107,548 lb**	—		—	
Power Shift Differential Steer	—		47 872 kg	**105,539 lb**	48 361 kg	**106,618 lb**
Engine Model	**3408C SCAC**		**C18 ACERT**		**C18 ACERT**	
Rated Engine RPM	**1900**		**1833**		**1800**	
No. of Cylinders	**8**		**6**		**6**	
Bore	137 mm	**5.4"**	145 mm	**5.7"**	145 mm	**5.7"**
Stroke	152 mm	**6"**	183 mm	**7.2"**	183 mm	**7.2"**
Displacement	18 L	**1099 in^3**	18.1 L	**1106 in^3**	18.1 L	**1106 in^3**
Track Rollers (Each Side)	**8**		**8**		**8**	
Width of Standard Track Shoe	610 mm	**24"**	610 mm	**24"**	610 mm	**24"**
Length of Track on Ground	3.47 m	**11'5"**	3.47 m	**11'5"**	3.47 m	**11'5"**
Ground Contact Area (w/Std. Shoe)	4.24 m^2	**6569 in^2**	4.24 m^2	**6569 in^2**	4.24 m^2	**6569 in^2**
Track Gauge	2.25 m	**7'5"**	2.25 m	**7'5"**	2.25 m	**7'5"**
GENERAL DIMENSIONS:						
Height[3] (Stripped Top)[4]	3.69 m	**12'1"**	3.69 m	**12'1"**	3.69 m	**12'1"**
Height[3] (To Top of ROPS Canopy)	4.00 m	**13'1"**	4.00 m	**13'1"**	4.00 m	**13'1"**
Height[3] (To Top of FOPS Cab)	3.82 m	**12'6"**	3.82 m	**12'6"**	3.82 m	**12'6"**
Overall Length (with SU Blade)[5]	6.88 m	**22'6"**	6.88 m	**22'6"**	6.88 m	**22'6"**
(without Blade)	5.18 m	**17'0"**	5.18 m	**17'0"**	5.18 m	**17'0"**
(with SU Blade and Ripper)[5]	8.23 m	**27'0"**	8.23 m	**27'0"**	8.23 m	**27'0"**
(without Blade and Ripper)	4.91 m	**16'1"**	4.91 m	**16'1"**	4.91 m	**16'1"**
Width (over Trunnion)	3.30 m	**10'8"**	3.30 m	**10'8"**	3.30 m	**10'8"**
Width (w/o Trunnion — Std. Shoe)	2.88 m	**9'5"**	2.88 m	**9'5"**	2.88 m	**9'5"**
Ground Clearance[6]	496 mm	**1'7"**	496 mm	**1'7"**	496 mm	**1'7"**
Blade Types and Widths:						
Universal	4.65 m	**15'3"**	4.65 m	**15'3"**	4.65 m	**15'3"**
Semi-U	4.31 m	**14'2"**	4.31 m	**14'2"**	4.31 m	**14'2"**
Fuel Tank Refill Capacity	818 L	**216 U.S. gal**	889 L	**235 U.S. gal**	821 L	**217 U.S. gal**
DEF Tank Refill Capacity	—		—		36 L	**9.5 U.S. gal**

[1] Product available to meet Tier 2/Stage II/Japan 2001 (Tier 2) equivalent OR Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.
[2] Operating weight includes ROPS canopy, operator, lubricants, coolant, full fuel tank, hydraulic controls and fluids, semi universal blade with tilt, back-up alarm, seat belts, lights, and single shank ripper.
— D9R equipped with track guides, ROPS/FOPS cab, single shank ripper and SU blade.
[3] Dimensions measured from ground line. Add grouser height for total dimension on hard surfaces.
[4] Height (Stripped Top) — without ROPS canopy, exhaust, seat back or other easily removed encumbrances.
[5] Includes drawbar.
[6] Per ISO 6746 — Must add grouser height for total dimension on hard surfaces.

MODEL	D10T2		D11T		D11T CD	
Emission Standards	**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)[1]**		**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)[1]**		**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)[1]**	
Flywheel Power	447 kW	**600 hp**	634 kW	**850 hp**	634 kW	**850 hp**
Reverse Gears	538 kW	**722 hp**	—		—	
Operating Weight:[2]						
Power Shift Clutch Brake	70 171 kg	**154,700 lb**	104 236 kg	**229,800 lb**	112 718 kg	**248,500 lb**
Engine Model	**C27 ACERT**		**C32 ACERT**		**C32 ACERT**	
Rated Engine RPM	**1800**		**1800**		**1800**	
No. of Cylinders	**12**		**12**		**12**	
Bore	137 mm	**5.4"**	145 mm	**5.71"**	145 mm	**5.71"**
Stroke	152 mm	**6"**	162 mm	**6.38"**	162 mm	**6.38"**
Displacement	27 L	**1648 in^3**	32.1 L	**1959 in^3**	32.1 L	**1959 in^3**
Track Rollers (Each Side)	**8**		**8**		**8**	
Width of Standard Track Shoe	610 mm	**24"**	710 mm	**28"**	915 mm	**36"**
Length of Track on Ground (Idler to Idler)	3.88 m	**12'9"**	4.44 m	**14'7"**	4.44 m	**14'7"**
Ground Contact Area (w/Std. Shoe)	4.74 m^2	**7347 in^2**	6.31 m^2	**9781 in^2**	8.13 m^2	**12,605 in^2**
Track Gauge	2.55 m	**8'4"**	2.89 m	**9'6"**	2.89 m	**9'6"**
GENERAL DIMENSIONS:						
Height (Stripped Top)[3]	3.222 m	**10'7"**	3.64 m	**11'11"**	3.64 m	**11'11"**
Height (To Top of ROPS Canopy)	4.41 m	**14'5"**	4.70 m	**15'5"**	4.70 m	**15'5"**
Height (To Top of FOPS Cab)	4.10 m	**13'5"**	4.39 m	**14'5"**	4.39 m	**14'5"**
Overall Length:						
(with SU Blade and SS Ripper)[4]	9.16 m	**30'1"**	10.59 m	**34'9"**	10.70 m	**35'1"**
(without Blade and Ripper)[5]	5.32 m	**17'5"**	6.16 m	**20'3"**	6.16 m	**20'3"**
Width (over Trunnion)	3.74 m	**12'3"**	4.38 m	**14'4"**	4.38 m	**14'4"**
Width (w/o Trunnion — Std. Shoe)	3.30 m	**10'10"**	3.78 m	**12'5"**	3.81 m	**12'6"**
Ground Clearance[6]	632 mm	**2'1"**	675 mm	**2'3"**	675 mm	**2'3"**
Blade Types and Widths:						
CarryDozer	—		—		6.71 m	**22'0"**
Universal	5.26 m	**17'3"**	6.36 m	**20'10"**	—	
Semi-U	4.94 m	**16'3"**	5.60 m	**18'4"**	—	
Fuel Tank Refill Capacity	1204 L	**314 U.S. gal**	1609 L	**425 U.S. gal**	1609 L	**425 U.S. gal**
Fuel Tank Refill Capacity (Extra Capacity)	—		1987 L	**505 U.S. gal**	1987 L	**505 U.S. gal**

[1] Product available to meet Tier 2/Stage II/Japan 2001 (Tier 2) equivalent OR Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) emission standards.
[2] Operating weight includes coolant, lubricants, full fuel tank, ROPS, FOPS cab, SU ABR bulldozer (D10T2) or U ABR bulldozer (D11T), dual tilt, single-shank ripper with pin-puller, fast fuel, standard ES shoes, and operator.
D11T CD has 11 Carrydozer and single-shank Carrydozer ripper.
[3] Height (Stripped Top) — without ROPS canopy, cab, exhaust, lift cylinders, seat back or other easily removed encumbrances.
[4] Overall length of D11T CD includes Straight (CarryDozer) Blade and SS Ripper.
[5] Overall length of machine from front tag link trunnion to rigid drawbar and excludes track grouser height.
[6] Per ISO 6746 — Must add grouser height for total dimension on hard surfaces.

All dimensions are approximate.

TRAVEL SPEED

POWER SHIFT MODEL	D3K2[1] All Models		D3K2 All Models		D4K2[1] All Models		D4K2 All Models		D5K2[1] All Models		D5K2 All Models		D6K2 All Models	
HYDROSTATIC	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph
FORWARD	9.0	**5.6**	9.0	**5.6**	9.0	**5.6**	9.0	**5.6**	9.0	**5.6**	9.0	**5.6**	10.0	**6.2**
REVERSE	10.0	**6.2**	10.0	**6.2**	10.0	**6.2**	10.0	**6.2**	10.0	**6.2**	10.0	**6.2**	10.0	**6.2**

[1] Meets Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.

POWER SHIFT MODEL	D5R2 Powershift with AutoShift		D6R2 Powershift with AutoShift		D6T		D7E		D7E LGP		D7R	
FORWARD	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph
1	3.3	**2.1**	3.8	**2.4**	3.8	**2.3**	—	—	—	—	3.52	**2.19**
1.5	4.2	**2.6**	4.8	**3.0**	—	—	—	—	—	—	—	—
2	5.8	**3.6**	6.5	**4.1**	6.5	**4.0**	—	—	—	—	6.10	**3.79**
2.5	7.3	**4.5**	8.4	**5.2**	—	—	—	—	—	—	—	—
3	10.1	**6.3**	11.5	**7.1**	11.3	**7.0**	—	—	—	—	10.54	**6.55**
REVERSE												
1	4.2	**2.6**	4.8	**3.0**	4.7	**2.9**	—	—	—	—	4.54	**2.82**
1.5	5.2	**3.2**	6.2	**3.9**	—	—	—	—	—	—	—	—
2	7.3	**4.5**	8.4	**5.2**	8.3	**5.1**	—	—	—	—	7.85	**4.88**
2.5	7.3	**4.5**	8.4	**5.2**	—	—	—	—	—	—	—	—
3	12.5	**7.8**	14.5	**9.1**	14.6	**9.0**	—	—	—	—	13.58	**8.44**
ELECTRIC												
FORWARD	—	—	—	—	—	—	11.3	**7.0**	11.3	**7.0**	—	—
REVERSE	—	—	—	—	—	—	11.3	**7.0**	11.3	**7.0**	—	—

GEAR	D6N* Powershift with AutoShift		D6N* Powershift with AutoShift — Sound Suppressed	
FORWARD	km/h	mph	km/h	mph
0.5	2.5	**1.6**	2.4	**1.5**
0.7	2.8	**1.7**	2.7	**1.6**
1.0	3.3	**2.1**	3.0	**1.9**
1.5	4.4	**2.7**	4.4	**2.7**
1.7	4.9	**3.0**	4.9	**3.0**
2.0	5.8	**3.6**	5.8	**3.6**
2.5	7.5	**4.7**	7.5	**4.7**
2.7	8.3	**5.2**	8.3	**5.2**
3.0	9.8	**6.1**	9.8	**6.1**
REVERSE				
0.5	3.1	**1.9**	2.9	**1.8**
0.7	3.4	**2.1**	3.1	**1.9**
1.0	4.1	**2.5**	3.5	**2.2**
1.5	5.4	**3.4**	5.4	**3.4**
1.7	6.0	**3.7**	6.0	**3.7**
2.0	7.1	**4.4**	7.1	**4.4**
2.5	9.5	**5.9**	9.5	**5.9**
2.7	10.5	**6.5**	10.5	**6.5**
	12.2	**7.6**	12.2	**7.6**

*Meets Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) emission standards.

TRAVEL SPEED

POWER SHIFT MODEL	Differential Steer D8R		D8T		D9R		D9T		D10T2		D11T/CD		D11T/CD High Altitude	
FORWARD	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph	km/h	mph
1	3.5	**2.2**	3.4	**2.1**	3.8	**2.4**	3.9	**2.4**	4.0	**2.5**	3.9	**2.4**	4.0	**2.5**
2	6.2	**3.9**	6.0	**3.7**	6.8	**4.2**	6.8	**4.2**	7.2	**4.5**	6.8	**4.2**	7.0	**4.4**
3	10.8	**6.7**	10.6	**6.6**	11.9	**7.4**	11.7	**7.3**	12.7	**7.9**	11.8	**7.3**	12.0	**7.5**
REVERSE														
1	4.7	**2.9**	4.5	**2.8**	4.7	**2.9**	4.7	**2.9**	5.2	**3.2**	4.7	**2.9**	4.8	**3.0**
2	8.1	**5.0**	7.9	**4.9**	8.4	**5.2**	8.4	**5.2**	9.0	**5.6**	8.2	**5.1**	8.3	**5.2**
3	13.9	**8.6**	14.2	**8.8**	14.7	**9.1**	14.3	**8.9**	15.8	**9.8**	14.0	**8.7**	14.9	**9.0**

GEAR	D6T Powershift with AutoShift		D6T Powershift with AutoShift — Sound Suppressed	
FORWARD	km/h	mph	km/h	mph
0.5	2.7	**1.7**	2.7	**1.7**
0.7	3.3	**2.0**	3.2	**2.0**
1.0	3.7	**2.3**	3.2	**2.0**
1.5	4.7	**2.9**	4.7	**2.9**
1.7	5.7	**3.6**	5.7	**3.6**
2.0	6.5	**4.0**	6.3	**3.9**
2.5	8.2	**5.1**	8.2	**5.1**
2.7	10.0	**6.2**	10.0	**6.2**
3.0	11.3	**7.0**	10.9	**6.8**
REVERSE				
0.5	3.5	**2.2**	3.5	**2.2**
0.7	4.2	**2.6**	3.9	**2.4**
1.0	4.7	**2.9**	3.9	**2.4**
1.5	6.0	**3.7**	6.0	**3.7**
1.7	7.3	**4.5**	7.3	**4.5**
2.0	8.3	**5.1**	8.0	**5.0**
2.5	10.4	**6.5**	10.4	**6.5**
2.7	12.7	**7.9**	12.7	**7.9**
3.0	14.4	**9.0**	13.8	**8.6**

HYDRAULIC CONTROLS

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Features:

- **Designed and built for specific tractor applications.** Valves and components sized for exacting quality and performance.
- **Job requirements matched** through various arrangements.
- **Hydraulic blade and ripper controls:** Mechanical controls on G Series. Electro hydraulic controls on D6N and D6K2. Pilot blade and ripper controls on D6T Tier 3/Stage IIIA, Japan 2006 (Tier 3) equivalent with optional electro hydraulic blade control. Electro hydraulic blade and ripper controls on D6T Tier 4 Interim/ Stage IIIB/Japan 2011 (Tier 4 Interim) equivalent Mechanical controls on D9R. Electro hydraulic blade and ripper controls on D7E, D8T, D9T, D10T2, and D11T.
- **Full flow filters***… all oil completely filtered.
- **Dual tilt** — standard on D11T and D11T CD, attachment option on D7E, D8R, D8T, D9R, D9T, D10T2.

*Exception — D8R 2-pump.

BULLDOZERS

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Features:

- **Straight Bulldozers** — adjustable tilt angle controls blade penetration.
- **Variable cutting edge Power Angle and Tilt (VPAT)** — blade is available on the D3K2, D4K2, D5K2, D6K2, D6N, and D6T. The blade can be mechanically tipped forward for improved penetration or back for more productivity and easier finish grading.
- **Angling Bulldozers** — 25° right/left angling; C-frame allows mounting other tools.
- **Universal Bulldozers** — 25° wings provide increased capacity, less spillage.
- **Semi-Universal Bulldozers** — combines penetration ability of straight blade with increased load capacity provided by short 25° wings.
- **Wheel Dozer blades** are offered in straight and universal blade design with hydraulic pitch and tilt control.
- **Box-section construction** on blades adds rigidity and strength.
- **Cutting edges** are heat treated and reversible for extra life.

BLADE SELECTION

Properly matching tractor and dozer is a basic requirement for maximizing production. First consider the kind of work the tractor will be doing most of its life. Then evaluate:

- Material to be moved.
- Tractor limitations.

Materials to be moved

Most materials are dozeable. However, dozer performance will vary with material characteristics such as:
Particle Size and Shape — The larger the individual particle size, the harder it is for a cutting edge to penetrate. Particles with sharp edges resist the natural rolling action of a dozer blade. These particles require more horsepower to move than a similar volume of material with rounded edges.
Voids — Few voids or the absence of voids means the individual particles have most or all of their surface area in contact with other particles. This forms a bond which must be broken. A well graded material, which lacks voids, is generally heavy, and will be hard to remove from the bank state.
Water Content — In most materials the lack of moisture increases the bond between particles and makes the material difficult to remove from the bank state. A high moisture content makes dozing difficult because the material is heavy and requires more force to move. Optimum moisture reduces dust and offers the best condition for dozing ease and operator comfort.

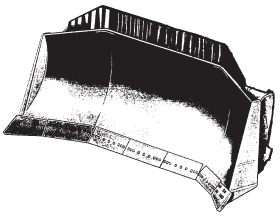
The effect of freezing depends on the moisture content. When frozen, the material's bond strengthens as moisture content increases and temperature decreases. However, freezing a completely dry material does not change its characteristics.

An indication of a blade's ability to penetrate and obtain a blade load is kW per meter (or horsepower per foot) of cutting edge. The higher the kW/meter (HP/foot), the more aggressive the blade. Kilowatt per Lm^3 (horsepower per loose cubic yard) indicates a blade's ability to push material. The higher the kW/Lm^3 (HP/LCY), the greater the blade's potential capability for carrying material at a greater speed.

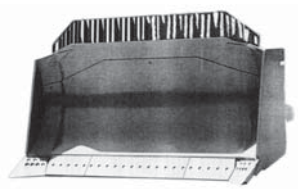
Tractor Limitations

The weight and horsepower of the machine determines its ability to push. No tractor can exert more pounds push than the machine itself weighs and its power train can develop. Various terrain and underfoot conditions on the job limit the tractor's ability to use its weight and horsepower. The "approximate coefficient of traction factors" chart in the Tables Section presents these traction factors for common materials. To use the chart, take the total tractor weight (with attachments) times the factor to arrive at the maximum usable push the dozer can exert.

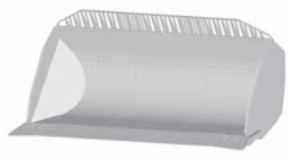
Production Dozing Tools



"U" — Universal blade — the large wings on this blade include one end bit and at least one section of cutting edge which make it efficient for moving big loads over long distances as in land reclamation, stockpile work, charging hoppers and trapping for loaders. As this blade has a lower kW/meter (HP/foot) of cutting edge than an "S" or "SU", penetration should not be a prime objective. With a lower kW/Lm^3 (HP/LCY) than an "S" or "SU", this blade is best for lighter or relatively easily dozed material. If equipped with tilt cylinders the U blade can be used to pry out, level, cut ditches and steer the tractor.

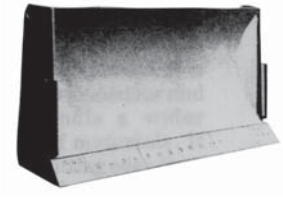


"SU" — The Semi-U blade combines the desirable characteristics of S and U-blades into one package. It has increased capacity by the addition of short wings which include only the dozer end bits. The wings provide improved load retention capabilities while maintaining the blade's ability to penetrate and load quickly in tightly packed materials and to handle a wide variety of materials in production oriented applications. Tilt cylinder(s) increase both the productivity and versatility of this dozer. Equipped with a push plate, it is effectively used for push loading scrapers.



"CD" — The CD or CarryDozer Blade is available for the D11T CarryDozer only. It is built to the same high standard of structural integrity as the "U" and "SU" Dozers. The CD Blade has a unique "bucket" shape that allows it to carry several cubic yards or cubic meters of material in the blade. This acts as a disposable counterweight that allows the CarryDozer to push more material per pass than a standard D11T. The CarryDozer will not be as effective as the "U" or "SU" dozer in tightly packed or poorly shot material. It is also more sensitive to the carryback in sticky materials.

General Purpose Dozing Tools



"S" — The Straight blade provides excellent versatility. Since it is physically smaller than the SU or U-blade, it is easier to maneuver and can handle a wider range of materials. It has a higher kW/ meter (HP/foot) of cutting edge than the SU or U-blade; consequently, the "S" is more aggressive in penetrating and obtaining a blade load. A tilt cylinder increases both the productivity and versatility of this dozer. With a high kW/Lm^3 (HP/LCY), the S-blade can handle heavy material easily.

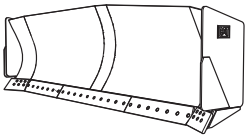
Power Angle and Tilt Blade — Versatility is its key feature with its ability to perform a variety of site development to general dozing work as well as heavy-duty applications. Angle and tilt control is with 2 levers on some machines, 1 lever on others.

Variable Power Angle and Tilt (VPAT) blade can be mechanically tipped forward for improved penetration or shedding sticky material and backward for finish grading and improved productivity.

Special Application Dozing Tools

Caterpillar provides specialty bulldozers for specific applications. The blades are designed to increase production while performing certain tasks. Following are the most popular special applications blades.

Variable Radius (VR) Blades



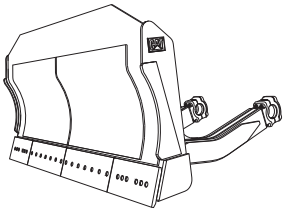
Variable Radius Semi-U Blades are excellent tools for land improvement, soil conservation, site development or general construction. They combine the penetration ability of a Semi-U Blade with the load retention and high capacity of a U-blade.

They provide the aggressive cutting action needed for digging, while having the material retention characteristics needed for moving high volumes over a distance. This is accomplished through a moldboard which varies in radius from the edge to the center. This creates a rolling action in the material being moved, pushing it to the center of the blade for better retention. The extended side wings, angled to thirty degrees, further increase the capacity over a standard blade.

Angle Blade (A-Blade)

"A" — Or Angling blade can be positioned straight or angled 25 degrees to either side. It is designed for side-casting, pioneering roads, backfilling, cutting ditches and other similar tasks. It can reduce the amount of maneuvering required to do these jobs. Its "C" frame can be used for attachments such as pushing, land clearing, or snow removal tools. A-blades are not recommended for rock or severe applications.

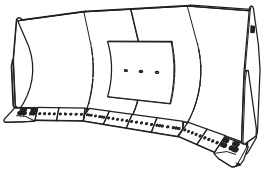
Cushion Dozers



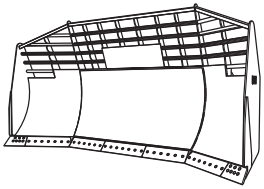
Cushion Dozers are designed to push-load wheel-tractor scrapers, or track-type tractors. The heavy-duty design includes reinforcement to transfer machine power without damaging the blade or the tractor. Blade cylinders are pinned to the C-frame, and the blade height is such that the blade lift cylinders are isolated from damaging forces.

The taller blade allows pushing from a higher position, eliminating blade drag and increasing productivity. The blade curvature is matched to the curve of the Cat Push Block for maximum contact area, preventing the block from riding over the top of the blade. Extended side plates make it easier for operators to "catch" the stinger when repositioning for a new pass. The center of the blade is armored with T-1 plate steel for maximum service life. The narrow width of the cushion blade increases machine maneuverability in congested cuts and reduces the possibility of cutting tires associated with SU and U-blades.

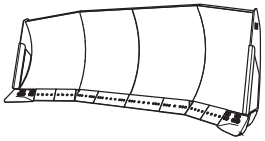
When not push-loading, the dozer can be used for cut maintenance and other general dozing jobs.



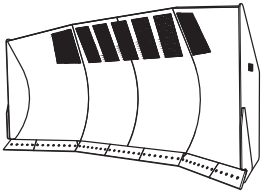
Coal U-Blades are designed specifically to move large volumes of coal in coal piles, at powerplants and transshipment points. The wing angle of thirty degrees crowds material to the center of the blade, maximizing capacity by minimizing side spill. The moldboard is much higher and wider than standard, specifically to match the material density and loading characteristics of coal. The curve of the moldboard rolls the material forward, enhancing the carrying capacity. With this design, coal-moving capacity can be as much as 200 percent greater than a standard U-blade.



Landfill U-Blades provide capacity increases of up to fifty percent over a straight blade. Landfill blades have the height and width to handle large volumes of low-density refuse, but are tough enough to dig and bulldoze ground cover. Vision to the load is provided by areas of screen in the upper blade. Angled wings slice into natural bed earth for trenches or cover material, adding to the versatility in the landfill.

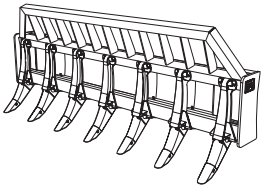


Reclamation U-Blades — are purpose-built for reclamation of mine spoil piles. The blade has a larger capacity than a standard U-blade. The wing angle of 28 degrees provides a good balance between load retention and shearing action, keeping the optimal load in front of the blade, but cutting cleanly through the material when necessary.



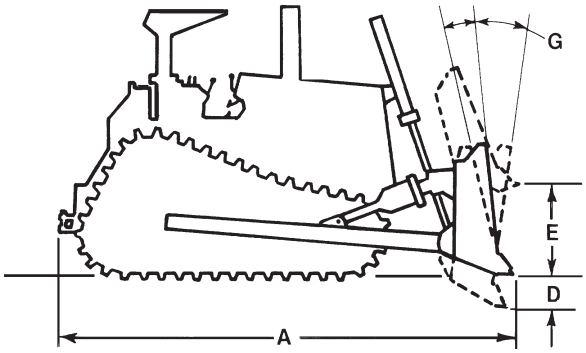
The width of **Woodchip U-Blades** gives operators maximum control and greater confidence, even in steep chip piles. Deep curvature of the moldboard keeps material flowing to liven dead chips and optimize production on long pushes. Blade height and wings angled at thirty degrees combine for excellent material retention – giving better production with every pass. An operator visibility window in the top section is standard.

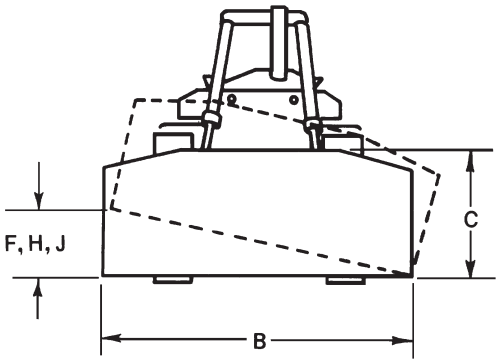
Multi-Application/Rock and Root Rakes



Multi-Application/Rock and Root Rakes are perfectly suited for heavy duty land clearing including removal of stumps, large rocks or large trees and for work in clay and other heavy soils. Frames are constructed of high strength steel for longer life. Cast teeth, with replaceable tips, are designed for maximum ground penetration and resistance to shock loading when prying or pushing trees, stumps and rocks. Brush rack is standard and increases height and capacity by as much as 40%.

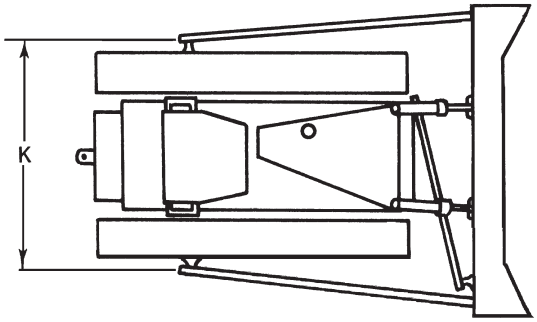
Rake is a direct replacement for existing blade, and utilizes existing push arms and C-frames.





KEY

A Length (Blade Straight)
Blade:
B Width (including standard end bits)
C Height
D Maximum Digging Depth
E Ground Clearance @ Full Lift
F Maximum Tilt (Manual)
G Maximum Pitch Adjustment
H Maximum Hydraulic Tilt
J Hydraulic Tilt (manual brace centered)
K Push Arm Trunnion Width (to Ball Centers)



Blade capacities on the following pages are as determined by SAE recommended practice J1265. Capacities are defined as:

$Vs = 0.8\ WH^2$.

$Vu = ZH\ (W\text{-}Z)\ \tan X$.

Where: Vs = Capacity of straight or angling blade.
Vu = Capacity of semi-U or full U-blade.
W = Blade width exclusive of end bits.
H = Effective blade height considering tapered top corners, etc.
Z = Wing length measured parallel to blade width @ ground line of cutting edges.
X = Wing angle.

MODEL	D6R2							
	6S		6SU		6SU XL		6S LGP	
Gauge	—		1880 mm	**74"**	1880 mm	**74"**	2286 mm	**90"**
Type	**Straight**		**Semi-Universal**		**Semi-Universal**		**Straight**	
Blade Capacities*	3.89 m^3	**5.1 yd^3**	5.61 m^3	**7.3 yd^3**	5.55 m^3	**7.26 yd^3**	3.75 m^3	**4.9 yd^3**
Weight, Shipping** (Dozer)	2251 kg	**4963 lb**	2333 kg	**5143 lb**	2570 kg	**5666 lb**	2418 kg	**5331 lb**
Tractor and Dozer Dimensions:								
A Length (Blade Straight)	4903 mm	**193.1"**	5095 mm	**200.6"**	5332 mm	**210.0"**	5465 mm	**215.2"**
Blade Dimensions:								
B Width (including std. end bits)	3360 mm	**132.3"**	3260 mm	**128.3"**	3260 mm	**128.3"**	4063 mm	**160"**
C Height	1257 mm	**49.5"**	1412 mm	**55.6"**	1412 mm	**55.6"**	1101 mm	**43.3"**
D Max. Digging Depth	473 mm	**18.6"**	473 mm	**18.6"**	459 mm	**18.1"**	655 mm	**25.8"**
E Ground Clearance @ Full Lift	1104 mm	**43.5"**	1104 mm	**43.5"**	1195 mm	**47.0"**	1083 mm	**42.6"**
G Max. Pitch Adjustment	**+5.3 to 4.8°**		**+5.6 to –5.2°**		**+5.6 to –5.2°**		**+4.4 to –4.4°**	
H Max. Hydraulic Tilt	765 mm	**30.1"**	743 mm	**29.3"**	743 mm	**29.3"**	701 mm	**27.6"**
K Push Arm Trunnion Width (to Ball Centers)	2640 mm	**103.9"**	2640 mm	**103.9"**	2640 mm	**103.9"**	3490 mm	**137.4"**

MODEL	D6R2				D6T			
	6A		6A XL		6A		6SU	
Gauge	1880 mm	**74"**	1880 mm	**74"**	1880 mm	**74"**	1880 mm	**74"**
Type	**Angling**		**Angling**		**Angling**		**Semi-Universal**	
Blade Capacities*	3.93 m^3	**5.1 yd^3**	3.89 m^3	**5.1 yd^3**	3.64 m^3	**4.75 yd^3**	5.35 m^3	**6.99 yd^3**
Weight, Shipping** (Dozer)	2715 kg	**5986 lb**	2625 kg	**5787 lb**	3138 kg	**6904 lb**	2973 kg	**6540 lb**
Tractor and Dozer Dimensions:								
A Length (Blade Straight)	5007 mm	**197.2"**	5209 mm	**205.1"**	5.00 m	**16'5"**	5.08 m	**17'6"**
Length (Blade Angled)	—		—		5.83 m	**19'2"**	—	
Width (Blade Angled)	—		—		3.78 m	**12'5"**	—	
Width (with C-Frame only)	—		—		2.93 m	**9'8"**	—	
Blade Dimensions:								
B Width (including std. end bits)	4166 mm	**164.0"**	4166 mm	**164.0"**	4.16 m	**13'8"**	3.26 m	**10'8"**
C Height	1155 mm	**45.5"**	1155 mm	**45.5"**	1154 mm	**3'10"**	1411 mm	**4'8"**
D Max. Digging Depth	506 mm	**19.9"**	524 mm	**20.6"**	506 mm	**1'8"**	453 mm	**1'6"**
E Ground Clearance @ Full Lift	1142 mm	**45.0"**	1205 mm	**47.4"**	1144 mm	**3'9"**	1204 mm	**3'11"**
G Max. Pitch Adjustment	**25°**		**25°**		—		**+5.6° to –5.2°**	
H Max. Hydraulic Tilt	408 mm	**16.1"**	408 mm	**16.1"**	519 mm	**1'8"**	811 mm	**2'8"**
Blade Angle	—		—		**25°**		—	
J Hydraulic Tilt (Manual Brace Centered)	—		—		—		455 mm	**1'6"**
K Push Arm Trunnion Width (to Ball Centers)	2640 mm	**103.9"**	2625 mm	**103.9"**	2.58 m	**8'6"**	2.58 m	**8'6"**

*Blade capacities as determined by SAE J1265. Tractor and dozer dimensions variations due to SystemOne undercarriage products are negligible. Notice that the capacity of the SU-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the SU-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.

**Shipping Weight — Total Bulldozer Arrangement includes: Blade, push arms or C-frame, braces, cylinders, lines, trunnions and lift cylinder mountings.

MODEL	D6T 6A XL		D6T 6SU XL		D6T 6VPAT XL		D6T 6A XW	
Gauge	1.88 m	**74"**	1.88 m	**74"**	2.13 m	**84"**	2.03 m	**80"**
Type	**Angling**		**Semi-Universal**		**VPAT**		**Angling**	
Blade Capacities*	3.94 m^3	**5.15 yd^3**	5.55 m^3	**7.26 yd^3**	4.64 m^3	**6.07 yd^3**	4.35 m^3	**5.69 yd^3**
Weight, Shipping** (Dozer)	3086 kg	**6803 lb**	2831 kg	**6242 lb**	3464 kg	**7637 lb**	3731 kg	**8226 lb**
Tractor and Dozer Dimensions:								
A Length (Blade Straight)	5.21 m	**17'1"**	5.33 m	**17'6"**	5.39 m	**17'8"**	5.29 m	**17'4"**
Length (Blade Angled)	6.05 m	**19'10"**	—		3.54 m	**11'7"**	6.20 m	**20'4"**
Width (Blade Angled)	3.77 m	**12'5"**	—		3.49 m	**11'5"**	4.11 m	**13'6"**
Width (with C-Frame only)	2.99 m	**9'10"**	—		—		3.29 m	**10'10"**
Blade Dimensions:								
B Width (including std. end bits)	4.16 m	**13'8"**	3.26 m	**10'8"**	3.88 m	**12'9"**	4.52 m	**14'10"**
C Height	1154 mm	**3'10"**	1407 mm	**4'7"**	1294 mm	**4'3"**	1153 mm	**3'9"**
D Max. Digging Depth	555 mm	**1'10"**	501 mm	**1'7"**	792 mm	**2'7"**	541 mm	**1'9"**
E Ground Clearance @ Full Lift	1112 mm	**3'7"**	1180 mm	**3'10"**	1053 mm	**3'5"**	1139 mm	**3'9"**
G Max. Pitch Adjustment	—		**+4.0° to –4.0°**		**+0.5° to –3.1°**		—	
H Max. Hydraulic Tilt	424 mm	**1'5"**	811 mm	**2'8"**	410 mm	**1'4"**	424 mm	**1'5"**
Blade Angle	**25°**		—		**24°**		**25°**	
J Hydraulic Tilt (Manual Brace Centered)	—		455 mm	**1'6"**	—		—	
K Push Arm Trunnion Width (to Ball Centers)	2.58 m	**8'6"**	2.58 m	**8'6"**	—		2.89 m	**9'8"**

MODEL	D6T 6SU XW		D6T 6A LGP		D6T 6S LGP		D6T 6VPAT LGP/XW	
Gauge	2.03 m	**80"**	2.29 m	**90"**	2.29 m	**90"**	2.29 m	**90"**
Type	**Semi-Universal**		**Angling**		**Straight**		**VPAT**	
Blade Capacities*	5.64 m^3	**7.38 yd^3**	4.94 m^3	**6.46 yd^3**	3.79 m^3	**4.96 yd^3**	5.02 m^3	**6.57 yd^3**
Weight, Shipping** (Dozer)	2976 kg	**6562 lb**	3745 kg	**8255 lb**	2720 kg	**5997 lb**	3558 kg	**7845 lb**
Tractor and Dozer Dimensions:								
A Length (Blade Straight)	5.33 m	**17'6"**	5.81 m	**19'1"**	5.50 m	**18'1"**	5.53 m	**18'2"**
Length (Blade Angled)	—		6.81 m	**22'4"**	—		—	
Width (Blade Angled)	—		4.63 m	**15'2"**	—		3.72 m	**12'2"**
Width (with C-Frame only)	—		3.77 m	**12'5"**	—		—	
Blade Dimensions:								
B Width (including std. end bits)	3.56 m	**11'8"**	5.07 m	**16'8"**	4.06 m	**13'3"**	4.16 m	**13'8"**
C Height	1407 mm	**4'7"**	1150 mm	**3'9"**	1108 mm	**3'8"**	1294 mm	**4'3"**
D Max. Digging Depth	502 mm	**1'7"**	853 mm	**2'10"**	590 mm	**1'11"**	743 mm	**2'5"**
E Ground Clearance @ Full Lift	1180 mm	**3'10"**	1004 mm	**3'3"**	1094 mm	**3'7"**	1102 mm	**3'7"**
G Max. Pitch Adjustment	**+4.0° to –4.0°**		—		**+4.4° to –4.4°**		**+0.5° to –3.1°**	
H Max. Hydraulic Tilt	791 mm	**2'7"**	618 mm	**2'0"**	747 mm	**2'5"**	435 mm	**1'5"**
Blade Angle	—		**24.2°**		—		**24°**	
J Hydraulic Tilt (Manual Brace Centered)	442 mm	**1'5"**	—		399 mm	**1'4"**	—	
K Push Arm Trunnion Width (to Ball Centers)	2.89 m	**9'8"**	3.42 m	**11'5"**	3.42 m	**11'5"**	—	

*Blade capacities as determined by SAE J1265.
Notice that the capacity of the SU-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the SU-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.
**Shipping Weight — Total Bulldozer Arrangement includes: Blade, push arms or C-frame, braces, cylinders, lines, trunnions and lift cylinder mountings.

MODEL	D9R/D9T			
	9SU		9U	
Type	Semi-U		Universal	
Blade Capacities*	13.5 m^3	**17.7 yd^3**	16.4 m^3	**21.4 yd^3**
Weight, Shipping** (Dozer)	6863 kg	**15,130 lb**	7388 kg	**16,288 lb**
Tractor and Dozer Dimensions:				
A Length (Blade Straight)	6.60 m	**21'6"**	6.96 m	**22'8"**
Blade Dimensions:				
B Width (including std. end bits)	4.31 m	**14'1"**	4.65 m	**15'2"**
C Height	1934 mm	**6'4.1"**	1934 mm	**6'4.1"**
D Max. Digging Depth	606 mm	**1'11.9"**	606 mm	**1'11.9"**
E Ground Clearance @ Full Lift	1422 mm	**4'8"**	1422 mm	**4'8"**
G Max. Pitch Adjustment	**+3.4° to 2.9°**		**+3.4° to 2.9°**	
H Max. Hydraulic Tilt	940 mm	**3'1"**	1014 mm	**3'3.9"**
J Hydraulic Tilt (Manual Brace Centered)	570 mm	**1'10.4"**	616 mm	**2'0.3"**
K Push Arm Trunnion Width (to Ball Centers)	3.30 m	**10'8"**	3.30 m	**10'8"**
Maximum Track Width Permitted	762 mm	**2'6"**	762 mm	**2'6"**
Dual Tilt Option				
G Dual Pitch Adj.	**+4.8° to 5.2°**		**+4.8° to 4.9°**	
H Dual Max. Hyd. Tilt	1139 mm	**3'8.8"**	1231 mm	**4'0.5"**

*Blade capacities as determined by SAE J1265.
Notice that the capacity of the U-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the U-blade. It is intended for **relative comparisons of dozer sizes**, and not for predicting capacities or productivities in actual field conditions.
Notice that the capacity of the SU-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the SU-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.
**Shipping Weight — Total Bulldozer Arrangement includes: Blade, push arms or C-frame, braces, cylinders, lines, trunnions and lift cylinder mountings.

MODEL	D11T					
	11SU		11U		11 CD	
Type	Semi-U		Universal		CarryDozer	
Blade Capacities*	27.2 m^3	**35.5 yd^3**	34.4 m^3	**45.0 yd^3**	43.6 m^3	**57.0 yd^3**
Weight, Shipping**						
Standard Dozer	14 813 kg	**32,658 lb**	17 296 kg	**38,131 lb**	24 085 kg	**53,099 lb**
Abrasion Dozer	16 192 kg	**35,698 lb**	18 823 kg	**41,498 lb**	—	
Tractor and Dozer Dimensions:						
A Length	8.58 m	**28'2"**	8.64 m	**28'4"**	8.77 m	**28'9"**
Width	5.50 m	**18'1"**	6.26 m	**20'7"**	6.43 m	**21'1"**
Blade Dimensions:						
B Width (including std. end bits)	5.58 m	**18'4"**	6.35 m	**20'10"**	6.71 m	**22'0"**
C Height	2.75 m	**9'0"**	2.83 m	**9'3"**	2.96 m***	**9'8"*** **
D Max. Digging Depth	766 mm	**2'6.2"**	766 mm	**2'6.2"**	688 mm	**2'3"**
E Ground Clearance @ Full Lift	1533 mm	**5'0.4"**	1533 mm	**5'0.4"**	1850 mm	**6'1"**
G Max. Pitch Adjustment	**+2.1° to 2.2°**		**+2.1° to 2.2°**		—	
H Max. Hydraulic Tilt	1184 mm	**3'10.6"**	1344 mm	**4'4.9"**	1800 mm	**5'11"**
J Hydraulic Tilt (Manual Brace Centered)	886 mm	**2'10.9"**	1006 mm	**3'3.6"**	—	
K Push Arm Trunnion Width (to Ball Centers)	4.18 m	**13'9"**	4.18 m	**13'9"**	4.18 m	**13'9"**
Maximum Track Width Permitted	914 mm	**3'0"**	914 mm	**3'0"**	914 mm	**3'0"**
Dual Tilt Option	**+7.5° to 7.6°** or		**+7.5° to 7.6°** or			
G Dual Pitch Adjustment	**+0° to 13°**		**+0° to 13°**		**+47.8° to 10.4°**	
H Dual Max. Hyd. Tilt	1706 mm	**5'7.2"**	1938 mm	**6'4.3"**	—	

*Blade capacities as determined by SAE J1265.
Notice that the capacity of the U-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the U-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.
Notice that the capacity of the SU-blade is the volume carried by a straight blade of the same dimensions plus the volume included in the "cup" of the SU-blade. It is intended for **relative comparisons of dozer sizes,** and not for predicting capacities or productivities in actual field conditions.
**Shipping Weight — Total Bulldozer Arrangement includes: Blade, push arms or C-frame, braces, cylinders, lines, trunnions and lift cylinder mountings.
***Blade height with cutting edge at 53°.

All dimensions are approximate.

BULLDOZER PRODUCTION OFF-THE-JOB

You can estimate bulldozer production using the production curves that follow and the correction factors that are applicable. Use this formula:

$$\text{Production } (Lm^3/hr) \text{ (LCY/hr)} = \text{Maximum production} \times \text{Correction factors}$$

The bulldozer production curves give maximum uncorrected production for universal, semi-universal, and straight blades and are based on the following conditions:

1. 100% efficiency (60 minute hour — level cycle).
2. Power shift machines with 0.05 min. fixed times.
3. Machine cuts for 15 m (50 feet), then drifts blade load to dump over a high wall. (Dump time — 0 sec.)
4. Soil density of 1370 kg/Lm^3 (2300 lb/LCY).
5. Coefficient of traction:*
   a. Track machines — 0.5 or better
   b. Wheel machines — 0.4 or better
6. Hydraulic controlled blades used.
7. Dig 1F**
   Carry 2F**
   Return 2R**

To obtain estimated production in bank cubic meters or bank cubic yards, appropriate load factor from the Tables section should be applied to the corrected production as calculated above.

$$\text{Production } Bm^3/hr \text{ (BCY/h)} = Lm^3/hr \text{ (LCY/h)} \times LF$$

*Coefficient of traction assumed to be at least 0.4. While poor traction affects both track and wheel vehicles, causing them to take smaller blade loads, wheeled units are affected more severely and production falls much more rapidly. While no fixed rules can predict this production loss, a rough rule of thumb is that wheel dozer production falls off 4% for each one-hundredth decrease in coefficient of traction below 0.40. If, for example, coefficient of traction is 0.30, the difference is ten-hundredths (0.10), and production is 60% (10 × 4% = 40% decrease).

**This gear sequence is based on level to downhill terrain, light to medium density material, and no blade extensions such as spill plates, rock guards, etc. Exceeding these conditions may require carry in 1F, but productivity should equal or exceed "standard conditions" due to the larger loads that can be carried in 1F.

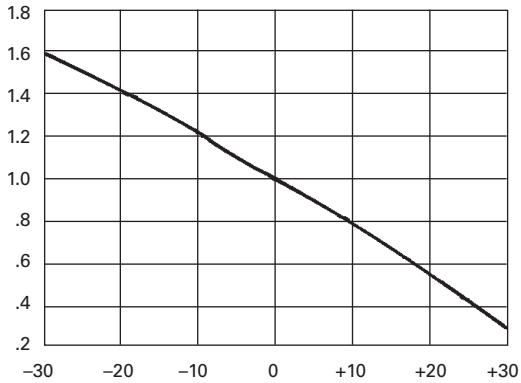
JOB CONDITION CORRECTION FACTORS

	TRACK-TYPE TRACTOR
OPERATOR —	
Excellent	1.00
Average	0.75
Poor	0.60
MATERIAL —	
Loose stockpile	1.20
Hard to cut; frozen —	
with tilt cylinder	0.80
without tilt cylinder	0.70
Hard to drift; "dead" (dry, non-cohesive material) or very sticky material	0.80
Rock, ripped or blasted	0.60-0.80
SLOT DOZING	1.20
SIDE BY SIDE DOZING	1.15-1.25
VISIBILITY —	
Dust, rain, snow, fog or darkness	0.80
JOB EFFICIENCY —	
50 min/hr	0.83
40 min/hr	0.67
BULLDOZER*	
Adjust based on SAE capacity relative to the base blade used in the Estimated Dozing Production graphs.	
GRADES — See following graph.	

***NOTE:** Angling blades and cushion blades are not considered production dozing tools. Depending on job conditions, the A-blade and C-blade will average 50-75% of straight blade production.

% Grade vs. Dozing Factor

(–) Downhill
(+) Uphill



ESTIMATING DOZER PRODUCTION OFF-THE-JOB

Example problem:

Determine average hourly production of a D8T/8SU (with tilt cylinder) moving hard-packed clay an average distance of 45 m (150 feet) down a 15% grade, using a slot dozing technique.

Estimated material weight is 1600 kg/Lm^3 (2650 lb/LCY). Operator is average. Job efficiency is estimated at 50 min/hr.

Uncorrected Maximum Production — 458 Lm^3/h (600 LCY/hr) (example only)

Applicable Correction Factors:

Hard-packed clay is "hard to cut" material . . .–0.80
Grade correction (from graph) . . . . . .–1.30
Slot dozing . . . . . .–1.20
Average operator . . . . . .–0.75
Job efficiency (50 min/hr) . . . . . .–0.83
Weight correction. . . . . (2300/2650)–0.87

Production = Maximum Production × Correction Factors
= (600 LCY/hr) (0.80) (1.30) (1.20) (0.75) (0.83) (0.87)
= 405.5 LCY/hr

To obtain production in metric units, the same procedure is used substituting maximum uncorrected production in Lm^3.

= 458 Lm^3/h × Factors
= 309.6 Lm^3/h

RIPPERS

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Features:

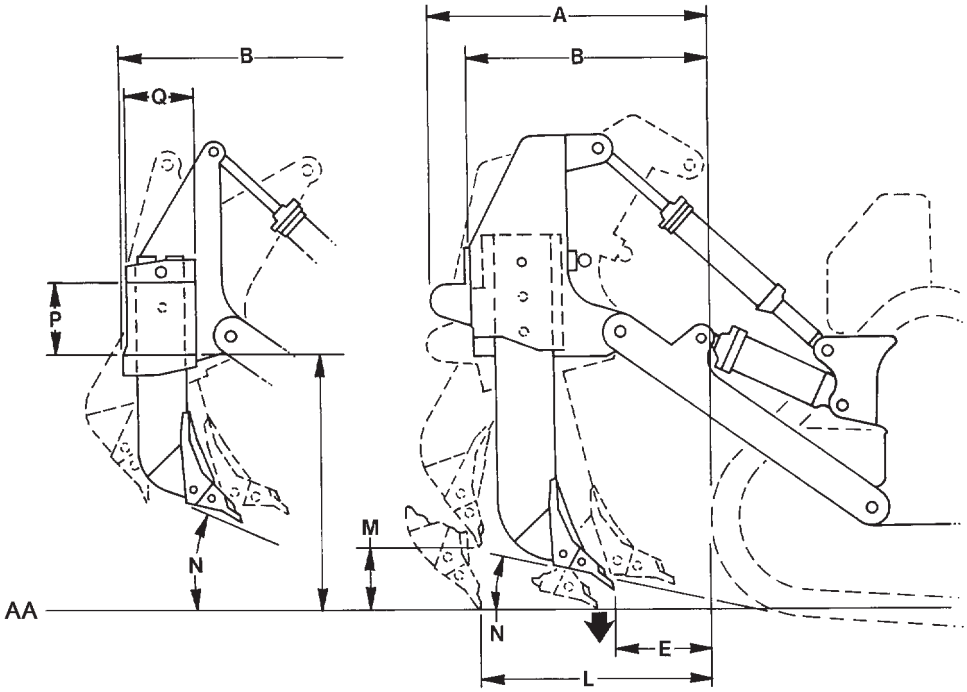
- **Parallelogram linkage with hydraulically variable pitch** on D7E, D7R, D8R/D8T, D9R/D9T, D10T2 and D11T. Operator can adjust angle of ripper tip to the material for penetration at all ripping depths to increase production.
- **Fixed Parallelogram linkage design** used on D3K2, D4K2, D5K2, D6K2, D6N, D6R, D6R XL, D6T and D6T XL. This design holds tooth angle constant at all ripping depths.
- **Adjustable Single shank** arrangements available for D8R/D8T, D9R/D9T, D10T2 and D11T for tough ripping applications and deep ripping requirements.
- **Hydraulically Variable Pitch Multi-shank** arrangements available on D7E, D7R, D8R/D8T, D9R/D9T, D10T2 and D11T allow wide-beam coverage in easier-to-rip materials.
- **Counterweighted CarryDozer Ripper single shank** available for D11T and D11T CD, multi-shank available for D11T CD.

DEFINITION OF FORCES SHOWN IN TABLES THAT FOLLOW

"Pryout," (Breakout) kilonewtons (and pounds) — the maximum sustained upward force, generated by the lift cylinders measured at the ripper tip. Breakout force is measured with the shank in the top hole, shank vertical and ripper full down. Breakout force may be hydraulically or balance limited.

"Penetration force," kilonewtons (and pounds) — the maximum sustained downward force, generated by the ripper lift cylinders measured at the ripper tip, which is required to raise the back end of the vehicle with the tip on ground and the shank (pinned in the top hole) vertical.

Adjustable Parallelogram Ripper

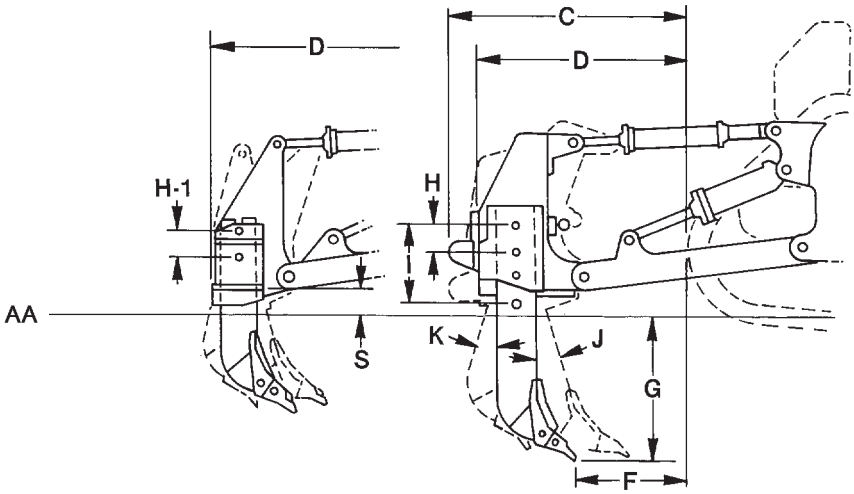


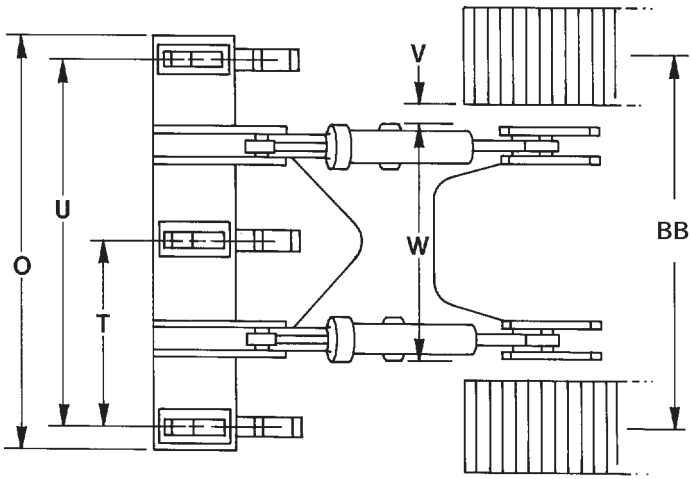
NOTE: Letters correspond to ripper specifications on pages that follow.

KEY

AA — Ground Line

Adjustable Parallelogram Ripper





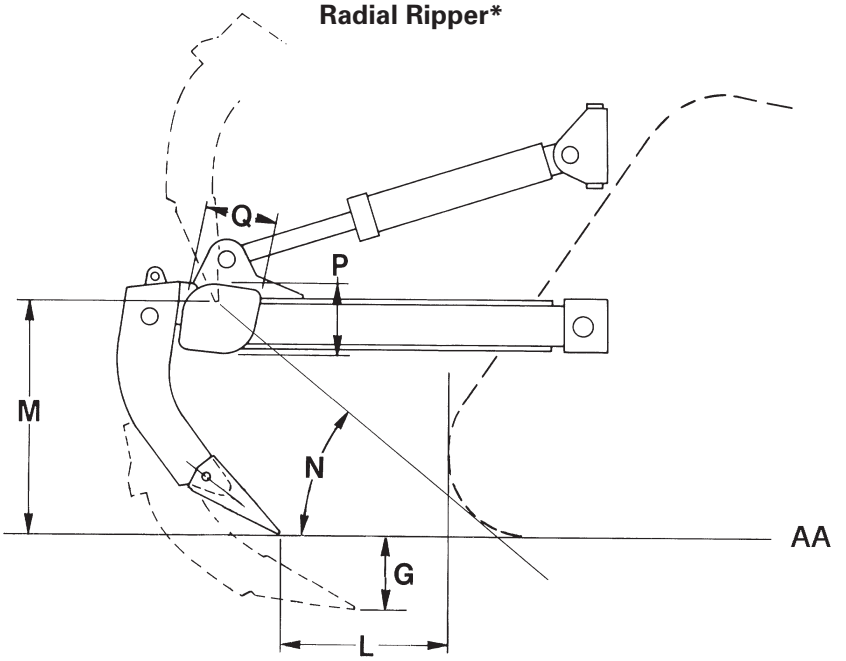
NOTE: Letters correspond to ripper specifications on pages that follow.

KEY

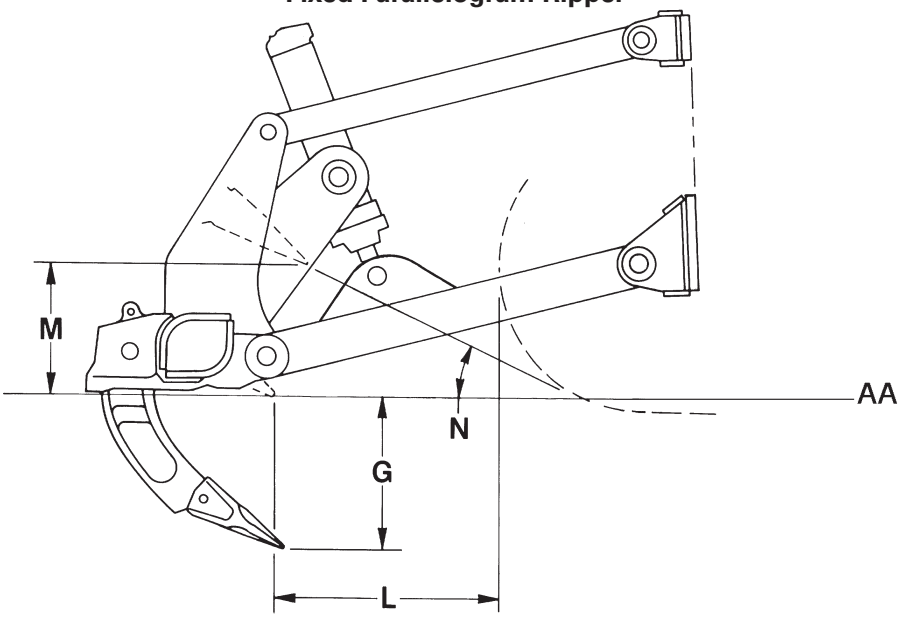
AA — Ground Line
BB — Track Gauge

Specification Diagrams
- Radial Ripper
- Fixed Parallelogram Ripper

Radial Ripper*



Fixed Parallelogram Ripper



NOTE: Letters correspond to ripper specifications on pages that follow.

KEY

AA — Ground Line
* — Tip Standard

TRACTOR/RIPPER	D11T		D11T	
	Adjustable Parallelogram			
Ripper Type	**Multi-shank**		**CD Multi-shank**	
Dimensions:				
Ripper to Track				
Ripper length behind track, shank vertical, ripper up (A)				
A With Pushblock	**N/A**		**N/A**	
B Without Pushblock	1.69 m	**5'6"**	1.71 m	**5'8"**
Ripper length behind track, shank vertical, ripper down (A)				
C With Pushblock	**N/A**		**N/A**	
D Without Pushblock	2.16 m	**7'1"**	2.16 m	**7'1"**
Tip to track distance, shank vertical (A)				
E Ripper Up	0.78 m	**2'7"**	0.78 m	**2'7"**
F Ripper Down	1.95 m	**6'5"**	1.96 m	**6'5"**
Shank*				
G Maximum digging depth	1100 mm	**3'7.3"**	1100 mm	**3'7.3"**
H Dig adjustment per hole	280 mm	**11"**	280 mm	**11"**
I Total dig adjustment	280 mm	**11"**	280 mm	**11"**
Pitch Adjustment, ripper down:				
J Forward	**12.2°**		**12.2°**	
K Backward	**31.8°**		**31.8°**	
L Maximum reach at ground line	1.71 m	**5'7"**	1.71 m	**5'7"**
M Maximum ground clearance under tooth (shank pinned in bottom hole)	1090 mm	**3'6.9"**	1090 mm	**3'6.9"**
N Maximum ramp angle, ripper up (shank pinned in bottom hole)	**36.4°**		**36.4°**	
Shank Section	100 × 400 mm	**3.9" × 15.7"**	100 × 400 mm	**3.9" × 15.7"**
Ripper Beam				
O Overall width	3.33 m	**10'11"**	3.34 m	**10'11.5"**
P Height	560 mm	**22"**	595 mm	**23.4"**
Q Length	560 mm	**22"**	595 mm	**23.4"**
Clearance under beam, shank vertical				
R Ripper Up	2.06 m	**6'9"**	2.03 m	**6'8"**
S Ripper Down	282 mm	**11.1"**	247 mm	**9.7"**
Number of Pockets	**3**		**3**	
T Pocket Spacing	1.5 m	**4'11"**	1.5 m	**4'11"**
U Shank Gauge	3.0 m	**9'10"**	3.0 m	**9'10"**
V Track Clearance with standard shoe	166 mm	**5.6"**	166 mm	**5.6"**
W Width across widest part of lift cylinders	1.9 m	**6'3"**	1.9 m	**6'3"**
Installed Weights:				
Ripper with standard shank	8674 kg	**19,123 lb**	11 790 kg	**25,993 lb**
Each additional tooth group	689 kg	**1519 lb**	689 kg	**1519 lb**
Ripper Forces:**				
Penetration Force, shank vertical	335 kN	**75,311 lb**	365 kN	**82,055 lb**
Pryout Force, shank vertical	632 kN	**142,079 lb**	636 kN	**142,978 lb**

*Hydraulic pin puller is standard with deep ripping shank. Deep Ripping Arrangement maximum digging depth is 2.18 m **(7'2")**.
**Forces are for a ripper on a tractor equipped with an EROPS, U-Dozer and performance track. Forces will vary slightly with other vehicle configurations.

TIP SELECTION FOR THE D8R/D8T, D9R/D9T, D10T2 AND D11T RIPPERS

Three tip configurations (short, intermediate and long) in two styles (centerline and penetration) are available for economical operation in a variety of conditions.

RECOMMENDED TIP USAGE

Short — Use in high impact conditions where breakage problems occur. The shorter the tip, the more it resists breakage.

Intermediate — Most effective in moderate impact conditions where abrasion is not excessive.

Long — Use in loose, abrasive materials where breakage is not a problem. Generally offers the most wear material.

Centerline vs Penetration

The materials being ripped and the tractor doing the ripping will both have an effect on which tip will do the best job. High density material requires a "penetration" tip. High impact material requires a "centerline" tip. The following is a general guide to tip application.

	Tips to use		
Ripping Condition	**D8R/D8T D9R/D9T**	**D10T2**	**D11T**
Tandem Tractors	Short	Short	Short
Single Shank and Multi-shank			
Extreme Duty.	Int.	Short	Short
Medium Duty.	Long	Int.	Int.
Abrasive Duty	Long	Long	Long

Always use the longest tip that will wear without excessive breakage. Different tips should be tried to determine the most economical.

ESTIMATING RIPPING PRODUCTION

Ripping costs must be compared to other methods of loosening the material — usually drilling and blasting — on a cost per ton or bank cubic yard basis. Thus, an accurate estimation of ripper production is needed to determine unit ripping costs.

There are three general methods of estimating ripping production:

1. The best method is to record the time spent ripping, then remove (using scrapers or loaders and trucks) and weigh the ripped material. The total weight divided by the time spent will give hourly production. If the contractor is paid by volume, then a density must be used and the accuracy is only as good as the density used. For payment by volume removed, method 2 may be desirable. Some care will be needed to assure that only ripped material is removed.
2. Another method is to cross-section the area and then record the time spent ripping. After the material has been removed, cross-section the area again to determine the volume of rock removed. The volume divided by the time spent ripping gives the ripping rate per minute or hour.
3. Timing the ripper over a measured distance is the least accurate method, but valuable for quick estimating on the job. An average cycle time should be determined from a number of timed cycles. Turn-around or back-up time must be included. Measure the average rip distance, rip spacing and depth of penetration. This data will give the volume per cycle from which the production in bank cubic yards can be calculated. Experience has shown results obtained from this method are about 10 to 20% higher than the more accurate method of cross-sectioning.

An example of the measured distance method for calculating ripper production is:

Data — D10T2 — No. 10 with one shank.
910 mm (36 in) between passes.
1.6 km/h (1 mph) average speed (including slippage and stalls).

Every 91 m (300 ft) requires 0.25 min to raise, pivot, turn, and lower again: 91 m (300 ft) = 1 pass.

610 mm (24 in) penetration.

Full time ripping (no pushing or dozing assignment).

Example of Estimating Production (Metric)

Time per pass:

1.6 km/h = 26.7 m/min. Then $\frac{91 \text{ m}}{26.7 \text{ m/min}} = 3.41$ min;

3.41 min + 0.25 min (turn time) = 3.66 min/pass.

If the operator works an average of 45 min per h, it is possible to make = $\frac{45}{3.66} = 12.3$ passes per h

Volume ripped: 91 m × 0.9 m × 0.6 m = 49.1 BCM per pass

Production = 49.1 × 12.3 = 604 BCM per h

Remember the results from this method are usually 10 to 20 per cent higher than the actual production that can be expected on the job.

●●●

Example of Estimating Production (English)

Time per pass:

MPH = 88 fpm. Then $\frac{300 \text{ ft}}{88 \text{ fpm}} = 3.41$ min;

3.41 min + 0.25 min. (turn time) = 3.66 min/pass.

If the operator works an average of 45 min per h, it is possible to make = $\frac{45}{3.66} = 12.3$ passes per h

Volume ripped: $\frac{300 \times 3 \times 2}{27} = 66.7$ BCY per pass

Production = 66.7 × 12.3 = 820 BCY per hr

●●●

NOTE: The demands of heavy ripping will increase the normal owning and operating costs of the tractor.

These costs should be increased no less than 30-40% in heavy ripping applications to estimate rock loosening costs.

There is no ready answer or rule-of-thumb solution to predict ripping production. Even if everything is known about the seismic velocity of the material, its composition, job conditions, equipment and operator, only a "guesstimate" can be given. The final answer must come from a production study obtained on the job site.

Sample problem (Metric)

Determine the loosening costs in the following situation:

Machine	— D10T2 Tractor with No. 10 Single Shank Ripper
Rip Spacing	— 915 mm
Ripper Penetration	— 610 mm
Rip Distance	— 91 m
Rip Time	— 3.41 minutes
Maneuver Time	— 0.25 minutes
Seismic Velocity	— 1830 meters per second

Assume 60 min. hour

Solution:

1. Total Cycle Time = 3.41 + 0.25 = 3.66 min

   Cycles/hour = $\frac{60 \text{ min/hr}}{3.66 \text{ min/cycle}} = 16.4$

2. Production per cycle = 91 m × 0.9 m × 0.6 m = 49.1 BCM/cycle
3. Production = 49.1 BCM/cycle × 16.4 cycles/h = 805 BCM/h
4. Remember results of this method are usually 10 to 20% high.

   Actual Production = 80% of 805 BCM/h = 644 BCM/h

   Or 90% of 805 BCM/h = 725 BCM/h
5. Owning and Operating Costs

   A D10T2 (ripping only) could have a $115.00/h O & O costs including $30/h operator.
6. Loosening Costs

   $115.00/hr ÷ 644 BCM/h = $0.179/BCM

   $115.00/hr ÷ 725 BCM/h = $0.159/BCM

   The loosening cost should range from 15.9¢ to 17.9¢/BCM

●●●

Sample problem (English)

Determine the loosening costs in the following situation:

Machine	— D10T2 Tractor with No. 10 Single Shank Ripper
Rip Spacing	— 3 feet
Ripper Penetration	— 2 feet
Rip Distance	— 300 feet
Rip Time	— 3.41 minutes
Maneuver Time	— 0.25 minutes
Seismic Velocity	— 6000 feet per second

Assume 60 min. hour

Solution:

1. Total Cycle Time = 3.41 + 0.25 = 3.66 min

$$\text{Cycles/hour} = \frac{60 \text{ min/hr}}{3.66 \text{ min/cycle}} = 16.4$$

2. Production per cycle = $\frac{300 \times 3 \times 2}{27}$ = 66.7 BCY/cycle

3. Production = 66.7 BCY/cycle × 16.4 cycles/hr = 1094 BCY/hour

4. Remember results of this method are usually 10 to 20% high.
   Actual Production = 80% × 1094
   = 875 BCY/hr
   or 90% × 1094 = 984 BCY/hr

5. Owning and Operating Costs
   A D10T2 (ripping only) could have a $115.00/hr O & O costs including $30/hr operator

6. Loosening Costs
   $115.00/hr ÷ 875 BCY/hr = $0.131/BCY
   $115.00/hr ÷ 984 BCY/hr = $0.117/BCY
   The loosening cost should range from 11.7¢ to 13.1¢/BCY

●●●

USE OF SEISMIC VELOCITY CHARTS

The charts of ripper performance estimated by seismic wave velocities have been developed from field tests conducted in a variety of materials. Considering the extreme variations among materials and even among rocks of a specific classification, the charts must be recognized as being at best only one indicator of rippability.

Accordingly, consider the following precautions when evaluating the feasibility of ripping a given formation:

— Tooth penetration is often the key to ripping success, regardless of seismic velocity. This is particularly true in homogeneous materials such as mudstones and claystones and the fine-grained caliches. It is also true in tightly cemented formations such as conglomerates, some glacial tills and caliches containing rock fragments.

— Low seismic velocities of sedimentaries can indicate probable rippability. However, if the fractures and bedding joints do not allow tooth penetration, the material may not be ripped effectively.

— Pre-blasting or "popping" may induce sufficient fracturing to permit tooth entry, particularly in the caliches, conglomerates and some other rocks; but the economics should be checked carefully when considering popping in the higher grades of sandstones, limestones and granites.

Ripping is still more art than science, and much will depend on operator skill and experience. Ripping for scraper loading may call for different techniques than if the same material is to be dozed away. Cross-ripping requires a change in approach. The number of shanks used, length and depth of shank, tooth angle, direction, throttle position — all must be adjusted according to field conditions. Ripping success may well depend on the operator finding the proper combination for those conditions.

WHEEL LOADERS
INTEGRATED TOOLCARRIERS

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WHEEL LOADERS

Features:

- **Cat® heavy duty diesel engine.**
- **Productive operator environment. Excellent visibility.**
- **Automatic lift and bucket controls.**
- **Adjustable suspension seat and steering column.**
- **Four wheel enclosed wet disc brakes.**
- **Automatic power shift transmissions.** Allows operator to select automatic or manual mode.
- **Hydrostatic drive on 903C2, 906K/M, 907K/M, 908K/M, 910K/M, 914K/M, 918M, 924K, 926M, 930K/M and 938K/M.**
- **Transmission neutralizer switch (950H-980H, 950K-980K, 950L-980L and 950M-982M).**
- **Advanced power train with continuously variable transmission** available on the 966M XE and 972M XE.
- **Computerized machine function monitoring.**
- **Command control steering** with integrated transmission controls and electro-hydraulic controls … 950H-980H.
- **Electro-Hydraulic (EH) Joystick Steering with Force Feedback (Speed Sensitive) on 966K, 966M, 972K, 972M, 980K, 980M and 982M (optional on 950M and 962M).**
- **Lock up clutch on 950L, 950M, 962L, 962M, 966L, 966M, 972L, 972M, 980L, 980M, 982M, 988K, 990K and 994K (optional on the 980K, 992K and 993K).**
- **Impeller clutch on 988K, 990K, 992K, 993K and 994K.**
- **Tilting hood … 950H-980H, 950K-980K, 950L-980L and 950M-982M.**
- **Brake wear indicator.**
- **Limited slip differentials on 924K, 926M, 930K/M, 938K/M (optional on 950H-980H, 950K-980K, 980L, 980M and 982M).**
- **Differential locks … 903C2, 906K/M, 907K/M, 908K/M, 910K/M, 914K/M, 918M, 924K, 926M, 930K/M, 938K/M, 950M, 962M, 966M and 972M (optional on 950L, 962L, 966L and 972L).**
- **Automatic Ride Control suspension system.** Operator select "on," "off" or "automatic" (excluding 903C2).
- **Payload control system** (excluding models below 924K).
- **Optional Fusion coupler system** for attachment interchangeability with pin-on performance. Attachments can interchange across the entire SWL/MWL/IT line (excluding models below 924K).
- **Performance Series Buckets** — Reduced dig times and better material retention lead to significant productivity and fuel efficiency improvements (910K/M, 914K/M, 918M, 924K, 926M, 930K/M, 938K/M, 950H-980H, 950K- 980K, 950L-980L and 950M-982M).

Listed features may be standard on some models, optional or unavailable on others. Contact your Cat dealer for specific information.

MODEL	950H		962H		966H	
Emission Standards	**Tier 3 equivalent***		**Tier 3 equivalent***		**Tier 3 equivalent***	
Maximum Engine: Net	147 kW	**197 hp**	156 kW	**209 hp**	195 kW	**262 hp**
Gross	162 kW	**217 hp**	172 kW	**231 hp**	211 kW	**283 hp**
Engine Model	**C7 ACERT**		**C7 ACERT**		**C11 ACERT**	
Maximum Net Power Engine RPM	**1800**		**1800**		**1800**	
Bore	110 mm	**4.3"**	110 mm	**4.3"**	130 mm	**5.1"**
Stroke	127 mm	**5"**	127 mm	**5"**	140 mm	**5.5"**
No. Cylinders	**6**		**6**		**6**	
Displacement	7.2 L	**439 in³**	7.2 L	**439 in³**	11.1 L	**677 in³**
Speeds Forward:	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**
1st	6.9	**4.3**	7.0	**4.4**	6.7	**4.2**
2nd	12.7	**7.9**	13.0	**8.1**	12.6	**7.8**
3rd	22.3	**13.9**	22.6	**14.0**	22.1	**13.7**
4th	37.0	**23.0**	38.0	**23.6**	37.4	**23.2**
Speeds Reverse:	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**
1st	7.6	**4.7**	7.6	**4.7**	7.4	**4.6**
2nd	13.9	**8.6**	13.9	**8.6**	13.9	**8.6**
3rd	24.5	**15.2**	24.5	**15.2**	24.3	**15.1**
4th	40.0	**24.9**	40.0	**24.9**	37.4	**23.2**
Hydraulic Cycle Time, Rated Load in Bucket:	**Seconds**		**Seconds**		**Seconds**	
Raise (from Carry Position)	**6.2**		**6.2**		**5.9**	
Dump (at Maximum Raise)	**2.0**		**2.0**		**1.6**	
Lower (Empty, Float Down)	**2.5**		**2.5**		**2.4**	
Total	**10.7**		**10.7**		**9.9**	
Tread Width	2.14 m	**7'0"**	2.14 m	**7'0"**	2.23 m	**7'4"**
Width Over Tires	2.79 m	**9'2"**	2.79 m	**9'2"**	3.06 m	**9'10"**
Ground Clearance	412 mm	**16"**	412 mm	**16"**	434 mm	**17"**
Fuel Tank Capacity	264 L	**70 U.S. gal**	264 L	**70 U.S. gal**	380 L	**100 U.S. gal**
Hydraulic Tank Capacity	110 L	**29 U.S. gal**	110 L	**29 U.S. gal**	110 L	**29 U.S. gal**
Hydraulic System Capacity (includes tank)	186 L	**48.4 U.S. gal**	186 L	**48.4 U.S. gal**	200 L	**52 U.S. gal**

*Meets Tier 3, Stage IIIA, Japan 2006 (Tier 3) equivalent emission standards.
NOTE: Net Engine Power is provided according to SAE J1349 and ISO 9249. Gross Engine Power is provided according to SAE J1995. Machines may only be available in certain regions. Contact your local Cat dealer for product availability.

MODEL	972H		980H		986H		990K	
Emission Standards	**Tier 3 equivalent***		**Tier 3 equivalent***		**Tier 2 equivalent or Tier 3 equivalent****		**Tier 2 equivalent or Tier 4 Final*****	
Maximum Engine: Net	214 kW	**287 hp**	260 kW	**349 hp**	305 kW	**409 hp**	521 kW	**699 hp**
Gross	232 kW	**311 hp**	293 kW	**392 hp**	335 kW	**449 hp**	561 kW	**752 hp**
Rated Payload†	—		—		10 tonnes	**11 tons**	15.9 tonnes	**17.5 tons**
Gross Rated Bucket Payload†	—		—		—		24 249 kg	**53,460 lb**
Engine Model	**C13 ACERT**		**C15 ACERT**		**C15 ACERT**		**C27 ACERT**	
Maximum Net Power Engine RPM	**1800**		**1800**		**1800**		**1800**	
Bore	130 mm	**5.1"**	137 mm	**5.4"**	137 mm	**5.4"**	137 mm	**5.4"**
Stroke	157 mm	**6.2"**	171 mm	**6.75"**	171 mm	**6.75"**	152 mm	**6"**
No. Cylinders	**6**		**6**		**6**		**12**	
Displacement	12.5 L	**763 in³**	15.2 L	**928 in³**	15.2 L	**928 in³**	27.0 L	**1650 in³**
Speeds Forward:	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**
1st	7.2	**4.5**	6.6	**4.1**	7.3	**5**	7.3	**4.5**
2nd	12.6	**7.8**	11.8	**7.3**	12.7	**8**	13.3	**8.3**
3rd	21.4	**13.3**	20.7	**12.9**	22	**14**	22.9	**14.2**
4th	36.9	**22.9**	36.3	**22.6**	39	**24**	—	
Speeds Reverse:	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**
1st	8.2	**5.1**	7.6	**4.7**	7.6	**5**	7.9	**4.9**
2nd	14.2	**8.8**	13.5	**8.4**	14.1	**9**	14.7	**9.1**
3rd	24.3	**15.1**	23.6	**14.7**	25	**12**	24.9	**15.5**
4th	38.8	**24.0**	41.5	**25.8**	—		—	
Hydraulic Cycle Time, Rated Load in Bucket:	**Seconds**		**Seconds**		**Seconds**		**Seconds**	
Raise††	**5.9**		**6.0**		**8.5**		**8.2**	
Dump (at Maximum Raise)	**2.1**		**2.1**		**3**		**2.9**	
Lower (Empty, Float Down)	**2.4**		**3.4**		**4.3**		**3.6**	
Total	**10.4**		**11.5**		**15.8**		**13.8**	
Tread Width	2.23 m	**7'4"**	2.43 m	**8'0"**	2.59 m	**8'6"**	3.1 m	**10'2"**
Width Over Tires	3.00 m	**9'10"**	3.18 m	**10'5"**	3.54 m	**11'7"**	4.1 m	**13'5"**
Ground Clearance	434 mm	**17"**	430 mm	**16.9"**	459 mm	**18"**	596 mm	**23.5"**
Fuel Tank Capacity	380 L	**100 U.S. gal**	453 L	**120 U.S. gal**	600 L	**159 U.S. gal**	1114 L	**294 U.S. gal**
Hydraulic Tank Capacity	110 L	**29 U.S. gal**	125 L	**33 U.S. gal**	130 L	**34 U.S. gal**	—	
Implement and Fan	—		—		—		261 L	**68.9 U.S. gal**
Steering and Braking	—		—		—		132 L	**34.9 U.S. gal**
Hydraulic System Capacity (includes tank)	200 L	**52 U.S. gal**	250 L	**66 U.S. gal**	330 L	**87 U.S. gal**	795 L	**210 U.S. gal**

*Meets Tier 3, Stage IIIA, Japan 2006 (Tier 3) equivalent emission standards.
**Meets Tier 2/Stage II/Japan 2001 (Tier 2) equivalent OR Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.
***Meets Tier 2/Stage II/Japan 2001 (Tier 2) equivalent OR Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) emission standards.
†Changes in bucket weight, including field installed wear iron, can impact rated payload. Consult your Cat dealer for assistance in selecting and configuring the proper bucket for the application. The Cat Large Wheel Loader Payload Policy is a guideline intended to maximize wheel loader structural and component life. The Cat Payload Policy is that the "Gross Bucket plus Payload Capacity" is the MAXIMUM weight that should be carried on the end of the Lift Arm/Boom.
††Raise is from carry position for the 972H and 980H.
NOTE: 972H and 980H Net Engine Power is provided according to SAE J1349 and ISO 9249. Gross Engine Power is provided according to SAE J1995. The 972H and 980H are not available in all regions. Contact your local Cat dealer for product availability.

MODEL	992K		993K		994K	
Maximum Engine: Net	607 kW	**814 hp**	764 kW	**1024 hp**	1297 kW	**1739 hp**
Gross	671 kW	**900 hp**	773 kW	**1036 hp**	1377 kW	**1847 hp**
Rated Payload:*						
STD	21.8 tonnes	**24 tons**	22.7 tonnes	**30 tons**	40.8 tonnes	**45 tons**
HL, EHL, SHL	19 tonnes	**21 tons**	24.9 tonnes	**27.5 tons**	38.1 tonnes	**42 tons**
Gross Rated Bucket Payload:*						
STD	33 687 kg	**74,265 lb**	42 912 kg	**94,603 lb**	64 791 kg	**142,838 lb**
HL	30 138 kg	**66,441 lb**	40 459 kg	**89,195 lb**	61 458 kg	**135,489 lb**
Engine Model	**C32 ACERT****		**C32 ACERT****		**3516E**	
Emission Level						
Rated Engine RPM	**1750**		**1900**		**1600**	
Bore	145 mm	**5.7"**	145 mm	**5.7"**	170 mm	**6.7"**
Stroke	162 mm	**6.4"**	162 mm	**6.4"**	215 mm	**8.5"**
No. Cylinders	**12**		**12**		**16**	
Displacement	32.1 L	**1959 in³**	32.1 L	**1959 in³**	78 L	**4766 in³**
Speeds Forward:	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**
1st	7.1	**4.4**	6.8	**4.2**	7.4	**4.6**
2nd	12.2	**7.6**	11.9	**7.4**	12.9	**8.0**
3rd	20.6	**12.8**	20.5	**12.7**	24.0	**14.9**
Speeds Reverse:	**km/h**	**mph**	**km/h**	**mph**	**km/h**	**mph**
1st	7.4	**4.6**	7.5	**4.7**	8.1	**5.0**
2nd	13.0	**8.1**	13.1	**8.1**	14.1	**8.8**
3rd	22.4	**13.9**	22.5	**13.9**	24.0	**14.9**
Hydraulic Cycle Time, Rated Load in Bucket:	**Seconds**		**Seconds**		**Seconds**	
Raise	**9.4**		**9.2**		**12.6**	
Dump	**1.8**		**1.8**		**3.1**	
Lower (Empty, Float Down)	**3.7**		**3.1**		**4.2**	
Total	**14.9**		**14.1**		**19.9**	
Tread Width	3.3 m	**10'10"**	3.54 m	**11'6"**	4.3 m	**14'1"**
Width Over Tires	4.5 m	**14'9"**	4.93 m	**16'2"**	5.49 m	**18'10"**
Ground Clearance	682 mm	**26.8"**	721 mm	**2'5"**	898 mm	**33"**
Fuel Tank Capacity	1610 L	**425 U.S. gal**	2170 L	**573 U.S. gal**	3445 L	**910 U.S. gal**
Hydraulic Systems:						
Lift, Tilt	646 L	**171 U.S. gal**	755 L	**199 U.S. gal**	1022 L	**270 U.S. gal**
Tank Only	326 L	**86 U.S. gal**	553 L	**146 U.S. gal**	756 L	**200 U.S. gal**
Steering and Brakes	231 L	**61 U.S. gal**	227 L	**60 U.S. gal**	379 L	**100 U.S. gal**
Tank Only	159 L	**42 U.S. gal**	185 L	**48.9 U.S. gal**	340 L	**90 U.S. gal**

*Changes in bucket weight, including field installed wear iron, can impact rated payload. Consult your Cat dealer for assistance in selecting and configuring the proper bucket for the application. The Cat Large Wheel Loader Payload Policy is a guideline intended to maximize wheel loader structural and component life. The Cat Payload Policy is that the "Gross Bucket plus Payload Capacity" is the MAXIMUM weight that should be carried on the end of the Lift Arm/Boom.

**Products available to meet Tier 2/Stage II/Japan 2001 (Tier 2) equivalent OR Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) emission standards.

NOTE: The 994K meets Tier 1 equivalent emission standards.

Bucket Type		General Purpose — Pin On								High Lift Delta
Edge Type		Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	
Capacity — rated	m³	3.80	3.80	4.00	4.00	4.20	4.20	4.60	4.60	—
	yd³	**4.97**	**4.97**	**5.23**	**5.23**	**5.49**	**5.49**	**6.02**	**6.02**	**—**
Capacity — 110%	m³	4.18	4.18	4.40	4.40	4.62	4.62	5.06	5.06	—
	yd³	**5.47**	**5.47**	**5.75**	**5.75**	**6.04**	**6.04**	**6.62**	**6.62**	**—**
Width	mm	3220	3271	3220	3271	3220	3271	3220	3271	—
	ft/in	**10'6"**	**10'8"**	**10'6"**	**10'8"**	**10'6"**	**10'8"**	**10'6"**	**10'8"**	**—**
Dump clearance at maximum lift and 45° discharge	mm	3067	2915	3058	2905	2991	2837	2977	2823	558
	ft/in	**10'0"**	**9'6"**	**10'0"**	**9'6"**	**9'9"**	**9'3"**	**9'9"**	**9'3"**	**1'9"**
Reach at maximum lift and 45° discharge	mm	1327	1467	1334	1473	1388	1525	1400	1537	–25
	ft/in	**4'4"**	**4'9"**	**4'4"**	**4'10"**	**4'6"**	**5'0"**	**4'7"**	**5'0"**	**–1"**
Reach at level lift arm and bucket level	mm	2739	2943	2750	2955	2838	3043	2857	3062	404
	ft/in	**8'11"**	**9'7"**	**9'0"**	**9'8"**	**9'3"**	**9'11"**	**9'4"**	**10'0"**	**1'3"**
Digging depth	mm	124	124	124	124	124	124	124	124	–25
	in	**4.9**	**4.9**	**4.9**	**4.9**	**4.9**	**4.9**	**4.9**	**4.9**	**–1"**
Overall length	mm	8681	8906	8693	8918	8780	9005	8799	9024	697
	ft/in	**28'6"**	**29'3"**	**28'7"**	**29'4"**	**28'10"**	**29'7"**	**28'11"**	**29'8"**	**2'3"**
Overall height with bucket at maximum lift	mm	5788	5788	5902	5902	5902	5902	5874	5874	558
	ft/in	**19'0"**	**19'0"**	**19'5"**	**19'5"**	**19'5"**	**19'5"**	**19'4"**	**19'4"**	**1'9"**
Loader clearance circle with bucket at carry position	mm	14 727	14 899	14 733	14 905	14 778	14 951	14 787	14 961	481
	ft/in	**48'4"**	**48'11"**	**48'5"**	**48'11"**	**48'6"**	**49'1"**	**48'7"**	**49'1"**	**1'6"**
Static tipping load, straight (ISO)*	kg	16 045	15 863	16 024	15 842	15 831	15 648	15 822	15 636	372
	lb	**35,364**	**34,963**	**35,319**	**34,915**	**34,893**	**34,488**	**34,872**	**34,463**	**821**
Static tipping load, straight (rigid tire)*	kg	17 316	17 131	17 305	17 120	17 104	16 917	17 120	16 931	299
	lb	**38,164**	**37,757**	**38,141**	**37,733**	**37,697**	**37,287**	**37,732**	**37,318**	**658**
Static tipping load, articulated (ISO)*	kg	14 052	13 869	14 028	13 845	13 848	13 664	13 829	13 643	166
	lb	**30,971**	**30,569**	**30,918**	**30,514**	**30,522**	**30,117**	**30,479**	**30,070**	**366**
Static tipping load, articulated (rigid tire)*	kg	15 312	15 128	15 298	15 113	15 111	14 925	15 116	14 928	112
	lb	**33,749**	**33,342**	**33,718**	**33,309**	**33,304**	**32,894**	**33,316**	**32,901**	**248**
Breakout force**	kN	187	185	185	183	173	171	170	168	–14
	lbf	**42,151**	**41,781**	**41,695**	**41,326**	**38,984**	**38,618**	**38,277**	**37,912**	**–3170**
Operating weight*	kg	23 073	23 211	23 125	23 263	23 181	23 319	23 221	23 359	1763
	lb	**50,853**	**51,157**	**50,968**	**51,272**	**51,091**	**51,395**	**51,179**	**51,483**	**3888**

*Static tipping loads and operating weights shown are based on standard machine configuration with 26.5R25 L3 Michelin XHA2 radial tires, power train guard, full fuel tank, coolants, lubricants, air conditioner and operator.
Static tipping loads conform to the international standard as defined in ISO 14397-1 (SEPT2007).
Measured 100 mm **(4") behind tip of cutting edge with bucket hinge pin as pivot point in accordance with SAE J732 (APR2007).

NOTE: Specifications and ratings conform to all applicable standards recommended by the Society of Automotive Engineers, including SAE Standard J732 (APR2007) which governs loader ratings.

NOTE: Bucket availability varies by region. Consult your local dealer for availability.

Bucket Type		Rock — Pin On		Material Handling/Standard — Pin On				
Edge Type		Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	High Lift Delta
Capacity — rated	m³	3.40	3.40	4.00	4.00	4.60	4.60	—
	yd³	**4.45**	**4.45**	**5.23**	**5.23**	**6.02**	**6.02**	**—**
Capacity — 110%	m³	3.74	3.74	4.40	4.40	5.06	5.06	—
	yd³	**4.89**	**4.89**	**5.75**	**5.75**	**6.62**	**6.62**	**—**
Width	mm	3252	3252	3220	3271	3220	3271	—
	ft/in	**10'8"**	**10'8"**	**10'6"**	**10'8"**	**10'6"**	**10'8"**	**—**
Dump clearance at maximum lift and 45° discharge	mm	3124	3026	2978	2815	2893	2730	558
	ft/in	**10'2"**	**9'11"**	**9'9"**	**9'2"**	**9'5"**	**8'11"**	**1'9"**
Reach at maximum lift and 45° discharge	mm	1454	1576	1252	1379	1337	1464	–25
	ft/in	**4'9"**	**5'2"**	**4'1"**	**4'6"**	**4'4"**	**4'9"**	**–1"**
Reach at level lift arm and bucket level	mm	2818	2974	2769	2973	2889	3093	404
	ft/in	**9'2"**	**9'9"**	**9'1"**	**9'9"**	**9'5"**	**10'1"**	**1'3"**
Digging depth	mm	68	68	124	124	124	124	–25
	in	**2.7**	**2.7**	**4.9**	**4.9**	**4.9**	**4.9**	**–1"**
Overall length	mm	8745	8906	8711	8936	8831	9056	697
	ft/in	**28'9"**	**29'3"**	**28'7"**	**29'4"**	**29'0"**	**29'9"**	**2'3"**
Overall height with bucket at maximum lift	mm	5845	5845	5858	5858	5982	5982	558
	ft/in	**19'3"**	**19'3"**	**19'3"**	**19'3"**	**19'8"**	**19'8"**	**1'9"**
Loader clearance circle with bucket at carry position	mm	14 813	14 901	14 742	14 914	14 804	14 978	481
	ft/in	**48'8"**	**48'11"**	**48'5"**	**49'0"**	**48'7"**	**49'2"**	**1'6"**
Static tipping load, straight (ISO)*	kg	16 255	16 185	15 834	15 653	15 622	15 438	372
	lb	**35,826**	**35,672**	**34,899**	**34,499**	**34,431**	**34,026**	**821**
Static tipping load, straight (rigid tire)*	kg	17 542	17 471	17 078	16 894	16 885	16 699	299
	lb	**38,663**	**38,507**	**37,640**	**37,235**	**37,216**	**36,805**	**658**
Static tipping load, articulated (ISO)*	kg	14 217	14 147	13 861	13 680	13 655	13 471	166
	lb	**31,334**	**31,180**	**30,551**	**30,151**	**30,096**	**29,690**	**366**
Static tipping load, articulated (rigid tire)*	kg	15 496	15 425	15 097	14 913	14 909	14 723	112
	lb	**34,153**	**33,998**	**33,274**	**32,870**	**32,861**	**32,450**	**248**
Breakout force**	kN	186	185	182	181	166	165	–14
	lbf	**41,828**	**41,704**	**41,111**	**40,742**	**37,481**	**37,117**	**–3170**
Operating weight*	kg	24 004	24 056	23 134	23 272	23 267	23 404	1763
	lb	**52,905**	**53,019**	**50,987**	**51,291**	**51,279**	**51,583**	**3888**

*Static tipping loads and operating weights shown are based on standard machine configuration with 26.5R25 L3 Michelin XHA2 radial tires, power train guard, full fuel tank, coolants, lubricants, air conditioner and operator.
Static tipping loads conform to the international standard as defined in ISO 14397-1 (SEPT2007).
Measured 100 mm **(4") behind tip of cutting edge with bucket hinge pin as pivot point in accordance with SAE J732 (APR2007).

NOTE: Specifications and ratings conform to all applicable standards recommended by the Society of Automotive Engineers, including SAE Standard J732 (APR2007) which governs loader ratings.

NOTE: Bucket availability varies by region. Consult your local dealer for availability.

Bucket Type		General Purpose — Pin On						High Lift Delta
Edge Type		Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	
Capacity — rated	m³	5.40	5.40	5.70	5.70	6.00	6.00	—
	yd³	**7.06**	**7.06**	**7.46**	**7.46**	**7.85**	**7.85**	**—**
Capacity — 110%	m³	5.94	5.94	6.27	6.27	6.60	6.60	—
	yd³	**7.77**	**7.77**	**8.20**	**8.20**	**8.63**	**8.63**	**—**
Width	mm	3447	3535	3447	3535	3447	3535	—
	ft/in	**11'3"**	**11'7"**	**11'3"**	**11'7"**	**11'3"**	**11'7"**	**—**
Dump clearance at maximum lift and 45° discharge	mm	3242	3077	3174	3007	3156	2989	220
	ft/in	**10'7"**	**10'1"**	**10'4"**	**9'10"**	**10'4"**	**9'9"**	**8"**
Reach at maximum lift and 45° discharge	mm	1580	1717	1628	1762	1649	1784	2
	ft/in	**5'2"**	**5'7"**	**5'4"**	**5'9"**	**5'4"**	**5'10"**	**0"**
Reach at level lift arm and bucket level	mm	3064	3276	3148	3360	3176	3388	160
	ft/in	**10'0"**	**10'8"**	**10'3"**	**11'0"**	**10'5"**	**11'1"**	**6"**
Digging depth	mm	133	133	133	133	133	133	–1
	in	**5.2**	**5.2**	**5.2**	**5.2**	**5.2**	**5.2**	**–0**
Overall length	mm	9637	9878	9721	9962	9749	9990	200
	ft/in	**31'8"**	**32'5"**	**31'11"**	**32'9"**	**32'0"**	**32'10"**	**8"**
Overall height with bucket at maximum lift	mm	6391	6391	6213	6213	6239	6239	221
	ft/in	**21'0"**	**21'0"**	**20'5"**	**20'5"**	**20'6"**	**20'6"**	**9"**
Loader clearance circle with bucket at carry position	mm	15 857	16 080	15 902	16 125	15 917	16 141	175
	ft/in	**52'1"**	**52'10"**	**52'3"**	**52'11"**	**52'3"**	**53'0"**	**7"**
Static tipping load, straight (ISO)*	kg	20 504	20 322	20 272	20 089	20 136	19 952	–1720
	lb	**45,192**	**44,790**	**44,681**	**44,277**	**44,379**	**43,974**	**–3792**
Static tipping load, straight (rigid tire)*	kg	22 086	21 900	21 855	21 667	21 719	21 531	–1950
	lb	**48,678**	**48,268**	**48,168**	**47,755**	**47,870**	**47,456**	**–4299**
Static tipping load, articulated (ISO)*	kg	17 895	17 710	17 677	17 492	17 544	17 358	–1550
	lb	**39,441**	**39,035**	**38,961**	**38,552**	**38,667**	**38,257**	**–3416**
Static tipping load, articulated (rigid tire)*	kg	19 764	19 578	19 546	19 358	19 414	19 226	–1787
	lb	**43,561**	**43,150**	**43,079**	**42,666**	**42,789**	**42,375**	**–3939**
Breakout force**	kN	201	199	190	188	186	184	3
	lbf	**45,379**	**44,838**	**42,792**	**42,264**	**41,931**	**41,407**	**719**
Operating weight*	kg	29 945	30 084	30 028	30 167	30 124	30 263	115
	lb	**65,999**	**66,304**	**66,182**	**66,487**	**66,393**	**66,698**	**253**

*Static tipping loads and operating weights shown are based on standard machine configuration with 29.5R25, L3 Michelin XHA2 radial tires, power train guard, full fuel tank, coolant, lubricants, air conditioner and operator.
Static tipping loads conform to the international standard as defined in ISO 14397-1 (SEPT2007).
Measured 100 mm **(4") behind tip of cutting edge with bucket hinge pin as pivot point in accordance with SAE J732 (APR2007).

NOTE: Specifications and ratings conform to all applicable standards recommended by the Society of Automotive Engineers, including SAE Standard J732 (APR2007) which governs loader ratings.

NOTE: Bucket availability varies by region. Consult your local dealer for availability.

Bucket Type		Material Handling — Pin On		Rock — Pin On		Coal — Pin On	General Purpose/ Heavy Duty — Pin On		
Edge Type		Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Teeth & Segments	Bolt-on Cutting Edges	Bolt-on Cutting Edges	Teeth & Segments	High Lift Delta
Capacity — rated	m³	5.70	5.70	4.40	4.40	8.20	5.70	5.70	—
	yd³	**7.46**	**7.46**	**5.75**	**5.75**	**10.73**	**7.46**	**7.46**	**—**
Capacity — 110%	m³	6.27	6.27	4.84	4.84	9.02	6.27	6.27	—
	yd³	**8.20**	**8.20**	**6.33**	**6.33**	**11.80**	**8.20**	**8.20**	**—**
Width	mm	3447	3535	3504	3504	3638	3447	3535	—
	ft/in	**11'3"**	**11'7"**	**11'5"**	**11'5"**	**11'11"**	**11'3"**	**11'7"**	**—**
Dump clearance at maximum lift and 45° discharge	mm	3075	2898	3101	3101	2887	3174	3007	220
	ft/in	**10'1"**	**9'6"**	**10'2"**	**10'2"**	**9'5"**	**10'4"**	**9'10"**	**8"**
Reach at maximum lift and 45° discharge	mm	1543	1665	1844	1844	1724	1628	1762	2
	ft/in	**5'0"**	**5'5"**	**6'0"**	**6'0"**	**5'7"**	**5'4"**	**5'9"**	**0"**
Reach at level lift arm and bucket level	mm	3173	3385	3360	3360	3435	3148	3360	160
	ft/in	**10'4"**	**11'1"**	**11'0"**	**11'0"**	**11'3"**	**10'3"**	**11'0"**	**6"**
Digging depth	mm	133	133	106	106	138	133	133	–1
	in	**5.2**	**5.2**	**4.1**	**4.1**	**5.4**	**5.2**	**5.2**	**–0**
Overall length	mm	9746	9987	9949	9949	10 011	9721	9962	200
	ft/in	**32'0"**	**32'10"**	**32'8"**	**32'8"**	**32'11"**	**31'11"**	**32'9"**	**8"**
Overall height with bucket at maximum lift	mm	6212	6212	6184	6184	6506	6213	6213	221
	ft/in	**20'5"**	**20'5"**	**20'4"**	**20'4"**	**21'5"**	**20'5"**	**20'5"**	**9"**
Loader clearance circle with bucket at carry position	mm	15 916	16 139	16 094	16 093	16 236	15 902	16 125	175
	ft/in	**52'3"**	**53'0"**	**52'10"**	**52'10"**	**53'4"**	**52'3"**	**52'11"**	**7"**
Static tipping load, straight (ISO)*	kg	19 825	19 643	21 253	21 285	19 512	20 116	19 932	–1720
	lb	**43,694**	**43,295**	**46,843**	**46,913**	**43,006**	**44,336**	**43,932**	**–3792**
Static tipping load, straight (rigid tire)*	kg	21 360	21 175	22 897	22 940	21 151	21 694	21 507	–1950
	lb	**47,078**	**46,670**	**50,466**	**50,560**	**46,616**	**47,815**	**47,402**	**–4299**
Static tipping load, articulated (ISO)*	kg	17 271	17 088	18 537	18 550	16 932	17 519	17 334	–1550
	lb	**38,067**	**37,663**	**40,857**	**40,884**	**37,318**	**38,613**	**38,204**	**–3416**
Static tipping load, articulated (rigid tire)*	kg	19 091	18 906	20 482	20 509	18 854	19 385	19 198	–1787
	lb	**42,078**	**41,670**	**45,144**	**45,202**	**41,556**	**42,726**	**42,313**	**–3939**
Breakout force**	kN	187	184	190	189	157	189	187	3
	lbf	**42,029**	**41,504**	**42,739**	**42,551**	**35,358**	**42,665**	**42,136**	**719**
Operating weight*	kg	30 153	30 292	31 109	31 184	30 532	30 175	30 313	115
	lb	**66,457**	**66,762**	**68,564**	**68,730**	**67,293**	**66,504**	**66,809**	**253**

*Static tipping loads and operating weights shown are based on standard machine configuration with 29.5R25, L3 Michelin XHA2 radial tires, power train guard, full fuel tank, coolant, lubricants, air conditioner and operator.
Static tipping loads conform to the international standard as defined in ISO 14397-1 (SEPT2007).
Measured 100 mm **(4") behind tip of cutting edge with bucket hinge pin as pivot point in accordance with SAE J732 (APR2007).

NOTE: Specifications and ratings conform to all applicable standards recommended by the Society of Automotive Engineers, including SAE Standard J732 (APR2007) which governs loader ratings.

NOTE: Bucket availability varies by region. Consult your local dealer for availability.

Bucket Type		Rock — Pin On					Rock/ Heavy Duty/Extra Wide Bucket — Pin On	
Edge Type		Teeth & Segments + Side Protector	Teeth + Side Protector	Teeth & Segments + Side Protector	Teeth + Side Protector	Teeth + Side Protector	Teeth & Segments + Side Protector	High Lift Delta
Capacity — rated	m³	4.48	4.31	5.66	5.38	5.38	5.41	—
	yd³	**5.86**	**5.64**	**7.40**	**7.03**	**7.03**	**7.07**	**—**
Capacity — 110%	m³	4.93	4.75	6.22	5.91	5.91	5.95	—
	yd³	**6.45**	**6.21**	**8.14**	**7.74**	**7.74**	**7.78**	**—**
Width	mm	3504	3504	3504	3504	3510	3645	—
	ft/in	**11'5"**	**11'5"**	**11'5"**	**11'5"**	**11'6"**	**11'11"**	**—**
Dump clearance at maximum lift and 45° discharge	mm	3051	3051	2890	2890	2983	2941	220
	ft/in	**10'0"**	**10'0"**	**9'5"**	**9'5"**	**9'9"**	**9'7"**	**8"**
Reach at maximum lift and 45° discharge	mm	1788	1788	1979	1979	1930	1965	2
	ft/in	**5'10"**	**5'10"**	**6'5"**	**6'5"**	**6'4"**	**6'5"**	**0"**
Reach at level lift arm and bucket level	mm	3359	3359	3608	3608	3512	3561	160
	ft/in	**11'0"**	**11'0"**	**11'10"**	**11'10"**	**11'6"**	**11'8"**	**6"**
Digging depth	mm	106	71	106	71	77	77	–1
	in	**4.1**	**2.8**	**4.1**	**2.8**	**3.0**	**3.0**	**–0**
Overall length	mm	9948	9948	10 197	10 197	10 069	10 156	200
	ft/in	**32'8"**	**32'8"**	**33'6"**	**33'6"**	**33'1"**	**33'4"**	**8"**
Overall height with bucket at maximum lift	mm	6204	6204	6378	6378	6378	6378	221
	ft/in	**20'5"**	**20'5"**	**21'0"**	**21'0"**	**21'0"**	**21'0"**	**9"**
Loader clearance circle with bucket at carry position	mm	16 093	16 093	16 235	16 235	16 156	16 340	175
	ft/in	**52'10"**	**52'10"**	**53'4"**	**53'4"**	**53'1"**	**53'8"**	**7"**
Static tipping load, straight (ISO)*	kg	20 998	21 519	20 119	20 693	20 705	19 813	–1720
	lb	**46,279**	**47,428**	**44,343**	**45,607**	**45,635**	**43,669**	**–3792**
Static tipping load, straight (rigid tire)*	kg	22 649	23 190	21 764	22 361	22 374	21 461	–1950
	lb	**49,918**	**51,112**	**47,968**	**49,285**	**49,313**	**47,301**	**–4299**
Static tipping load, articulated (ISO)*	kg	18 265	18 775	17 439	17 995	18 008	17 091	–1550
	lb	**40,257**	**41,381**	**38,436**	**39,663**	**39,690**	**37,669**	**–3416**
Static tipping load, articulated (rigid tire)*	kg	20 223	20 750	19 387	19 965	19 977	19 053	–1787
	lb	**44,572**	**45,733**	**42,730**	**44,003**	**44,031**	**41,993**	**–3939**
Breakout force**	kN	188	204	159	172	184	173	3
	lbf	**42,289**	**45,879**	**35,932**	**38,725**	**41,402**	**38,896**	**719**
Operating weight*	kg	31 475	31 175	31 821	31 521	31 517	32 239	115
	lb	**69,370**	**68,709**	**70,132**	**69,471**	**69,463**	**71,055**	**253**

*Static tipping loads and operating weights shown are based on standard machine configuration with 29.5R25, L3 Michelin XHA2 radial tires, power train guard, full fuel tank, coolant, lubricants, air conditioner and operator.
Static tipping loads conform to the international standard as defined in ISO 14397-1 (SEPT2007).
Measured 100 mm **(4") behind tip of cutting edge with bucket hinge pin as pivot point in accordance with SAE J732 (APR2007).

NOTE: Specifications and ratings conform to all applicable standards recommended by the Society of Automotive Engineers, including SAE Standard J732 (APR2007) which governs loader ratings.

NOTE: Bucket availability varies by region. Consult your local dealer for availability.

			Standard Lift						
Bucket Type			Rock			Heavy Duty Rock		High Abrasion Rock	
Ground Engaging Tools			Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments
Cutting Edge Type			Spade	Spade	Spade	Spade	Spade	Spade	Spade
Rated bucket capacity (§)		m^3	10.7	11.5	12.3	10.7	11.5	10.7	10.7
		yd^3	**14.0**	**15.0**	**16.0**	**14.0**	**15.0**	**14.0**	**14.0**
Operating load at rated capacity		kg	21 773	21 773	21 773	21 773	21 773	21 773	21 773
		lb	**48,000**	**48,000**	**48,000**	**48,000**	**48,000**	**48,000**	**48,000**
Struck capacity (§)		m^3	8.9	9.5	10.2	8.9	9.5	8.9	8.9
		yd^3	**11.6**	**12.4**	**13.3**	**11.6**	**12.4**	**11.6**	**11.6**
Bucket width (§)		mm	4824	4884	4824	5068	4824	5165	5068
		ft/in	**15'10"**	**16'0"**	**15'10"**	**16'7"**	**15'10"**	**16'11"**	**16'7"**
Dump clearance at full lift SAE 45° discharge (§)		mm	4849	4785	4741	4849	4788	4935	4935
		ft/in	**15'11"**	**15'8"**	**15'7"**	**15'11"**	**15'8"**	**16'2"**	**16'2"**
	Tooth tip	mm	4607	4548	4495	4612	4545	4699	4699
		ft/in	**15'1"**	**14'11"**	**14'8"**	**15'1"**	**14'11"**	**15'5"**	**15'5"**
Reach at full lift SAE 45° discharge (§)		mm	2092	2149	2194	2092	2151	2036	2036
		ft/in	**6'11"**	**7'0"**	**7'2"**	**6'11"**	**7'11"**	**6'10"**	**6'10"**
	Tooth tip	mm	2326	2378	2427	2322	2385	2292	2292
		ft/in	**7'7"**	**7'10"**	**8'0"**	**7'7'**	**7'10"**	**7'6"**	**7'6"**
Reach with boom horizontal and bucket level		mm	5114	5193	5265	5108	5200	5025	5025
		ft/in	**16'10"**	**17'0"**	**17'4"**	**16'10"**	**17'1"**	**16'6"**	**16'6"**
Digging depth (segment) (§)		mm	196	201	201	196	198	175	175
		in	**7.7**	**7.9**	**7.9**	**7.7**	**7.8**	**6.9**	**6.9**
Overall length — bucket level ground (§)		mm	15 736	15 818	15 890	15 729	15 823	15 632	15 632
		ft/in	**51'7"**	**51'11"**	**51'1"**	**51'7"**	**51'11"**	**51'4"**	**51'4"**
Overall height with bucket at full raise (§)		mm	9313	9313	9492	9313	9313	9392	9313
		ft/in	**30'7"**	**30'7"**	**31'1"**	**30'7"**	**30'7"**	**30'10"**	**30'7"**
Loader clearance radius with bucket in carry position (§)		mm	11 097	11 121	11 131	11 096	11 122	11 085	11 085
		ft/in	**36'5"**	**36'6"**	**36'6"**	**36'5"**	**36'6"**	**36'5"**	**36'5"**
Tipping load straight* (§)		kg	55 216	54 526	54 184	53 745	54 784	51 692	53 325
		lb	**121,730**	**120,209**	**119,455**	**118,487**	**120,778**	**113,961**	**117,561**
Static tipping load full 35° turn* (§)		kg	48 361	47 695	47 341	46 893	47 953	44 839	46 474
		lb	**106,618**	**105,149**	**104,369**	**103,381**	**105,718**	**98,853**	**102,458**
Static tipping load full 40° turn* (§)		kg	46 440	45 780	45 422	44 972	46 037	42 919	44 554
		lb	**102,383**	**100,928**	**100,138**	**99,146**	**101,494**	**94,620**	**98,225**
Static tipping load full 43° turn* (§)		kg	45 201	44 546	44 185	43 735	44 803	41 681	43 316
		lb	**99,651**	**98,207**	**97,411**	**96,419**	**98,774**	**91,891**	**95,495**
Tipping load straight** (§)		kg	57 096	56 402	56 093	55 615	56 662	53 564	55 194
		lb	**125,874**	**124,344**	**123,663**	**122,610**	**124,918**	**118,088**	**121,681**
Static tipping load full 35° turn** (§)		kg	51 328	50 653	50 338	49 847	50 913	47 796	49 426
		lb	**113,158**	**111,671**	**110,976**	**109,893**	**112,244**	**105,372**	**108,965**
Static tipping load full 40° turn** (§)		kg	49 634	48 965	48 648	48 153	49 225	46 102	47 732
		lb	**109,424**	**107,950**	**107,250**	**106,159**	**108,523**	**101,638**	**105,231**
Static tipping load full 43° turn** (§)		kg	48 527	47 863	47 544	47 047	48 123	44 996	46 625
		lb	**106,984**	**105,519**	**104,817**	**103,720**	**106,092**	**99,198**	**102,791**
Breakout force*** (§)		kg	58 466	55 998	54 249	57 842	56 147	59 381	60 218
		lbf	**128,894**	**123,454**	**119,599**	**127,519**	**123,782**	**130,913**	**132,758**
Operating weight*** (§)		kg	98 610	99 012	99 391	100 786	97 469	102 956	101 232
		lb	**217,398**	**218,284**	**219,119**	**222,195**	**214,882**	**226,979**	**223,178**

*Tipping loads were calculated within guidelines of ISO 14397-1:2007 to include tire squash (Tire pressure at 683 kPa **[99 psi]**).
**Tipping load is calculated without tire squash.
***Static tipping load and operating weight shown are based on standard machine configurations with a fuel tank, coolant, lubricants, and operator.

NOTE: Specifications and ratings conform to all applicable standards recommended by the Society for Automotive Engineers. SAE Standards J732C govern loader ratings and are denoted in the text by (§).

Bucket Type			High Lift						
			Rock			Heavy Duty Rock		High Abrasion Rock	
Ground Engaging Tools			Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments	Teeth & Segments
Cutting Edge Type			Spade	Spade	Spade	Spade	Spade	Spade	Spade
Rated bucket capacity (§)		m^3	10.7	11.5	12.3	10.7	11.5	10.7	10.7
		yd^3	**14.0**	**15.0**	**16.0**	**14.0**	**15.0**	**14.0**	**14.0**
Operating load at rated capacity		kg	19 051	19 051	19 051	19 051	19 051	19 051	19 051
		lb	**42,000**	**42,000**	**42,000**	**42,000**	**42,000**	**42,000**	**42,000**
Struck capacity (§)		m^3	8.9	9.5	10.2	8.9	9.5	8.9	8.9
		yd^3	**11.6**	**12.4**	**13.3**	**11.6**	**12.4**	**11.6**	**11.6**
Bucket width (§)		mm	4824	4884	4824	4884	4824	4900	4900
		ft/in	**15'10"**	**16'0"**	**15'10"**	**16'7"**	**15'10"**	**16'11"**	**16'7"**
Dump clearance at full lift SAE 45° discharge (§)	**Tooth tip**	mm	5224	5166	5112	5229	5162	5316	5316
		ft/in	**17'2"**	**16'11"**	**16'9"**	**17'2"**	**16'11"**	**17'5"**	**17'5"**
Reach at full lift SAE 45° discharge (§)	**Tooth tip**	mm	2193	2246	2294	2189	2252	2159	2159
		ft/in	**7'2"**	**7'4"**	**7'6"**	**7'2"**	**7'5"**	**7'1"**	**7'1"**
Reach with boom horizontal and bucket level		mm	5504	5583	5655	5498	5590	5415	5415
		ft/in	**18'1"**	**18'4"**	**18'7"**	**18'0"**	**18'4"**	**17'9"**	**17'9"**
Digging depth (segment) (§)		mm	176	181	181	176	178	155	155
		in	**7.0**	**7.0**	**7.0**	**7.0**	**7.0**	**6.0**	**6.0**
Overall length — bucket level ground (§)		mm	16 197	16 279	16 351	16 191	16 284	16 095	16 095
		ft/in	**53'2"**	**53'5"**	**53'8"**	**53'1"**	**53'5"**	**52'10"**	**52'10"**
Overall height with bucket at full raise (§)		mm	9930	9930	9930	9930	9930	9930	9930
		ft/in	**32'7"**	**32'7"**	**32'7"**	**32'7"**	**32'7"**	**32'7"**	**32'7"**
Loader clearance radius with bucket in carry position (§)		mm	11 326	11 352	11 349	11 324	11 352	11 313	11 313
		ft/in	**37'2"**	**37'3"**	**37'3"**	**37'2"**	**37'3"**	**37'1"**	**37'1"**
Tipping load straight* (§)		kg	51 408	50 761	50 436	49 938	51 017	47 875	49 522
		lb	**113,335**	**111,909**	**111,192**	**110,094**	**112,473**	**105,546**	**109,177**
Static tipping load full 35° turn* (§)		kg	44 798	44 172	43 833	43 332	44 427	41 268	42 916
		lb	**98,763**	**97,382**	**96,635**	**95,531**	**97,945**	**90,980**	**94,613**
Static tipping load full 40° turn* (§)		kg	42 946	42 325	41 981	41 481	42 580	39 417	41 065
		lb	**94,680**	**93,311**	**92,552**	**91,450**	**93,873**	**86,900**	**90,533**
Static tipping load full 43° turn* (§)		kg	41 753	41 135	40 789	40 288	41 390	38 224	39 873
		lb	**92,049**	**90,687**	**89,924**	**88,820**	**91,249**	**84,269**	**87,905**
Tipping load straight** (§)		kg	53 044	52 396	52 099	51 567	52 653	49 505	51 149
		lb	**116,942**	**115,513**	**114,858**	**113,686**	**116,080**	**109,140**	**112,764**
Static tipping load full 35° turn** (§)		kg	47 472	46 840	46 535	45 994	47 097	43 932	45 577
		lb	**104,658**	**103,264**	**102,592**	**101,399**	**103,831**	**96,853**	**100,480**
Static tipping load full 40° turn** (§)		kg	45 835	45 209	44 901	44 358	45 466	42 296	43 940
		lb	**101,049**	**99,669**	**98,990**	**97,793**	**100,235**	**93,247**	**96,871**
Static tipping load full 43° turn** (§)		kg	44 766	44 143	43 834	43 289	44 400	41 227	42 871
		lb	**98,692**	**97,319**	**96,637**	**95,436**	**97,885**	**90,890**	**94,514**
Breakout force*** (§)		kg	57 948	55 495	53 760	57 324	55 656	58 856	59 693
		lbf	**127,753**	**122,345**	**118,520**	**126,378**	**122,700**	**129,755**	**131,600**
Operating weight*** (§)		kg	99 788	100 182	100 561	101 956	99 963	104 126	102 404
		lb	**219,995**	**220,863**	**221,699**	**224,774**	**220,380**	**229,558**	**225,762**

*Tipping loads were calculated within guidelines of ISO 14397-1:2007 to include tire squash (Tire pressure at 683 kPa **[99 psi]**).
**Tipping load is calculated without tire squash.
***Static tipping load and operating weight shown are based on standard machine configurations with a fuel tank, coolant, lubricants, and operator.

NOTE: Specifications and ratings conform to all applicable standards recommended by the Society for Automotive Engineers. SAE Standards J732C govern loader ratings and are denoted in the text by (§).

SPECIFICATION DEFINITIONS FOR FRONT END LOADERS

Cat wheel and track loader specifications conform to Society of Automotive Engineers (SAE) definitions as expressed in standards J732 (JUN92), as follows:

Description of Specification Machine

On wheel loaders the tire inflation pressure at which specifications are taken must be described in addition to the current written basic machine description. On track loaders the type of grouser must be specified.

Hydraulic Cycle Times

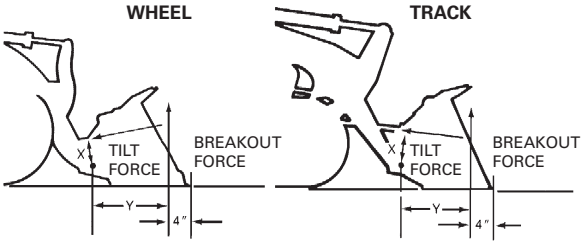
a. "Raise Time" — Time in seconds required to raise the bucket from level position on the ground.
b. "Lower Time" — Time in seconds required to lower the empty bucket from the full height to a level position on the ground.
c. "Dump Time" — Time in seconds required to move the bucket at maximum height from the maximum rollback position to full dump position while dumping the SAE loose material operating load.

Breakout Force

"Breakout force," pounds (and kilonewtons or kilograms) — the maximum sustained vertical upward force exerted 100 mm (4") behind the tip of the bucket cutting edge and achieved through the ability to lift and/or rollback about the specified pivot point under the following conditions:

a. Loader on a hard level surface with transmission in neutral.
b. All brakes released.
c. Unit at standard operating weight — rear of loader not tied down.
d. Bottom of cutting edge parallel to and not more than 20 mm (0.75") above or below the ground line.
e. When bucket circuit is used the pivot point must be specified as the bucket hinge pin, and the unit blocked under the bucket hinge pin pivot point in order to minimize linkage movement.
f. When the lift circuit is used, the pivot point must be specified as the lift arm hinge pin. Wheel loaders shall have front axle blocked to eliminate change in position of pivot pins due to tire deflection.
g. If both circuits are used simultaneously, the dominating pivot point listed in (e) or (f) must be specified.
h. If the circuit used causes the rear of the vehicle to leave the ground, then the vertical force value required to raise the rear of the vehicle is the breakout force.
i. For irregular shaped buckets, the tip of the bucket cutting edge referred to above shall mean the farther forward point of the cutting edge.

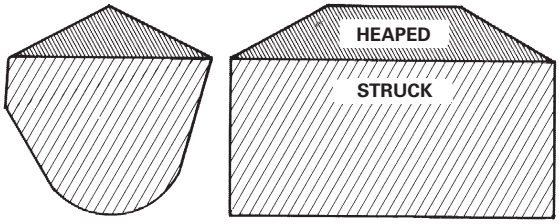
The following are illustrations used (according to provisions of SAE J732 JUN92) to measure Cat Loader breakout forces.



a. Breakout force resulting from rack back:
(Tilt Force) × (Dist. "X") = ("Y" Dist.) × (Breakout Force)

$$\frac{\text{(Tilt Force)} \times \text{(Dist. "X")}}{\text{"Y" Dist.}} = \text{Breakout Force}$$

SAE BUCKET RATING



SAE Bucket Capacities

Struck capacity is that volume contained in a bucket after a load is leveled by drawing a straight edge resting on the cutting edge and the back of the bucket.

Heaped capacity is a struck capacity plus that additional material that would heap on the struck load at a 2:1 angle of repose with the struck line parallel to the ground.

SAE J742 (FEB85) specifies that the addition of any auxiliary spill guard to protect against spillage which might injure the operator will not be included in bucket capacity ratings. Buckets with irregular shaped cutting edges (vee edge) the strike plane should be drawn at one-third the distance of the protruding portion of the cutting edge. Cat rock buckets are built with integral see-through rock guards. Cat light material buckets come standard with bolt-on edges. These features which add to actual bucket capacity are included in published ratings.

Dump Height

SAE J732 JUN92 specifies that dump height is the vertical distance from the ground to the lowest point of the cutting edge with the bucket hinge pin at maximum height and the bucket at a 45° dump angle. Dump angle is the angle in degrees that the longest flat section of the inside bottom of the bucket will rotate below horizontal.

SELECTING A MACHINE

Steps in selecting the proper size loader:

1. Determine production required or desired.
2. Determine loader cycle time and cycles per hour. A machine size must be assumed to select a basic cycle time.
3. Determine required payload per cycle in loose cubic yards and pounds (meters and kilograms).
4. Determine bucket size needed.
5. Make machine selection using bucket size and payload as criteria to meet production requirements.
6. Compare the loader cycle time used in calculations to the cycle time of the machine selected. If there is a difference, rework the process beginning at step 2.

1. Production Required

The production required of a wheel or track loader should be slightly greater than the production capability of the other critical units in the earth or material moving system. For example, if a hopper can handle 300 tons per hour, a loader capable of slightly more than 300 tons should be used. Required production should be carefully calculated so the proper machine and bucket selections are made.

2. Loader Cycle Times

When hauling loose granular material on a hard smooth operating surface, a .45-.55 minute basic cycle time is considered reasonable for Cat articulated loaders with a competent operator. This includes load, dump, four reversals of direction, full cycle of hydraulics and minimum travel.

Material type, pile height, and other factors may improve or reduce production, and should be added to or subtracted from the basic cycle time when applicable.

When hauls are involved, obtain the haul and return portion of the cycle from the estimated travel chart (this section). Add the haul and return times to the estimated basic cycle time to obtain total cycle time.

CYCLE TIME FACTORS

A basic cycle time (Load, Dump, Maneuver) of .45-.55 minutes is average for an articulated loader [the basic cycle for large loaders, 3 m^3 (4 yd^3) and up, can be slightly longer], but variations can be anticipated in the field. The following values for many variable elements are based on normal operations. Adding or subtracting any of the variable times will give the total basic cycle time.

	Minutes added (+) or Subtracted (–) From Basic Cycle
Machine	
— Material handler	–.05
Materials	
— Mixed	+.02
— Up to 3 mm (1/8 in)	+.02
— 3 mm (1/8 in) to 20 mm (3/4 in)	–.02
— 20 mm (3/4 in) to 150 mm (6 in)	.00
— 150 mm (6 in) and over	+.03 and Up
— Bank or broken	+.04 and Up
Pile	
— Conveyor or Dozer piled 3 m (10 ft) and up	.00
— Conveyor or Dozer piled 3 m (10 ft) or less	+.01
— Dumped by truck	+.02
Miscellaneous	
— Common ownership of trucks and loaders	Up to –.04
— Independently owned trucks	Up to +.04
— Constant operation	Up to –.04
— Inconsistent operation	Up to +.04
— Small target	Up to +.04
— Fragile target	Up to +.05

Using actual job conditions and the above factors, total cycle time can be estimated. Convert total cycle time to cycles per hour.

$$\textit{Cycles per hour at 100\% Efficiency} = \frac{60\ \textit{min}}{\textit{Total Cycle Time in Minutes}}$$

Job efficiency is an important factor in machine selection. Efficiency is the actual number of minutes worked during an hour. Job efficiency accounts for bathroom breaks and other work interruptions.

$$\text{Cycles per hour at 50 minutes per hour (83\% efficiency)} = \text{Cycles per hour at 100\% efficiency} \times \frac{\text{50 min actual work time}}{\text{60 min hour}}$$

TRUCK LOADING

Average loader cycle times

910K-962H	0.45-0.50 min
966H-980H	0.50-0.55 min
986H-990K	0.55-0.60 min
992K-994K	0.60-0.70 min

3. Required Payload Per Cycle

Required payload per cycle is determined by dividing required hourly production by the number of cycles per hour.

4. Bucket Selection

After required payload per cycle has been calculated, the payload should be divided by the loose cubic yard (meter) material weight to determine number of loose cubic yards (meters) required per cycle.

The bulk of material handled does not weigh 1800 kg/m^3 (3000 lb/yd^3), so a reasonable knowledge of material weight is necessary for accurate production estimates. The Tables Section has average weight for certain materials when actual weights are not known.

The percentage of rated capacity a bucket carries in various materials is estimated below. The bucket size required to handle the required volume per cycle is found with the aid of the percentage of rated bucket capacity called "Bucket Fill Factor."

The bucket size needed is determined by dividing loose cubic meters (or yards) required per cycle by the bucket fill factor.

$$\textit{Bucket size} = \frac{\textit{Volume Required/Cycle}}{\textit{Bucket Fill Factor}}$$

BUCKET FILL FACTORS

The following indicates the approximate amounts of material as a percent of rated bucket capacity which will actually be delivered per bucket per cycle. This is known as "Bucket Fill Factor."

Loose Material	Fill factor
Mixed moist aggregates	95-100%
Uniform aggregates up to 3 mm (1/8 in)	95-100
3 mm (1/8 in) to 9 mm (3/8 in)	90-95
12 mm (1/2 in) to 20 mm (3/4 in)	85-90
24 mm (1.0 in) and over	85-90

Blasted Rock

Well blasted	80-95%
Average	75-90
Poor	60-75

Other

Rock dirt mixtures	100-120%
Moist loam	100-110
Soil, boulders, roots	80-100
Cemented materials	85-95

NOTE: Fill factors on wheel loaders are affected by bucket penetration, breakout force, rack back angle, bucket profile and ground engaging tools such as bucket teeth or bolt-on replaceable cutting edges.

Example:

12 mm (1/2 in) material and 3 m^3 (4 yd^3) bucket.
0.90 × 3 m^3 = 2.75 Loose m^3 delivered per cycle.
0.90 × 4 yd^3 = 3.6 Loose yd^3 delivered per cycle.

NOTE: Check the static tipping load on the specific machine to determine if bucket load is in fact a safe operating load.

Bucket Selection

$$\textit{Tons Required/Cycle} = \frac{\textit{Tons Required/Hour}}{\textit{Cycles/Hour}}$$

$$\textit{Kg (Pounds) Required/Cycle} = \textit{Tons Required/Cycle} \times \textit{907 kg (2000 lb)}$$

$$\textit{Volume Required/Cycle} = \frac{\textit{kg (Pounds) Cycle}}{\textit{Material Weight kg/m}^3\textit{ (lb/yd}^3\textit{)}}$$

Always select a machine with a greater capacity than the calculated required operating capacity. For most applications, payload above recommended and excessive counterweight can hinder machine performance and reduce dynamic stability and machine life.

For optimum performance in fast cycling situations such as truck loading, operating loads should not exceed the recommended capacity. To provide extra stability, calcium chloride ($CaCl_2$) ballast may be desired when operating at recommended operating load, see SAE Loader rating pages in this section. For specific stability data and optional tire sizes, see the "Performance Data" pages in this section.

When selecting special application buckets, such as multi-purpose and side dump the additional bucket weight must be deducted from recommended capacity.

Specific circumstances may involve other conditions which would also affect loader capacity. Because of the greatly varied applications and conditions, your Cat dealer should be contacted for guidance.

Example problem:

JOB CONDITIONS

Application	Truck loading
Production Required	450 metric ton (496 Tons) per hour
Material	9 mm (3/8") gravel in 6 m (20 ft) high stockpile
Density	1660 kg/m^3 (2800 lb/yd^3)

Trucks are 6-9 m^3 (8-12 yd^3) capacity and are owned by three contractors. Loading is constant. Hard level surface for loader maneuvering.

1. *PRODUCTION REQUIRED:* Given

2. *CYCLE TIME:* Assume loader size between 910K and 962H for initial choice of basic cycle.

(Refer to Cycle Time Factors in this section)

Independent trucks	.04 min
Basic Cycle	.50 min
Material	–.02 min
Independent trucks	+.04 min
Constant operation	–.02 min
Total Cycle	.50 min

NOTE: Load and carry times not required in total cycle.

$$\text{Cycles/hr at 83\% efficiency} = 120 \text{ cycles/hr} \times \frac{\text{50 min actual work time}}{\text{60 min per hr}} = 100 \text{ cycles/hr}$$

3. *VOLUME REQUIRED PER CYCLE*

(Density in tons)

Density in this example was given. When not given, refer to Tables Section to obtain an estimated density for the material being handled.

$$\textit{Metric:}\ \frac{1660 \text{ kg/m}^3}{1000 \text{ kg/ton}} = 1.66 \text{ ton/m}^3$$

$$\textit{English:}\ \frac{2800 \text{ lb/yd}^3}{2000 \text{ lb/ton}} = 1.4 \text{ tons/yd}^3$$

Production Rate Required

Metric: $\frac{450 \text{ tons/hr}}{1.66 \text{ tons/m}^3} = 271 \text{ m}^3\text{/hr}$

English: $\frac{496 \text{ tons/hr}}{1.4 \text{ tons/yd}^3} = 354 \text{ yd}^3\text{/hr}$

Volume Required per Cycle

Metric: $\frac{271 \text{ m}^3\text{/hr}}{100 \text{ cycles/hr}} = 2.71 \text{ m}^3\text{/cycle}$

English: $\frac{354 \text{ yd}^3\text{/hr}}{100 \text{ cycles/hr}} = 3.54 \text{ yd}^3\text{/cycle}$

4. *DETERMINE BUCKET SIZE*

BUCKET FILL FACTOR

The volume of material required per cycle has been determined. Because of varying material fill factors, buckets do not always carry their rated load, a larger capacity bucket may be needed to carry the volume required. For fill factors, refer to Bucket Fill Factor Chart in this section.

Rated Bucket Capacity Required (Heaped)

$\frac{2.71 \text{ m}^3\text{/cycle}}{0.95 \text{ fill factor}} = 2.85 \text{ m}^3$

$\frac{3.54 \text{ yd}^3\text{/cycle}}{0.95 \text{ fill factor}} = 3.73 \text{ yd}^3$

A 2.9 m³ (3.75 yd³) bucket would provide the required capacity.

5. *MACHINE SELECTION*

The bucket size required and material density lead to the choice of a 950H with a 2.9 m³ (3.75 yd³) General Purpose Bucket (see bucket selection guide pages which follow.)

Finally, SAE payload criteria must be satisfied as follows:

The required operating capacity must not exceed one-half of the full turn static tipping load of the loader as equipped with a specific bucket.

The required operating capacity of the machine is determined by the volume the machine will carry per load times the density.

$2.9 \text{ m}^3 \times 1660 \text{ kg/m}^3 = 4814 \text{ kg}$
$(3.75 \text{ yd}^3 \times 2800 \text{ lb/yd}^3 = 10{,}500 \text{ lb})$

One half of full turn static tipping load for the 950H with a 2.9 m³ (3.75 yd³) General Purpose Bucket is 5410 kg (11,925 lb). SAE criteria is satisfied.

● ● ●

An Alternative Method of Machine Selection

Another method of selecting the right Wheel Loader and bucket to meet production requirements is by use of the nomographs on the following pages. The method is quicker and easier than the preceding example because it does not require as many calculations, yet the accuracy is about the same within the normal limits of input data.

Be careful when entering and reading data from the nomographs because some scales increase from bottom to top, while others are the reverse. Do not be overly concerned with the precision as affected by pencil line width or reading to the hundredth of a m³ (yd³). Remember that bucket fill factor, material density and cycle time are at best close estimates.

Example problem:

A Wheel Loader must produce 230 m³ (300 yd³) per hour in a truck loading application. Estimated cycle time is .6 minutes, working 45 minutes per hour. Bucket fill factor is 95% and material density is 1780 kg/m³ (3000 lb/yd³).

Determine bucket size and machine model.

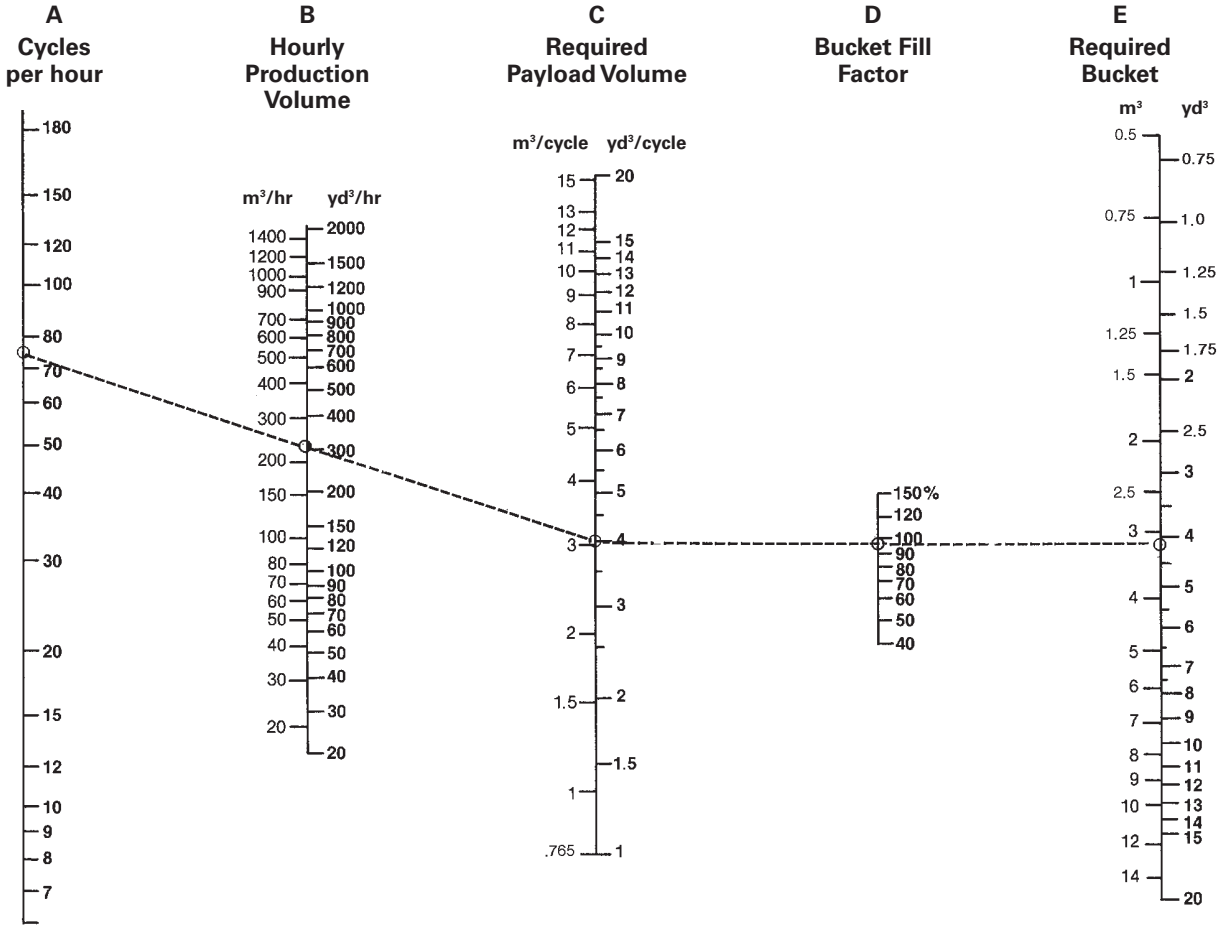
Solution:

At full efficiency, the Wheel Loader will cycle 100 times per hour. Since only an average of 45 minutes are available, only 75 cycles will be completed.

Starting on Scale A at 75 cycles per hour draw a straight line intersecting 230 m³/hr (300 yd³/hr) on Scale B and extending it on to Scale C giving 3 m³/cycle (4 yd³/cycle) required payload. Follow solution steps 1-10.

Production and Machine Selection Nomograph
● To find required bucket payload and bucket size

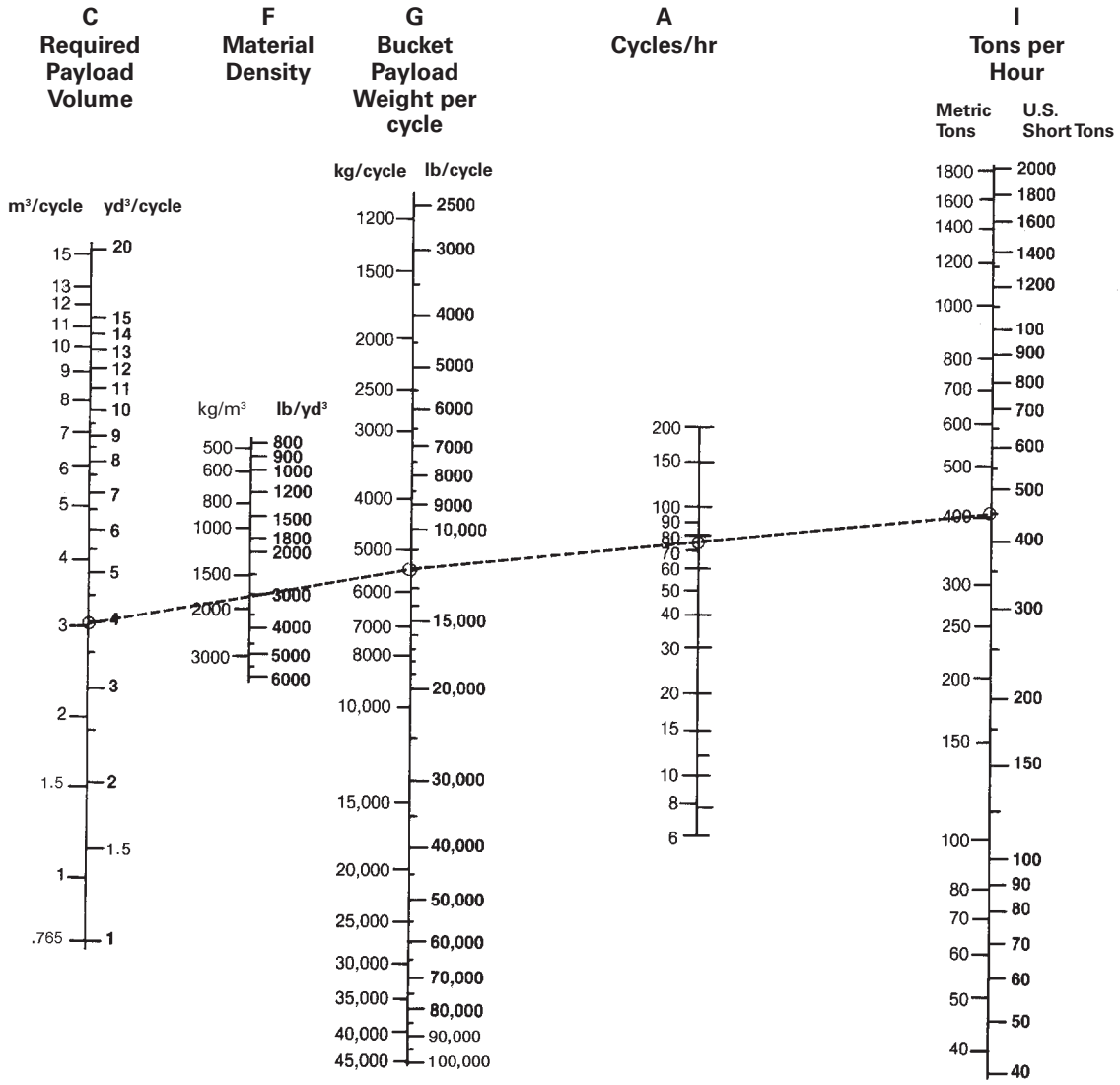
1. Enter required hourly production on Scale B 230 m^3/hr (300 yd^3/hr).
2. Enter cycles per hour on Scale A (60 ÷ .6 = 100 × .75 = 75 cycles/hr).
3. Connect A through B to C. This shows a required payload of 3 m^3 (4 yd^3) per cycle.
4. Enter estimated bucket fill factor on Scale D (0.95).
5. Connect C through Scale D to E for required bucket size 3 m^3 (4 yd^3).
6. Transfer cycles per hour Scale A and required payload Scale C to the following page.



7. Enter material density on Scale F 1780 kg/m³ (3000 lb/yd³).
8. Connect C through Scale F to Scale G to give payload weight per cycle 5300 kg (11,500 lb).
9. Compare Scale G quantity 5300 kg (11,500 lb) with recommended machine working range listed on the following bucket selection pages.

Operating capacity for the 950H with 3.1 m³ (4 yd³) bucket is dependent on material density and bucket capacity (see bucket selection pages that follow).

10. For hourly tonnage, draw a straight line from Scale G through Scale A to Scale I 400 metric tons (450 U.S. tons).



Model	Interface	Bucket Type	Width Range		Capacity Range		Weight Range		GET
			mm	in	m³	yd³	kg	lb	
986H	Pin On	General Purpose Performance Series	3695	**145**	6.1-7.7	**8.0-10.0**	3648-4065	**8042-8962**	K110
		Rock Performance Series	3772	**149**	5.4-6.1	**7.0-8.0**	3726-3941	**8214-8688**	K110
		Heavy Duty Rock Performance Series	4014	**158**	5.4	**7.0**	5061	**11,158**	K130
		Extreme Duty Rock	4146	**163**	5.0	**6.5**	5195	**12,050**	K130
		Serrated Edge Rock	3812	**150**	6.1	**8.0**	4232	**9330**	N/A
		Coal	3692	**145**	10.0	**13.5**	5195	**11,453**	BOCE Included
988K	Pin On	General Purpose Performance Series	3855	**152**	6.9-8.4	**9.0-11.0**	4539-4994	**10,007-11,010**	K110
		Rock Performance Series	4020	**158**	6.4-7.7	**8.3-10.0**	4880-5263	**10,759-11,603**	K130
		Heavy Duty Rock Performance Series	4080	**161**	6.4	**8.3**	6360	**14,021**	K130
		Heavy Duty Granite Performance Series	3986	**157**	6.4	**8.3**	7433	**16,385**	K130
		Serrated Edge Rock	3968	**156**	6.4-6.9	**8.3-9.0**	5455-5634	**12,026-12,421**	N/A
		Iron Ore	3922	**154**	4.7	**6.2**	5771	**12,723**	K130
		Coal	4120	**162**	11.5-13.0	**15.0-17.0**	6023-6435	**13,278-14,186**	BOCE Included
		Slag	3900-4032	**154-159**	5.4-6.4	**7.0-8.3**	7633-8454	**16,828-18,638**	J600/Serrated Edge

N/A = Not Applicable

Model	Interface	Bucket Type	Width Range		Capacity Range		Weight Range		GET
			mm	in	m³	yd³	kg	lb	
990K	Pin On	Rock Performance Series	4610	**182**	8.6-10.0	**11.25-13.0**	7247-7497	**15,977-16,528**	K130
		Heavy Duty Rock Performance Series	4670	**184**	8.6	**11.25**	8980	**19,798**	K130
		Heavy Duty Granite Performance Series	4634	**182**	8.6	**11.25**	12 055	**26,520**	K150
		Slag	4450-4500	**175-177**	8.5-9.2	**11.2-12.0**	9149-9613	**20,127-21,149**	Weld-on edge included
		Coal	4370	**172**	13.4	**17.5**	7460	**16,410**	BOCE Included
		Iron Ore	4450	**175**	7.0	**9.2**	8525	**18,750**	K150
		Serrated Edge Rock	4610	**182**	9.5	**12.4**	8140	**17,910**	N/A
992K	Pin On	Rock	4824-4884	**190-192**	10.7-12.2	**14.0-16.0**	9382-10 574	**20,684-23,262**	K150/K170
		Heavy Duty Rock	5068	**200**	10.7	**14.0**	11 560	**25,485**	K170
		High Abrasion Rock	5068	**200**	10.7	**14.0**	11 927	**26,295**	K150
		Heavy Duty Granite	5165	**203**	10.7	**14.0**	13 720	**30,247**	K150
		Coal	6170	**243**	19.0	**25.0**	12 504	**27,506**	BOCE Included
		Iron Ore	4900	**193**	9.0	**11.8**	11 172	**24,577**	K150
		Serrated Edge Rock	4824	**190**	12.3	**16.0**	10 282	**22,620**	N/A
993K	Pin On	Rock	5068	**200**	12.2-14.5	**16.0-19.0**	12 864-14 209	**28,301-31,260**	K170
		High Abrasion Rock	5160	**203**	12.2-13.0	**16.0-17.0**	15 205-15 456	**33,451-34,004**	K170
		Heavy Duty Granite	5160	**203**	13.0	**17.0**	17 418	**38,320**	K170
		Coal	6300	**248**	23.0	**31.0**	17 673	**38,880**	K170
		Iron Ore	5160	**203**	10.0	**13.0**	14 063	**30,940**	K170
		Serrated Edge Rock	5080	**200**	15.0	**19.5**	13 915	**30,615**	N/A
994K	Pin On	Rock	6223	**245**	19.1-24.5	**25-32**	19 205-21 293	**42,340-46,942**	Spade edge*
		Heavy Duty Rock	6240	**246**	19.1-21.4	**25-28**	20 699-21 303	**45,633-46,966**	Spade edge*
		Coal	6964	**274**	32.1-39.8	**42-52**	20 862-22 773	**45,992-50,206**	Straight edge*
		Iron Ore	6240	**246**	17.2	**22.5**	19 518	**43,029**	Spade edge*

*With teeth and segments.
N/A = Not Applicable

986H — Standard Lift

Material Density				Bucket Volume	
kg/m³	**tonnes/m³**	**lb/yd³**	**tons/yd³**	**m³**	**yd³**
1632-1795	1.63-1.80	**2750-3025**	**1.38-1.51**	6.1	**8**
1740-1914	1.74-1.91	**2933-3227**	**1.46-1.61**	5.7	**7.5**
1865-2051	1.86-2.05	**3143-3457**	**1.57-1.73**	5.4	**7**

*Density range covers 100% rated payload to 110% rated payload in accordance with Large Wheel Loader payload policy.

988K

Material Density				Bucket Volume	
kg/m³	**tonnes/m³**	**lb/yd³**	**tons/yd³**	**m³**	**yd³**
1468-1614	1.47-1.61	**2500-2750**	**1.25-1.38**	7.7	**10**
1638-1801	1.64-1.80	**2778-3056**	**1.39-1.53**	6.9	**9**
1766-1942	1.77-1.94	**3001-3300**	**1.50-1.65**	6.4	**8.33**

990K

Material Density				Bucket Volume	
kg/m³	**tonnes/m³**	**lb/yd³**	**tons/yd³**	**m³**	**yd³**
1590-1749	1.59-1.75	**2692-2962**	**1.35-1.48**	10	**13**
1728-1901	1.73-1.90	**2917-3208**	**1.46-1.60**	9.2	**12**
1849-2034	1.85-2.03	**3111-3422**	**1.56-1.71**	8.6	**11.25**

992K — Standard

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
12.2	**16**	1780	**3000**
11.5	**15**	1890	**3200**
10.7	**14**	2030	**3430**

992K — High Lift

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
12.2	**16**	1560	**2630**
11.5	**15**	1560	**2630**
10.7	**14**	1560	**2630**

993K — Standard

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
15.3	**20**	1780	**3000**
14.5	**19**	1870	**3160**
13.8	**18**	1970	**3330**

993K — High Lift

Up to specified density for 100% fill factor

Bucket Volume		Material Density	
m^3	yd^3	kg/m^3	lb/yd^3
14.5	**19**	1720	**2890**
13.8	**18**	1810	**3060**
13.0	**17**	1920	**3240**

WHEEL TRACTOR-SCRAPERS

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WHEEL TRACTOR-SCRAPERS

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Specifications
- Twin Engine Open Bowl
- Optional Push-Pull

MODEL	627K		637K		657G	
Flywheel Power: Tractor	304 kW	**407 hp**	425 kW	**570 hp**	421/447 kW	**564/600 hp**
Scraper	216 kW	**290 hp**	216 kW	**290 hp**	306/337 kW	**410/451 hp**
Approx. Operating Weight (Empty)◀	40 811 kg	**89,973 lb**	52 140 kg	**114,950 lb**	68 384 kg	**150,760 lb**
Scraper Capacity: Struck	13 m^3	**17.1 yd^3**	18.3 m^3	**24 yd^3**	24.5 m^3	**32 yd^3**
Heaped	18.4 m^3	**24 yd^3**	26 m^3	**34 yd^3**	33.6 m^3	**44 yd^3**
Rated Load	26 127 kg	**57,610 lb**	37 285 kg	**82,200 lb**	47 174 kg	**104,000 lb**
Weight Distribution — Empty: Front	**59%**		**59%**		**58%**	
Rear	**41%**		**41%**		**42%**	
Weight Distribution — Loaded: Front	**50%**		**50%**		**50%**	
Rear	**50%**		**50%**		**50%**	
Engine Model: Tractor	**C13 ACERT**		**C18 ACERT**		**C18 ACERT**	
Scraper	**C9.3 ACERT**		**C9 ACERT**		**C15 ACERT**	
Emission Standards	**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**		**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**		**Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent**	
Rated Engine RPM: Tractor	**2000**		**1900**		**1800**	
Scraper	**2150**		**2150**		**1800**	
Displacement: Tractor	12.5 L	**763 in^3**	18.1 L	**1105 in^3**	18.1 L	**1105 in^3**
Scraper	9.3 L	**567 in^3**	9.3 L	**567 in^3**	15.2 L	**928 in^3**
Top Speed (Loaded)	53.9 km/h	**33.5 mph**	55.8 km/h	**34.7 mph**	53 km/h	**33 mph**
180° Curb-to-Curb Turning Width	18.25 m	**59'11"**	19.94 m	**65'5"**	22.33 m	**73'3"**
Tires — Tractor/Scraper	**33.25R29★★E3**		**37.25R35★★E3**		**40.5/75R39★★E3**	
Width of Cut	3.14 m	**10'4"**	3.51 m	**11'6"**	3.85 m	**12'8"**
Maximum Depth of Cut	315 mm	**12.4"**	475 mm	**18.7"**	440 mm	**17.3"**
Maximum Depth of Spread	540 mm	**21.3"**	451 mm	**17.8"**	660 mm	**26"**
Fuel Tank Refill Capacity	1272 L	**336 U.S. gal**	1400 L	**370 U.S. gal**	1597 L	**424 U.S. gal**
Tractor DEF Tank	31.5 L	**8.3 U.S. gal**	31.5 L	**8.3 U.S. gal**	—	
Scraper DEF Tank	23.1 L	**6.1 U.S. gal**	22.9 L	**6.0 U.S. gal**	—	
GENERAL DIMENSIONS: Non Push-Pull						
Height — Overall Shipping	4.03 m	**13'2"**	4.15 m	**13'7"**	4.62 m	**15'2"**
Wheelbase	7.99 m	**26'2"**	8.81 m	**28'11"**	9.96 m	**32'8"**
Overall Length	14.02 m	**45'10"**	15.04 m	**49'4"**	16.2 m	**53'1"**
Overall Width	3.57 m	**11'7"**	3.94 m	**12'11"**	4.35 m	**14'4"**
Shipping Width (Draft Arm on Inside of Bowl)	—		—		3.91 m *	**12'10"**
Center Line of Scraper Tread	2.29 m	**7'5"**	2.46 m	**8'1"**	2.81 m	**9'3"**
Center Line of Tractor Tread	2.28 m	**7'4"**	2.46 m	**8'1"**	2.63 m	**8'8"**
GENERAL DIMENSIONS: Push-Pull						
Operating Weight (Empty)◀	42 158 kg	**92,942 lb**	54 005 kg	**119,060 lb**	72 804 kg	**160,505 lb**
Overall Length	15.58 m	**51'1"**	16.64 m	**54'7"**	18.01 m	**59'1"**
Weight Distribution — Empty:						
Front	**59%**		**61%**		**58%**	
Rear	**41%**		**39%**		**42%**	
Weight Distribution — Loaded:						
Front	**50%**		**51%**		**51%**	
Rear	**50%**		**49%**		**49%**	

*Standard Shipping Configuration.

◀ Operating weight includes standard machine, coolant, lubricants, full fuel tank, and operator. Operating weights for the 627K and 637K are based on Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) platform machines. Deduct 569 kg **(1254 lb)** for the operating weight for the 627K Tier 2/Stage II/Japan 2001 (Tier 2) equivalent. Deduct 650 kg **(1433 lb)** for the operating weight for the 637K Tier 2/Stage II/Japan 2001 (Tier 2) equivalent. 657G is not available in Tier 2/Stage II/Japan 2001 (Tier 2) equivalent.

NOTE: Wheel Tractor-Scrapers are not emission certified in Japan market.

MODEL	637K		657G	
Flywheel Power: Tractor	425 kW	**570 hp**	421/447 kW	**564/600 hp**
Scraper	216 kW	**290 hp**	306/337 kW	**410/451 hp**
Approx. Operating Weight (Empty)	53 425 kg	**117,782 lb**	72 190 kg	**158,817 lb**
Scraper Capacity: Struck	31 m^3	**41 yd^3**	45 m^3	**59 yd^3**
Heaped	38 m^3	**50 yd^3**	56 m^3	**73 yd^3**
Emission Standards	**Tier 4 Final/Stage IV/ Japan 2014 (Tier 4 Final)**		**Tier 3/Stage IIIA/ Japan 2006 (Tier 3) equivalent**	
Rated Load	37 285 kg	**82,200 lb**	49 895 kg	**110,000 lb**
Approx. Operating Weight (Loaded)	90 710 kg	**199,982 lb**	121 933 kg	**268,817 lb**
Top Speed (Loaded)	55.8 km/h	**34.7 mph**	53 km/h	**33 mph**
180° Curb-to-Curb Turning Width	21.46 m	**70'5"**	24.43 m	**80'2"**
GENERAL DIMENSIONS:				
Height — Overall Shipping	4.15 m	**13'7"**	4.62 m	**15'2"**
Wheelbase	9.57 m	**31'5"**	11.01 m	**36'1"**
Overall Length	15.48 m	**50'10"**	17.21 m	**56'5"**
Overall Width	3.94 m	**12'11"**	4.35 m	**14'4"**
Shipping Width (Draft Arm on Inside of Bowl)	—		3.91 m *	**12'10"**
Center Line of Scraper Tread	2.46 m	**8'1"**	2.81 m	**9'3"**
Center Line of Tractor Tread	2.46 m	**8'1"**	2.63 m	**8'8"**

*Standard Shipping Configuration.
◀Operating weight includes standard machine, coolant, lubricants, full fuel tank, and operator. Operating weights for the 637K are based on Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) and operating weights for the 657G are based on Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent platform machines. Deduct 650 kg **(1433 lb)** for the operating weight for the 637K Tier 2/Stage II/Japan 2001 (Tier 2) equivalent.
NOTE: Wheel Tractor-Scrapers are not emission certified in Japan market.

Coal Bowl

Coal Bowl Wheel Tractor-Scrapers are typically used for building and maintaining coal stockpiles and hauling coal to the supply system at coal power plants. The self-loading capability, large capacity, coal pile compaction, and high speed of Coal Bowl Wheel Tractor-Scrapers make them the tool of choice for moving coal both short and long distances. Coal Bowl Wheel Tractor-Scrapers are available in the 637K and 657G tandem engine models.

Coal Bowl Advantages:
- Load hoppers
- Manage coal stockpiles
- Compaction reduces risk of spontaneous combustion in coal stockpile
- Exclusively designed large capacity coal bowls

Notes:
- The 637K Coal Scraper is 736 mm **(29.0")** longer, the bowl sides are 476 mm **(18.7")** taller, and the apron is 499 mm **(19.6")** taller than its earthmoving counterpart.
- The 657G Coal Scraper is 1072 mm **(42.2")** longer, the bowl sides are 1010 mm **(39.8")** taller, the apron is 677 mm **(26.7")** taller, and the ejector is 944 mm **(37.2")** taller than its earthmoving counterpart.

USE OF RIMPULL-SPEED-GRADEABILITY CURVES

The following explanation applies to Rimpull-Speed-Gradeability curves for Wheel Tractor-Scrapers, Construction & Mining Trucks/Tractors and Articulated Trucks.

Maximum speed attainable, gear range and available rimpull can be determined from curves on the following pages when machine weight and total effective grade (or total resistance) are known.

Rimpull is the force (in kg, lb or kN) available between the tire and the ground to propel the machine (limited by traction).

Weight is defined as Gross Machine Weight (kg or lb) = Machine + Payload.

Total Effective Grade (or Total Resistance) is grade resistance plus rolling resistance expressed as percent grade.

Grade is measured or estimated.

Rolling resistance is estimated (see Tables section for typical values.)

10 kg/metric ton (20 lb/U.S. ton) = 1% adverse grade.

Example

With a 6% grade and a rolling resistance of 40 kg/metric ton (80 lb/U.S. ton), find total resistance.

Rolling resistance = 40 kg/t ÷ 10 = 4% Effective Grade

(English: 80 lb ÷ 20 = 4%)

Total resistance = 4% rolling + 6% grade = 10%

Altitude Derating

Rimpull force and speed must be derated for altitude similar to flywheel horsepower. The percentage loss in rimpull force approximately corresponds to the percentage loss in flywheel horsepower. See Tables Section for altitude derations.

Rimpull-Speed-Gradeability

To determine gradeability performance: Read from gross weight down to the % of total resistance. (Total resistance equals actual % grade *plus* 1% for each 10 kg/metric ton (20 lb./U.S. ton) of rolling resistance.) From this weight-resistance point, read horizontally to the curve with the highest obtainable speed range, then down to the maximum speed. Usable rimpull depends upon traction and weight on drive wheels.

Example problem:

A 631K with an estimated payload of 37 013 kg (81,600 lb) is operating on a total effective grade of 10%. Find the available rimpull and maximum attainable speed.

Empty weight payload = Gross Weight
47 628 kg + 37 013 kg = 84 641 kg
(105,002 lb + 81,600 lb = 186,602 lb)

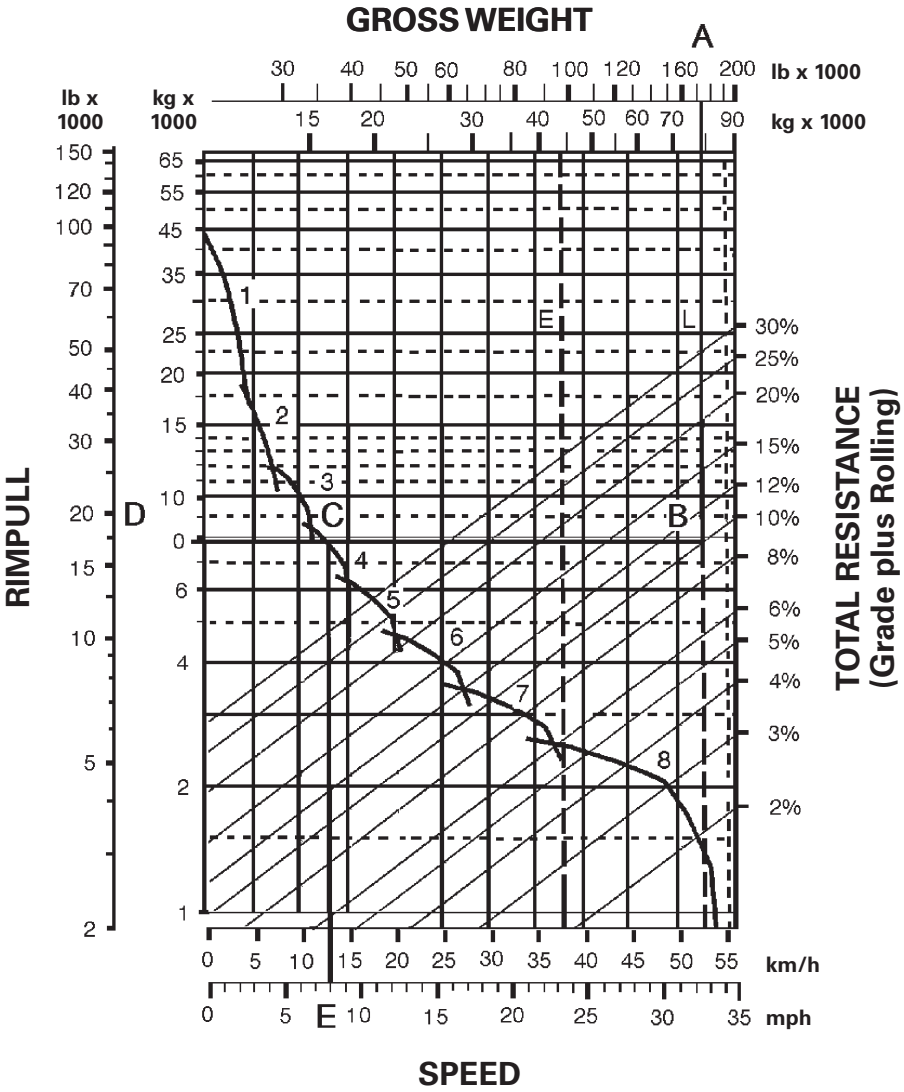
Solution: Using graph on the next page, read from 84 641 kg (186,602 lb) (point A) on top of gross weight scale down the line to the intersection of the 10% total resistance line (point B).

Go across horizontally from B to the Rimpull Scale on the left (point D). This gives the required rimpull: 7756 kg (17,100 lb).

Where the line cuts the speed curve (point C), read down vertically (point E) to obtain the maximum speed attainable for the 10% effective grade: 12.9 km/h (8 mph).

ANSWER: The machine will climb the 10% effective grade at a maximum speed of 12.9 km/h (8 mph) in 4th gear. Available rimpull is 7756 kg (17,100 lb).

● ● ●



KEY

1 — 1st Gear Torque Converter Drive
2 — 2nd Gear Torque Converter Drive
3 — 3rd Gear Direct Drive
4 — 4th Gear Direct Drive
5 — 5th Gear Direct Drive
6 — 6th Gear Direct Drive
7 — 7th Gear Direct Drive
8 — 8th Gear Direct Drive

KEY

A — Loaded 84 641 kg (186,602 lb)
B — Intersection with 10% total resistance line
C — Intersection with rimpull curve (4th gear)
D — Required rimpull 7756 kg (17,100 lb)
E — Speed 12.9 km/h (8 mph)

TYPICAL FIXED TIMES FOR SCRAPERS

(Times may vary depending on job conditions)

Model	Loaded By	Load Time (Min.)	Maneuver and Spread or Maneuver and Dump (Min.)
613G	Self	0.9	0.7
623K	Self	0.9	0.7
621K	One D8	0.5	0.7
627K	One D8	0.5	0.6
621K	One D9	0.4	0.7
627K	One D9	0.4	0.6
627K/PP	Self	0.9*	0.6
631K	One D9	0.6	0.7
637K	One D9	0.6	0.6
631K	One D10	0.5	0.7
637K	One D10	0.5	0.6
637K/PP	Self	1.0*	0.6
657G	One D11	0.6	0.6
657G	Push Pull Self	1.1*	0.6
637K	Coal	0.8	0.7
657G	Coal	0.8	0.6

*Load time per pair, including transfer time.

NOTE: Empty Weights shown on the Wheel Tractor-Scraper charts includes ROPS Canopy. When calculating TMPH loadings *any* additional weight must be considered in establishing mean tire loads.

USE OF RETARDER CURVES

The following explanation applies to retarder curves for Wheel Tractor-Scrapers and Articulated Trucks.

The speed that can be maintained (without use of service brake) when the machine is descending a grade with retarder fully on can be determined from the retarder curves in this section if gross machine weight and total effective grade are known.

Total Effective Grade (or Total Resistance) is grade assistance *minus* rolling resistance.

10 kg/metric ton (20 lb/U.S. ton) = 1% adverse grade.

Example

15% favorable grade with 5% rolling resistance. Find Total Effective Grade.

Total Effective Grade = 15% Grade Assistance — 5%

Rolling Resistance = 10% Total Effective Grade Assistance.

Example problem:

A 651E with an estimated payload of 47 175 kg (104,000 lb) descends a 10% total effective grade. Find constant speed and gear range with maximum retarder effort. Find travel time if the slope is 610 m (2000 ft) long.

Empty Weight + Payload = Gross Weight
= 60 950 kg + 47 175 kg = 108 125 kg
(134,370 lb + 104,000 lb = 238,370 lb)

Solution: Using the retarder curve below, read from 108 125 kg (238,370 lb) (point A) on top of gross weight scale down the line to the intersection of the 10% effective grade line (point B).

Go across horizontally from point B to the intersection of the retarder curve (point C). Point C intersects at the 5 (5th gear) range.

Where point C intersects the retarder curve, read down vertically to point D on the bottom scale to obtain the constant speed: 21.7 km/h (13.5 mph).

ANSWER: The 651E will descend the slope at 21.7 km/h (13.5 mph) in 5th gear. Travel time is 1.68 minutes.

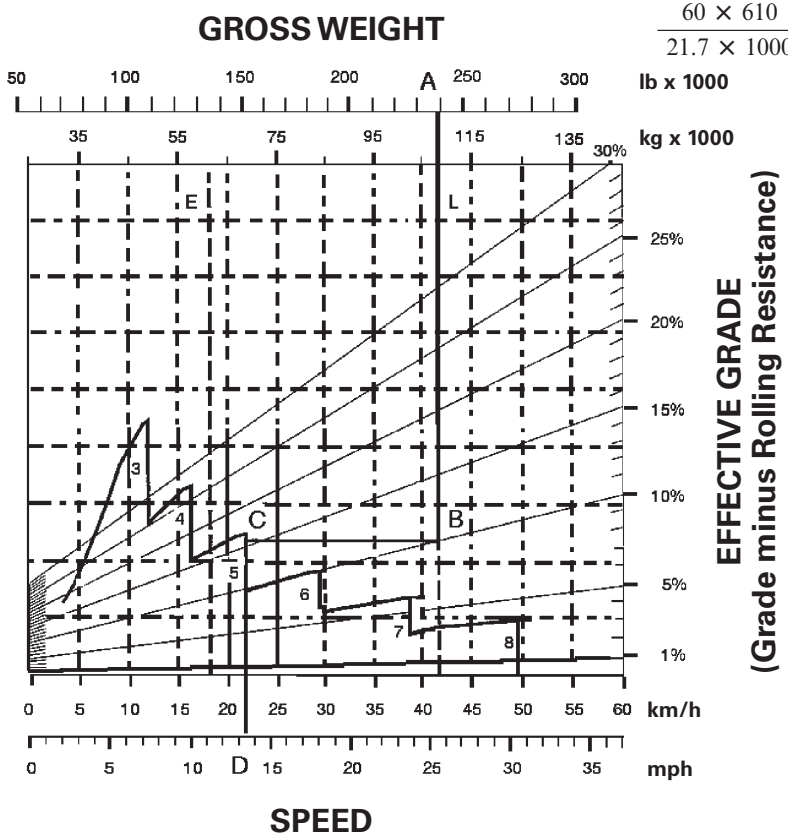
$$\frac{610 \text{ m}}{363 \text{ m/min}} = 1.68 \text{ min}$$

*(mph × 88 = F.P.M.)

$$\frac{2000 \text{ ft}}{13.5 \text{ mph} \times 88^*} = 1.68 \text{ min}$$

NOTE: The basic Distance-Speed-Time formula is 60 D ÷ S = T (or "60 D Street"), where 60 is minutes, D is distance, S is speed and T is time. In the above problem, 60 × 610 m ÷ 21.7 km/h × 1000 = T.

$$\frac{60 \times 610}{21.7 \times 1000} = T = (1.68)$$



KEY

3 — 3rd Gear Direct Drive
4 — 4th Gear Direct Drive
5 — 5th Gear Direct Drive
6 — 6th Gear Direct Drive
7 — 7th Gear Direct Drive
8 — 8th Gear Direct Drive

KEY

A — Loaded 108 125 kg (238,370 lb)
B — Intersection with 10% effective grade line
C — Intersection with retarder curve (5th gear)
D — Constant speed 21.7 km/h (13.5 mph)

MINING AND EARTHMOVING

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INTRODUCTION

This section explains the earthmoving principles used to determine machine productivity. It shows how to calculate production on-the-job or estimate production off-the-job.

ELEMENTS OF PRODUCTION

Production is the hourly rate at which material is moved. Production can be expressed in various units:

Metric

Bank Cubic Meters — BCM — bank m^3
Loose Cubic Meters — LCM — loose m^3
Compacted Cubic Meters — CCM — compacted m^3
Tonnes

English

Bank Cubic Yards — BCY — bank yd^3
Loose Cubic Yards — LCY — loose yd^3
Compacted Cubic Yards — CCY — compacted yd^3
Tons

For most earthmoving and material handling applications, production is calculated by multiplying the quantity of material (load) moved per cycle by the number of cycles per hour.

Production = Load/cycle × cycles/hour

The load can be determined by
1) load weighing with scales
2) load estimating based on machine rating
3) surveyed volume divided by load count
4) machine payload measurement system

Generally, earthmoving and overburden removal for coal mines are calculated by volume (bank cubic meters or bank cubic yards). Metal mines and aggregate producers usually work in weight (tons or tonnes).

Volume Measure — Material volume is defined according to its state in the earthmoving process. The three measures of volume are:

BCM (BCY) — one cubic meter (yard) of material as it lies in the natural bank state.

LCM (LCY) — one cubic meter (yard) of material which has been disturbed and has swelled as a result of movement.

CCM (CCY) — one cubic meter (yard) of material which has been compacted and has become more dense as a result of compaction.

In order to estimate production, the relationships between bank measure, loose measure, and compacted measure must be known.

Swell — Swell is the percentage of original volume (cubic meters or cubic yards) that a material increases when it is removed from the natural state. When excavated, the material breaks up into different size particles that do not fit together, causing air pockets or voids to reduce the weight per volume. For example to hold the same weight of one cubic unit of bank material it takes 30% more volume (1.3 times) after excavation. (Swell is 30%.)

$$1 + \text{Swell} = \frac{\text{Loose cubic volume for a given weight}}{\text{Bank cubic volume for the same given weight}}$$

$$\text{Bank} = \frac{\text{Loose}}{(1 + \text{Swell})}$$

$$\text{Loose} = \text{Bank} \times (1 + \text{Swell})$$

Example Problem:

If a material swells 20%, how many loose cubic meters (loose cubic yards) will it take to move 1000 bank cubic meters (1308 bank cubic yards)?

Loose = Bank × (1 + Swell) =
1000 BCM × (1 + 0.2) = 1200 LCM
1308 BCY × (1 + 0.2) = 1570 LCY

How many bank cubic meters (yards) were moved if a total of 1000 loose cubic meters (1308 yards) have been moved? Swell is 25%.

Bank = Loose ÷ (1 + Swell) =
1000 LCM ÷ (1 + 0.25) = 800 BCM
1308 LCY ÷ (1 + 0.25) = 1046 BCY

Load Factor — Assume one bank cubic yard of material weighs 3000 lb. Because of material characteristics, this bank cubic yard swells 30% to 1.3 loose cubic yards when loaded, with no change in weight. If this 1.0 bank cubic yard or 1.3 loose cubic yards is compacted, its volume may be reduced to 0.8 compacted cubic yard, and the weight is still 3000 lb.

Instead of dividing by 1 + Swell to determine bank volume, the loose volume can be multiplied by the load factor.

If the percent of material swell is known, the load factor (L.F.) may be obtained by using the following relationship:

$$\text{L.F.} = \frac{100\%}{100\% + \%\ \text{swell}}$$

Load factors for various materials are listed in the Tables Section of this handbook.

To estimate the machine payload in bank cubic yards, the volume in loose cubic yards is multiplied by the load factor:

$$\text{Load (BCY)} = \text{Load (LCY)} \times \text{L.F.}$$

The ratio between compacted measure and bank measure is called shrinkage factor (S.F.):

$$\text{S.F.} = \frac{\text{Compacted cubic yards (CCY)}}{\text{Bank cubic yards (BCY)}}$$

Shrinkage factor is either estimated or obtained from job plans or specifications which show the conversion from compacted measure to bank measure. Shrinkage factor should not be confused with percentage compaction (used for specifying embankment density, such as Modified Proctor or California Bearing Ratio [CBR]).

Material Density — Density is the weight per unit volume of a material. Materials have various densities depending on particle size, moisture content and variations in the material. The denser the material the more weight there is per unit of equal volume. Density estimates are provided in the Tables Section of this handbook.

$$\text{Density} = \frac{\text{Weight}}{\text{Volume}} = \frac{\text{kg (lb)}}{\text{m}^3\,(\text{yd}^3)}$$

$$\text{Weight} = \text{Volume} \times \text{Density}$$

A given material's density changes between bank and loose. One cubic unit of loose material has less weight than one cubic unit of bank material due to air pockets and voids. To correct between bank and loose use the following equations.

$$1 + \text{Swell} = \frac{\text{kg/BCM}}{\text{kg/LCM}} \text{ or } \frac{\text{lb/BCY}}{\text{lb/LCY}}$$

$$\text{lb/LCY} = \frac{\text{lb/BCY}}{(1 + \text{Swell})}$$

$$\text{lb/BCY} = \text{lb/LCY} \times (1 + \text{Swell})$$

Fill Factor — The percentage of an available volume in a body, bucket, or bowl that is actually used is expressed as the fill factor. A fill factor of 87% for a hauler body means that 13% of the rated volume is not being used to carry material. Buckets often have fill factors over 100%.

Example Problem:

A 14 cubic yard (heaped 2:1) bucket has a 105% fill factor when operating in a shot sandstone (4125 lb/BCY and a 35% swell).

a) What is the loose density of the material?
b) What is the usable volume of the bucket?
c) What is the bucket payload per pass in BCY?
d) What is the bucket payload per pass in tons?

a) lb/LCY = lb/BCY ÷ (1 + Swell) = 4125 ÷ (1.35) = 3056 lb/LCY
b) LCY = rated LCY × fill factor = 14 × 1.05 = 14.7 LCY
c) lb/pass = volume × density lb/LCY = 14.7 × 3056 = 44,923 lb
BCY/pass = weight ÷ density lb/BCY = 44,923 ÷ 4125 = 10.9 BCY
or bucket LCY from part b ÷ (1 + Swell) = 14.7 ÷ 1.35 = 10.9 BCY
d) tons/pass = lb ÷ 2000 lb/ton = 44,923 ÷ 2000 = 22.5 tons

Example Problem:

Construct a 10,000 compacted cubic yard (CCY) bridge approach of dry clay with a shrinkage factor (S.F.) of 0.80. Haul unit is rated 14 loose cubic yards struck and 20 loose cubic yards heaped.

a) How many bank yards are needed?
b) How many loads are required?

a) $\text{BCY} = \frac{\text{CCY}}{\text{S.F.}} = \frac{10{,}000}{0.80} = 12{,}500 \text{ BCY}$

b) Load (BCY) = Capacity (LCY) × Load factor (L.F.) = 20 × 0.81 = 16.2 BCY/Load

(L.F. of 0.81 from Tables)

$$\text{Number of loads required} = \frac{12{,}500 \text{ BCY}}{16.2 \text{ BCY/Load}} = 772 \text{ Loads}$$

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Soil Density Tests — There are a number of acceptable methods that can be used to determine soil density. Some that are currently in use are:

Nuclear density moisture gauge
Sand cone method
Oil method
Balloon method
Cylinder method

All these except the nuclear method use the following procedure:

1. Remove a soil sample from bank state.
2. Determine the volume of the hole.
3. Weigh the soil sample.
4. Calculate the bank density kg/BCM (lb/BCY).

The nuclear density moisture gauge is one of the most modern instruments for measuring soil density and moisture. A common radiation channel emits either neutrons or gamma rays into the soil. In determining soil density, the number of gamma rays absorbed and back scattered by soil particles is *indirectly* proportional to the soil density. When measuring moisture content, the number of moderated neutrons reflected back to the detector after colliding with hydrogen particles in the soil is *directly* proportional to the soil's moisture content.

All these methods are satisfactory and will provide accurate densities when performed correctly. Several repetitions are necessary to obtain an average.

NOTE: Several newer methods have been successfully applied, along with weigh scales to determine volume and loose density of material moved in hauler bodies. These measurements include photogrammatic and laser scanning technologies.

FIGURING PRODUCTION ON-THE-JOB

Load Weighing — The most accurate method of determining the actual load carried is by weighing. This is normally done by weighing the haul unit one wheel or axle at a time with portable scales. Any scales of adequate capacity and accuracy can be used. While weighing, the machine must be level to reduce error caused by weight transfer. Enough loads must be weighed to provide a good average. Machine weight is the sum of the individual wheel or axle weights.

The weight of the load can be determined using the empty and loaded weight of the unit.

Weight of
load = gross machine weight – empty weight

To determine the bank cubic measure carried by a machine, the load weight is divided by the bankstate density of the material being hauled.

$$\text{BCY} = \frac{\text{Weight of load}}{\text{Bank density}}$$

Times Studies — To estimate production, the number of complete trips a unit makes per hour must be determined. First obtain the unit's cycle time with the help of a stop watch. Time several complete cycles to arrive at an average cycle time. By allowing the watch to run continuously, different segments such as load time, wait time, etc. can be recorded for each cycle. Knowing the individual time segments affords a good opportunity to evaluate the balance of the spread and job efficiency. The following is an example of a scraper load time study form. Numbers in the white columns are stop watch readings; numbers in the shaded columns are calculated:

Total Cycle Times (less delays)	Arrive Cut	Wait Time	Begin Load	Load Time	End Load	Begin Delay	Delay Time	End Delay
	0.00	0.30	0.30	0.60	0.90			
3.50	3.50	0.30	3.80	0.65	4.45			
4.00	7.50	0.35	7.85	0.70	8.55	9.95	1.00	10.95
4.00	12.50	0.42	12.92	0.68	13.60			

NOTE: All numbers are in minutes

This may be easily extended to include other segments of the cycle such as haul time, dump time, etc. Haul roads may be further segmented to more accurately define performance, including measured speed traps. Similar forms can be made for pushers, loaders, dozers, etc. *Wait Time* is the time a unit must wait for another unit so that the two can function together (haul unit waiting for pusher). *Delay Time* is any time, other than wait time, when a machine is not performing in the work cycle (scraper waiting to cross railroad track).

To determine trips-per-hour at 100% efficiency, divide 60 minutes by the average cycle time less all wait and delay time. Cycle time may or may not include wait and/or delay time. Therefore, it is possible to figure different kinds of production: measured production, production without wait or delay, maximum production, etc. For example:

Actual Production: includes all wait and delay time.

Normal Production (without delays): includes wait time that is considered normal, but no delay time.

Maximum Production: to figure maximum (or optimum) production, both wait time and delay time are eliminated. The cycle time may be further altered by using an optimum load time.

Example (English)

A job study of a Wheel Tractor-Scraper might yield the following information:

Average wait time	= 0.28 minute
Average load time	= 0.65
Average delay time	= 0.25
Average haul time	= 4.26
Average dump time	= 0.50
Average return time	= 2.09
Average total cycle	= 8.03 minutes
Less wait & delay time	= 0.53
Average cycle 100% eff.	= 7.50 minutes

Weight of haul unit empty — 48,650 lb

Weights of haul unit loaded —

Weighing unit #1 —	93,420 lb
Weighing unit #2 —	89,770 lb
Weighing unit #3 —	88,760 lb
	271,950 lb;
	average = 90,650 lb

1. Average load weight = 90,650 lb – 48,650 lb = 42,000 lb
2. Bank density = 3125 lb/BCY
3. $\text{Load} = \dfrac{\text{Weight of load}}{\text{Bank density}}$

$$= \frac{42{,}000 \text{ lb}}{3125 \text{ lb/BCY}} = 13.4 \text{ BCY}$$

4. Cycles/hr =

$$\frac{60 \text{ min/hr}}{\text{Cycle time}} = \frac{60 \text{ min/hr}}{7.50 \text{ min/cycle}} = 80 \text{ cycles/hr}$$

5. Production = Load/cycle × cycles/hr
   (less delays) = 13.4 BCY/cycle × 8.0 cycles/hr
   = 107.2 BCY/hr

Example (Metric)

A job study of a Wheel Tractor-Scraper might yield the following information:

Average wait time	= 0.28 minute
Average load time	= 0.65
Average delay time	= 0.25
Average haul time	= 4.26
Average dump time	= 0.50
Average return time	= 2.09
Average total cycle	= 8.03 minutes
Less wait & delay time	= 0.53
Average cycle 100% eff.	= 7.50 minutes

Weight of haul unit empty — 22 070 kg
Weights of haul unit loaded —
Weighing unit #1 — 42 375 kg
Weighing unit #2 — 40 720 kg
Weighing unit #3 — 40 260 kg
123 355 kg;
average = 41 120 kg

1. Average load weight = 41 120 kg – 22 070 kg = 19 050 kg
2. Bank density = 1854 kg/BCM
3. $\text{Load} = \dfrac{\text{Weight of load}}{\text{Bank density}}$

   $= \dfrac{19\,050 \text{ kg}}{1854 \text{ kg/BCM}} = 10.3 \text{ BCM}$
4. Cycles/hr =

   $\dfrac{60 \text{ min/hr}}{\text{Cycle time}} = \dfrac{60 \text{ min/hr}}{7.50 \text{ min/cycle}} = 80 \text{ cycles/hr}$
5. Production = Load/cycle × cycles/hr
   (less delays) = 10.3 BCM/cycle × 8.0 cycles/hr
   = 82 BCM/hrr

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ESTIMATING PRODUCTION OFF-THE-JOB

It is often necessary to estimate production of earthmoving machines which will be selected for a job. As a guide, the remainder of the section is devoted to discussions of various factors that may affect production. Some of the figures have been rounded for easier calculation.

Rolling Resistance (RR) is a measure of the force that must be overcome to roll or pull a wheel over the ground. It is affected by ground conditions and load — the deeper a wheel sinks into the ground, the higher the rolling resistance. Internal friction and tire flexing also contribute to rolling resistance. Experience has shown that minimum resistance is 1%-1.5% (see Typical Rolling Resistance Factors in Tables section) of the gross machine weight (on tires). A 2% base resistance is quite often used for estimating. Resistance due to tire penetration is approximately 1.5% of the gross machine weight for each inch of tire penetration (0.6% for each cm of tire penetration). Thus rolling resistance can be calculated using these relationships in the following manner:

RR = 2% of GMW + 0.6% of GMW per cm tire penetration
RR = 2% of GMW + 1.5% of GMW per inch tire penetration

It's *not* necessary for the tires to actually penetrate the road surface for rolling resistance to increase above the minimum. If the road surface flexes under load, the effect is nearly the same — the tire is always running "uphill." Only on very hard, smooth surfaces with a well compacted base will the rolling resistance approach the minimum.

When actual penetration takes place, some variation in rolling resistance can be noted with various inflation pressures and tread patterns.

NOTE: When figuring "pull" requirements for track-type tractors, rolling resistance applies only to the trailed unit's *weight on wheels*. Since track-type tractors utilize steel wheels moving on steel "roads," a tractor's rolling resistance is relatively constant and is accounted for in the Drawbar Pull rating.

Estimating Production Off-the-Job
- Grade Resistance
- Total Resistance
- Traction

Grade Resistance is a measure of the force that must be overcome to move a machine over unfavorable grades (uphill). Grade assistance is a measure of the force that assists machine movement on favorable grades (downhill).

Grades are generally measured in percent slope, which is the ratio between vertical rise or fall and the horizontal distance in which the rise or fall occurs. For example, a 1% grade is equivalent to a 1 m (ft) rise or fall for every 100 m (ft) of horizontal distance; a rise of 4.6 m (15 ft) in 53.3 m (175 ft) equals an 8.6% grade.

$$\frac{\text{4.6 m (rise)}}{\text{53.3 m (horizontal distance)}} = \text{8.6\% grade}$$

$$\frac{\text{15 ft (rise)}}{\text{175 ft (horizontal distance)}} = \text{8.6\% grade}$$

Uphill grades are normally referred to as adverse grades and downhill grades as favorable grades. Grade resistance is usually expressed as a positive (+) percentage and grade assistance is expressed as a negative (–) percentage.

It has been found that for each 1% increment of adverse grade an additional 10 kg (20 lb) of resistance must be overcome for each metric (U.S.) ton of machine weight. This relationship is the basis for determining the Grade Resistance Factor which is expressed in kg/metric ton (lb/U.S. ton):

$$\begin{aligned}\text{Grade Resistance Factor} &= \text{10 kg/m ton} \times \text{\% grade}\\ &= \text{20 lb/U.S. ton} \times \text{\% grade}\end{aligned}$$

Grade resistance (assistance) is then obtained by multiplying the Grade Resistance Factor by the machine weight (GMW) in metric (U.S.) tons.

$$\text{Grade Resistance} = \text{GR Factor} \times \text{GMW in metric (U.S.) tons}$$

Grade resistance may also be calculated using percentage of gross weight. This method is based on the relationship that grade resistance is approximately equal to 1% of the gross machine weight for 1% of grade.

$$\text{Grade Resistance} = \text{1\% of GMW} \times \text{\% grade}$$

Grade resistance (assistance) affects both wheel and track-type machines.

Total Resistance is the combined effect of rolling resistance (wheel vehicles) and grade resistance. It can be computed by summing the values of rolling resistance and grade resistance to give a resistance in kilogram (pounds) force.

$$\text{Total Resistance} = \text{Rolling Resistance} + \text{Grade Resistance}$$

Total resistance can also be represented as consisting completely of grade resistance expressed in percent grade. In other words, the rolling resistance component is viewed as a corresponding quantity of additional adverse grade resistance. Using this approach, total resistance can then be considered in terms of percent grade.

This can be done by converting the contribution of rolling resistance into a corresponding percentage of grade resistance. Since 1% of adverse grade offers a resistance of 10 kg (20 lb) for each metric or (U.S.) ton of machine weight, then each 10 kg (20 lb) of resistance per ton of machine weight can be represented as an additional 1% of adverse grade. Rolling resistance in percent grade and grade resistance in percent grade can then be summed to give Total Resistance in percent or Effective Grade. The following formulas are useful in arriving at Effective Grade.

$$\begin{aligned}\text{Rolling Resistance (\%)} &= \text{2\% + 0.6\% per cm tire penetration}\\ &= \text{2\% + 1.5\% per inch tire penetration}\\ \text{Grade Resistance (\%)} &= \text{\% grade}\\ \text{Effective Grade (\%)} &= \text{RR (\%) + GR (\%)}\end{aligned}$$

Effective grade is a useful concept when working with Rimpull-Speed-Gradeability curves, Retarder curves, Brake Performance curves, and Travel Time curves.

Traction — is the driving force developed by a wheel or track as it acts upon a surface. It is expressed as usable Drawbar Pull or Rimpull. The following factors affect traction: weight on the driving wheel or tracks, gripping action of the wheel or track, and ground conditions. The coefficient of traction (for any roadway) is the ratio of the maximum pull developed by the machine to the total weight on the drivers.

$$\text{Coeff. of traction} = \frac{\text{Pull}}{\text{weight on drivers}}$$

Therefore, to find the usable pull for a given machine:
Usable pull = Coeff. of traction × weight on drivers

Example: Track-Type Tractor

What usable drawbar pull (DBP) can a 26 800 kg (59,100 lb) Track-type Tractor exert while working on firm earth? on loose earth? (See table section for coefficient of traction.)

Answer:

Firm earth — Usable DBP =
0.90 × 26 800 kg = 24 120 kg
(0.90 × 59,100 lb = 53,190 lb)

Loose earth — Usable DBP =
0.60 × 26 800 kg = 16 080 kg
(0.60 × 59,100 lb = 35,460 lb)

If a load required 21 800 kg (48,000 lb) pull to move it, this tractor could move the load on firm earth. However, if the earth were loose, the tracks would spin.

NOTE: D8R through D11R Tractors may attain higher coefficients of traction due to their suspended undercarriage.

Example: Wheel Tractor-Scraper

What usable rimpull can a 621F size machine exert while working on firm earth? on loose earth? The total loaded weight distribution of this unit is:

Drive unit	Scraper unit
wheels: 23 600 kg (52,000 lb)	wheels: 21 800 kg (48,000 lb)

Remember, use weight on drivers only.

Answer:

Firm earth — 0.55 × 23 600 kg = 12 980 kg
(0.55 × 52,000 lb = 28,600 lb)

Loose earth — 0.45 × 23 600 kg = 10 620 kg
(0.45 × 52,000 lb = 23,400 lb)

On firm earth this unit can exert up to 12 980 kg (28,600 lb) rimpull without excessive slipping. However, on loose earth the drivers would slip if more than 10 620 kg (23,400 lb) rimpull were developed.

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Altitude — Specification sheets show how much pull a machine can produce for a given gear and speed when the engine is operating at rated horsepower. When a standard machine is operated in high altitudes, the engine may require derating to maintain normal engine life. This engine deration will produce less drawbar pull or rimpull.

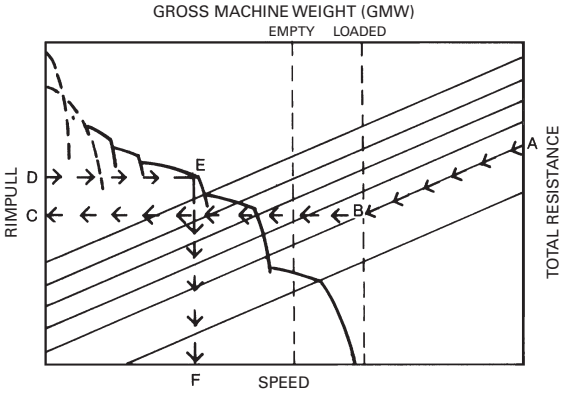
The Tables Section gives the altitude deration in percent of flywheel horsepower for current machines. It should be noted that some turbocharged engines can operate up to 4570 m (15,000 ft) before they require derating. Most machines are engineered to operate up to 1500-2290 m (5000-7500 ft) before they require deration.

The horsepower deration due to altitude must be considered in any job estimating. The amount of power deration will be reflected in the machine's gradeability and in the load, travel, and dump and load times (unless loading is independent of the machine itself). Altitude may also reduce retarding performance. Consult a Cat representative to determine if deration is applicable. Fuel grade (heat content) can have a similar effect of derating engine performance.

The example job problem that follows indicates one method of accounting for altitude deration: by increasing the appropriate components of the total cycle time by a percentage equal to the percent of horsepower deration due to altitude. (i.e., if the travel time of a hauling unit is determined to be 1.00 minute at full HP, the time for the same machine derated to 90% of full HP will be 1.10 min.) This is an approximate method that yields reasonably accurate estimates up to 3000 m (10,000 feet) elevation.

Travel time for hauling units derated more than 10% should be calculated as follows using Rimpull-Speed-Gradeability charts.

1) Determine total resistance (grade plus rolling) in percent.



2) Beginning at point A on the chart follow the total resistance line diagonally to its intersection, B, with the vertical line corresponding to the appropriate gross machine weight. (Rated loaded and empty GMW lines are shown dotted.)

3) Using a straight-edge, establish a horizontal line to the left from point B to point C on the rim-pull scale.

4) Divide the value of point C as read on the rim-pull scale by the percent of total horsepower available after altitude deration from the Tables Section. This yields rimpull value D higher than point C.

5) Establish a horizontal line right from point D. The farthest right intersection of this line with a curved speed range line is point E.

6) A vertical line down from point E determines point F on the speed scale.

7) Multiply speed in kmh by 16.7 (mph by 88) to obtain speed in m/min (ft/min). Travel time in minutes for a given distance in feet is determined by the formula:

$$\text{Time (min)} = \frac{\text{Distance in m (ft)}}{\text{Speed in m/min (ft/min)}}$$

The Travel Time Graphs in sections on Wheel Tractor-Scrapers and Construction & Mining Trucks can be used as an alternative method of calculating haul and/or return times.

Job Efficiency is one of the most complex elements of estimating production since it is influenced by factors such as operator skill, minor repairs and adjustments, personnel delays, and delays caused by job layout. An approximation of efficiency, if no job data is available, is given below.

Operation	Working Hour	Efficiency Factor
Day	50 min/hr	0.83
Night	45 min/hr	0.75

These factors do not account for delays due to weather or machine downtime for maintenance and repairs. You must account for such factors based on experience and local conditions.

The following example provides a method to manually estimate production and cost. Today, computer programs, such as Caterpillar's Fleet Production and Cost Analysis (FPC), provide a much faster and more accurate means to obtain those application results.

Example problem (English)

A contractor is planning to put the following spread on a dam job. What is the estimated production?

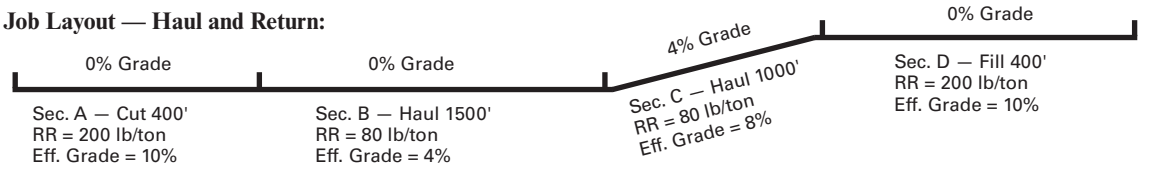
Equipment:

11 — 631G Wheel Tractor-Scrapers
2 — D9T Tractors with C-dozers
2 — 12H Motor Graders
1 — 825G Tamping Foot Compactor

Material:

Description — Sandy clay; damp, natural bed
Bank Density — 3000 lb/BCY
Load Factor — 0.80
Shrinkage Factor — 0.85
Traction Factor — 0.50
Altitude — 7500 ft

Job Layout — Haul and Return:



Total Effective Grade = RR (%) ± GR (%)

Sec. A: Total Effective Grade = 10% + 0% = 10%
Sec. B: Total Effective Grade = 4% + 0% = 4%
Sec. C: Total Effective Grade = 4% + 4% = 8%
Sec. D: Total Effective Grade = 10% + 0% = 10%

1. Estimate Payload:

Est. load (LCY) × L.F. × Bank Density = payload
31 LCY × 0.80 × 3000 lb/BCY = 74,400 lb payload

2. Establish Machine Weight:

Empty Wt. — 102,460 lb or 51.27 tons
Wt. of Load — 74,400 lb or 37.2 tons
Total (GMW) — 176,860 lb or 88.4 tons

3. Calculate Usable Pull (traction limitation):

Loaded: (weight on driving wheels = 54%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 176,860 lb × 54% = 47,628 lb

Empty: (weight on driving wheels = 69%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 102,460 lb × 69% = 35,394 lb

4. Derate for Altitude:

Check power available at 7500 ft from altitude deration table in the Tables Section.

631G — 100% 12H — 83%
D9T — 100% 825G —100%

Then adjust if necessary:

Load Time — controlled by D9T, at 100% power, no change.

Travel, Maneuver and Spread time — 631G, no change.

5. Compare Total Resistance to Tractive Effort on haul:

Grade Resistance —

GR = lb/ton × tons × adverse grade in percent

Sec. C: = 20 lb/ton × 88.4 tons × 4% grade = 7072 lb

Rolling Resistance —

RR = RR Factor (lb/ton) × GMW (tons)

Sec. A: = 200 lb/ton × 88.4 tons = 17,686 lb
Sec. B: = 80 lb/ton × 88.4 tons = 7072 lb
Sec. C: = 80 lb/ton × 88.4 tons = 7072 lb
Sec. D: = 200 lb/ton × 88.4 tons = 17,686 lb

Total Resistance —

TR = RR + GR

Sec. A: = 17,686 lb + 0 = 17,686 lb
Sec. B: = 7072 lb + 0 = 7072 lb
Sec. C: = 7072 lb + 6496 lb = 14,144 lb
Sec. D: = 17,686 lb + 0 = 17,686 lb

Check usable pounds pull against maximum pounds pull required to move the 631G.

Pull usable … 47,628 lb loaded

Pull required … 17,686 lb maximum total resistance

Estimate travel time for haul from 631G (loaded) travel time curve; read travel time from distance and effective grade.

Travel time (from curves):

Sec. A: 0.60 min
Sec. B: 1.00
Sec. C: 1.20
Sec. D: 0.60
3.40 min

NOTE: This is an estimate only; it *does not account for all the acceleration and deceleration tim*e, therefore it is not as accurate as the information obtained from a computer program.

6. Compare Total Resistance to Tractive Effort on return:

Grade Assistance —

GA = 20 lb/ton × tons × negative grade in percent

Sec. C: = 20 lb/ton × 51.2 tons × 4% grade = 4096 lb

Rolling Resistance —

RR = RR Factor × Empty Wt (tons)

Sec. D: = 200 lb/ton × 51.2 tons = 10,240 lb
Sec. C: = 80 lb/ton × 51.2 tons = 4091 lb
Sec. B: = 80 lb/ton × 51.2 tons = 4091 lb
Sec. A: = 200 lb/ton × 51.2 tons = 10,240 lb

Total Resistance —

TR = RR – GA

Sec. D: = 10,240 lb – 0 = 10,240 lb
Sec. C: = 4096 lb – 4096 lb = 0
Sec. B: = 4096 lb – 0 = 4096 lb
Sec. A: = 10,240 lb – 0 = 10,240 lb

Check usable pounds pull against maximum pounds pull required to move the 631G.

Pounds pull usable … 35,349 lb empty

Pounds pull required … 10,240 lb

Estimate travel time for return from 631G empty travel time curve.

Travel time (from curves):

Sec. A: 0.40 min
Sec. B: 0.55
Sec. C: 0.80
Sec. D: 0.40
2.15 min

7. Estimate Cycle Time:

Total Travel Time (Haul plus Return)	= 5.55 min
Adjusted for altitude: 100% × 5.55 min	= 5.55 min
Load Time	0.7 min
Maneuver and Spread Time	0.7 min
Total Cycle Time	6.95 min

8. Check pusher-scraper combinations:

Pusher cycle time consists of load, boost, return and maneuver time. Where actual job data is not available, the following may be used.

Boost time = 0.10 minute
Return time = 40% of load time
Maneuver time = 0.15 minute
Pusher cycle time = 140% of load time + 0.25 minute
Pusher cycle time = 140% of 0.7 min + 0.25 minute
= 0.98 + 0.25 = 1.23 minute

Scraper cycle time divided by pusher cycle time indicates the number of scrapers which can be handled by each pusher.

$$\frac{6.95 \text{ min}}{1.23 \text{ min}} = 5.65$$

Each push tractor is capable of handling five plus scrapers. Therefore the two pushers can adequately serve the eleven scrapers.

9. Estimate Production:

Cycles/hour = 60 min ÷ Total cycle time
= 60 min/hr ÷ 6.95 min/cycle
= 8.6 cycles/hr
Estimated load = Heaped capacity × L.F.
= 31 LCY × 0.80
= 24.8 BCY
Hourly unit production = Est. load × cycles/hr
= 24.8 BCY × 8.6 cycles/hr
= 213 BCY/hr
Adjusted production = Efficiency factor × hourly production
= 0.83 (50 min hour) × 213 BCY
= 177 BCY/hr
Hourly fleet production = Unit production × No. of units
= 177 BCY/hr × 11
= 1947 BCY/hr

10. Estimate Compaction:

Compaction requirement = S.F. × hourly fleet production
= 0.85 × 1947 BCY/hr
= 1655 CCY/hr

Compaction capability (given the following):

Compacting width, 7.4 ft	(W)
Average compacting speed, 6 mph	(S)
Compacted lift thickness, 7 in	(L)
No. of passes required, 3	(P)

825G production =

$$\text{CCY/hr} = \frac{W \times S \times L \times 16.3}{P} \text{ (conversion constant)}$$

$$= \frac{7.4 \times 6 \times 7 \times 16.3}{3}$$

$$= 1688 \text{ CCY/hr}$$

Given the compaction requirement of 1655 CCY/hr, the 825G is an adequate compactor match-up for the rest of the fleet. However, any change to job layout that would increase fleet production would upset this balance.

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Example problem (Metric)

A contractor is planning to put the following spread on a dam job. What is the estimated production?

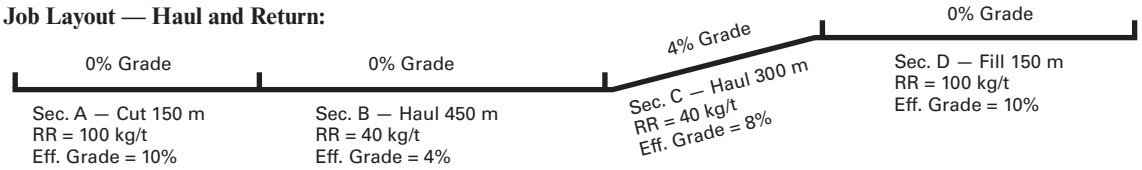
Equipment:

11 — 631G Wheel Tractor-Scrapers
2 — D9T Tractors with C-dozers
2 — 12H Motor Graders
1 — 825G Tamping Foot Compactor

Material:

Description — Sandy clay; damp, natural bed
Bank Density — 1770 kg/BCM
Load Factor — 0.80
Shrinkage Factor — 0.85
Traction Factor — 0.50
Altitude — 2300 meters

Job Layout — Haul and Return:



Total Effective Grade = RR (%) ± GR (%)
Sec. A: Total Effective Grade = 10% + 0% = 10%
Sec. B: Total Effective Grade = 4% + 0% = 4%
Sec. C: Total Effective Grade = 4% + 4% = 8%
Sec. D: Total Effective Grade = 10% + 0% = 10%

1. Estimate Payload:
Est. load (LCM) × L.F. × Bank Density = payload
24 LCM × 0.80 × 1770 kg/BCM = 34 000 kg payload

2. Machine Weight:
Empty Wt. — 46 475 kg or 46.48 metric tons
Wt. of Load — 34 000 kg or 34 metric tons
Total (GMW) — 80 475 kg or 80.48 metric tons

3. Calculate Usable Pull (traction limitation):
Loaded: (weight on driving wheels = 54%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 80 475 kg × 54% = 21 728 kg
Empty: (weight on driving wheels = 69%) (GMW)
Traction Factor × Wt. on driving wheels =
0.50 × 46 475 kg × 69% = 16 034 kg

4. Derate for Altitude:
Check power available at 2300 m from altitude deration table in the Tables Section.
631G — 100% 12H — 83%
D9T — 100% 825G — 100%
Then adjust if necessary:
Load Time — controlled by D9T, at 100% power, no change.
Travel, Maneuver and Spread time — 631G, no change.

5. Compare Total Resistance to Tractive Effort on haul:
Grade Resistance —
GR = 10 kg/metric ton × tons × adverse grade in percent
Sec. C: = 10 kg/metric ton × 80.48 metric tons × 4% grade = 3219 kg

Rolling Resistance —
RR = RR Factor (kg/mton) × GMW (metric tons)
Sec. A: = 100 kg/metric ton × 80.48 metric tons = 8048 kg
Sec. B: = 40 kg/metric ton × 80.48 metric tons = 3219 kg
Sec. C: = 40 kg/metric ton × 80.48 metric tons = 3219 kg
Sec. D: = 100 kg/metric ton × 80.48 metric tons = 8048 kg

Total Resistance —
TR = RR + GR
Sec. A: = 8048 kg + 0 = 8048 kg
Sec. B: = 3219 kg + 0 = 3219 kg
Sec. C: = 3219 kg + 3219 kg = 6438 kg
Sec. D: = 8048 kg + 0 = 8048 kg

Check usable kilogram force against maximum kilogram force required to move the 631G.
Force usable … 21 728 kg loaded
Force required … 8048 kg maximum total resistance
Estimate travel time for haul from 631G (loaded) travel time curve; read travel time from distance and effective grade.
Travel time (from curves):
Sec. A: 0.60 min
Sec. B: 1.00
Sec. C: 1.20
Sec. D: 0.60
3.40 min

NOTE: This is an estimate only; it *does not account for all the acceleration and deceleration tim*e, therefore it is not as accurate as the information obtained from a computer program.

6. Compare Total Resistance to Tractive Effort on return:
Grade Assistance —
GA = 10 kg/mton × metric tons × negative grade in percent
Sec. C: = 10 kg/metric ton × 46.48 metric tons × 4% grade = 1859 kg

Rolling Resistance —
RR = RR Factor × Empty Wt.
Sec. D: = 100 kg/metric ton × 46.48 metric tons
= 4648 kg
Sec. C: = 40 kg/metric ton × 46.48 metric tons
= 1859 kg
Sec. B: = 40 kg/metric ton × 46.48 metric tons
= 1859 kg
Sec. A: = 100 kg/metric ton × 46.48 metric tons
= 4648 kg

Total Resistance —
TR = RR – GA
Sec. D: = 4648 kg – 0 = 4648 kg
Sec. C: = 1859 kg – 1859 kg = 0
Sec. B: = 1859 kg – 0 = 1859 kg
Sec. A: = 4648 kg – 0 = 4648 kg

Check usable kilogram force against maximum force required to move the 631G.
Kilogram force usable … 16 034 kg empty
Kilogram force required … 4645 kg
Estimate travel time for return from 631G empty travel time curve.
Travel time (from curves):
Sec. A: 0.40 min
Sec. B: 0.55
Sec. C: 0.80
Sec. D: 0.40
2.15 min

7. Estimate Cycle Time:

Total Travel Time (Haul plus Return)	= 5.55 min
Adjusted for altitude: 100% × 5.55 min	= 5.55 min
Load Time	0.7 min
Maneuver and Spread Time	0.7 min
Total Cycle Time	6.95 min

8. Check pusher-scraper combinations:
Pusher cycle time consists of load, boost, return and maneuver time. Where actual job data is not available, the following may be used.

Boost time = 0.10 minute
Return time = 40% of load time
Maneuver time = 0.15 minute
Pusher cycle time = 140% of load time + 0.25 minute
Pusher cycle time = 140% of 0.7 min + 0.25 minute
= 0.98 + 0.25 = 1.23 minute

Scraper cycle time divided by pusher cycle time indicates the number of scrapers which can be handled by each pusher.

$$\frac{6.95 \text{ min}}{1.23 \text{ min}} = 5.65$$

Each push tractor is capable of handling five plus scrapers. Therefore the two pushers can adequately serve the eleven scrapers.

9. Estimate Production:

Cycles/hour = 60 min ÷ Total cycle time
= 60 min/hr ÷ 6.95 min/cycle
= 8.6 cycles/hr
Estimated load = Heaped capacity × L.F.
= 24 LCM × 0.80
= 19.2 BCM
Hourly unit production = Est. load × cycles/hr
= 19.2 BCM × 8.6 cycles/hr
= 165 BCM
Adjusted production = Efficiency factor × hourly production
= 0.83 (50 min hour) × 165 BCM
= 137 BCM/hour
Hourly fleet production = Unit production × No. of units
= 137 BCM/hr × 11 units
= 1507 BCM/hr

10. Estimate Compaction:

Compaction requirement = S.F. × hourly fleet production
= 0.85 × 1507 BCM/hr
= 1280 CCM/hr

Compaction capability (given the following):

Compacting width, 2.26 m	(W)
Average compacting speed, 9.6 km/h	(S)
Compacted lift thickness, 18 cm	(L)
No. of passes required, 3	(P)

825G production =

$$\text{CCY/hr} = \frac{W \times S \times L \times 10}{P} \text{ (conversion factor)}$$

$$= \frac{2.26 \times 9.6 \times 18 \times 10}{3}$$

$$= 1302$$

Given the compaction requirement of 1280 CCM/h, the 825G is an adequate compactor match-up for the rest of the fleet. However, any change to job layout that would increase fleet production would upset this balance.

●●●

PRODUCTION ESTIMATING

Loading Match — Loading tools have a production range that varies with material, bucket configuration, target size, operator skill and load area conditions. The loader/truck matches given in the following table are with the typical number of passes and production range.

Your Cat® dealer can provide advice and estimates based on your specific conditions.

FUEL CONSUMPTION AND PRODUCTIVITY

Fuel efficiency is the term used to relate fuel consumption and machine productivity. It is expressed in units of material moved per volume of fuel consumed. Common units are cubic meters or tonnes per liter of fuel (cubic yards or tons/gal). Determining fuel efficiency requires measuring both fuel consumption and production.

Measuring fuel consumption involves tapping into the vehicle's fuel supply system — without contaminating the fuel. The amount of fuel consumed during operation is then measured on a weight or volumetric basis and correlated with the amount of work the machine has done. Cat machines equipped with VIMS™ system can record fuel consumed with relative accuracy, given the engine is performing close to specifications.

Cat Earthmoving and Mining Systems Production/50 Min. Hr.

Please refer to the individual machine section for production targets.

Cat Aggregate Systems Production/50 Min. Hr.

Please refer to the individual machine section for production targets.

FORMULAS AND RULES OF THUMB

Production, hourly = Load (BCM)/cycle × cycles/hr

= Load (BCY)/cycle × cycles/hr

Load Factor (L.F.) $= \dfrac{100\%}{100\% + \%\ \text{swell}}$

Load (bank measure) = Loose cubic meters (LCM) × L.F.

= Loose cubic yards (LCY) × L.F.

Shrinkage Factor (S.F.) $= \dfrac{\text{Compacted cubic meters (or yards)}}{\text{Bank cubic meters (or yards)}}$

Density = Weight/Unit Volume

Load (bank measure) $= \dfrac{\text{Weight of load}}{\text{Bank density}}$

Rolling Resistance Factor
= 20 kg/t + (6 kg/t/cm × cm)
= 40 lb/ton + (30 lb/ton/inch × inches)

Rolling Resistance
= RR Factor (kg/t) × GMW (tons)
= RR Factor (lb/ton) × GMW (tons)

Rolling Resistance (general estimation)
= 2% of GMW + 0.6% of GMW per cm tire penetration
= 2% of GMW + 1.5% of GMW per inch tire penetration

$\%\ \text{Grade} = \dfrac{\text{vertical change in elevation (rise)}}{\text{corresponding horizontal distance (run)}}$

Grade Resistance Factor = 10 kg/m ton × % grade
= 20 lb/ton × % grade

Grade Resistance = GR Factor (kg/t) × GMW (tons)
= GR Factor (lb/ton) × GMW (tons)

Grade Resistance = 1% of GMW × % grade

Total Resistance
= Rolling Resistance (kg or lb) + Grade Resistance (kg or lb)

Total Effective Grade (%) = RR (%) + GR (%)

Usable pull (traction limitation)
= Coeff. of traction × weight on drivers
= Coeff. of traction × (Total weight × % on drivers)

Pull required = Rolling Resistance + Grade Resistance
= Total Resistance

Total Cycle Time = Fixed time + Variable time

Fixed time: See respective machine production section.

Variable time = Total haul time + Total return time

Travel Time $= \dfrac{\text{Distance (m)}}{\text{Speed (m/min)}}$

$= \dfrac{\text{Distance (ft)}}{\text{Speed (fpm)}}$

Cycles per hour $= \dfrac{60\ \text{min/hr}}{\text{Total cycle time (min/cycle)}}$

Adjusted production = Hourly production × Efficiency factor

No. of units required $= \dfrac{\text{Hourly production required}}{\text{Unit hourly production}}$

No. of scrapers a pusher will load $= \dfrac{\text{Scraper cycle time}}{\text{Pusher cycle time}}$

Pusher cycle time (min) = 1.40 Load time (min) + 0.25 min

Grade Horsepower $= \dfrac{\text{GMW (kg)} \times \text{Total Effective Grade} \times \text{Speed (km/h)}}{273.75}$

$= \dfrac{\text{GMW (lb)} \times \text{Total Effective Grade} \times \text{Speed (mph)}}{375}$

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SWELL — VOIDS — LOAD FACTORS

SWELL (%)	VOIDS (%)	LOAD FACTOR
5	4.8	0.952
10	9.1	0.909
15	13.0	0.870
20	16.7	0.833
25	20.0	0.800
30	23.1	0.769
35	25.9	0.741
40	28.6	0.714
45	31.0	0.690
50	33.3	0.667
55	35.5	0.645
60	37.5	0.625
65	39.4	0.606
70	41.2	0.588
75	42.9	0.571
80	44.4	0.556
85	45.9	0.541
90	47.4	0.526
95	48.7	0.513
100	50.0	0.500

Throughout this document, references to Tier 4 Interim/Stage IIIB/Japan 2011 (Tier 4 Interim) include U.S. EPA Tier 4 Interim, EU Stage IIIB, and Japan 2011 (Tier 4 Interim) equivalent emission standards. References to Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) include U.S. EPA Tier 4 Final, EU Stage IV, and Japan 2014 (Tier 4 Final) emission standards.

Throughout this document, references to Tier 1/Stage I include U.S. EPA Tier 1 and EU Stage I equivalent emission standards. References to Tier 2/Stage II/Japan 2001 (Tier 2) equivalent include U.S. EPA Tier 2, EU Stage II, and Japan 2001 (Tier 2) equivalent emission standards. References to Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent include U.S. EPA Tier 3, EU Stage IIIA, and Japan 2006 (Tier 3) equivalent emission standards.

BUCKET FILL FACTORS

Loose Material	Fill Factor
Mixed Moist Aggregates	95-100%
Uniform Aggregates up to 3 mm (1/8")	95-100
3 mm-9 mm (1/8"-3/8")	90-95
12 mm-20 mm (1/2"-3/4")	85-90
24 mm (1") and over	85-90
Blasted Rock	
Well Blasted	80-95%
Average Blasted	75-90
Poorly Blasted	60-75
Other	
Rock Dirt Mixtures	100-120%
Moist Loam	100-110
Soil, Boulders, Roots	80-100
Cemented Materials	85-95

NOTE: Loader bucket fill factors are affected by bucket penetration, breakout force, rack back angle, bucket profile and ground engaging tools such as bucket teeth or bolt-on replaceable cutting edges.

NOTE: For bucket fill factors for hydraulic excavators, see bucket payloads in the hydraulic excavator section.

NOTE: Above values are not valid for Hydraulic Mining Shovels.

ANGLE OF REPOSE OF VARIOUS MATERIALS

MATERIAL	ANGLE BETWEEN HORIZONTAL AND SLOPE OF HEAPED PILE	
	Ratio	Degrees
Coal, industrial	1.4:1—1.3:1	35-38
Common earth, Dry	2.8:1—1.0:1	20-45
Moist	2.1:1—1.0:1	25-45
Wet	2.1:1—1.7:1	25-30
Gravel, Round to angular	1.7:1—0.9:1	30-50
Sand & clay	2.8:1—1.4:1	20-35
Sand, Dry	2.8:1—1.7:1	20-30
Moist	1.8:1—1.0:1	30-45
Wet	2.8:1—1.0:1	20-45

TYPICAL ROLLING RESISTANCE FACTORS

Various tire sizes and inflation pressures will greatly reduce or increase the rolling resistance. The values in this table are approximate, particularly for the track and track + tire machines. These values can be used for estimating purposes when specific performance information on particular equipment and given soil conditions is not available. See Mining and Earthmoving Section for more detail.

UNDERFOOTING	ROLLING RESISTANCE, PERCENT*			
	Tires		Track	Track
	Bias	Radial	**	+Tires
A very hard, smooth roadway, concrete, cold asphalt or dirt surface, no penetration or flexing	1.5%*	1.2%	0%	1.0%
A hard, smooth, stabilized surfaced roadway without penetration under load, watered, maintained	2.0%	1.7%	0%	1.2%
A firm, smooth, rolling roadway with dirt or light surfacing, flexing slightly under load or undulating, maintained fairly regularly, watered	3.0%	2.5%	0%	1.8%
A dirt roadway, rutted or flexing under load, little maintenance, no water, 25 mm (1") tire penetration or flexing	4.0%	4.0%	0%	2.4%
A dirt roadway, rutted or flexing under load, little maintenance, no water, 50 mm (2") tire penetration or flexing	5.0%	5.0%	0%	3.0%
Rutted dirt roadway, soft under travel, no maintenance, no stabilization, 100 mm (4") tire penetration or flexing	8.0%	8.0%	0%	4.8%
Loose sand or gravel	10.0%	10.0%	2%	7.0%
Rutted dirt roadway, soft under travel, no maintenance, no stabilization, 200 mm (8") tire penetration and flexing	14.0%	14.0%	5%	10.0%
Very soft, muddy, rutted roadway, 300 mm (12") tire penetration, no flexing	20.0%	20.0%	8%	15.0%

*Percent of combined machine weight.

**Assumes drag load has been subtracted to give Drawbar Pull for good to moderate conditions. Some resistance added for very soft conditions.

WEIGHT* OF MATERIALS	LOOSE kg/m³	LOOSE lb/yd³	BANK kg/m³	BANK lb/yd³	LOAD FACTORS
Basalt	1960	**3300**	2970	**5000**	0.67
Bauxite, Kaolin	1420	**2400**	1900	**3200**	0.75
Caliche	1250	**2100**	2260	**3800**	0.55
Carnotite, uranium ore	1630	**2750**	2200	**3700**	0.74
Cinders	560	**950**	860	**1450**	0.66
Clay — Natural bed	1660	**2800**	2020	**3400**	0.82
Dry	1480	**2500**	1840	**3100**	0.81
Wet	1660	**2800**	2080	**3500**	0.80
Clay & gravel — Dry	1420	**2400**	1660	**2800**	0.85
Wet	1540	**2600**	1840	**3100**	0.85
Coal — Anthracite, Raw	1190	**2000**	1600	**2700**	0.74
Washed	1100	**1850**			0.74
Ash, Bituminous Coal	530-650	**900-1100**	590-890	**1000-1500**	0.93
Bituminous, Raw	950	**1600**	1280	**2150**	0.74
Washed	830	**1400**			0.74
Decomposed rock —					
75% Rock, 25% Earth	1960	**3300**	2790	**4700**	0.70
50% Rock, 50% Earth	1720	**2900**	2280	**3850**	0.75
25% Rock, 75% Earth	1570	**2650**	1960	**3300**	0.80
Earth — Dry packed	1510	**2550**	1900	**3200**	0.80
Wet excavated	1600	**2700**	2020	**3400**	0.79
Loam	1250	**2100**	1540	**2600**	0.81
Granite — Broken	1660	**2800**	2730	**4600**	0.61
Gravel — Pitrun	1930	**3250**	2170	**3650**	0.89
Dry	1510	**2550**	1690	**2850**	0.89
Dry 6-50 mm (1/4"-2")	1690	**2850**	1900	**3200**	0.89
Wet 6-50 mm (1/4"-2")	2020	**3400**	2260	**3800**	0.89
Gypsum — Broken	1810	**3050**	3170	**5350**	0.57
Crushed	1600	**2700**	2790	**4700**	0.57
Hematite, iron ore, high grade	1810-2450	**4000-5400**	2130-2900	**4700-6400**	0.85
Limestone — Broken	1540	**2600**	2610	**4400**	0.59
Crushed	1540	**2600**	—	**—**	—
Magnetite, iron ore	2790	**4700**	3260	**5500**	0.85
Pyrite, iron ore	2580	**4350**	3030	**5100**	0.85
Sand — Dry, loose	1420	**2400**	1600	**2700**	0.89
Damp	1690	**2850**	1900	**3200**	0.89
Wet	1840	**3100**	2080	**3500**	0.89
Sand & clay — Loose	1600	**2700**	2020	**3400**	0.79
Compacted	2400	**4050**			
Sand & gravel — Dry	1720	**2900**	1930	**3250**	0.89
Wet	2020	**3400**	2230	**3750**	0.91
Sandstone	1510	**2550**	2520	**4250**	0.60
Shale	1250	**2100**	1660	**2800**	0.75
Slag — Broken	1750	**2950**	2940	**4950**	0.60
Snow — Dry	130	**220**			
Wet	520	**860**			
Stone — Crushed	1600	**2700**	2670	**4500**	0.60
Taconite	1630-1900	**3600-4200**	2360-2700	**5200-6100**	0.58
Top Soil	950	**1600**	1370	**2300**	0.70
Taprock — Broken	1750	**2950**	2610	**4400**	0.67
Wood Chips**	—	**—**	—	**—**	—

*Varies with moisture content, grain size, degree of compaction, etc. Tests must be made to determine exact material characteristics.

**Weights of commercially important wood species can be found in the last pages of the Logging & Forest Products section. To obtain wood weights use the following equations: $lb/yd^3 = (lb/ft^3) \times .4 \times 27$

$kg/m^3 = (kg/m^3) \times .4$

ALTITUDE DERATION

PERCENT FLYWHEEL HORSEPOWER AVAILABLE AT SPECIFIED ALTITUDES

MODEL	0-760 m (0-2500')	760-1500 m (2500-5000')	1500-2300 m (5000-7500')	2300-3000 m (7500-10,000')	3000-3800 m (10,000-12,500')	3800-4600 m (12,500-15,000')
D3K XL	100	100	100	100	88	85
D3K LGP	100	100	100	100	88	85
D4K XL	100	100	100	100	88	85
D4K LGP	100	100	100	100	88	85
D5K XL	100	100	100	100	88	85
D5K LGP	100	100	100	100	88	85
D5R2 XL & LGP	100	100	100	100	N/A	N/A
D5T XL	100	100	100	100	N/A	N/A
D6K2 XL & LGP	100	100	100	100	N/A	N/A
D6N XL & LGP*	100	100	100	100	100	100
D6R Series 3 (All)	100	100	100	100	92	84
D6R2	100	100	100	100	92	84
D6T[1]	100	100	100	100	100	100
D7E	100	100	100	100	99	95
D7R	100	100	100	100	100	96
D8R	100	100	100	93	85	77
D8T	100	100	100	100	100	100
D9R	100	100	100	93	85	77
D9T[1]	100	100	100	100	100	100
D9T[2]	100	100	100	99	92	83
D9T[3]	100	100	100	100	100	100
D9T[4]	100	100	100	98	91	80
D9T[5]	100	100	100	100	99	88
D10T2[5]**	100	100	100	100	100	100
D10T2[6]**	100	100	100	100	100	100
D11T/D11T CD[5]***	100	100	100	100	100	86
D11T/D11T CD[6]***	100	100	100	100	83	67

*Information not available at time of printing.
**In forward gears.
***D11T — High altitude arrangement available.
[1] Meets Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) emission standards.
[2] Meets Tier 3 equivalent emission standards, North America — Standard Altitude.
[3] Meets Tier 3 equivalent emission standards, North America — High Altitude.
[4] Meets Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.
[5] Meets Tier 2/Stage II/Japan 2001 (Tier 2) equivalent emission standards.
[6] Meets Tier 4 Final.

ALTITUDE DERATION (Continued)

MODEL	0-760 m (0-2500')	760-1500 m (2500-5000')	1500-2300 m (5000-7500')	2300-3000 m (7500-10,000')	3000-3800 m (10,000-12,500')	3800-4600 m (12,500-15,000')
120K	100	100	100	97	92	85
120K2	100	100	100	97	92	85
120M	100	100	100	100	95	88
120M AWD	100	98	96	94	89	85
120M2	100	100	100	100	94	82
120M2 AWD	100	100	100	100	94	82
12K	100	99	98	94	89	85
12M	100	100	100	100	95	88
12M2	100	100	100	100	100	100
12M2 AWD	100	100	100	100	100	99
12M3	100	100	100	100	100	100
12M3 AWD	100	100	100	100	100	98
140K	100	100	100	100	92	90
140K2	100	100	100	100	92	90
140M	100	100	100	100	92	90
140M AWD	100	100	100	100	92	90
140M2	100	100	100	100	100	99
140M2 AWD	100	100	100	100	97	93
140M3	100	100	100	100	100	98
140M3 AWD	100	100	100	100	100	90
160K	100	100	100	100	92	90
160M	100	100	100	100	92	90
160M AWD	100	100	100	100	92	90
160M2	100	100	100	99	95	91
160M2 AWD	100	100	100	99	94	88
160M3	100	100	100	100	100	90
160M3 AWD	100	100	100	100	98	83
14M3*	100	100	100	100	100	97
14M3**	100	100	100	100	100	100
14M3***	100	100	100	100	100	100
16M3*	100	100	100	100	100	100
16M3**	100	100	100	100	100	95
16M3***	100	100	100	100	100	100
18M3*	100	100	100	100	100	100
18M3**	100	100	100	100	100	95
18M3***	100	100	100	100	100	100
24M B9K**	100	100	95	90	80	70
24M B9K Unregulated	100	100	100	100	90	85
24M B93**	100	100	100	98	89	75
24M B93*	100	100	100	100	91	86

*Meets Tier 2/Stage II/Japan 2001 (Tier 2) equivalent emission standards.
**Meets Tier 3/Stage IIIA/Japan 2006 (Tier 3) equivalent emission standards.
***Meets Tier 4 Final/Stage IV/Japan 2014 (Tier 4 Final) emission standards.

Appendix B.2.5

Direct Quotes

Fred Charles

From: Fawcett, Clayton <CFawcett@conteches.com>
Sent: Tuesday, February 5, 2019 9:25 AM
To: Fred Charles
Subject: RE: confirm or update costs for ACBs (reply requested by end of day Monday Feb 4, if possible)

Fred,

Hello and good morning. I hope this message finds you doing well. I made it back in to the office this morning and saw your e-mails.

Material and installation costs we discussed in September are still good. Please feel free to use those to complete your estimate.

Regarding your questions:

1. Yes, installation costs are the same for both downchutes and dissipator basins.
2. Yes, installation cost does include crushed stone infill (purchase and install)

Regarding your follow up e-mail with questions pertaining to cut-off walls.

1. Cut-off walls are not always required, however they are a good idea. The use of cut-off walls has increased in the last five years and as such, they are now recommended for inclusion at dissipator basins.
2. Material and installation costs for the installation of a cut-off wall <u>are not</u> included in the costs previously discussed and should be added.

I hope this information helps. Feel free to contact me directly with any additional questions.

Regards,

Clayton Fawcett PE (co)
Armortec Area Manager - West

CONTECH Engineered Solutions
970-290-2971 (cell)
cfawcett@conteches.com

From: Fred Charles [mailto:fcharles@telesto-inc.com]
Sent: Sunday, February 3, 2019 3:28 PM
To: Fawcett, Clayton <CFawcett@conteches.com>
Subject: confirm or update costs for ACBs (reply requested by end of day Monday Feb 4, if possible)

Hi Clayton. This email is a follow up to our email correspondence in September 2018 regarding material and installation costs for articulated concrete blocks (ACBs) used for downdrains at Chino. We've been using the cost info you passed along to me at that time. Now, I need you to confirm those costs or update them. We will use this information in a reclamation cost estimate (financial assurance for closure bonding) which we are currently finalizing for Chino and other mines in that area.

<u>Costs</u>
As we had discussed, the material costs for ACBs (includes non-woven geotextile and microgrid/geogrid) are as follows:

- $7.42/square foot (Block Class 40T, for the channel of each downdrain)

- $10.65/square foot (Block Class 70T, for the dissipation basin at bottom of each downdrain)

Also, you quoted $4.63/square foot for installation costs, which covers the following installation process: off-load the truck and place delivered ACBs in temporary storage area, fine grade base/subgrade soils, compact soils to 90% Standard Proctor (D698), place and secure filter fabric (non-woven geotextile), place 4-6" drainage layer overlaid by geogrid, place ACBs in final configuration, grout seams, and backfill ACBs with crushed stone.

2 questions

In addition to you confirming or updating the material and installation costs, I have two questions: (1) Is the installation cost ($4.63/square foot) the same for both channel downdrains and dissipation basins? (2) Does the installation or material cost include the crushed stone used to backfill the ACBs?

Please create a new email to me with updated unit costs or reply to this email to confirm what I show is still correct. I will present what you provide for documentation in the cost estimate we submit to the state agencies.

Thanks,

Fred Charles, Ph.D., P.E. Senior Engineer
Office: 970-484-7704, Ext 120 Cell: 720-318-5021
3801 Automation Way, Suite 201, Fort Collins, CO 80525
fcharles@telesto-inc.com

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www.telesto-inc.com

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ROCKY MOUNTAIN RECLAMATION

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(307) 745-5230

ron@reveg.us
www.reveg.us

P.O. Box 1695
Laramie, WY 82073

FREEPORT MCMORAN – NEW MEXICO MINING OPERATIONS

PRICE ESTIMATES FOR REVEGETATION SERVICES FOR BUDGETING ESTIMATES

Table 1 –Freeport McMoRan, New Mexico Mining Operations – Price Estimates for Revegetation Services for Budgeting Estimates, prepared April, 2018.

	REVEGETATION OPERATION	ESTIMATED QUANTITY	UNITS	COST/UNIT ($)	TOTAL COST
I.	**OPERATIONS:**				
1	**SCARIFYING**	500	Acres	$30.00	$15,000.00
2	**DISCING**	500	Acres	$20.00	$10,000.00
3	**DRILL SEEDING (special Rangeland Drill)**	500	Acres	$80.00	$40,000.00
4	**MULCHING**	500	Acres	$148.00	$74,000.00
5	**CRIMPING**	500	Acres	$55.00	$27,500.00
6	**DAILY PER DIEM, ETC.**	50	Days	$385.00	$19,250.00
7	**MOBILIZATION**	1	Each	$13,500.00	$13,500.00
	Subtotal				**$199,250.00**
II.	**MATERIALS:**				
1	**SEED** at 8.9 PLS/acre	500	Acres	$210.00	$105,000.00
2	**HAY MULCH** - nox. weed free, native	1000	Tons	$245.00	$245,000.00
	Subtotal				**$350,000.00**
	TOTAL ESTIMATED REVEGETATION COST BEFORE TAX				**$549,250.00**
	Add New Mexico Gross Receipts Tax	5.9375	%		**$32,611.72**
	ESTIMATED REVEGETATION COST PER ACRE:			**$1,163.72**	
	TOTAL ESTIMATED REVEGETATION COST				**$581,861.72**

Estimate prepared by Ron Schreibeis, Rocky Mountain Reclamation, for use for Budgeting Estimates.

Layne Christensen Company
12030 E. Riggs Road
Chandler, Arizona 85249
Office: 480.895.9336
Fax: 480.895.9536

Estimate

Company:	**Freeport McMoRan Tyrone**	**Date:**	**July 31, 2018**
Contact:	**David Princehouse**	**Project:**	**Tyrone Hole Abandonment**
Address:	**Box 571 Hwy 90 South**	**Location:**	**Tyrone Mine**
City:	**Tyrone**	**Estimated By:**	**Joel Campbell**
State:	**NM**	**Proposal Number:**	**18-000-RC**
Postal Code:	**88065**	**Estimated Footage:**	**1,500 feet**
Phone:	**575 912 5752**	**Number of Holes:**	**1**
Cell:	**575 654 5246**	**Max. Depth:**	**1,500 feet**
Email:	dprinceh@fmi.com	**Average Depths:**	**1,500 feet**

HAMMER DRILLING	RATE PER HOUR	
FOOTAGE RANGE	**Hole Size**	**Hourly**
0-1,500 Feet	5.5-inch	$375.00

MOB / DEMOB	LUMP SUM	HOURLY
*MOBILIZATION	$5,000.00	
DEMOBILIZATION	$5,000.00	

ADDITIONAL EQUIPMEN	PER MONTH	PER HOUR
FORKLIFT RENTAL		N/A
AUX. AIR OP RATE	N/A	$20.00

PER DIEM CHARGE	PER MAN/PER DAY
3 MAN CREW	$85.00

FUEL	RATE
SUPPLIED BY TYRONE	COST

CREW TRAVEL TIME	RATE
Included in Footage Rate	N/C

OPERATING HOURLY RIG RATE ACTIVITIES	PER HOUR
DRILL HOLE ABANDONMENT	$375.00

STANDBY HOURLY RIG RATE ACTIVITIES	PER HOUR
CLIENT DIRECTED STANDBY WITH CREW	$300.00
WEATHER DELAY- NON OPERATING RATE	$300.00

SUPPLIES	RATE
CEMENT 47lb BAG EACH	$7.61
ABANTONITE 50lb BAG EACH	$16.00
LOST TOOLING / DRILL STEEL	Cost
DRILLING FLUID ADDITIVES	Cost plus 10%
OTHER MATERIALS / SUPPLIES AS NEEDED	Cost plus 10%

PROPOSED LAYNE SUPPLIED RC DRILLING EQUIPMENT:

One (1) Schramm 450 Track Rotary rig complete with 1,500 ft. of drill pipe, conventional downhole hammer, bit and tool subs, lubricants, wet rotary splitter, and tools necessary
One (1) 4 X 4 water truck with 1,600 gallon capacity.
One (1) 4 X 4 pipe truck
CREW: One (1) Driller; Two (2) Helpers
One (1) Ford F-250 4 x 4 Crew truck

BID CONDITIONS:
- RIG WILL WORK 1 (ONE) - 12 HOUR SHIFT PER DAY ON A 10 DAYS ON WITH 4 DAYS OFF SCHEDULE OR AS AGREED BY THE PARTIES.
- WATER SUPPLY, ACCESS, DRILL SITES, AND ALL REQUIRED PERMITS ARE THE RESPONSIBILITY OF THE

Layne Christensen Company
12030 E. Riggs Road
Chandler, Arizona 85249
Office: 480.895.9336
Fax: 480.895.9536

Estimate

Company:	**Freeport McMoRan Tyrone**	**Date:**	**July 31, 2018**
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Phone:	**575 912 5752**	**Number of Holes:**	**1**
Cell:	**575 654 5246**	**Max. Depth:**	**1,500 feet**
Email:	dprinceh@fmi.com	**Average Depths:**	**1,500 feet**

Description	Quantity	Unit	Cost	Total
Mobilization and Moving				
Move Rig and Equipment	1	LS	$5,000.00	$5,000.00
De -Mobilize Rig and Equipment	1	LS	$5,000.00	$5,000.00
Move between holes 12hrs / move		HR	$375.00	$0.00
			Job Total	**$10,000.00**
Abandon 1 x 5.5-inch Hole to 1,500 Feet				
Mix and Pump Cement Grout Whilst Pulling Rods	6	HR	$375.00	$2,250.00
Cement Materials	454	Bag	$7.61	$3,454.94
Sundry Materials Supplied - cost plus 15%				$0.00
				$0.00
				$0.00
				$0.00
			Total 1 Well	**$5,704.94**

July 31, 2018

To: David Princehouse
Tyrone Mining NM

Re: Abandonment of Exploration Holes

Layne intends to abandon the exploration holes drilled for Tyrone Mining for the RC Exploration program adhering to the following procedures

1. Upon reaching total depth the hole will be backfilled filling from the bottom up through the drill rods with a neat cement grout.

2. Verification of proper sealing is that the volume of sealing material placed in the hole during abandonment operations equals or exceeds the volume of the borehole to be filled and sealed

Regards

Audie Medhurst
General Manager, Mineral Exploration
Mineral Services Western US
LAYNE | water + mineral + energy
12030 E. Riggs Road | Chandler, AZ | 85249
Office: 602-824-0934 | Cell: 602-359-3010
audie.medhurst@layne.com | **layne.com**

Appendix B.2.6

Fuel Cost

Fuel Price Data

Data 1: U.S. No 2 Diesel Retail Prices (Dollars per Gallon)	
Date	U.S. No 2 Diesel Retail Prices[1]
1995	1.109
1996	1.235
1997	1.198
1998	1.044
1999	1.121
2000	1.491
2001	1.401
2002	1.319
2003	1.509
2004	1.81
2005	2.402
2006	2.705
2007	2.885
2008	3.803
2009	2.467
2010	2.992
2011	3.84
2012	3.968
2013	3.922
2014	3.825
2015	2.707
2016	2.304
2017	2.65
2018	3.178

Date	U.S. No 2 Diesel Retail Prices[1]
Jan 2019	2.98

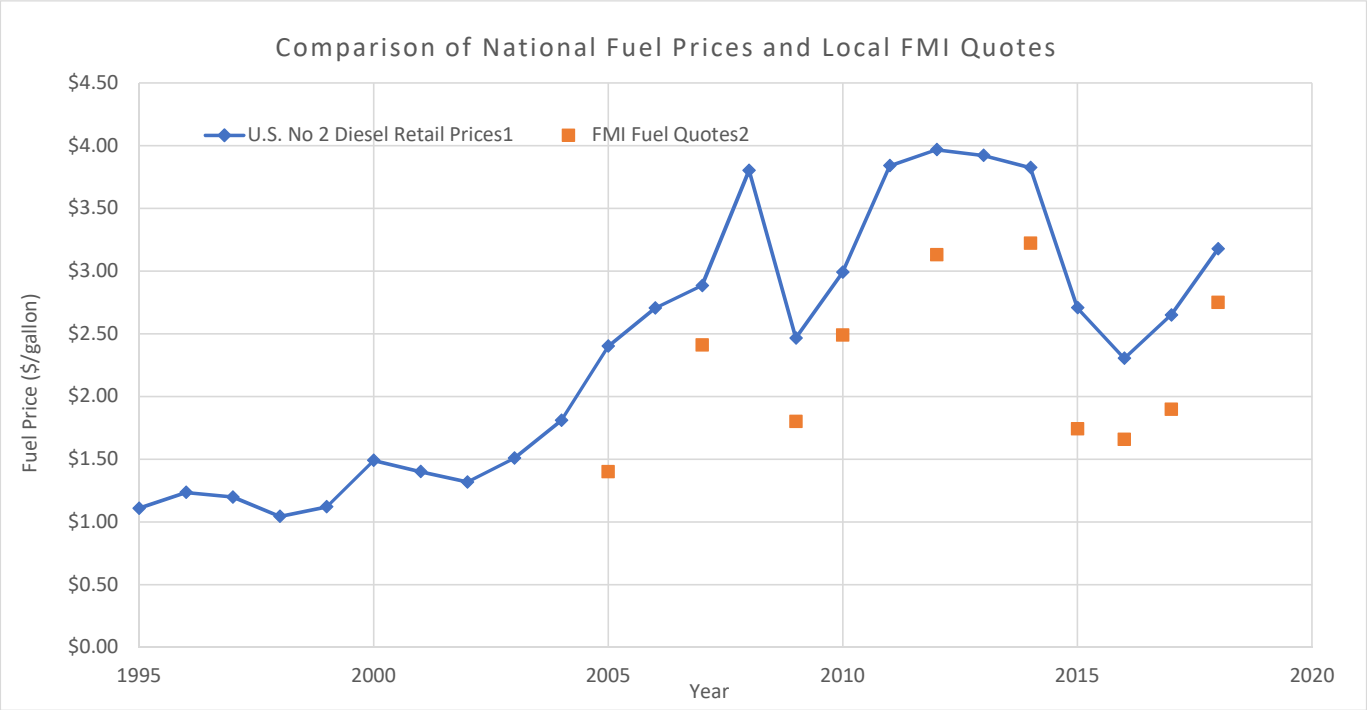
FMI Fuel Quotes[2]			
Site	Date	Dyed, low-sulfur diesel	Notes
Continental	1/21/2005	$1.40	Tom Shelley - quote from fuel broker
Chino & Tyrone	5/9/2007	$2.41	Porter Oil Quote (7500 gal capacity)
Continental	1/23/2009	$1.80	Porter Oil Quote (7500 gal capacity)
Tyrone (Little Rock)	1/14/2010	$2.49	Porter Oil Quote (7500 gal capacity)
Tyrone	7/7/2012	$3.13	Western Refining Oil
Continental	6/18/2014	$3.22	Western Refining Oil
Chino (North Lampbright)	11/5/2015	$1.74	Western Refining Oil
Chino	5/20/2016	$1.66	Western Refining Oil
Tyrone (Little Rock)	4/24/2017	$1.90	Western Refining Oil
Continental	3/12/2018	$2.75	Griffin Propane
Chino	10/10/2018	$2.75	Griffin Propane

1. U.S. Energy Information Administration
http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_NUS_DPG&f=M
2. Quotes obtained from Freeport-McMoRan (FMI)

Correlation Between U.S. No.2 Diesel Retail Prices and FMI Fuel Quotes Since 1995

Year	U.S. No 2 Diesel Retail Prices[1]	FMI Fuel Quotes[2]
1995	1.109	
1996	1.235	
1997	1.198	
1998	1.044	
1999	1.121	
2000	1.491	
2001	1.401	
2002	1.319	
2003	1.509	
2004	1.81	
2005	2.402	$1.40
2006	2.705	
2007	2.885	$2.41
2008	3.803	
2009	2.467	$1.80
2010	2.992	$2.49
2011	3.84	
2012	3.968	$3.13
2013	3.922	
2014	3.825	$3.22
2015	2.707	$1.74
2016	2.304	$1.66
2017	2.65	$1.90
2018	3.178	$2.75

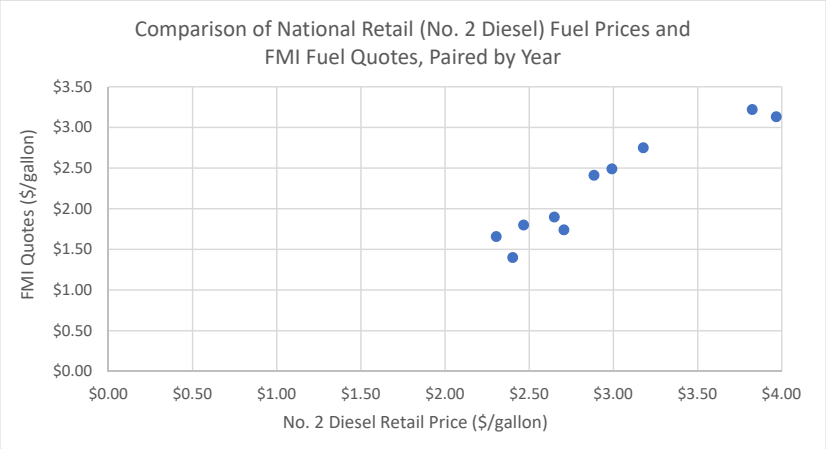
Correlatior 0.952

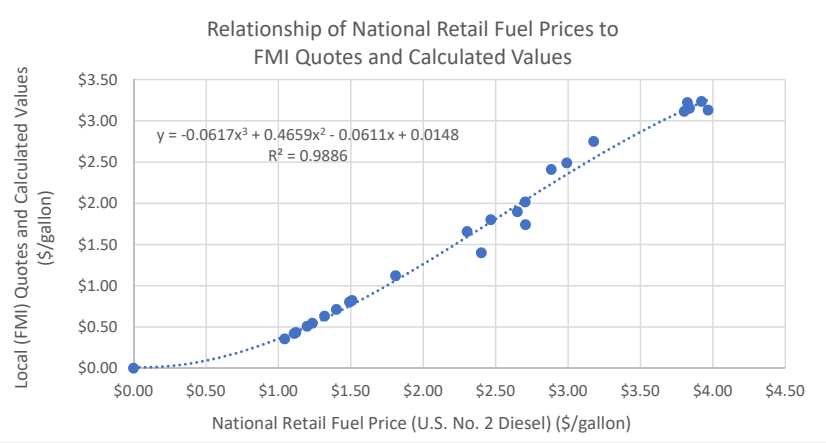


1. U.S. Energy Information Administration
http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_NUS_DPG&f=M
2. Quotes obtained from Freeport-McMoRan (FMI)

Calculations and Results for Fuel Price Prediction

U.S. No. 2 Diesel Retail Prices[1]	FMI Fuel Quotes[2]	Difference Between Retail Prices and FMI Quotes	Calculated FMI Values Based on Average Difference	Calculated FMI Values and Quotes	y = -0.0617x3 + 0.4659x2 - 0.0611x + 0.0148
$0.00				*$0.00*	$0.01
$1.11			$0.42	*$0.42*	$0.44
$1.24			$0.55	*$0.55*	$0.53
$1.20			$0.51	*$0.51*	$0.50
$1.04			$0.36	*$0.36*	$0.39
$1.12			$0.43	*$0.43*	$0.44
$1.49			$0.80	*$0.80*	$0.75
$1.40			$0.71	*$0.71*	$0.67
$1.32			$0.63	*$0.63*	$0.60
$1.51			$0.82	*$0.82*	$0.77
$1.81			$1.12	*$1.12*	$1.06
$2.40	$1.40	$1.00		$1.40	$1.70
$2.71			$2.02	*$2.02*	$2.04
$2.89	$2.41	$0.47		$2.41	$2.23
$3.80			$3.11	*$3.11*	$3.13
$2.47	$1.80	$0.67		$1.80	$1.77
$2.99	$2.49	$0.50		$2.49	$2.35
$3.84			$3.15	*$3.15*	$3.16
$3.97	$3.13	$0.84		$3.13	$3.25
$3.92			$3.23	*$3.23*	$3.22
$3.83	$3.22	$0.61		$3.22	$3.14
$2.71	$1.74	$0.97		$1.74	$2.04
$2.30	$1.66	$0.65		$1.66	$1.59
$2.65	$1.90	$0.75		$1.90	$1.98
$3.18	$2.75	$0.43		$2.75	$2.89
	Average	$0.69			





Correlations

Between No. 2 Retail Price and FMI Quotes	0.95
Between No. 2 Retail Price and 3rd order polynomial FMI Quotes	0.99
Between New FMI quotes and 3rd order polynomial FMI Quotes	0.96
Between FMI quotes and 3rd order polynomial FMI Quotes	0.99

New Fuel Rate	U.S. No 2 Diesel Retail Prices[1]		Proposed Fuel Quote
	Jan 2019	$2.98	$2.34

1. U.S. Energy Information Administration
http://tonto.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2D_PTE_NUS_DPG&f=M
2. Quotes obtained from Freeport-McMoRan (FMI)

Appendix C

Water Management Costs

Appendix C
Water Management Cost

Prepared for

Freeport-McMoRan Inc.
Chino Mines Company
99 Santa Rita Mine Road
Vanadium, New Mexico 88043

Prepared by

Telesto Solutions Inc.
3801 Automation Way, Suite 201
Fort Collins, Colorado 80525

December 2014
May 2018
Updated March 2019

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Signature Page

Appendix C
Water Management Cost

December 2014
May 2018
Updated March 2019

Report Authors and Contributors

Telesto Solutions, Inc.

Fred Charles, P.E. – Primary Author

Walter Niccoli, PE – Report Review

Contributor:
Peggy Carter

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1.0 INTRODUCTION

This water management reclamation cost estimate update includes operations and maintenance (O&M), replacement, and removal costs related to post-closure water management for the Continental Mine. Impacted stormwater and seeps are currently captured in ponds and tanks and piped to Chino for treatment and/or inclusion in Chino's process water stream. Following reclamation and establishment of revegetation, infiltration will be reduced, waste rock facility seeps are expected to decrease and eventually cease flowing (Condition 83; Golder, 2009), stormwater runoff from reclaimed surfaces will no long be impacted and will be released, and the Main Tailings Impoundment (MTI) seeps are expected to decrease and eventually cease flowing. The reduction in the aforementioned sources will decrease the water requiring management. Facilities and post-closure uses, based on the EOY 2023 mine plan, are shown in Table C-1. Water quality monitoring is assumed to continue for a 100-year period.

2.0 TOTAL COST ESTIMATE FOR WATER MANAGEMENT

The total current dollar cost for water management is **$2,145,000**, which includes $490,000 in capital costs plus $1,655,000 in O&M costs. A summary of the estimate is provided in Table C-2. The costs presented in this estimate are current (2019) dollar costs.

Table C-1 Water Management Facilities Descriptions

Impoundment Designation	Surface Area (acres)	Mine Use	Liner	Reclamation Schedule
Decant Pond #4	0.62	Seep and Stormwater	HDPE	Removed Reclamation Year 12
Grape Gulch Pond #3	0.38	Stormwater	HDPE	Removed Reclamation Year 12
North Tailings Decant Pond	0.46	Stormwater	Concrete Dam Unlined	Removed Reclamation Year 12
Magnetite Seepage Pond	0.2	Seep and Stormwater	HDPE	Removed Reclamation Year 12
Reclaim Pond	16	Emergency Water Management, Seep and Stormwater	Concrete Dam Unlined	Reclaimed with MTI by Reclamation Year 5
Surge Tank	0.18	Emergency Water Management, Seep and Stormwater	Stainless Steel	Industrial Post Mining Land Use (PMLU)
SWRF Dam 1 (181-2003-Dam 1)	0.52	Stormwater	Concrete Dam Unlined	Removed Reclamation Year 12
SWRF Dam 2 (181-2003-Dam 2)	0.34	Stormwater	Concrete Dam Unlined	Removed Reclamation Year 12
SWRF Dam 3 (181-2003-Dam 3)	0.84	Stormwater	Concrete Dam Unlined	Removed Reclamation Year 12
Upper Creek Containment Pond 1	0.74	Seep and Stormwater	HDPE Lined	Removed Reclamation Year 12
Seeps Routed to Upper Creek Containment Pond 1				
Borehole Seep and Borehole Access Road (Vent Seep)	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9
Blackman's Seep	0.01	Seep	HDPE	Removed Reclamation Year 9
East Haul Road & Rock Dam Seep	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9
Unnamed Seep	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9
Cottonwood Seep	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9
Seeps Routed to Decant Pond # 4				
Dam Toe Seep	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9
Cement Pond (Replaced by East WRF Containment by EOY 2019)	NA	Seep and Stormwater	HDPE Lined	Seepage ceases flow by Reclamation Year 5, Continue use for Stormwater Removed Reclamation Year 12
Estrada Seep	NA	Seep	Unlined	Seepage Ceases flow by Reclamation Year 5
Magnetite Seepage Pond (Magnetite Interceptor Trench seepage reports to Magnetite Seepage Pond then to Decant Pond #4)	NA	Seep	Unlined	Seepage Ceases flow and, Reclaimed with Magnetite Tailings Impoundment by Reclamation Year 5
Peach Tree Spring Seep	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9
Union Hill Adit Seep	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9
Weber Pond	NA	Seep	Unlined	Seepage ceases flow by Reclamation Year 9

Table C-2 Water Management Cost Summary

Item	Direct Cost	Indirect Cost	Total Estimated Cost
Water Management Capital		**30%**	
Ponds	$168,022	$50,407	$218,429
Pumps	$0	$0	$0
Pipelines	$0	$0	$0
Electrical	$0	$0	$0
Subtotal	**$168,022**	**$50,407**	**$218,429**
Capital Removal [1]		**30%**	
Pumps	$0	$0	$0
Pipelines	$157,440	$47,232	$204,672
Electrical Infrastructure	$51,298	$15,389	$66,687
Subtotal	**$208,738**	**$62,621**	**$271,359**
Operations and Maintenance		**17.5%**	
Ponds and Tanks	$191,405	$33,496	$224,901
Pumps	$544,615	$95,308	$639,923
Pipelines	$142,143	$24,875	$167,018
Electrical Infrastructure	$121,843	$21,323	$143,166
Electricity and Fuel (Pumps)	$35,074	$6,138	$41,212
Environmental Sampling	$373,198	$65,310	$438,508
Subtotal	**$1,408,278**	**$246,450**	**$1,654,728**
Total Estimated Cost	**$1,785,000**	**$359,000**	**$2,145,000**

[1] Removal costs for ponds and tanks are included in the earthwork portion of the cost estimate.

3.0 QUANTITY OF WATER TO BE MANAGED

The sources and quantities of water used in the cost estimate were determined by:

- Estimating average annual pre-reclamation stormwater runoff
- Estimating average annual post-reclamation stormwater runoff
- Estimating post-reclamation flows from WRF seeps
- Estimating post-reclamation seepage from MTI drain down

Details and results of the analysis are presented in the 2018 update (Telesto, 2018) to the original 2014 CCP (Telesto, 2014b). Yearly average seepage quantities are summarized in Table C-3. Managed water volumes as a function of time are summarized in Table C-4.

Table C-3 Estimated Stormwater Flow and Seepage Quantities

Seep		Stormwater Volume (acre-ft)	Seepage Volume (acre-ft)	Stormwater Flow Rate, Pre-Reclamation (gpm)	Average Seepage Flow Rate, Pre-Reclamation (gpm)
Main Tailing Impoundment Seeps[1]	Stormwater and Seeps Routed to Upper Creek Containment Pond #1 (excludes Cottonwood Seep)	46.63		28.91	
	Cottonwood Seep	-	3.15	-	1.95
	Upper Creek Containment Pond #1 Average Estimated Yearly Stormwater Runoff[2]	16.35	-	10.14	-
	Estimated Seepage Routed to Upper Creek Containment Pond #1	-	33.43	-	20.73
	Dam Toe Seep	-	116.8	-	72.42
	Peach Tree Spring Seep	-	19.57	-	12.13
	Weber Pond	-	0	-	0.00
	Total Main Tailing Impoundment Seepage	-	169.8	-	105.27
Estrada Seep[2]		-	2.34	-	1.45
Union Hill Adit Seep[2]		-	0.52	-	0.32
Cement Pond (Replaced by EOY 2019 with East WRF Containment)[2]		-	1.30	-	0.81
Magnetite Interceptor Trench[2]		-	0.45	-	0.28

4.0 WATER MANAGEMENT COST ESTIMATE

The water management cost estimate is divided into five components: (1) ponds and tanks, (2) pumps, (3) pipelines, (4) electrical infrastructure, and (5) water monitoring. Table C-5 provides a brief description of each worksheet (Sheet) used in the cost estimate (see Appendix C.1). Throughout this document, the items described are followed by a reference to the location of the corresponding calculation Sheet.

[1] Measured 2013 seepage volumes (Golder, 2014)
[2] The estimated yearly stormwater runoff for Upper Creek Containment #1 is based on EOY 2023 mine configuration and calculations (Telesto, 2018)

Table C-4 Water Management Volumes through Time

Year	Average SWRDF Seeps (gpm)[3]	Average Main Tailings Impoundment (gpm)[4]	Average Storm Water Runoff (gpm)[5]	Average Magnetite Tailings Impoundment (gpm)[6]	Total Average to Chino via Bull Frog (gpm)
0	2.6	62.7	66.5	0.3	132.0
1	2.6	56.4	66.5	0.3	125.7
2	2.6	50.2	66.5	0.3	119.5
3	2.6	43.9	66.5	0.3	113.2
4	2.6	37.7	66.5	0.3	107.0
5	2.6	31.4	66.5	0.3	100.7
6	0.0	25.1	3.5	0.0	28.6
7	0.0	18.6	3.5	0.0	22.1
8	0.0	11.8	3.5	0.0	15.3
9	0.0	4.7	3.5	0.0	8.2
10	0.0	0.0	3.5	0.0	3.5
11	0.0	0.0	3.5	0.0	3.5
12…	0.0	0.0	0.0	0.0	0.0
…100	0.0	0.0	0.0	0.0	0.0

Table C-5 Cost Estimate Sheet Descriptions

Worksheet	Description
20190329_ContMine_Water Mgmt_RCE.xlsx (Water Management Sheets)	
1 Reclamation and O&M Costs	Ponds/Tanks, Pumps, Pipelines, and Electrical Infrastructure capital and O&M direct cost calculations.
2 Sampling Cost	Post-closure sampling cost development and sampling schedule.
3 WM Cash Flow	Cost over time
4 Summary	Cost summary including indirect cost percentages and direct costs calculated on Sheets 1 and 2

[3] Average seep flow rate at EOY 2023 based on average East WRF, Union Hill, and Estrada Seeps flow rates 2013 (Golder, 2014)
[4] Calculated drain down rates are from Telesto (2018)
[5] Calculated stormwater runoff for reclaimed areas (Telesto [2018])
[6] Average seep flow rate at EOY 2023 based on average Magnetite Interceptor Trench Seeps flow rates 2013 (Golder, 2014)

Assumptions and methods common throughout the cost estimate include the following:

- Water management variables are provided in Table C-6 and used on Water Management Sheet 1.
- Miscellaneous unit costs are taken from several sources including R.S. Means Heavy Construction Cost Online Data (R.S. Means, 2019). All costs taken from R.S. Means are adjusted in the online data based on the Las Cruces location. Miscellaneous unit costs are summarized in Table C-7 and used on Water Management Sheet "Unit Cost Table". Supporting documentation is included in Appendix C.2.
- Reclamation begins in 2024.
- Infrastructure used for the capture and conveyance of water is removed on or by reclamation year 12 (Table C-1). The Reclaim Pond and all associated infrastructure is removed when the MTI is reclaimed, assumed no later than reclamation year 5. Removal costs for ponds, tanks, and dams are included in earthwork portion of the cost estimate (see Appendix B).

Table C-6 Water Management Variables

Description	Variable
Steel Tank Life Expectancy (yr)	50
Lined Pond Life Expectancy (yr)	30
Small Concrete Dam Life Expectancy (yr)	50
Pump Life Expectancy (yr)	20
HDPE Pipeline Life Expectancy (yr)	100
Pump / Motor Efficiency	0.70
Reclaim Pond Pump Fuel Consumption Rate (gal/hr)	1.0
Chezy Head Loss Coefficient	150
Power Pole Spacing (ft)	100
Annual Pond Maintenance to Capital Factor	1.5%
Annual Pump Maintenance to Capital Factor	1.5%
Annual Pipeline Maintenance to Capital Factor	1.0%
Annual Electrical Infrastructure Maintenance to Capital Factor	1.5%
Estimated average stormwater runoff non-revegetated (CN=85, gal/year/acre)	48,155
Estimated average stormwater runoff, after 12-year vegetation establishment period (Condition 87 CN=62, gal/year/acre)	2,530
Reclamation Start Year (2020)	0
Reclamation Finished	5
Vegetation Established Assume stormwater released	12

Table C-7 Miscellaneous Unit Costs

Activity	Unit	Unit Cost ($/unit)	R.S. Means Item Number	Description
Utility Pole Demo	ea	$179.92	024113800100	Selective demolition, utility poles & cross arms, utility poles, wood, 20'-30' high
Cross Arm Demo	ea	$77.86	024113800300	Selective demolition, utility poles & cross arms, cross arms, wood, 4'-6' long
Wood Electrical Utility Poles a.)	ea	$636.54	337116336020	Electrical utility pole, wood pole CCA/ACA-treated, 30', class 1, type C, excludes excavation, backfill and cast in place concrete
Utility Pole Installation b.)	ea	$1,108.74	337116236010	Electrical utility pole, digging holes in rock, average
Utility Pole Installation c.)	ea	$1.71	337116339000	Electrical utility pole, wood poles disposal of surplus material; base unit rate $90.04/mile scaled to per pole (each) assuming 100 ft power pole spacing/5280 ft/mile
Utility Pole Installation d.)	ea	$301.40	337116337600	Electrical utility pole, poles, wood, cross arms with hardware & insulators, 4' long, excludes excavation, backfill and cast in place concrete
Electrical Wiring Installation a.)	wire mile	$509.29	337139130110	Overhead line conductors & devices, conductors, primary circuits, material handling & spotting
Electrical Wiring Installation b.)	wire mile	$14,307.12	337139130150	Overhead line conductors & devices, conductors, primary circuits, per wire, 210 to 636 kcmil
Electrical Wiring Installation c.)	mile	$270.35	337139130810	Overhead line conductors & devices, disposal of surplus material, high voltage conductors
Potential Transformers	ea	$4,885.68	337126264100	Station capacitors, potential transformers, 13 to 26 kV
Pipeline Demolition (Flushing and Cover)	lf	$3.75	026510300320	Sludge/water removal at $0.13/ft assuming 18-inch pipe diameter 1/3 full, scaled based on RS Means unit cost to remove sludge/water from 9,000-12,000 (average 10,500) gallon tank at $306.69/each; placement of cover material over pipe at $3.62/ft after sludge/water removal
Excavation of Soil	cy	$7.17	G10301201600 (2)	3/4 C.Y. backhoe, three 8 C.Y. dump trucks, 1 mi round trip; unit rate not presented online, therefore use RS Means 2019 Handbook [hardcopy], 33rd edition with unit rate of $8.40/cy x 0.854 [Las Cruces adjustment] = $7.17/cy
Reservoir Liners HDPE	sf	$1.39	310519531200	Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick, per S.F.
Small Concrete Dam	lf	$79,833	323213103100	Cast-in place retaining walls, reinforced concrete cantilever, 33-degree slope embankment, 10' high, includes excavation, backfill & reinforcing; 250 ft is the assumed length of retaining wall (dam) @ $319.33/lineal ft (RS Means online data)
Water Treatment Tank	ea	$324,459	331623131000	Steel water storage tanks, ground level, ht./diam. less than 1, 250,000 gallons, excl. foundation
Pump	ea	$10,000	-	Engineering Judgment 15 to 30 gpm - includes pump control, control panel, installation, and flow meter
Pump	ea	$15,000	-	Engineering Judgment 50 gpm - includes pump control, control panel, installation, and flow meter
Pump	ea	$25,000	-	Engineering Judgment 100 to 700 gpm - includes pump control, control panel, installation, and flow meter
Pump	ea	$30,000	-	Engineering Judgment 800 to 2000 gpm - includes pump control, control panel, installation, and flow meter
Water Supply Piping	lf	$7.32	331413350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21
Water Supply Piping	lf	$11.21	331413350200	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 6" diameter, SDR 21
Water Supply Piping	lf	$15.78	331413350300	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 8" diameter, SDR 21
Water Supply Piping	lf	$19.17	331413350400	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 10" diameter, SDR 21
Water Supply Piping	lf	$22.06	331413350500	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 12" diameter, SDR 21
Water Supply Piping	lf	$31.79	331413350600	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 14" diameter, SDR 21
Water Supply Piping	lf	$39.27	331413350700	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 16" diameter, SDR 21
Facility Water Distribution Piping	lf	$260.76	221113481210, 221113481780	Steel Pipe Schedule 40, black 24" diameter (RS Means 221113481210) $269.00 (material) + $95.46 (labor); unit cost without coupling and hanger (RS Means 221113481780) is reduced 35% for material and 10% for labor = $174.85 + $85.91
Electric Rate	kWh	$0.0587	-	Industrial rate data 3/12/2019 (http://www.electricitylocal.com/states/new-mexico/silver-city/)
Electric Panel Cost	ea	$10,000	-	Engineering Judgment
Diesel Fuel Cost ($/gal)	gal	$2.34	-	Diesel fuel cost is estimated by correlating historical local quotes with public data, as agreed upon in November 2018 discussions with the agencies
Environmental Sampler	hr	$60	-	Engineering Judgment
Environmental Sampling Reviewer	hr	$70	-	Engineering Judgment
Environmental Sampling	sample	$280	-	23 Constituents. Energy Laboratories, Inc., Quote March 2018-2019
Shipping Environmental Sampling	cooler	$400	-	Overnight UPS $400 for a 10 lb. package 30”x18”x18” Silver City, NM to Casper, WY Energy Labs

1) RS Means Online unit cost includes CCI adjustment for Las Cruces New Mexico - 2019 R.S. Means Online, www.remeansonline.com
2) RS Means hard copy, 33rd ed., 2019 (base rate, CCI adj. 0.854 for Las Cruces)

- Pond volumes, pipeline lengths and diameters, and flow rates were obtained from 1) *DP-1403 Condition 36 – 2013 Annual Water Management Model Update* letter (Telesto, 2014a) and 2) *Water Management System Analysis and Upgrade Recommendations Report* (Telesto, 2012).
- Capital indirect costs of 30% are applied to the capital direct costs based on discussions involving the FA Work Group as agreed in January 2019 (see Appendix D). The FA Work Group involved representatives of Freeport-McMoRan New Mexico Operations (FNMO), MMD, NMED, and Gila Resources Information Project (GRIP). The indirect costs include but are not limited to Mobilization and Demobilization, Contingencies, Engineering Redesign Fee, Contractor Profit and Overhead, Project Management Fee, and State Procurement Cost.
- Operations and maintenance indirect costs of 17.5% are applied for long-term O&M direct costs, also as agreed by the FA Work Group for FNMO's RCEs (see Appendix D). The indirect costs include but are not limited to Mobilization and Demobilization, Contingencies, Engineering Redesign Fee, Contractor Profit and Overhead, Project Management Fee, and State Procurement Cost.

4.1 Ponds and Tanks

Water management information and costs for ponds and tanks are presented in Appendix C.1 Water Management Sheet 1. Assumptions and methods for this portion of the cost estimate include the following:

- Replacement costs are based on replacement ages from Table C-6 and age at reclamation. The SWRF Dams 1-3 are currently 20 years old, all membrane lined ponds are 30 years old (with the exception of the Upper Creek Containment Pond #1), and the East Waste Rock Facility Containment is new in 2023. The Surge Tank will be maintained during the O&M period and not replaced, based on a recent evaluation of the 250,000-gallon steel tank which concluded that the tank is suitable for its current use–only repairs and maintenance are needed as its use continues.
- New and replacement costs for lined ponds assume excavating 1/3 the capacity of the pond and replacing with a double liner.
- The Reclaim Pond and North Tailings Decant Pond require no maintenance beyond what is already included in the Earthwork cost estimate for the site as a whole.

4.2 Pumps

Water management information and costs for pumps are presented in Appendix C.1, Water Management Sheet 1. Assumptions and methods for this portion of the cost estimate include the following:

- All pumps will be rebuilt over time during the first 12 years of O&M, instead of purchasing new pumps. The annual cost for the ongoing rebuilding of each pump is assumed to equal the new pump cost if spread over 12 years of O&M. Upon termination of pumping, each pump will be buried as part of pipeline demolition (flushing and cover operations).
- Pipe head loss calculations use average combined pumping rate when multiple pumps are present.
- Pump operating time was calculated by dividing average annual water volume by the average pump capacity.

4.3 Pipelines

Water management information and costs for pipelines are presented in Appendix C.1 Water Management Sheet 1. Replacement costs are based on replacement ages from Table C-6 and age at reclamation. Pipelines will be demolished by removing the sludge/water and placement of a 3-ft cover over the pipe.

4.4 Electrical Infrastructure

Water management information and costs for electrical infrastructure are presented in Appendix C.1, Water Management Sheet 1. Assumptions and methods for this portion of the cost estimate include the following:

- Electric power lines currently follow major pipeline corridors.
- All power lines are high voltage and require a transformer and electrical panel.

4.5 Water Monitoring

Closure and post-closure monitoring of surface water and groundwater is required in the New Mexico Energy and Natural Resources Department, Mining and Minerals Division (MMD) Permits and DP-1403. Sampling and analysis are quarterly for years 0 through 5, decreasing to semi-annually for years 6 through 12, and then annually thereafter.

Sampling information and costs are presented in Appendix C.1, Water Management Sheet 2. Unit rate information is shown in Table C-7.

5.0 REFERENCES

Energy Laboratories, Inc. 2018. Quote for analytical work (www.energylab.com).

Golder Associates (Golder). 2009. Condition 83 Revised Seepage Investigation Waste Rock Facilities and Main Tailings Impoundment for Supplemental Discharge Plan Condition 83 Requirements Continental Mine, Grant County, New Mexico. March 3, 2009.

Golder Associates (Golder). 2014. Golder Associates Cumulative Seep and Spring Flow Measurements Spreadsheet dated April 2014, Data from 2013 annual total. April 2014.

R.S. Means. 2019. Heavy Construction Cost Data. 33rd Annual Edition. R.S. Means Company, Inc.

Telesto Solutions, Inc. (Telesto). 2012. Water Management System Analysis and Upgrade Recommendations Report. Prepared for Cobre Mining Company, Hurley, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. April 2012.

Telesto Solutions, Inc. (Telesto). 2014a. DP-1403 Condition 36 – 2013 Annual Water Management Model Update letter. Prepared for Cobre Mining Company, Hurley, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. January 2014.

Telesto Solutions, Inc. (Telesto). 2014b. Continental Mine Closure/Closeout Plan. Prepared for Cobre Mining Company, Hurley, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. December 2014.

Telesto Solutions, Inc. (Telesto). 2018. Continental Mine Closure/Closeout Plan Update. Prepared for Cobre Mining Company, Hurley, New Mexico by Telesto Solutions, Inc., Fort Collins, Colorado. May 2018.

Appendix C.1

Cost Calculations

Water Management Cost Estimate

Variables

Description	Variable
Steel Tank Life Expectancy (yr)	50
Lined Pond Life Expectancy (yr)	30
Small Concrete Dam Life Expectancy (yr)	50
Pump Life Expectancy (yr)	20
HDPE Pipeline Life Expectancy (yr)	100
Pump / Motor Efficiency	0.70
Reclaim Pond Pump Fuel Consumption Rate (gal/hr)	1.0
Chezy Head Loss Coefficient	150
Power Pole Spacing (ft)	100
Annual Pond Maintenance to Capital Factor	1.5%
Annual Pump Maintenance to Capital Factor	1.5%
Annual Pipeline Maintenance to Capital Factor	1.0%
Annual Electrical Infrastructure Maintenance to Capital Factor	1.5%
Estimated average stormwater runoff non-revegetated (CN=85, gal/year/acre)	48,155
Estimated average stormwater runoff, after 12-year vegetation establishment period (Condition 87 CN=62, gal/year/acre)	2,530
Original CCP Year (2014)	-6
Original Reclamation Start Year (2020) ["0" refers to the beginning of the first year]	0
Reclamation Finished	5
Vegetation Established Assume Stormwater Released	12

PONDS AND TANKS

Location	Construction Type	Capacity (gallons)	Capacity (cy)	Pond Area (acres)	Age Today (yr)	Age at Reclamation (yr)	Removal Year** (yr)	First Replacement Year (yr)	Number of Replacements	**Direct Cost New and Replacement ($/ea)**	**Capital Cost New and Replacement ($)**	**Direct Cost Maintenance Ponds ($/yr)**	**Direct Cost O&M Ponds ($)**
SWRF Dam 1 (181-2003-Dam 1)	concrete dam, unlined	1,116,800	5,530	-	19	25	12	-	0	$79,833	$0	$1,197	$15,567
SWRF Dam 2 (181-2003-Dam 2)	concrete dam, unlined	827,700	4,098	-	19	25	12	-	0	$79,833	$0	$1,197	$15,567
SWRF Dam 3 (181-2003-Dam 3)	concrete dam, unlined	2,925,300	14,485	-	19	25	12	-	0	$79,833	$0	$1,197	$15,567
Decant Pond #4	HDPE lined	972,500	4,815	0.62	19	25	12	5	1	$86,589	$86,589	$1,299	$16,885
Upper Creek Containment Pond #1	HDPE lined	1,879,200	9,305	1.29	0	6	12	-	0	$178,453	$0	$2,677	$34,798
Grape Gulch Pond #3	HDPE lined	911,600	4,514	0.38	29	35	12	0	1	$56,805	$56,805	$852	$11,077
Blackman's Seep (Pond #2)	unlined	25,000	124	-	29	35	9	0	1	$296	$296	$4	$44
Surge Tank***	steel	352,500	1,745	-	49	55	12	0	1	$0	$0	$4,867	$63,270
Magnetite Seepage Pond	HDPE lined	9,600	48	0.20	29	35	12	0	1	$24,333	$24,333	$365	$4,745
East WRF Containment	concrete	900,000	4,456	0.50	-1	5	12	-	0	$71,199	$0	$1,068	$13,884
									Direct Annual Costs ($/yr):	-	-	$14,724	-
									Direct Cost Subtotals:	-	$168,022	-	$191,405

*Reclaim Pond and North Tailings Decant require no maintenance beyond what is already included in the Earthwork cost estimate for the site as a whole.
**Removal costs are included in earthwork portion of the cost estimate.
***Surge Tank is Industrial PMLU and, therefore, is not removed. Surge tank will not need replacement as its condition is suitable for its current use case, with repairs and maintenance continuing as part of O&M.

$$H_f = \frac{10.44\,Q^{1.85}}{C^{1.85}\,D_i^{4.865}}$$

PUMPS

From	To	Number	Age Today (yr)	Age at Reclamation (yr)	Removal Year (yr)	First Replacement Year (yr) [-1 means full replacement not taking place, but rebuilding of pump takes place throughout its operation under O&M]	Number of Replacements	Average Combined Operational Pumping Rate (gpm)	Starting Elevation (ft)	Maximum Elevation (ft)	Head Loss (ft)	Head on Pump (ft)	Power (HP)	Operational Kilowatts (kW)	Stormwater Capture Area, Pumped Water only (acres)	Average Seepage through Reclamation year 5 (gal/year)	Direct Pump Cost New and Replacement ($/replacement)
SWRF Dam 1 (181-2003-Dam 1)	SWRF Dam 3 (181-2003-Dam 3)	2	15	21	12	-1	1	1760	6650	6719	61	130	82	61	120.9	0	$60,000
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	2	15	21	12	-1	1	1940	6613	6715	54	156	109	81	48.7	0	$60,000
SWRF Dam 3 (181-2003-Dam 3)	Bullfrog pipeline	2	15	21	12	-1	1	940	6556	6745	11	200	68	51	96.9	0	$50,000
Decant Pond #4	Booster Pump 2	2	24	30	12	-1	1	3000	6688	6700	1	13	14	10	0	18001800	$50,000
Booster Pump 2	Surge Tank	2	24	30	12	-1	1	3000	6700	6925	10	235	254	189	0	0	$50,000
Decant Pond #4	Reclaim Pond	2	24	30	5	-1	1	1760	6688	7000	31	343	218	162	0	0	$60,000
Magnetite Interceptor Trench	Magnetite Tailings Seepage Pond	1	24	30	5	-1	1	100	6670	6695	0	25	1	1	0	146643	$15,000
Magnetite Seepage Pond	Decant Pond #4	2	24	30	12	-1	1	100	6695	6750	7	62	2	2	13.1	0	$30,000
Estrada Seep	Decant Pond #4	2	9	15	5	-1	1	45	6575	6688	19	132	2	2	0	762541	$20,000
Union Hill Adit Seep	Decant Pond #4	2	9	15	5	-1	1	30	6575	6688	96	209	2	2	0	169454	$20,000
Upper Creek Containment Pond #1	Surge Tank	2	24	30	12	-1	1	1980	6810	6925	358	473	338	252	53.7	0	$60,000
Grape Gulch Pond #3	Surge Tank	2	24	30	12	-1	1	1100	6775	6925	14	164	65	49	6.5	0	$60,000
Blackman's Seep (Pond #2)	Upper Creek Containment Pond 1	1	24	30	9	-1	1	125	6775	6810	0	35	2	1	0	0	$15,000
Surge Tank	Reclaim Pond	2	10	16	9	-1	1	3497	6925	7000	26	101	128	95	0	0	$60,000
Reclaim Pond	Surge Tank	1	10	16	5	-1	1	1240	7000	7010	46	56	25	19	316.1	0	$30,000
East WRF Containment	Decant Pond #4	2	-1	5	12	-	0	2000	6560	6688	70	198	143	106	69.8	423634	$20,000
tailings pipeline flushing																	
Mill No 1	Tailings Impoundment Top	1						4318	6825	7000	13	188	293	219			
Mill No 2	Tailings Impoundment Top	1						4318	6950	7000	13	63	98	73			

*Surge tank to bullfrog pipeline is gravity fed and thus pumping costs are not included.

PUMPS(continued)

		Post Closure Pre Completed Reclamation (Through Reclamation Year 5)					Post Closure Post Completed Reclamation (Reclamation Year 6 to 12)									
From	To	Average Pumping Rate (gal/yr)	Operating Time (hr/yr)	Annual Electrical Usage (kWh/yr)	Direct Annual Operational Cost ($/yr)	Direct Operational Cost ($)	Average Pumping Rate (gal/yr)	Operating Time (hr/yr)	Annual Electrical Usage (kWh/yr)	Direct Annual Operational Cost ($/yr)	Direct Operational Cost ($)	**Direct Pump Cost New and Replacement (O&M) ($)**	**Direct Cost Maintenance Over Yrs 0-12 ($/yr)**	**Direct Cost O&M ($)**	**Direct Cost Removal, Included in Pipeline Demo ($)**	**Direct Cost O&M Electricity and Fuel ($)**
SWRF Dam 1 (181-2003-Dam 1)	SWRF Dam 3 (181-2003-Dam 3)	5,821,936	55.1	3,381	198	1,191	305,888	3	178	$10	$73	$60,000	$4,615	$60,000	$0	$1,264
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	2,345,147	20.1	1,636	96	576	123,216	1	86	$5	$35	$60,000	$4,615	$60,000	$0	$611
SWRF Dam 3 (181-2003-Dam 3)	Bullfrog pipeline	12,833,300	227.5	11,520	676	4,057	8,412,249	149	7,552	$443	$3,103	$50,000	$3,846	$50,000	$0	$7,160
Decant Pond #4	Booster Pump 2	23,496,119	130.5	1,317	77	464	5,494,319	31	308	$18	$127	$50,000	$3,846	$50,000	$0	$591
Booster Pump 2	Surge Tank	23,496,119	130.5	24,734	1,452	8,711	23,496,119	131	24,734	$1,452	$10,163	$50,000	$3,846	$50,000	$0	$18,875
Decant Pond #4	Reclaim Pond	0	0.0	0	0	0	0	0	0	$0	$0	$60,000	$4,615	$27,692	$0	$0
Magnetite Interceptor Trench	Magnetite Tailings Seepage Pond	146,643	24.4	17	1	6	146,643	24	17	$1	$0	$15,000	$1,154	$6,923	$0	$6
Magnetite Seepage Pond	Decant Pond #4	777,473	129.6	216	13	76	179,787	30	50	$3	$21	$30,000	$2,308	$30,000	$0	$96
Estrada Seep	Decant Pond #4	762,541	282.4	450	26	159	0	0	0	$0	$0	$20,000	$1,538	$9,231	$0	$159
Union Hill Adit Seep	Decant Pond #4	169,454	94.1	159	9	56	0	0	0	$0	$0	$20,000	$1,538	$9,231	$0	$56
Upper Creek Containment Pond #1	Surge Tank	2,585,922	21.8	5,485	322	1,932	135,866	1	288	$17	$118	$60,000	$4,615	$60,000	$0	$2,050
Grape Gulch Pond #3	Surge Tank	313,007	4.7	231	14	81	16,446	0	12	$1	$5	$60,000	$4,615	$60,000	$0	$86
Blackman's Seep (Pond #2)	Upper Creek Containment Pond 1	0	0.0	0	0	0	0	0	0	$0	$0	$15,000	$1,154	$11,538	$0	$0
Surge Tank	Reclaim Pond	0	0.0	0	0	0	0	0	0	$0	$0	$60,000	$4,615	$46,154	$0	$0
Reclaim Pond	Surge Tank	15,221,786	204.6	-	479	2,872	799,763	11	25	$1	$0	$30,000	$2,308	$13,846	$0	$2,872
East WRF Containment	Decant Pond #4	3,784,851	31.5	3,359	197	1,183	176,601	1	157	$9	$64	$0	$0	$0	$0	$1,247
tailings pipeline flushing																
Mill No 1	Tailings Impoundment Top	5,764,479	22.2	4,865												
Mill No 2	Tailings Impoundment Top	6,800,790	26.2	1,928												
	Direct Annual Costs ($/yr):	-	-	-	$3,561	-	-	-	-	$1,961	-	-	$49,231	-	-	-
	Direct Cost Subtotals:	-	-	-	-	$21,365	-	-	-	-	$13,709	$0	-	$544,615	$0	$35,074

Water Management Cost Estimate

PIPELINES

From	To	Material	Length (ft)	Inside Diameter (in)	Age Today (yr)	Age at Reclamation (yr)	Removal Year (After Closure) (yr)	Reclamation Replacement Year (yr)	Number of Replacements	Direct Cost New and Replacement ($/ft)	Direct Cost Removal (Demo) ($/ft)	Direct Cost New and Replacement ($/ea)	**Direct Cost New and Replacement ($)**	**Direct Cost Maintenance ($/yr)**	**Direct Cost O&M ($)**	**Capital Cost Removal (Demo) ($)**
SWRF Dam 1 (181-2003-Dam 1)	SWRF Dam 3 (181-2003-Dam 3)	HDPE	4,466	10	15	21	12	-	0	$19.17	$3.75	$85,613	$0	$856	$11,130	$16,748
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	HDPE	3,300	10	15	21	12	-	0	$19.17	$3.75	$63,261	$0	$633	$8,224	$12,375
SWRF Dam 3 (181-2003-Dam 3)	Bullfrog pipeline	HDPE	220	6	15	21	12	-	0	$11.21	$3.75	$2,466	$0	$25	$321	$825
Decant Pond #4	Booster Pump 2	HDPE	100	15	24	30	12	-	0	$39.27	$3.75	$3,927	$0	$39	$511	$375
Booster Pump 2	Surge Tank	HDPE	1,936	15	24	30	12	-	0	$39.27	$3.75	$76,027	$0	$760	$9,883	$7,260
Decant Pond #4	Reclaim Pond	HDPE	5,502	12	24	30	5	-	0	$22.06	$3.75	$121,374	$0	$1,214	$7,282	$20,633
Magnetite Interceptor Trench	Magnetite Tailings Seepage Pond	HDPE	200	5	24	30	5	-	0	$11.21	$3.75	$2,242	$0	$22	$135	$750
Magnetite Seepage Pond	Decant Pond #4	HDPE	1,188	4	24	30	12	-	0	$7.32	$3.75	$8,696	$0	$87	$1,131	$4,455
Estrada Seep	Decant Pond #4	HDPE	3,470	3	24	30	5	-	0	$7.32	$3.75	$25,400	$0	$254	$1,524	$13,013
Union Hill Adit Seep	Decant Pond #4	HDPE	5,250	2	24	30	5	-	0	$7.32	$3.75	$38,430	$0	$384	$2,306	$19,688
Upper Creek Containment Pond #1	Surge Tank	HDPE	1,770	6	24	30	12	-	0	$11.21	$3.75	$19,842	$0	$198	$2,579	$6,638
Upper Creek Containment Pond #1	Surge Tank	HDPE	1,770	8	24	30	12	-	0	$15.78	$3.75	$27,931	$0	$279	$3,631	$6,638
Grape Gulch Pond #3	Surge Tank	HDPE	861	8	24	30	12	-	0	$15.78	$3.75	$13,587	$0	$136	$1,766	$3,229
Blackman's Seep (Pond #2)	Upper Creek Containment Pond 1	HDPE	100	5	24	30	9	-	0	$11.21	$3.75	$1,121	$0	$11	$112	$375
Surge Tank	Bullfrog pipeline *	HDPE	31,850	8	7	13	12	-	0	$15.78	-	$502,593	$0	$5,026	$65,337	$0
Surge Tank	Reclaim Pond	HDPE	3,923	15	24	30	9	-	0	$31.79	$3.75	$124,712	$0	$1,247	$12,471	$14,711
Reclaim Pond	Surge Tank	HDPE	3,855	9	24	30	5	-	0	$15.78	$3.75	$60,832	$0	$608	$3,650	$14,456
East WRF Containment	Decant Pond #4	HDPE	4,073	10	3	9	12	-	0	$19.17	$3.75	$78,079	$0	$781	$10,150	$15,274
tailings pipeline flushing																
Mill No 1	Tailings Impoundment Top	HDPE	6,850	21												
Mill No 2	Tailings Impoundment Top	HDPE	6,850	21												
												Direct Annual Costs ($/yr):	-	$12,561	-	-
												Direct Cost Subtotals:	$0	-	$142,143	$157,440

*Bullfrog pipeline has an Industrial PMLU

ELECTRICAL INFRASTRUCTURE

From	To	Line (ft)	Number of Poles	Removal Year	Direct Cost Pole and Crossarm ($)	Direct Cost Wiring Installation ($)	Number Transformer Stations	Direct Cost Transformer ($)	Direct Cost Electrical Panel ($)	**Direct Cost New ($)**	**Direct Cost Maintenance ($/yr)**	**Direct Cost O&M ($)**	**Capital Cost Removal ($)**
SWRF Dam 1 (181-2003-Dam 1)	SWRF Dam 2 (181-2003-Dam 2)	1,166	13	12	$26,629	$3,332	2	$9,771	$20,000	$59,732	$896	$11,648	$3,351
SWRF Dam 2 (181-2003-Dam 2)	SWRF Dam 3 (181-2003-Dam 3)	3,300	34	12	$69,645	$9,429	2	$9,771	$20,000	$108,846	$1,633	$21,225	$8,765
SWRF Dam 3 (181-2003-Dam 3)	Road	220	4	12	$8,194	$629	2	$9,771	$20,000	$38,594	$579	$7,526	$1,031
Decant Pond #4	Surge Tank	2,036	22	12	$45,064	$5,818	2	$9,771	$20,000	$80,653	$1,210	$15,727	$5,671
Upper Creek Containment Pond #1, Grape Gulch Pond #3, and Blackman's Seep (Pond #2)	Office Area	582	7	12	$14,339	$1,663	1	$4,886	$10,000	$30,887	$463	$6,023	$1,804
Surge Tank	Upper Creek Containment Pond 1	1,770	19	12	$38,919	$5,057	1	$4,886	$10,000	$58,862	$883	$11,478	$4,898
Magnetite Tailings Seepage Pond	Decant Pond #4	1,188	13	5	$26,629	$3,395	1	$4,886	$10,000	$44,909	$674	$4,042	$3,351
Estrada Seep	Road	500	6	5	$12,290	$1,429	1	$4,886	$10,000	$28,605	$429	$2,574	$1,547
Union Hill Adit Seep	Road	727	9	5	$18,435	$2,077	1	$4,886	$10,000	$35,398	$531	$3,186	$2,320
East WRF Containment	Decant Pond #4	4,582	47	12	$96,274	$13,092	1	$4,886	$10,000	$124,252	$1,864	$24,229	$12,116
Office Area	Road	2,327	25	12	$51,210	$6,649	1	$4,886	$10,000	$72,744	$1,091	$14,185	$6,445
									Direct Annual Costs ($/yr):	-	$10,252	-	-
									Direct Cost Subtotals:	-	-	$121,843	$51,298

ENVIRONMENTAL SAMPLING, ANALYSIS AND REPORTING [1]

Shipping and Analysis					Reporting						
Shipping (coolers per sample)	Shipping Cost ($/cooler)	Shipping Cost ($/sample)	Analysis ($/sample)	Analysis and Shipping Cost ($/sample)	Labor (hours/sample)	Reporting (hour/sample)	Rate ($/hour)	Review Work per Sample (hours)	Review Work Rate ($/hour)	Reporting Cost ($/sample)	Total Sample Cost ($/sample)
0.14	$ 400	$ 57	$ 280	$ 337	1.0	0.5	$ 60	0.1	$ 70	$ 100	$ 437

[1] Sampling vehicles and equipment are assumed to be included in the routine duty for site personnel.

SAMPLING SCHEDULE AND COST

	Tailings			Stockpiles			Intercept Wells				Sampling		Yearly
Year 0	Quarterly	Semi-Annual	Annual	Quarterly	Semi-Annual	Annual	Quarterly	Semi-Annual	Annual	Total Well Locations	Events Per Year	Cost ($/sample)	Cost ($)
0-5	1			4			2			7	4	$ 437	$ 12,236
5 - 12		1			4			2		7	2	$ 437	$ 6,118
12-99			1			4			2	7	1	$ 437	$ 3,059
												Total Cost Years 0-99	**$ 373,198**

Energy Labs Unit Rates:
23 Constituents. Energy Laboratories, Inc., Quote March 2018-2019 (www.energylab.com)

Alkalinity Total as CaCO3	$ 10
Anions by Ion Chromatography	$ 30
Chloride	
Fluoride	
Sulfate	
Total Dissolved Solids	$ 20
Nitrogen - Nitrate+Nitrite as N	$ 45
Metals by ICP/ICPMS, total	$ 160
Aluminum	
Arsenic	
Cadmium	
Calcium	
Chromium	
Cobalt	
Copper	
Iron	
Lead	
Magnesium	
Manganese	
Nickel	
Potassium	
Selenium	
Sodium	
Zinc	
Sample Prep	$ 15.00
	$ 280

Water Management Cash Flow

Continental Mine
Water Management Worksheet #3
3/29/2019

Component	Current Cost
Water Management Capital	$218,429
Capital Removal	$271,360
O&M	$1,654,727
Total	**$2,145,000**

	Water Management			
Cash Flow Year	Water Management Capital Current Cost	Capital Removal Current Cost	O&M Current Cost	Total Water Management Current Cost
1	$105,864	$0	$120,515	$226,378
2	$0	$0	$120,515	$120,515
3	$0	$0	$120,515	$120,515
4	$0	$0	$120,515	$120,515
5	$0	$0	$120,515	$120,515
6	$112,565	$98,484	$113,326	$324,375
7	$0	$0	$93,501	$93,501
8	$0	$0	$93,501	$93,501
9	$0	$0	$93,501	$93,501
10	$0	$19,612	$93,501	$113,113
11	$0	$0	$85,238	$85,238
12	$0	$0	$85,238	$85,238
13	$0	$153,264	$81,644	$234,908
14	$0	$0	$3,594	$3,594
15	$0	$0	$3,594	$3,594
16	$0	$0	$3,594	$3,594
17	$0	$0	$3,594	$3,594
18	$0	$0	$3,594	$3,594
19	$0	$0	$3,594	$3,594
20	$0	$0	$3,594	$3,594
21	$0	$0	$3,594	$3,594
22	$0	$0	$3,594	$3,594
23	$0	$0	$3,594	$3,594
24	$0	$0	$3,594	$3,594
25	$0	$0	$3,594	$3,594
26	$0	$0	$3,594	$3,594
27	$0	$0	$3,594	$3,594
28	$0	$0	$3,594	$3,594
29	$0	$0	$3,594	$3,594
30	$0	$0	$3,594	$3,594
31	$0	$0	$3,594	$3,594
32	$0	$0	$3,594	$3,594
33	$0	$0	$3,594	$3,594
34	$0	$0	$3,594	$3,594
35	$0	$0	$3,594	$3,594
36	$0	$0	$3,594	$3,594
37	$0	$0	$3,594	$3,594
38	$0	$0	$3,594	$3,594
39	$0	$0	$3,594	$3,594
40	$0	$0	$3,594	$3,594
41	$0	$0	$3,594	$3,594
42	$0	$0	$3,594	$3,594
43	$0	$0	$3,594	$3,594
44	$0	$0	$3,594	$3,594
45	$0	$0	$3,594	$3,594
46	$0	$0	$3,594	$3,594
47	$0	$0	$3,594	$3,594
48	$0	$0	$3,594	$3,594
49	$0	$0	$3,594	$3,594
50	$0	$0	$3,594	$3,594
51	$0	$0	$3,594	$3,594
52	$0	$0	$3,594	$3,594
53	$0	$0	$3,594	$3,594
54	$0	$0	$3,594	$3,594
55	$0	$0	$3,594	$3,594
56	$0	$0	$3,594	$3,594
57	$0	$0	$3,594	$3,594
58	$0	$0	$3,594	$3,594

Water Management Cash Flow

Continental Mine
Water Management Worksheet #3
3/29/2019

Component	Current Cost
Water Management Capital	$218,429
Capital Removal	$271,360
O&M	$1,654,727
Total	**$2,145,000**

	Water Management			
Cash Flow Year	Water Management Capital Current Cost	Capital Removal Current Cost	O&M Current Cost	Total Water Management Current Cost
59	$0	$0	$3,594	$3,594
60	$0	$0	$3,594	$3,594
61	$0	$0	$3,594	$3,594
62	$0	$0	$3,594	$3,594
63	$0	$0	$3,594	$3,594
64	$0	$0	$3,594	$3,594
65	$0	$0	$3,594	$3,594
66	$0	$0	$3,594	$3,594
67	$0	$0	$3,594	$3,594
68	$0	$0	$3,594	$3,594
69	$0	$0	$3,594	$3,594
70	$0	$0	$3,594	$3,594
71	$0	$0	$3,594	$3,594
72	$0	$0	$3,594	$3,594
73	$0	$0	$3,594	$3,594
74	$0	$0	$3,594	$3,594
75	$0	$0	$3,594	$3,594
76	$0	$0	$3,594	$3,594
77	$0	$0	$3,594	$3,594
78	$0	$0	$3,594	$3,594
79	$0	$0	$3,594	$3,594
80	$0	$0	$3,594	$3,594
81	$0	$0	$3,594	$3,594
82	$0	$0	$3,594	$3,594
83	$0	$0	$3,594	$3,594
84	$0	$0	$3,594	$3,594
85	$0	$0	$3,594	$3,594
86	$0	$0	$3,594	$3,594
87	$0	$0	$3,594	$3,594
88	$0	$0	$3,594	$3,594
89	$0	$0	$3,594	$3,594
90	$0	$0	$3,594	$3,594
91	$0	$0	$3,594	$3,594
92	$0	$0	$3,594	$3,594
93	$0	$0	$3,594	$3,594
94	$0	$0	$3,594	$3,594
95	$0	$0	$3,594	$3,594
96	$0	$0	$3,594	$3,594
97	$0	$0	$3,594	$3,594
98	$0	$0	$3,594	$3,594
99	$0	$0	$3,594	$3,594
100	$0	$0	$3,594	$3,594
Total	$218,429	$271,360	$1,654,727	$2,144,516

Water Management and Operations and Maintenance Cost Summary

Capital			**Current Value**
DIRECT COSTS	Water Management Capital (Ponds)		$168,022
DIRECT COSTS	Capital Removal (Pipelines and Electrical Infrastructure)		$208,738
INDIRECT COSTS		Indirect Percentage 30.0%	$113,028
		Total Capital	**$489,788**

Operations and Maintenance			
DIRECT COSTS	Ponds and Tanks, Pumps, Pipelines, Electrical Infrastructure		$1,000,006
DIRECT COSTS	Electricity and Fuel (Pump Operation), Environmental Sampling		$408,272
INDIRECT COSTS		Indirect Percentage 17.5%	$246,449
		Total O&M	**$1,654,727**

TOTAL COST	**$2,145,000**

Note: Indirect costs are based on 2019 agreement between FMI and the agencies (see Appendix D), and include but are not limited to mobilization and demobilization, engineering redesign fee, contingencies, contractor profit and overhead, project management fee, and state procurement cost.

Water Treatment Unit Costs

Activity	Unit	Unit Cost ($/unit)	RS Means Item Number (1)	Description
Utility Pole Demo	ea	$179.92	024113800100	Selective demolition, utility poles & cross arms, utility poles, wood, 20'-30' high
Cross Arm Demo	ea	$77.86	024113800300	Selective demolition, utility poles & cross arms, cross arms, wood, 4'-6' long
Wood Electrical Utility Poles a.)	ea	$636.54	337116336020	Electrical utility pole, wood pole CCA/ACA-treated, 30', class 1, type C, excludes excavation, backfill and cast in place concrete
Utility Pole Installation b.)	ea	$1,108.74	337116236010	Electrical utility pole, digging holes in rock, average
Utility Pole Installation c.)	ea	$1.71	337116339000	Electrical utility pole, wood poles disposal of surplus material; base unit rate $90.04/mile scaled to per pole (each) assuming 100 ft power pole spacing/5280 ft/mile
Utility Pole Installation d.)	ea	$301.40	337116337600	Electrical utility pole, poles, wood, cross arms with hardware & insulators, 4' long, excludes excavation, backfill and cast in place concrete
Electrical Wiring Installation a.)	wire mile	$509.29	337139130110	Overhead line conductors & devices, conductors, primary circuits, material handling & spotting
Electrical Wiring Installation b.)	wire mile	$14,307.12	337139130150	Overhead line conductors & devices, conductors, primary circuits, per wire, 210 to 636 kcmil
Electrical Wiring Installation c.)	mile	$270.35	337139130810	Overhead line conductors & devices, disposal of surplus material, high voltage conductors
Potential Transformers	ea	$4,885.68	337126264100	Station capacitors, potential transformers, 13 to 26 kV
Pipeline Demolition (Flushing and Cover)	lf	$3.75	026510300320	Sludge/water removal at $0.13/ft assuming 18-inch pipe diameter 1/3 full, scaled based on RS Means unit cost to remove sludge/water from 9,000-12,000 (average 10,500) gallon tank at $306.69/each; placement of cover material over pipe at $3.62/ft after sludge/water removal
Excavation of Soil	cy	$7.17	G10301201600 (2)	3/4 C.Y. backhoe, three 8 C.Y. dump trucks, 1 mi round trip; unit rate not presented online, therefore use RS Means 2019 Handbook [hardcopy], 33rd edition with unit rate of $8.40/cy x 0.854 [Las Cruces adjustment] = $7.17/cy
Reservoir Liners HDPE	sf	$1.39	310519531200	Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick, per S.F.
Small Concrete Dam	lf	$79,833	323213103100	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 10' high, includes excavation, backfill & reinforcing; 250 ft is the assumed length of retaining wall (dam) @ $319.33/lineal ft (RS Means online data)
Water Treatment Tank	ea	$324,459	331623131000	Steel water storage tanks, ground level, ht./diam. less than 1,250,000 gallons, excl. foundation
Pump	ea	$10,000	-	Engineering Judgment 15 to 30 gpm - includes pump control, control panel, installation, and flow meter
Pump	ea	$15,000	-	Engineering Judgment 50 gpm - includes pump control, control panel, installation, and flow meter
Pump	ea	$25,000	-	Engineering Judgment 100 to 700 gpm - includes pump control, control panel, installation, and flow meter
Pump	ea	$30,000	-	Engineering Judgment 800 to 2000 gpm - includes pump control, control panel, installation, and flow meter
Water Supply Piping	lf	$7.32	331413350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21
Water Supply Piping	lf	$11.21	331413350200	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 6" diameter, SDR 21
Water Supply Piping	lf	$15.78	331413350300	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 8" diameter, SDR 21
Water Supply Piping	lf	$19.17	331413350400	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 10" diameter, SDR 21
Water Supply Piping	lf	$22.06	331413350500	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 12" diameter, SDR 21
Water Supply Piping	lf	$31.79	331413350600	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 14" diameter, SDR 21
Water Supply Piping	lf	$39.27	331413350700	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 16" diameter, SDR 21
Facility Water Distribution Piping	lf	$260.76	221113481210 and 221113481780	Steel Pipe Schedule 40, black 24" diameter (RS Means 221113481210) $269.00 (material) + $95.46 (labor); unit cost without coupling and hanger (RS Means 221113481780) is reduced 35% for material and 10% for labor = $174.85 + $85.91
Electric Rate	kWh	$0.0587	-	Industrial rate data 3/12/2019 (http://www.electricitylocal.com/states/new-mexico/silver-city/)
Electric Panel Cost	ea	$10,000	-	Engineering Judgment
Diesel Fuel Cost ($/gal)	gal	$2.34	-	Diesel fuel cost is estimated by correlating historical local quotes with public data, as agreed upon in November 2018 discussions with the agencies
Environmental Sampler	hr	$60	-	Engineering Judgment
Environmental Sampling Reviewer	hr	$70	-	Engineering Judgment
Environmental Sampling	sample	$280	-	23 Constituents. Energy Laboratories, Inc., Quote March 2018-2019 (www.energylab.com)
Shipping Environmental Sampling	cooler	$400	-	Overnight UPS $400 (2019 rate) for a 10 lb. package 30"x18"x18" Silver City, NM to Casper, WY Energy Labs

(1) RS Means Online unit cost includes CCI adjustment for Las Cruces New Mexico - 2019 R.S. Means Online (www.rsmeansonline.com)

(2) RS Means hard copy, 33rd ed., 2019 (base rate, CCI adj. 0.854 for Las Cruces)

Appendix C.2

Supporting Documentation

RS Means Online Data

Accessed March 11, 2019

Line Number	Description	Unit	Material	Labor	Equipment	Total	Release Date	CCI Location
24113800100	Selective demolition, utility poles & cross arms, utility poles, wood, 20'-30' high	Ea.	$ -	$ 161.39	$ 18.53	$ 179.92	Year 2019	NEW MEXICO / LAS CRUCES (880)
24113800300	Selective demolition, utility poles & cross arms, cross arms, wood, 4'-6' long	Ea.	$ -	$ 77.86	$ -	$ 77.86	Year 2019	NEW MEXICO / LAS CRUCES (880)
337116336020	Electrical utility pole, wood pole CCA/ACA-treated, 30', class 1, type C, excludes excavation, backfill and cast in place concrete	Ea.	$ 325.80	$ 278.85	$ 31.89	$ 636.54	Year 2019	NEW MEXICO / LAS CRUCES (880)
337116236010	Electrical utility pole, digging holes in rock, average	Ea.	$ -	$ 879.45	$ 229.29	$ 1,108.74	Year 2019	NEW MEXICO / LAS CRUCES (880)
337116339000	Electrical utility pole, wood poles disposal of surplus material	Mile	$ -	$ 83.66	$ 6.38	$ 90.04	Year 2019	NEW MEXICO / LAS CRUCES (880)
337116337600	Electrical utility pole, poles, wood, cross arms with hardware & insulators, 4' long, excludes excavation, backfill and cast in place concrete	Ea.	$ 136.66	$ 164.74	$ -	$ 301.40	Year 2019	NEW MEXICO / LAS CRUCES (880)
337139130110	Overhead line conductors & devices, conductors, primary circuits, material handling & spotting	W.Mile	$ -	$ 403.26	$ 106.03	$ 509.29	Year 2019	NEW MEXICO / LAS CRUCES (880)
337139130150	Overhead line conductors & devices, conductors, primary circuits, per wire, 210 to 636 kcmil	W.Mile	$ 11,765.00	$2,016.30	$ 525.82	$ 14,307.12	Year 2019	NEW MEXICO / LAS CRUCES (880)
337139130810	Overhead line conductors & devices, disposal of surplus material, high voltage conductors	Mile	$ -	$ 251.39	$ 18.96	$ 270.35	Year 2019	NEW MEXICO / LAS CRUCES (880)
337126264100	Station capacitors, potential transformers, 13 to 26 kV	Ea.	$ 4,592.88	$ 244.53	$ 48.27	$ 4,885.68	Year 2019	NEW MEXICO / LAS CRUCES (880)
26510300320	Removal of underground storage tanks, petroleum storage tanks, non-leaking, remove sludge, water and remaining product from tank bottom of tank with vacuum truck, 9,000 - 12,000 gallon tank	Ea.	$ -	$ 98.95	$ 207.74	$ 306.69	Year 2019	NEW MEXICO / LAS CRUCES (880)
310519531200	Pond and reservoir liners, membrane lining systems HDPE, 100,000 S.F. or more, 60 mil thick, per S.F.	S.F.	$ 0.74	$ 0.65	$ -	$ 1.39	Year 2019	NEW MEXICO / LAS CRUCES (880)
323213103100	Cast-in place retaining walls, reinforced concrete cantilever, 33 degree slope embankment, 10' high, includes excavation, backfill & reinforcing	L.F.	$ 115.32	$ 179.87	$ 24.14	$ 319.33	Year 2019	NEW MEXICO / LAS CRUCES (880)
331623131000	Steel water storage tanks, ground level, ht./diam. less than 1, 250,000 gallons, excl. foundation	Ea.	$ -	$ -	$ -	$ 324,459.00	Year 2019	NEW MEXICO / LAS CRUCES (880)
331413350100	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 4" diameter, SDR 21	L.F.	$ 2.89	$ 3.00	$ 1.43	$ 7.32	Year 2019	NEW MEXICO / LAS CRUCES (880)
331413350200	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 6" diameter, SDR 21	L.F.	$ 6.54	$ 3.16	$ 1.51	$ 11.21	Year 2019	NEW MEXICO / LAS CRUCES (880)
331413350300	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 8" diameter, SDR 21	L.F.	$ 10.24	$ 3.75	$ 1.79	$ 15.78	Year 2019	NEW MEXICO / LAS CRUCES (880)
331413350400	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 10" diameter, SDR 21	L.F.	$ 13.26	$ 4.00	$ 1.91	$ 19.17	Year 2019	NEW MEXICO / LAS CRUCES (880)
331413350500	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 12" diameter, SDR 21	L.F.	$ 15.25	$ 4.60	$ 2.21	$ 22.06	Year 2019	NEW MEXICO / LAS CRUCES (880)
331413350600	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 14" diameter, SDR 21	L.F.	$ 17.75	$ 5.46	$ 8.58	$ 31.79	Year 2019	NEW MEXICO / LAS CRUCES (880)
331413350700	Water supply distribution piping, piping HDPE, butt fusion joints, 40' lengths, 16" diameter, SDR 21	L.F.	$ 22.13	$ 6.67	$ 10.47	$ 39.27	Year 2019	NEW MEXICO / LAS CRUCES (880)
221113481210	Pipe, fittings & valves, steel, black, grooved joint, 24" diameter, schedule 40, incl coupling & clevis type hanger 10' OC	L.F.	$ 269.00	$ 95.46	$ -	$ 364.46	Year 2019	NEW MEXICO / LAS CRUCES (880)
221113481780	Adjusted without coupler and hangar to decrease 221113481210 unit cost for material by 35% and labor by 10%	L.F.	$ 174.85	$ 85.91	$ -	$ 260.76	Year 2019	NEW MEXICO / LAS CRUCES (880)

Lai Cnces = 0.854 x National

22 11 13.48 Pipe, Fittings and Valves, Steel, Grooved-Joint	Crew	Daily Output	Labor-Hours	Unit	2019 Bare Costs Material	Labor	Equipment	Total	Total Incl O&P
0010 **PIPE, FITTINGS AND VALVES, STEEL, GROOVED-JOINT**									
0012 Fittings are ductile iron. Steel fittings noted.									
0020 Pipe includes coupling & clevis type hanger assemblies, 10′ OC									
1000 Schedule 40, black									
1040 3/4″ diameter	1 Plum	71	.113	L.F.	6.25	7.10		13.35	17.60
1050 1″ diameter		63	.127		6.05	8		14.05	18.70
1060 1-1/4″ diameter		58	.138		7.30	8.70		16	21
1070 1-1/2″ diameter		51	.157		7.95	9.90		17.85	23.50
1080 2″ diameter		40	.200		9.20	12.65		21.85	29
1090 2-1/2″ diameter	Q-1	57	.281		12.10	15.95		28.05	37.50
1100 3″ diameter		50	.320		14.20	18.20		32.40	43
1110 4″ diameter		45	.356		24	20		44	57
1120 5″ diameter		37	.432		43.50	24.50		68	85
1130 6″ diameter	Q-2	42	.571		49.50	33.50		83	105
1140 8″ diameter		37	.649		82	38		120	148
1150 10″ diameter		31	.774		110	45.50		155.50	190
1160 12″ diameter		27	.889		123	52.50		175.50	214
1170 14″ diameter		20	1.200		131	70.50		201.50	250
1180 16″ diameter		17	1.412		196	83		279	340
1190 18″ diameter		14	1.714		199	101		300	370
1200 20″ diameter		12	2		236	118		354	435
1210 24″ diameter		10	2.400		269	141		410	505
1740 To delete coupling & hanger, subtract									
1750 3/4″ diam. to 2″ diam.					65%	27%			
1760 2-1/2″ diam. to 5″ diam.					41%	18%			
1770 6″ diam. to 12″ diam.					31%	13%			
1780 14″ diam. to 24″ diam.					35%	10%			
1800 Galvanized									
1840 3/4″ diameter	1 Plum	71	.113	L.F.	6.50	7.10		13.60	17.85
1850 1″ diameter		63	.127		6.85	8		14.85	19.55
1860 1-1/4″ diameter		58	.138		8.25	8.70		16.95	22
1870 1-1/2″ diameter		51	.157		8.95	9.90		18.85	24.50
1880 2″ diameter		40	.200		10.60	12.65		23.25	30.50
1890 2-1/2″ diameter	Q-1	57	.281		13.45	15.95		29.40	39
1900 3″ diameter		50	.320		16.40	18.20		34.60	45.50
1910 4″ diameter		45	.356		27	20		47	60.50
1920 5″ diameter		37	.432		31.50	24.50		56	72
1930 6″ diameter	Q-2	42	.571		35	33.50		68.50	89
1940 8″ diameter		37	.649		52	38		90	115
1950 10″ diameter		31	.774		109	45.50		154.50	188
1960 12″ diameter		27	.889		132	52.50		184.50	224
2540 To delete coupling & hanger, subtract									
2550 3/4″ diam. to 2″ diam.					36%	27%			
2560 2-1/2″ diam. to 5″ diam.					19%	18%			
2570 6″ diam. to 12″ diam.					14%	13%			
4690 Tee, painted									
4700 3/4″ diameter	1 Plum	38	.211	Ea.	82	13.30		95.30	110
4740 1″ diameter		33	.242		63.50	15.30		78.80	93
4750 1-1/4″ diameter		27	.296		63.50	18.70		82.20	98
4760 1-1/2″ diameter		22	.364		63.50	23		86.50	105
4770 2″ diameter		17	.471		63.50	29.50		93	115
4780 2-1/2″ diameter	Q-1	27	.593		63.50	33.50		97	121

2019

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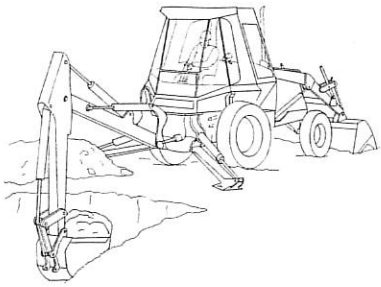
G1030 Site Earthwork



The Excavation of Common Earth System balances the productivity of the excavating equipment to the hauling equipment. It is assumed that the hauling equipment will encounter light traffic and will move up no considerable grades on the haul route. No mobilization cost is included. All costs given in these systems include a swell factor of 25% for hauling.

The Expanded System Listing shows Excavation systems using backhoes ranging from 1/2 Cubic Yard capacity to 3-1/2 Cubic Yards. Power shovels indicated range from 1/2 Cubic Yard to 3 Cubic Yards. Dragline bucket rigs range from 1/2 Cubic Yard to 3 Cubic Yards. Truck capacities range from 8 Cubic Yards to 20 Cubic Yards. Each system lists the number of trucks involved and the distance (round trip) that each must travel.

System Components	QUANTITY	UNIT	COST PER C.Y. EQUIP.	LABOR	TOTAL
SYSTEM G1030 120 1000					
EXCAVATE COMMON EARTH, 1/2 CY BACKHOE, TWO 8 CY DUMP TRUCKS, 1 MRT					
Excavating, bulk hyd. backhoe, wheel mtd., 1/2 C.Y.	1.000	B.C.Y.	.97	2.34	3.31
Hauling, 8 CY truck, cycle 0.5 mile, 20 MPH, 15 min. wait/Ld./Uld.	1.280	L.C.Y.	2.06	3.12	5.18
Spotter at earth fill dump or in cut	.020	Hr.		.99	.99
TOTAL			3.03	6.45	9.48

G1030 120	Excavate and Haul Common Earth	COST PER C.Y. EQUIP.	LABOR	TOTAL
1000	Excavate common earth, 1/2 C.Y. backhoe, two 8 C.Y. dump trucks, 1 MRT	3.03	6.45	9.48
1200	Three 8 C.Y. dump trucks, 3 mile round trip	6	11.05	17.05
1400	Two 12 C.Y. dump trucks, 4 mile round trip	6.55	8.45	15
1600	3/4 C.Y. backhoe, three 8 C.Y. dump trucks, 1 mile round trip	3.05	5.35	8.40
1700	Five 8 C.Y. dump trucks, 3 mile round trip	5.90	10.25	16.15
1800	Two 12 C.Y. dump trucks, 2 mile round trip	5.55	6.50	12.05
1900	Two 16 C.Y. dump trailers, 3 mile round trip	5.25	5.55	10.80
2000	Two 20 C.Y. dump trailers, 4 mile round trip	5.05	5.45	10.50
2200	1-1/2 C.Y. backhoe, eight 8 C.Y. dump trucks, 3 mile round trip	5.70	9.15	14.85
2300	Four 12 C.Y. dump trucks, 2 mile round trip	5.15	5.60	10.75
2400	Six 12 C.Y. dump trucks, 4 mile round trip	6.20	6.50	12.70
2500	Three 16 C.Y. dump trailers, 2 mile round trip	4.25	4.15	8.40
2600	Two 20 C.Y. dump trailers, 1 mile round trip	3.39	3.38	6.77
2700	Three 20 C.Y. dump trailers, 3 mile round trip	4.48	4.27	8.75
2800	2-1/2 C.Y. excavator, six 12 C.Y. dump trucks, 1 mile round trip	3.72	3.80	7.52
2900	Eight 12 C.Y. dump trucks, 3 mile round trip	5.35	5.35	10.70
3000	Four 16 C.Y. dump trailers, 1 mile round trip	3.73	3.44	7.17
3100	Six 16 C.Y. dump trailers, 3 mile round trip	5	4.69	9.69
3200	Six 20 C.Y. dump trailers, 4 mile round trip	4.66	4.31	8.97
3400	3-1/2 C.Y. backhoe, six 16 C.Y. dump trailers, 1 mile round trip	3.98	3.29	7.27
3600	Ten 16 C.Y. dump trailers, 4 mile round trip	5.65	4.69	10.34
3800	Eight 20 C.Y. dump trailers, 3 mile round trip	4.56	3.72	8.28
4000	1/2 C.Y. pwr. shovel, four 8 C.Y. dump trucks, 2 mile round trip	5.40	8.30	13.70
4100	Two 12 C.Y. dump trucks, 1 mile round trip	4.52	5.05	9.57
4200	Four 12 C.Y. dump trucks, 4 mile round trip	6.70	6.85	13.55
4300	Two 16 C.Y. dump trailers, 2 mile round trip	4.80	4.95	9.75
4400	Two 20 C.Y. dump trailers, 4 mile round trip	5.55	5.70	11.25
4800	3/4 C.Y. pwr. shovel, six 8 C.Y. dump trucks, 2 mile round trip	5.25	8	13.25
4900	Three 12 C.Y. dump trucks, 1 mile round trip	4.42	4.38	8.80
5000	Five 12 C.Y. dump trucks, 4 mile round trip	6.80	6.60	13.40
5100	Three 16 C.Y. dump trailers, 3 mile round trip	5.80	5.30	11.10
5200	Three 20 C.Y. dump trailers, 4 mile round trip	5.40	4.94	10.34
5400	1-1/2 C.Y. pwr. shovel, six 12 C.Y. dump trucks, 1 mile round trip	3.90	3.79	7.69
5500	Ten 12 C.Y. dump trucks, 4 mile round trip	6.30	6	12.30

2019

For customer support on your Heavy Construction Costs with RSMeans data, call 800.448.8182.

Silver City, NM Electricity Rates |

https://www.electricitylocal.com/states/new-mexico/silver-city/

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Comprehensive Local Electricity Guide

Silver City Electricity Rates

Commercial Electricity in Silver City

^ The average commercial electricity rate in Silver City, NM is 10.2¢/kWh.[1]

Residential Electricity in Silver City

^ The average residential electricity rate in Silver City, NM is 12.31¢/kWh.[1]

Industrial Electricity in Silver City

^ The average industrial electricity rate in Silver City, NM is 5.87¢/kWh.[1]

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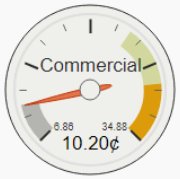
Silver City, NM Electricity Statistics

Commercial electricity rates in Silver City

Commercial Electricity in Silver City

› The average commercial electricity rate in Silver City is **10.2¢/kWh.**[1]

› This average (commercial) electricity rate in Silver City is **9.44% greater than** the New Mexico average rate of 9.32¢/kWh.[2]

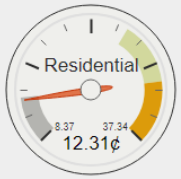


Residential electricity rates in Silver City

Residential Electricity in Silver City

› The average residential electricity rate in Silver City is **12.31¢/kWh.**[1]

› This average (residential) electricity rate in Silver City is **8.27% greater than** the New Mexico average rate of 11.37¢/kWh.[2]

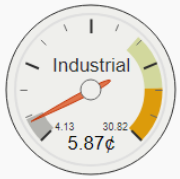


Industrial electricity rates in Silver City

Industrial Electricity in Silver City

› The average industrial electricity rate in Silver City is **5.87¢/kWh.**[1]

› This average (industrial) electricity rate in Silver City is **0.69% greater than** the New Mexico average rate of 5.83¢/kWh.[2]



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2:34 PM
3/13/2019

Quote #: C5258
Project Manager: Tessa Parke
Expires: 3/23/2019

Analytical Quote

Jean Humphrey
Telesto Solutions Inc
1303 No Pope
Silver City, NM 88061

TAT: 7 days
QC Level: STD

Project Name: Quarterly Samples

Schedule: Water Samples

Matrix: Aqueous

Comments:

Analyses	Method	Reporting Limit	Analyte Price
Major Ions			
Alkalinity			$10.00
Alkalinity, Total as CaCO3	A2320 B	5 mg/L	**
** Included in Alkalinity Price			
Anions by Ion Chromatography			$30.00
Chloride	E300.0	1 mg/L	**
Fluoride	E300.0	0.1 mg/L	**
Sulfate	E300.0	1 mg/L	**
** Included in Anions by Ion Chromatography Price			
Metals by ICP/ICPMS, Total			$160.00
Calcium	E200.7_8	1 mg/L	**
Magnesium	E200.7_8	1 mg/L	**
Potassium	E200.7_8	1 mg/L	**
Sodium	E200.7_8	1 mg/L	**
** Included in Metals by ICP/ICPMS, Total Price			
Physical Properties			
Solids, Total Dissolved			$20.00
Solids, Total Dissolved TDS @ 180 C	A2540 C	10 mg/L	**
** Included in Solids, Total Dissolved Price			
Nutrients			
Nitrogen, Nitrate + Nitrite			$25.00
Nitrogen, Nitrate+Nitrite as N	E353.2	0.01 mg/L	**
** Included in Nitrogen, Nitrate + Nitrite Price			
Nitrogen, Nitrate as N	E353.2	0.01 mg/L	$0.00

Nitrogen, Nitrite			$20.00
Nitrogen, Nitrite as N	A4500-NO2 B	0.01 mg/L	**

** Included in Nitrogen, Nitrite Price

Metals, Total

Metals by ICP/ICPMS, Total			~~
Aluminum	E200.7_8	0.03 mg/L	**
Arsenic	E200.7_8	0.001 mg/L	**
Cadmium	E200.7_8	0.001 mg/L	**
Chromium	E200.7_8	0.005 mg/L	**
Cobalt	E200.7_8	0.005 mg/L	**
Copper	E200.7_8	0.005 mg/L	**
Iron	E200.7_8	0.03 mg/L	**
Lead	E200.7_8	0.001 mg/L	**
Manganese	E200.7_8	0.001 mg/L	**
Nickel	E200.7_8	0.005 mg/L	**
Selenium	E200.7_8	0.001 mg/L	**
Zinc	E200.7_8	0.01 mg/L	**

** Included in Metals by ICP/ICPMS, Total Price

~~ Included in Major Ions Metals by ICP/ICPMS, Total Price

Preps For Water Samples

Metals Preparation by EPA 200.2	E200.2	$15.00

Schedule Price/Sample: $280.00

Schedule Name	Schedule Total
Water Samples	$280.00

Quote Sub Total:	$280.00
Discount:	0.00%
Misc Charges:	$0.00
Quote Total:	$280.00

Comments: As of January 1st, 2012 ELI will begin charging a $2.00 per sample surcharge for sample management. This fee will be applied to all solid and aqueous samples.

Quoted prices are based on net 30 days payment of invoices. Discounts will not apply if terms are not met.

Quoted prices reflect standard turn around time of ~7 working days. Additional charges may apply for accelerated TAT. Please advise ELI as to your project specific requirements.

To assure that the quoted analysis and pricing specifications are provided, please include the Quote ID number referenced above on the Chain of Custody or sample submittal documents.

Appendix D

Indirect Costs

State of New Mexico
ENERGY, MINERALS and NATURAL RESOURCES DEPARTMENT
and the
ENVIRONMENT DEPARTMENT

Michelle Lujan Grisham
Governor

Howie Morales
Lieutenant Governor

Sarah Cottrell Propst
Cabinet Secretary Designate, EMNRD

James Kenney
Cabinet Secretary Designate, NMED

7008 0500 0001 4875 1648

Certified Mail

January 16, 2019

Sherry Burt-Kested, Manager
Environmental Services
Freport-McMoRan Chion Mines Company
P.O. Box 10
Bayard, NM 88023

Re: Approval of Cost Estimate Resolutions (Agreement) and Request for Schedule

Dear Ms. Burt-Kested,

The New Mexico Mining and Minerals Division of the Energy, Minerals and Natural Resources Department (MMD-EMNRD), and the Mining Environmental Compliance Section (MECS) of the New Mexico Environment Department (MECS-NMED) (collectively, the Agencies) received a letter with tabulated cost estimate resolutions (Agreement) dated January 11, 2019, from Freeport McMoRan New Mexico Operations (FMNO). As noted in your letter, the Financial Assurance (FA) work group included representatives of the Agencies, FMNO, and the Gila Resources Information Project (GRIP). Over the course of multiple meetings and teleconferences, the FA work group developed the Agreement in 2018. The Agencies hereby approve the Agreement for the formulation of cost estimates for closure/closeout plans at the Continental, Little Rock, Tyrone and Chino Mines.

Since the FA work group reached agreement, the Agencies concur this precludes the need for a third party review of cost estimates that had been conditionally required by condition 8.N.7 of MMD Permit No. GR002RE Revision 15-2, and C113.E of NMED Draft DP-1403. FMNO must submit an updated cost estimate by April 3, 2019, in order to fulfill Continental permit condition 8.N.6 of MMD Permit No. GR002RE Revision 15-2, which is similar to condition C113.D of NMED Draft DP-1403.

In your letter, FMNO proposed a timeline for the Continental, Chino, and Tyrone mines for the submittal of updated cost estimates. To ensure efficient use of limited resources, the Agencies request FMNO submit a more detailed schedule that provides greater specificity of when the cost estimates and any other major milestones will be completed. The schedule should provide

managers and permit leads a best estimate of key FMNO submittals. With FMNO cooperation, the Agencies anticipate completion of reviews and approvals of cost estimates and associated changes to FA instruments before the end of 2019.

The Agencies acknowledge the successful resolution of multiple cost estimate issues. We appreciate that the FA work group reached agreement through extra effort by FMNO, GRIP, and the Agencies. This Agreement reduces much of the uncertainty associated with FMNO cost estimation and the Agencies' review process. Going forward, the Agencies believe the Agreement ensures timely updates of closure/closeout cost estimates that maintain adequate FA to the mutual benefit of all parties.

If you have any questions, please do not hesitate to contact us or the respective permit leads at MMD and NMED for Continental, Tyrone, Little Rock, and Chino Mines.

Sincerely,

Holland Shepherd
Program Manager
Mining Act Reclamation Program
Mining and Minerals Division-EMNRD
505-476-3437

Kurt Vollbrecht
Program Manager
Mining Environmental Compliance Section
New Mexico Environment Department
505-827-0195

cc: Allyson Siwik, Executive Director, GRIP
MMD mine permit files GR002RE, GR007RE, GR009RE and GR010RE.
NMED discharge permit files DP-1236, 1340, DP-1341 and DP-1403.

Table 1 Summary of Cost Estimate Resolutions

Issue Item	Resolution
Equipment Unit Cost Source and Removal of Indirect Cost Items from EquipmentWatch Ownership Values	Equipment costs determined in the following order sourced from EquipmentWatch: • Unmodified EquipmentWatch Average Rental Rate for Southern New Mexico • Unmodified EquipmentWatch Average Rental Rate for New Mexico • Unmodified Blue Book Rental Rate • If equipment is not listed in EquipmentWatch, then another piece of equipment must be used • Minimum listed rates will not be used • EquipmentWatch Average Rental Rates will be used without adjustment for duplicative indirect cost components
Revegetation	Revegetation steps costed in similar manner to other earthworks
Demolition Costs	Freeport will add 20% for buildings with large equipment (e.g., mills, SX, crusher)
Direct "Commodity" Costs / Quotes	It is fine to use quotes, but the quotes must be for the specifications and scope/scale of Freeport's default scenario (e.g., fuel to complete all Freeport New Mexico mine closures over a series of years). The following are specific examples discussed. • FNMO will compile a database of vendor quotes as they are developed for submittal to the agencies • Quotes will be used directly with no consideration to vendor's profit/overhead or other indirect costing items • Quotes will be used directly with no adjustment for duplicated indirect components
Fuel	Use historical quotes and correlate to public data for future cost estimates
Seed	Freeport quotes, specs and scope
Lime	Freeport quotes, specs and scope
Mulch	Freeport quotes, specs and scope
Articulated Concrete Blocks	Freeport quotes, specs and scope
Well Plugging/replacement	Freeport quotes, specs and scope
Geomembranes (e.g., stormwater pond replacement)	Use RS Means published data
Power	Published rates for area, scope considered
State Labor Rates	Use prevailing wage as published by NMDOLA, which includes fringe benefits
Indirect Rates	Negotiated total values (includes: mobilization and demobilization, contingencies, engineering redesign fees, contractor profit and overhead, project management, administrative expenses, bonding, state procurement costs, construction management, insurance, QA/QC, etc.)
All capital cost items	30%
All Operations and Maintenance cost items	17.5%

Items in black are reformatted from workgroup spreadsheet sent 11/19/2019 and subsequent negotiations

Items in red are from subsequent communications and added for clarity

DRAFT